XXVI TEXAS SYMPOSIUM on Relativistic Astrophysics 2012

São Paulo - BRAZIL

Bourbon Convention Ibirapuera, São Paulo

December 15 - 20, 2012

ABSTRACT BOOK

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TEXAS 2012 São Paulo

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LEVITA TUR

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Welcome

We welcome you to the 26th Texas Symposium on Relativistic Astrophysics and to the amazing city of São Paulo.

This is the second time that such a traditional and important Symposium is taking place in the southern hemisphere and the first time in South America. It is an honor for us in Brazil to host such a Symposium.

We thank very much the International Organizing Committee of Texas Symposia to give us such an opportunity.

As in its previous editions, Texas 2012 will cover recent developments in Cosmology, Gravitation, Astroparticle Physics and related areas of Relativistic Astrophysics with emphasis on the most recent developments in the field.

On behalf of the Local Organizing Committee we thank very much the excellent work done by the Scientific Organizing Committee, chaired and co-chaired by Drs. Odylio Aguiar and Jorge Horvath, respectively.

Twenty six invited plenary speakers review different topics related to relativistic astrophysics. We take this opportunity to thank all speakers for accepting talking at Texas 2012.

There is also a number of parallel sessions that cover: Cosmology, Galactic and Intergalactic Astrophysics, Compact Objects, High Energy Astrophysics, Astroparticle Physics, Alternative Models and Theories, New Windows, Gravitational Waves, New Projects and Missions, Quantum Effects in Relativistic Astrophysics, and Instrumentation for Relativistic Astrophysics. We thank very much the chairs of the parallel sessions for their help in drawing the scientific program.

Texas 2012 has also three public talks. We thank very much George Matsas, Martin Makler and Jorge Horvath for accepting talking in these public sessions.

It would be impossible for Brazil to host Texas 2012 without the financial support given by the Brazilian agencies CAPES, FAPESP and CNPq. We thank them very much for the support. We also thank IUPAP for some financial support.

The organization of a Symposium is only possible with the active participation of the Local Organizing Committee. We thank all my colleagues for their spirit of collaboration. Among them, it must be mentioned César Costa for his extremely valuable help with many issues.

Last but not least, we thank SBF, SAB, São Paulo Convention & Visitors Bureau, and our secretaries (headed by Valéria Fernandes) for their invaluable support.

J.C.N. de Araújo
LOC
Texas 2012 - São Paulo – Brazil

Contents

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Nelson Pinto Neto (CBPF)
Marcelo Byrro Ribeiro (UFRJ)
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Symposium Information

Symposium Venue

The 26th Texas Symposium on Relativistic Astrophysics will occur in São Paulo city, Brazil, from December 16-20, 2012, hosted by the **National Institute for Space Research** (INPE).

The Symposium will be held at **Hotel Bourbon Convention Ibirapuera:**

Avenida Ibirapuera, 2927, São Paulo - SP, Brazil
Tel: + 55 11 21612200
Fax: + 55 11 21612201
Toll Free 0800 770 2201

Room Allocation

The event will count with 4 rooms: Rouxinol 1, Rouxinol 2, Gaivota 2 and Gaivota 3. Plenary and Parallel sessions will be presented in Gaivota 2-3. While Posters will be displayed in the Foyer.

Information and Registration desk

The registration desk will be located on Rouxinol 1. For informations during the event look for a LOC member or the hotel staff.

Catering

Coffee-breaks will be serve in Rouxinol 1-2.

Wi-fi

The venue hotel offers WI-fi service. Please ask at the registration table for details.

Utility phones

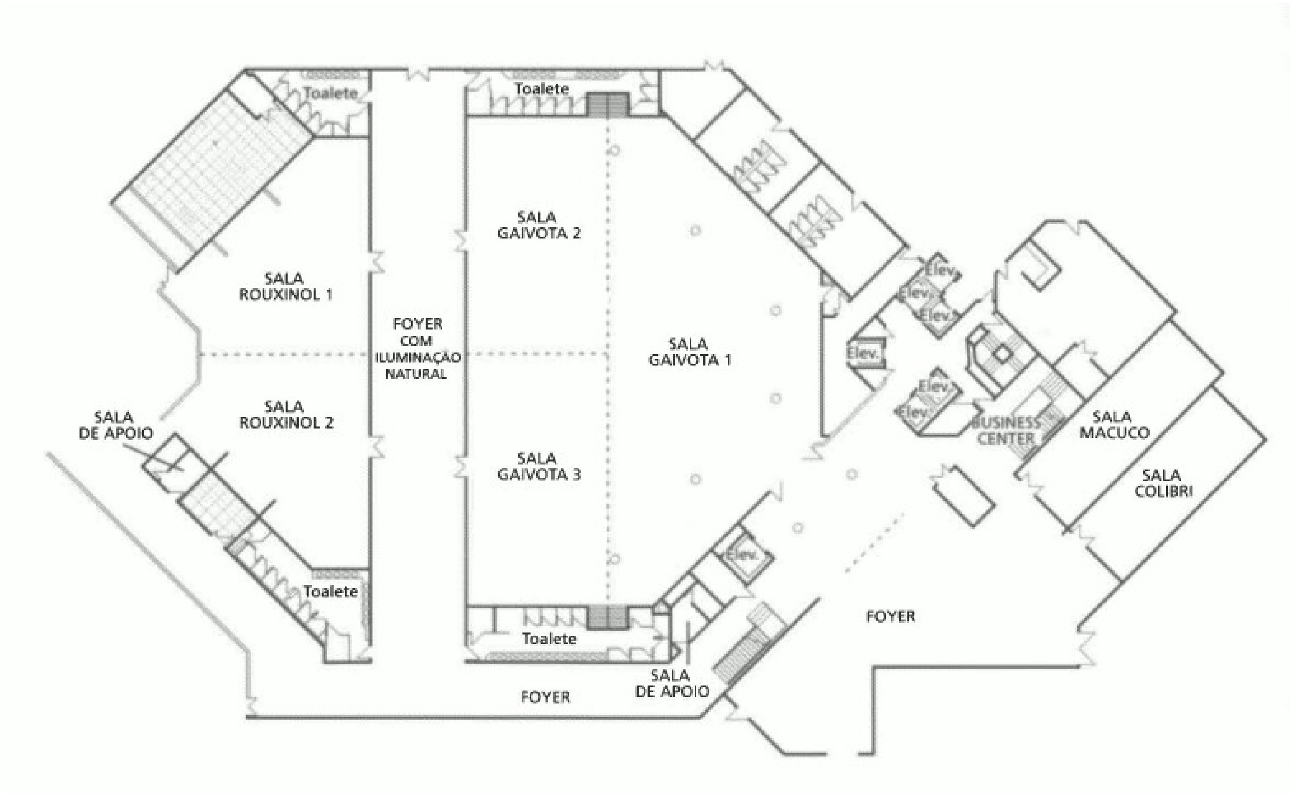
Police/Emergency – 190

Mobile Phones

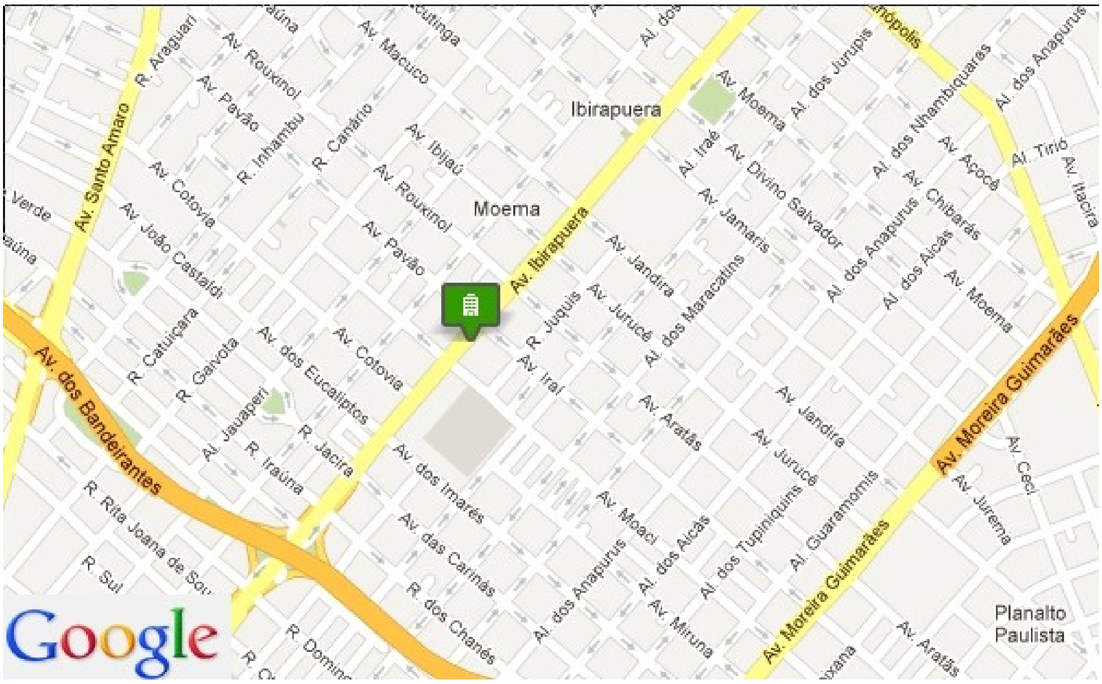
Delegates and Speakers are requested to turn off their mobile phones during all sessions. Other participants must put them on silence mode.

Maps

Convention Center Map



Area Map



Victor Heiss

The edition of the Texas Symposium on Relativist Astrophysics is in honor of *Victor Hess* and in celebration of 100 years of his discovery of Cosmic Rays.

Victor Franz Hess

Victor Franz Hess was born on the 24th of June, 1883, in Waldstein Castle, near Peggau in Steiermark, Austria. His father, Vinzens Hess, was a forester in Prince Öttingen-Wallerstein's service and his mother was Serafine Edle von Grossbauer-Waldstätt. He received his entire education in Graz: Gymnasium (1893-1901), and afterwards Graz University (1901-1905), where he took his doctor's degree in 1910.

He worked, for a short time, at the Physical Institute in Vienna, where Professor von Schweidler initiated him in recent discoveries in the field of radioactivity. During 1910-1920 he was Assistant under Stephan Meyer at the Institute of Radium Research of the Viennese Academy of Sciences. In 1919 he received the Lieben Prize for his discovery of the"ultra-radiation" (cosmic radiation), and the year after became Extraordinary Professor of Experimental Physics at the Graz University.

From 1921 to 1923, Hess was granted leave of absence, and worked in the United States, where he took a post as Director of the Research Laboratory (created by him) of the U.S. Radium Corporation, at Orange (New Jersey), and as Consulting Physicist for the U.S. Department of the Interior (Bureau of Mines), Washington D.C.

In 1923 he returned to Graz University and in 1925 he was appointed Ordinary Professor of Experimental Physics. In 1931 came his appointment as Professor at Innsbruck University and Director of the newly established Institute of Radiology. He founded the station at the Hafelekar mountain (2,300 m) near Innsbruck for observing and studying cosmic rays.

Victor Hess and his baloon

As well as the Nobel Prize for 1936, which he shared with C.D. Anderson, Hess has been awarded the Abbe Memorial Prize and the Abbe Medal of the Carl Zeiss Institute in Jena (1932); he was also Corresponding Member of the Academy of Sciences in Vienna.

Hess's work which gained him the Nobel Prize, was carried out during the years 1911-1913, and published in the Proceedings of the Viennese Academy of Sciences. In addition he has published some sixty papers and several books, of which the most important were: "Die Wärmeproduktion des Radiums" (The heat production of radium), 1912; "Konvektionserscheinungen in ionisierten Gasen-Ionenwind" (Convection phenomena in ionized gas-ionwinds), 1919-1920; "The measurement of gamma rays", 1916 (with R.W. Lawson); "The counting of alpha particles emitted from radium", 1918 (also with R. W. Lawson); *Elektrische Leitfähigkeit der Atmosphäre und ihre Ursachen* (book), 1926 (in English: *The Electrical Conductivity of the Atmosphere and Its Causes*, 1928); *Ionenbilanz der Atmosphäre* (The ionization balance of the atmosphere - book), 1933; *Luftelektrizität* (Electricity of the air - book, with H. Benndorf), 1928; "Lebensdauer der Ionen in der Atmosphäre" (Average life of the ions in the atmosphere), 1927-1928; "Schwankungen der Intensität in den kosmischen Strahlen" (Intensity fluctuations in cosmic rays), 1929-1936.

From *Nobel Lectures, Physics 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965

Victor F. Hess died on December 17, 1964.

São Paulo

What Defines São Paulo

Beautiful, wealthy, intellectual, inclusive, vibrant, sports-loving, cultural, sentimental, romantic, modern, sophisticated, self-confident and professional, São Paulo is all of these and more: no single adjective can accurately describe this world-renowned megacity.

Forged from a melting pot of nationalities, cultures, beliefs, philosophies and ideals, this huge and pioneering metropolis is truly cosmopolitan by vocation and choice. It's Italian, German, Jewish, Portuguese, Japanese, Chinese, French, African, Arab, Spanish, Latino, Brazilian and Paulistano. These and so many other facets are reflected in the architecture of the buildings, the streets, the refined tastes of the city's culinary delights and in the styles and mannerisms of a people who never stop as they boldly create the city's history, day after day.

The grandeur of São Paulo is demonstrated in many ways. The city houses Latin America's largest number of hotel and health care facilities, and is also Brazil's cultural centre. It is considered one of the world's dining capitals, is recognized worldwide as a leading destination for major events, trade fairs and expositions, and is home to the country's finest academic centres and research institutes.

São Paulo is one of few places where the past and present are seamlessly interwoven. The city has witnessed events from Brazilian Independence to political and cultural revolutions and pro-democracy protests. It is also home to hundreds of cinemas, museums, theaters, cultural heritage sites, parks, performance halls, amusement and theme parks, restaurants, bars, hotels, event spaces, street fairs, shopping centers and specialized retail districts.

Each year about ten million visitors come to do business, go shopping or simply enjoy the city's world class culture. Here, they experience an around-the-clock metropolis and a lifestyle that mixes work and pleasure like they were two sides of the same coin. Capital city of a state the size of the United Kingdom, with a population similar to Spain's, and generating almost half of Brazil's economic output, São Paulo has become Brazil's foremost tourism destination. That's why we proudly invite you to:

Come and visit São Paulo, It's All the Best!

SOURCE: http://www.visitesaopaulo.com

Must see

Museum of Art (MASP)

Paulista Avenue is one of the most vital streets in all of Brazil, let alone Sao Paulo. The vibrant urban artery is a good place to start in the city, namely with the excellent Museum of Art. The facility's architecture is as much the attraction as the art inside. Modernist architect Lina Bo Bardi drew up the plans for what is now a paramount city landmark.

Sao Paulo Museum of Art (MASP)

Bridge Octavio Frias de Oliveira (cable-stayed bridge)

Sao Paulo Cathedral

A Neo-Gothic masterpiece built in 1967, after decades of work, Sao Paulo Cathedral is immense and spectacular. With capacity for 8,000 people, the interior features incredible marble work and design details.

Bom Retiro and Luz

A central historic district of Sao Paulo rife with notable architecture, Bom Retiro has a lot to offer pedestrians. Start with the terrific Estaçao da Luz and Museum of the Portuguese Language and make your way to Jardim da Luz. If you can score a ticket to see a concert at the Julio Prestes Cultural Center, even better.

Luz Train Station (Estação da Luz)

Ibirapuera Park

In what could very well be one of the best urban parks in the world, let alone South America, Ibirapuera Park is the place to chill out and take a deep breath in Sao Paulo. The venerable city oasis offers a lot for visitors to see, from the Museum of Contemporary Art and Obelisk of Sao Paulo to Ibirapuera Auditorium, the brainchild of design wizard Oscar Niemeyer.

Mercado Municipal

Built to handle the produce coming into the city, the market now sells everything you can think of, and its restaurants offer lively fare.

Public Market (Mercado Municipal)

Vila Olimpia

For nightlife fun in Sao Paulo, head to the Vila Olimpia 'hood. This is where all the action is between sunset and sunrise. From dive bars and live music to ultra-swish dance clubs, Vila Olimpia has it all.

Edifício Itália

Mid-20th century design aesthetics may not be able to hold a candle to the modern skyscrapers of today but still, Sao Paulo's Edifício Itália is tremendous. What makes the 46 story high-rise worthwhile is the rooftop observation deck, with superb views of the city.

Panoramic view from Edificio Italia rooftop.

Pátio do Colégio

A Jesuit church and school that dates back to the mid-16th century, the Pátio do Colégio is one of the most important heritage landmarks in Sao Paulo. The edifice contains a museum and colonial art exhibit.

Vila Madalena and Pinheiros

Famous for nightlife and a dynamic civic vibe, the Vila Madalena district and Pinheiros borough of Sao Paulo is a definite must-see. Some refer to Pinheiros as the new downtown of the city and with scores of luxury shops, beautiful homes, clubs, restaurants and museums, the wealthy area is a great place to hang out in the city.

Credits and photos: http://www.ratestogo.com

City Tour

Levitur offers special tours for the participants of the 26th Texas Symposium on Relativistic Astrophysics. Visit their website at http://www.levitatur.com.br/26th-texas-symposium-on-relativistic-astrophysics/tours.

Scientific Program

Sunday December 16, 2012	
	Plenary Sessions
09h00 – 10h30	**Plenary Session I** — **Room Gaivota 2/3**
09h00	**Virginia Trimble** What ever became of ... ? Ideas from other TEXAS Symposia
09h30	**John Carlstrom** New Measurements of the Cosmic Microwave Background
09h55	**Keith Olive** LHC Results and Their Impact to Cosmology
10h30 – 11h00	**Coffee Break**
11h00 – 12h30	**Plenary Session II** — **Room Gaivota 2/3**
11h00	**José Ademir Sales Lima** The Accelerating Universe: Dark Energy and Alternative Models
11h35	**Jaan Einasto** Dark Matter
12h10	**Carlos Cunha** Dark Energy Survey (DES)
12h30 – 14h00	**Lunch**
20h00 – 21h00	**Public Talk**
20h00	**Martin Makler** Universo (The Universe)

Sunday December 16, 2012

Parallel Sessions[1]

14h00 – 15h30	COS-I (Gaivota 3) Nelson Pinto Neto		COB-I (Gaivota 2) Cecilia Chirenti
14h00	**Daisuke Nagai (2011 IUPAP winner of the YOUNG Scientist Prize in Astrophysics)** A New Era of Cosmology and Astrophysics with Galaxy Clusters (#1546)	14h00	**Jorge Rueda** On globally and locally neutral static and rotating neutron stars (#1548)
14h30	**Bruno Moraes** The CFTH/MegaCam Stripe-82 Survey (CS82): Overview and First Results (#1513)	14h18	**German Lugones** Hybrid Stars In The Light Of The Massive Pulsar PSR J1614−2230 (#1512)
14h45	**Victor De Castro Mourão Roque** Unveiling the QCD phase transition through the eLISA/NGO detector (#1509)	14h36	**Carlos Frajuca** Estimating pulsars' braking indices (#1471)
15h00	**Reinaldo Rosa** A new gravitational N-body simulation algorithm for investigation of chaotic advection in astrophysical and cosmological systems (#1544)	14h54	**Jorge Horvath** "Black Widow" pulsars and related objects (#1469)
15h15	**Tomonori Totani** FastSound: Testing Gravity at z>1 by Redshift Space Distortion with Subaru/FMOS (#1455)	15h12	**Riccardo Ciolfi** Poloidal-Field Instability In Magnetized Relativistic Stars (#1442)
15h30 – 16h10	Coffee break		
14h00 – 18h00	COS-II (Room Gaivota 3) Maria Luiza Bedran		COB-II (Room Gaivota 2) Jorge Rueda
16h10	**Nelson Pinto Neto** The quantum-to-classical transition of primordial cosmological perturbations (#1534)	16h10	**Joseph Mitchell** Shell Flashes on H/He Accreting CO White Dwarfs (#1465)
16h25	**Alnadhief Hamed Ahmed Alfedeel** The Null Cone Observations in Lemaître metric (#1552)	16h28	**Patricia Arevalo** Accretion disc-corona connection in AGN (#1503)
16h40	**Vladimir Strokov** Phenomenological Approach in the Study of Singularity Problem (#1452)	16h46	**Jaderson Schimoia** Short timescale variations of the H alpha double-peaked profile of the nucleus of NGC 1097 (#1499)
16h55	**Osamu Seto** Asymmetric dark matter after a cosmological phase transition (#1474)	17h04	**Jorge Cuadra** Stellar Winds and the Infalling Cloud in the Galactic Centre (#1502)
17h10	**Reinaldo Rosa** Alternative cosmology from cusp geometries (#1545)	17h22	**Mauri Valtonen** Proof of the no-hair theorem for the OJ287 primary black hole (#1422)
17h25	**Marcelo Byrro Ribeiro** Fractal Analysis Of The Galaxy Distribution In The Redshift Range 0.45<z<5.0 (#1555)	17h40	**M. Angelez Perez-Garcia** Multi-messenger emission from Neutron star internal phase transition (#1432)

1 For organization purposes we grouped some topics for the parallel sessions as:
- **COS** - Cosmology/Alternative Models and Theories
- **COB** - Compact Objects/Quantum Effects in Relativistic Astrophysics
- **GIA** - Galactic and Intergalactic Astrophysics
- **HEA** - High Energy Astrophysics/Astroparticle Physics/Instrumentation for Relativistic Astrophysics
- **NGW** - New Windows/Gravitational Waves/New Projects/Missions

Monday December 17, 2012

Plenary Sessions		
09h00 – 10h30	**Plenary Session III**	**Gaivota 2/3**
09h00	**Tiziana Di Matteo** Large-Scale Structure, Galaxy and SMBH Formation and Growth, and the Milky Way Case	
09h45	**Suvi Gezari** Tidal Disruption Events	
10h30 – 11h00	**Coffee Break**	
11h00 – 12h30	**Plenary Session IV**	**Gaivota 2/3**
11h00	**Thaisa Storchi-Bergmann** The feeding of supermassive black holes	
11h30	**Jonathan McKinney** Simulations of Accreting Black Holes on Horizon Scales	
11h55	**Ludovic van Waerbeke** Gravitational Lensing: The beginning of a new era for the study of the dark Universe?	
12h30 – 14h00	**Lunch**	
20h00-21h00	**Public Talk**	
20h00	**George Matsas** Buracos Negros: Rompendo os Limites da Ficção (Black Holes - beyond science fiction)	

Monday December 17, 2012

Parallel Sessions

14h00 – 15h30	**HEA-I (Gaivota 3)** João Braga		**GIA (Gaivota 2)** Thaisa Storchi-Bergmann
14h00	**Alexander Van Der Horst (2012 IUPAP winner of the YOUNG Scientist Prize in Astrophysics)** From gamma rays to radio waves: the extremes of gamma-ray bursts (#1543)	14h00	**Carlos Raúl Argüelles** Fermionic Dark Matter and galactic structures at all scales (#1539)
		14h18	**Ronaldo Vieira** A third integral of motion for nearly equatorial orbits in axisymmetric thin disks (#1470)
14h36	**Lixin Dai** Simulating tidal disruptions of stars by supermassive black holes: extracting black hole spin (#1497)	14h36	**Vanessa Pacheco De Freitas** Self-gravitating disks: aspects of stability (#1479)
14h54	**Roland Walter** The tidal disruption of an extrasolar planet detected at hard X-rays (#1421)	14h54	**Daniel Alf Drehmer** Dynamical model for the stellar kinematics and determination of the the mass of the supermassive black hole in NGC 4258 (#1507)
15h12	**Luis Juracy Lemos** Luminosity Function of GRBs (#1556)	15h12	**Michael Kesden** Tidal disruption by spinning supermassive black holes (#1490)

15h30 – 16h10	Coffee break	
16h10 – 17h40	**HEA-II (Gaivota 3)** Odylio Denys Aguiar	**COB-III (Gaivota 2)** Jorge Horvath
16h10	**João Braga** The MIRAX Mission on the Lattes Satellite (#1431)	**Claudia Aguilera Gómez** Failure Conditions of the Elastic Crust of Neutron Stars (#1478)
16h28	**Fabrizio Tavecchio** Axion-like particles and emission of very high energy gamma rays in blazars (#1441)	**Michael Gabler** Modulating the emission of magnetars - neutron star seismology with QPOs of SGRs (#1447)
16h46	**Ulisses De Almeida** Relativistic astrophysical sources: New results from MAGIC (#1476)	**Cecilia Chirenti** F-modes of slowly and differentially rotating stars (#1424)
17h04	**Peter Eger** Search for Very-high-energy gamma-ray emission from Galactic globular clusters with H.E.S.S. (#1484)	**Shinichiro Yoshida** A numerical eigenmode analysis of rotating relativistic stars (#1425)
17h22	**Amy Furniss** VERITAS Extragalactic Gamma-ray Observations (#1489)	**Manuel Malheiro** Magnetic moments of SGRs and AXPs as white dwarfs pulsars (#1553)

Tuesday December 18, 2012

Parallel Sessions		
09h00 – 10h30	**Plenary Session V**	**Gaivota 2/3**
09h00	**Francis Halzen** Particle Astrophysics with High Energy Neutrinos	
09h35	**Karl-Heinz Kampert** Ultra-High Energy Cosmic Rays: Theory, Results, and Prospects	
10h10	**Elisabete De Gouveia Dal Pino** CTA- Cherenkov Telescope Array	
10h30 – 11h00	**Coffee Break**	
11h00 – 12h45	**Plenary Session VI**	**Gaivota 2/3**
11h00	**Emanuele Berti** Astrophysical tests of general relativity in the strong-field regime	
11h35	**Marco Tavani** Gamma ray Astronomy from GeV to TeV Energies	
12h10	**Adam Burrows** Core-Collapse Supernova Explosions: The Theoretical Challenge	
12h45 – 14h00	**Lunch**	
Free Afternoon		
20h00-21h00	**Public Talk**	
20h00	**Jorge Horvath** Astrofisica Relativistica: Supernovas, Estrelas de Neutrons e Buracos negros hoje. (Relativistic Astrophysics: SuperNovae, Neutron Stars and Black Holes Today.)	

Wednesday December 19, 2012

Plenary Sessions		
09h00 – 10h30	**Plenary Session VII**	**Gaivota 2/3**
09h00	**Roger Blandford** The Incredible Crab	
09h30	**Ehud Nakar** Electromagnetic Signals that Accompany Neutron Stars Mergers, Supernova Shock Break Out and Low Luminosity GRB	
09h55	**Sandro Mereghetti** Pulsars and Magnetars	
10h30 – 11h00	**Coffee Break**	
11h00 – 12h30	**Plenary Session VIII**	**Gaivota 2/3**
11h00	**Fiona Harrison** The first Focusing High-Energy X-ray Telescopes: Opening a New Window on the High Energy Universe	
11h35	**Carlos Lousto** Binary Black Hole Mergers in Numerical General Relativistic Astrophysics	
12h10 – 14h00	**Lunch**	
20h00-21h00	**Banquet**	

Wednesday December 19, 2012

Parallel Sessions		
14h00 – 15h30	**HEA-III (Gaivota 3)** **João Braga**	**COB-IV (Gaivota 2)** **José C. N. De Araújo**
14h00	**Elisabete De Gouveia Dal Pino** Particle Acceleration by Magnetic Reconnection: from solar flares to AGNs and GRBs (#1454)	**William Lima** Awaking the vacuum in relativistic stars (#1429)
14h18	**Zhuo Li** Gamma-ray burst neutrino limit from IceCube and Fermi observations (#1456)	**Raissa Mendes** Vacuum awakening in spheroidal configurations (#1491)
14h36	**Arman Esmaili** Indirect Dark Matter Detection in the Light of Sterile Neutrinos (#1516)	**André Landulfo** Particle creation due to tachyonic instability in relativistic stars (#1428)
14h54	**Bernardo De Oliveira Fraga** Self-gravitating system of fermions as dark matter halos and central objects in galaxies (#1536)	**Rodrigo Macedo** Time evolution of non-symmetric Robinson-Trautman spacetimes (#1538)
15h12	**Andrea Giuliani** SNR W44, the first unambiguous evidence of gamma-rays emission from neutral-pions decay (#1495)	**Danilo Teixeira** No Evidence For Bardeen-Petterson Alignment In Conservative GRMHD Simulation Of Moderately Thin, Tilted Accretion Disk (#1532)
15h30 – 16h10	**Coffee break**	
16h10 – 17h40	**HEA-IV (Gaivota 3)** **Elisabete De Gouveia Dal Pino**	**NGW-I (Gaivota 2)** **César Augusto Costa**
16h10	**Kumiko Kotera** Pulsars, supernovae, and ultrahigh energy cosmic rays (#1423)	**Odylio Denys Aguiar** Schenberg Gravitational Wave Antenna: Status Report (#1510)
16h28	**Sander Walg** Relativistic AGN jets: The effect of radial stratification on internal shocks and jet integrity (#1430)	**Andrezj Krolak** Searching for gravitational wave signals from rotating neutron stars with the LIGO and Virgo detectors (#1434)
16h46	**Dmitry Chernyshov** Possible link between FERMI bubbles and cosmic rays (#1480)	**José C. N. De Araújo** Searching for Gravitational Waves with a Geostationary Interferometer (#1550)
17h04	**Ke Fang** Very High and Ultrahigh Energy Cosmic Ray Nuclei from Pulsars (#1494)	**Cristina Valeria Torres** Capitalizing on GW polarization bias for a pair of interferometric detectors to increase parameter estimation speed and the potential implications for cosmological models (#1518)
17h22		**Curt Cutler** Improved versions of the F-statistic for more efficient GW pulsar searches (#1519)

Thursday December 20, 2012

Plenary Sessions		
09h00 – 10h30	**Plenary Session IX** — **Gaivota 2/3**	
09h00	**Alberto Sesana** Gravitational-Wave Detection using Laser Interferometer Systems and Pulsar Timing Arrays	
09h40	**Patrick Brady** Gravitational-wave Observatories: current results and future prospects	
10h30 – 11h00	**Coffee Break**	
11h00 – 12h30	**Plenary Session X** — **Gaivota 2/3**	
11h00	**Reuven Opher** Challenges of Relativistic Astrophysics	
11h35	**Vincent Fish** New Frontiers in Relativistic Astrophysics: The Event Horizon Telescope and other Future Projects/Missions	
12h10	**Closing remarks**	
12h30 – 14h00	**Lunch**	
Parallel Sessions		
14h00 – 15h20	**HEA-V (Gaivota 3)** **Odylio Denys Aguiar**	**COB-V/NGW-II (Gaivota 2)** **Marcio Eduardo da Silva Alves**
14h00	**Jozef Skakala** No asymptotically highly damped quasi-normal modes without horizons? (#1445)	**Gabriel Perez-Giz** Bigrade Orbits Around Kerr Black Holes (#1540)
14h18	**Maria Victoria Del Valle** Bowshocks of runaway stars as gamma-ray sources (#1462)	**Motoyuki Saijo** Nonlinear effect of r-mode instability in uniformly rotating stars (#1468)
14h36	**Efrain Ferrer** Effect of Diquark-Diquark Repulsion in the EoS of Strongly Interacting Systems (#1531)	**Carlos Frajuca** Network of interferometric gravitational wave detectors sensitivity for identifying the metric theory of gravity (#1473)
14h54	**Ana Virginia Penacchioni** Recent progress on the Induced Gravitational Collapse Model (#1537)	**Daniela Delia Alic** Electromagnetic and Gravitational Wave emission from merger of supermassive black holes in force-free plasma (#1439)

Abstracts

Plenary Sessions

Plenary Session I

What ever became of ... ? Ideas from other Texas Symposia

Virginia Trimble

At the Vancouver Texas I reviewed the history of the Symposia themselves. The printed version appears with the proceedings from Heidelberg. This time, I would like to take a look at some of the ideas (hypotheses, theories, models, scenarios...) once though viable but no longer in the universe or discourse, and probably not in the real universe either. Examples include quasars as spinars or Christmas trees, the Mixmaster Universe, dominant baryonic dark matter, and pulsar glitches as starquakes. Members of the SOC and LOC and any others who see this draft abstract are invited to suggest their favorite falsified hypotheses, pertaining more or less to the realm of relativistic astrophysics, for inclusion. A more complete abstract will be provided closer to the event.

New Measurements of the Cosmic Microwave Background

John Carlstrom

Over the last decades measurements of the Cosmic Microwave Background (CMB) on large angular scales have revealed a great deal about the fundamental workings of the universe, leading to a standard cosmological model. Testing this model, refining its parameters and, most importantly, investigating the new physics it requires, such as Inflation, Dark Matter and Dark Energy is now being pursued with increasingly sensitive measurements of the CMB polarization and its fine angular scale anisotropy. Recently the characterization of the intrinsic CMB anisotropy through the damping scale has led to increased precision on inflationary parameters and new constraints on the number of relativistic species, as well as improvements in the standard cosmological parameters. Using large CMB telescopes, such as the South Pole Telescope (SPT) and the Atacama Cosmology Telescope (ACT), the fine angular scale CMB measurements are now probing the emergence and evolution of structure in the universe through the subtle, small-angular scale distortions they impart on the background, such as gravitational lensing from the mass in the universe and the scattering from ionized gas (the Sunyaev-Zel'dovich effects). These measurements provide further tests of the cosmological model and unique constraints on the dark energy equation of state and the reionization of the universe. This talk will review the status of the field, including the newest results from the South Pole Telescope, and expectations for the future.

LHC Results and Their Impact to Cosmology

Keith Olive

The last two years has seen an immense amount of activity and results from the Large Hadron Collider (LHC). Most notable, is the discovery of a new particle, which may very well be the long sought Higgs boson associated with electroweak symmetry breaking. There have also been many (up to now) unsuccessful searches for new particles associated with supersymmetry. One of the most attractive candidates for dark matter is the lightest super-symmetric particle (LSP). The recent results from the LHC have had a dramatic impact on our expectations for the properties of the LSP. These results can be used to revise expectations for both direct and indirect detection of dark matter.

Plenary Session II

The Accelerating Universe: Dark Energy and Alternative Models

José Ademir Sales Lima

The discovery of the accelerated expansion of the Universe was one of the biggest surprises in modern cosmology. Almost 15 years later, we are still searching for a satisfactory explanation of this phenomenon. I will summarize some of the main ideas proposed so far, ranging from new particles to modifications of General Relativity. A variety of cosmological observations have narrowed down the space of viable theories, but there are many questions left to answer. I will conclude by discussing the prospects for future experiments to identify the causes of cosmic acceleration.

Dark Matter

Jaan Einasto

I give a review of the development of the dark matter concept, its relation to the structure of galaxies and the cosmic web. I discuss the possible nature of dark matter and its role in the evolution of the Universe. I discuss shortly alternative hypotheses to the dark matter concept. I finish with a short description to contemporary searches for dark matter particles.

Dark Energy Survey (DES)

Carlos Cunha

The Dark Energy Survey (DES) is designed to probe the origin of the accelerating universe and help uncover the nature of dark energy by measuring the history of cosmic expansion with high precision. The project is using a 570 megapixel camera, DECam, mounted on the 4-m Blanco Telescope at Cerro Tololo, Chile, to observe around 300 million galaxies over 5000 sq. degrees of the southern sky. The instrument achieved first light in early September and progress has been rapid. I will describe the science goals of the survey, instrument operation, and present the first data collected.

Plenary Session III

Large-Scale Structure, Galaxy and SMBH Formation and Growth, and the Milky Way Case

Tiziana Di Matteo

At present, our understanding of galaxy formation remains sketchy even though a basic paradigm for it exists - the theory of hierarchical galaxy formation within the Lambda-CDM cosmology. The fundamental challenge is that galaxy formation involves a complicated blend of different physics that is non-linearly coupled on a wide range of scales, leading to extremely complex dynamics. For this reason large simulations have become the primary avenue for theoretical research in galaxy formation. I will discuss state-of-the-art cosmological hydrodynamical simulations of galaxy formation with unprecedented combination of resolution and physical complexity, including radiative cooling, star formation and black hole rowth. The prospect that we are reaching a position to use cosmology, i.e. the science of the Gpc horizon, in our simulations to make predictions for the mass distribution in the inner regions of galaxies is extraordinary.

Tidal Disruption Events

Suvi Gezari

The majority of supermassive black holes in the Universe lie dormant and starved of fuel. These hidden beasts can be temporarily illuminated when an unlucky star passes close enough to be tidally disrupted and consumed by the black hole. Theorists first proposed in 1975 that tidal disruption events should be an inevitable consequence of supermassive black holes in galaxy nuclei, and later argued that the resulting flare of radiation from the accretion of the stellar debris could be a unique signpost for the presence of a dormant black hole in the center of a normal galaxy. It was not until over two decades later that the first convincing tidal disruption event candidates emerged in the X-rays by the ROSAT All-Sky Survey. Since then over a dozen total candidates have now emerged from searches across the electromagnetic spectrum, including the X-rays, the ultraviolet, and the optical. In the last couple years, we have also witnessed a paradigm shift with the discovery of relativistic, beamed emission associated with tidal disruption events. I will review the census of observational candidates to date, and discuss the exciting prospects for using large samples of tidal disruption events discovered with the next-generation of ground-based and space-based synoptic surveys to probe accretion disk and/or jet formation and black hole demographics.

Plenary Session IV

The Feeding of Supermassive Black Holes

Thaisa Storchi-Bergmann

Abstract: It is now believed that all galaxies which have a bulge also harbor a supermassive black hole (SMBH) at the nucleus. Besides capturing stars which come closer than its tidal radius, the SMBH can also "be awaken" by large gas supplies which reach the nucleus probably as a result of interaction of the host galaxy with another nearby galaxy or capture of small satellites. This gas supply then triggers episodes of nuclear activity, giving origin to Active Galactic Nuclei (AGN), characterized by phenomena such as large luminosities of non-stellar origin and relativistic jets. I discuss observational signatures of this scenario, tracing the feeding of AGN: (1) at unresolved scales, in the form of double-peaked emission lines originating in accretion disks of few thousand of gravitational radia; (2) at scales of tens to hundred of parsecs (resolved in nearby galaxies), in the form of inflows along nuclear spiral arms, which may be the long sought mechanism to bring gas from kiloparsec scales down to the nucleus to feed

the SMBH.

Simulations of Accreting Black Holes on Horizon Scales

Jonathan McKinney

General relativistic magnetohydrodynamical simulations have exposed the role of magnetic fields in controlling accretion and jet production from rotating black holes. In this talk I discuss how a magnetic field can build-up to a natural saturation point by which the standard magneto-turbulent disk theories (based upon the magneto-rotational instability) are no longer applicable. Such naturally saturated magnetic fields lead to persistent jets with efficiencies of order 100% and to high-frequency quasi-periodic oscillations. In the limit of no strong ambient magnetic field, the field near the hole can spontaneously organize into a dipolar field and lead to transient jets.

Gravitational Lensing: The beginning of a new era for the study of the dark Universe?

Ludovic van Waerbeke

For the past ten years, independent observations have considerably strengthen the idea that dark matter and dark energy dominate the energy budget of our Universe. One of the cosmology probes, which contributed to this progress, was gravitational lensing. In the first half of this talk I will review the most recent advances in this area, and during the second half I will discuss what is to be expected from the coming surveys of the next decade. Future surveys will be pushing the field in new territory where we expect numerous discoveries to be made, but where the complexity of the data analysis challenge is also considerable. No doubt that a new era is opening up!

Plenary Session V

Particle Astrophysics with High Energy Neutrinos

Francis Halzen

Construction and commissioning of the cubic-kilometer IceCube neutrino detector and its low energy extension DeepCore have been completed. The instrument detects neutrinos over a wide energy range: from 10 GeV atmospheric neutrinos to 1e10 GeV cosmogenic neutrinos. We will discuss initial results based on a subsample of the more than 300,000 neutrino events recorded during construction. We will emphasize the observation of PeV-energy neutrinos, the first measurement of the high-energy atmospheric neutrino spectrum, the search for the still enigmatic sources of the Galactic and extragalactic cosmic rays and for the particle nature of dark matter.

Astrophysical tests of general relativity in the strong-field regime

Emanuele Berti

General relativity (GR) is an integral ingredient of modern astronomy. We have gone a long way since the first Texas Symposium in 1963, when astronomers would ask relativists about the meaning of the Riemann tensor, and relativists would interrupt astronomers to be instructed about the magnitude of a star.

Einstein's theory is well tested in the weak-field regime, but there is only circumstantial experimental evidence that astrophysical black holes are described by the Kerr solution of the Einstein equations, and there are theoretical reasons to believe that the theory may require modifications at high energies.

Astrophysical observations of compact objects (whether isolated or in binary systems) can constrain proposed extensions of Einstein's theory, and perhaps provide hints of high-energy modifications of the theory. I will review and compare some ideas to test GR and constrain its extensions by astrophysical observations in the electromagnetic spectrum and via future gravitational-wave observations.

Ultra-High Energy Cosmic Rays: Theory, Results, and Prospects

Karl-Heinz Kampert

The Pierre Auger and Telescope Array Observatories have provided a wealth of high quality and high statistics data on cosmic rays at the highest energies. A cut-off in the energy spectrum, as predicted by Greisen, Zatsepin and Kuzmin in 1966, and first hints of anisotropies in the arrival directions, most notably a directional correlation of the most energetic events with nearby AGN have been observed by the Auger Observatory. A key to learn about the origin of the particles is provided by measurements of their primary mass. Data from the Pierre Auger Observatory cannot be described by a proton dominated composition and indicate an increasing fraction of heavy primaries at the highest energies. This could most naturally be interpreted as a signature of a few nearby sources reaching their limiting energy according to E_max = Z*B*R. Data from the

Telescope Array, on the other hand, are consistent with a proton dominated composition at all energies. We shall report about the current status of the measurements and their systematics, and their interpretation in terms of the origin of cosmic rays. We shall finish with an outlook discussing plans for upgrades of existing observatories and for constructing a next generation giant ground based observatory.

CTA - Cherenkov Telescope Array

Elisabete de Gouveia Dal Pino

Gamma-ray astronomy has a huge potential in astrophysics, particle physics and cosmology. CTA is an international initiative to build the next generation ground-based gamma-ray observatory which will have a factor of 5-10 improvement in sensitivity in the 100 GeV-10 TeV range and an extension to energies well below 100 GeV and above 100 TeV. CTA will consist of two arrays (one in the North, another in the South) for full sky coverage and will be operated as open observatory. It will provide a deep insight into the non-thermal high-energy universe. In this talk we will briefly present the major design concepts of CTA as well as its vast science case.

Plenary Session VI

Gamma ray Astronomy from GeV to TeV Energies

Marco Tavani

Gamma-ray astrophysics from space has been recently boosted by the space missions AGILE and FERMI (operating in the energy range 100 MeV - 100 GeV) and by ground-based TeV observatories (HESS, MAGIC, VERITAS as well as MILAGRO and ARGO-YBJ). The combination of GeV and TeV data constitute a formidable combination of information on relativistic processes shaped by extreme gravity and hydrodynamical conditions. We will review the main results for both Galactic and extragalactic sources, and focus on the main sources for which a substantial advance in knowledge (not without surprises) has been obtained (pulsars, micro-quasars, Galactic transients, diffuse Galactic emission, and "bubbles", Supernova Remnants, blazars and other active galaxies, gamma-ray GRBs, dark matter limits). The surprising discovery of gamma-ray flares from the Crab Nebula will be presented together with the relevant new implications for particle acceleration models. We will also briefly discuss possible future developments.

Core-Collapse Supernova Explosions: The Theoretical Challenge

Adam Burrows

"Core-collapse supernovae have challenged theorists and computational science for half a century. Such explosions are the source of many of the heavy elements in the Universe and the birthplace of neutron stars and stellar-mass black holes. However, determining the mechanism of explosion remains the key goal of theory. Recently, using sophisticated numerical tools and platforms, theorists have been able to conduct multi-dimensional simulations with some physical fidelity that have provided insight into the phenomena that attend stellar death and explosion. The core of the emerging theoretical synthesis is the centrality of hydrodynamic instability and asphericity. In this talk, I review the state of the field and the contending explosion models. In the process, I will highlight the computational astrophysics that has been applied to date, and that may be necessary in the future to credibly unravel this mystery.

Plenary Session VII

The Incredible Crab

Roger Blandford

The Crab Nebula continues to delight and surprise astronomers as it has for the past millennium. Recent developments include the realization that the total nebula flux is declining on a timescale of roughly thirty years, that pulses from the pulsar are seen at energies up to about 400 GeV and that the flux at energies between 0.1 and 1 GeV can vary in hours without apparently showing variation in other spectral bands. These observations suggest new emission paradigms, specifically that the pulsar acts as a current generator and radiates though inverse Compton scattering at the highest energies, that the nebula plasma is ultrarelativistic and that radiation reaction-limited synchrotron emission can occur. As has been true in the past, the Crab Nebula opens new portals to relativistic astrophysics.

Electromagnetic Signals that Accompany Neutron Stars Mergers, Supernova Shock Break Out and Low Luminosity GRBs

Ehud Nakar

I will discuss the electromagnetic (EM) signature of two astrophysical relativistic phenomena – the merger of two neutron stars and the breakout of a relativistic shock through the surface of an exploding star. The EM counterparts of a double neutron star merger are of special interest due to the merger's strong gravitational wave (GW) signal, whose detection is one of the main goals of the next generation ground based GW detectors. I will focus on the predicted EM emission from matter that is ejected dynamically during the first stages of the merger. This sub to mildly relativistic outflow is expected to shine on time scales of hours to days in IR-UV due to the radioactive decay of freshly synthesized r-process elements and on time scales of weeks to years in the radio due to the interaction with the circum-merger medium. Breakout of a relativistic shock takes place in any energetic explosion of envelope stripped or compact star, including type Ia and energetic Ib/c supernovae. I will show that such breakouts produce gamma and X-ray emission that holds a wealth of information on the progenitor and on the explosion itself. I will discuss the prospects to detect such breakouts and the possibility that low-luminosity gamma-ray bursts are in fact relativistic shock breakouts.

Pulsars and Magnetars

Sandro Mereghetti

The great diversity in observational properties of neutron stars as revealed by X-ray and radio observations in the past decade has been a significant surprise in the field. Although astronomy textbooks previously suggested that young neutron stars are all born like the Crab pulsar, today we know this is not true: from "Anomalous X-Ray Pulsars" to "Central Compact Objects," from "Soft Gamma Repeaters" to "Dim Isolated Neutron Stars," we now know neutron stars can take on a wide variety of properties. Today the leading hypothesis for the origin of this diversity lies in the magnetic field of the star. In this talk I will review the properties of the different types of young neutron stars identified today and discuss efforts and current thinking toward unifying them under a single physical theory.

Plenary Session VIII

The first Focusing High-Energy X-ray Telescopes: Opening a New Window on the High Energy Universe

Fiona Harrison

The Nuclear Spectroscopic Telescope Array (NuSTAR) mission, launched on June 13, 2012, is the first space-based focusing high-energy X-ray telescope. The ASTRO-H mission, to be launched in 2014, will carry a hard X-ray focusing capability to complement its high spectral resolution calorimeter. NuSTAR and Astro-H HXI operate in the band from 4 – 79 keV, extending the sensitivity of focusing far beyond the ~10 keV high-energy cutoff achieved by any previous X-ray telescope. These telescopes can address a range of scientific topics ranging from probing obscured AGN activity in the nearby (z<2) universe by surveying selected regions of the sky, studying the population of hard X-ray emitting compact objects in the Galaxy by mapping the central regions of the Milky Way, studying the non-thermal radiation in young supernova remnants both in hard X-ray continuum and emission from the radioactive element 44Ti, studying accretion phenomena in Ultraluminous X-ray sources, Active Galactic Nuclei, and Galactic Binaries. This talk will discuss the scientific capabilities of these missions, and present first results from the NuSTAR science program.

Numerical Relativity

Carlos Lousto

The Numerical INJection Analysis (NINJA) project is a collaborative effort between members of the numerical relativity and gravitational-wave data analysis communities. The purpose of NINJA is to study the sensitivity of existing gravitational-wave search algorithms using numerically generated waveforms and to foster closer collaboration between the numerical relativity and data analysis communities. We present the results of the first NINJA analysis, which focused on gravitational waveforms from binary black hole coalescence. Ten numerical relativity groups contributed numerical data, which were used to generate a set of gravitational-wave signals. These signals were injected into a simulated data set, designed to mimic the response of the initial LIGO and Virgo gravitational-wave detectors. Nine groups analyzed this data-using search and parameter-estimation pipelines. Matched filter algorithms, un-modeled-burst searches and Bayesian parameter estimation and model-selection algorithms were applied to the data. We present the efficiency of these search methods in detecting the numerical waveforms and measuring their parameters.

Plenary Session IX

Gravitational-Wave Detection using Laser Interferometer Systems and Pulsar Timing Arrays

Alberto Sesana

In the coming years the detection of gravitational waves

(GW) will be a reality, opening a completely new window on the Universe. Ground based detectors like the Advanced LIGO will observe coalescing compact binaries out to hundreds of megaparsecs, revealing the hidden face of the local Universe. At lower frequencies, future space based interferometers (like LISA) and precise timing of millisecond pulsars (Pulsar Timing Arrays) will primary target inspiralling and coalescing massive black hole binaries throughout the Universe. I will briefly describe the principles of GW detection via laser interferometry and pulsar timing, the relevant astrophysical GW sources, and the multiple scientific payouts of gravitational wave detection. I will pay particular attention to the low frequency regime, discussing how future GW observation will shed light on the formation and evolution of massive black hole binaries along the cosmic history.

Gravitational-wave Observatories: current results and future prospects

Patrick Brady

I will present the results of searches for gravitational waves in data taken by LIGO and Virgo with an emphasis on the astrophysical interpretation. Although no gravitational waves have been identified in the data, the results provide a glimpse into the possibilities that await with data from the next generation of detectors. I will also summarize the first tentative efforts to undertake joint gravitational and electromagnetic observing campaigns and the lessons learned from that exercise. Finally, I will discuss prospects for observations with advanced detectors.

Plenary Session X

Challenges of Relativistic Astrophysics

Reuven Opher

I discuss some of the most outstanding challenges of relativistic astrophysics: the environment (e.g., gravitational field, magnetic field, plasma properties) near the horizons of single and merging Black Holes and the emitted relativistic jets and gravitational waves from compact binary coalescences; The equation-of state of Neutron Stars (NSs) and the emission from spinning magnetized NSs; A Primordial Inflation theory which predicts the amplitude of primordial density fluctuations, whose initial lengths are greater than the Planck length; and Modified Gravity that explains Dark Energy and/or Dark Matter at small and large scales. I discuss near-future possibilities for addressing these challenges.

New Frontiers in Relativistic Astrophysics: The Event Horizon Telescope and other Future Projects/Missions

Vincent Fish

Multiple future projects and missions promise to open new windows on Relativistic Astrophysics. A range of innovative techniques will target physical processes from high energies to radio wavelengths, enabling new probes of environments where relativistic effects either dominate or can be clearly distinguished. An environment of particular interest is the Galactic Center, where it is now almost certain that a 4 million solar mass black hole exists. Because of its proximity to Earth, this object, known as Sagittarius A*, presents astronomers with the best opportunity in the Universe to spatially resolve and image a black hole Event Horizon. To do this requires using Very Long Baseline Interferometry (VLBI), the technique whereby radio telescopes around the world are linked together in a Global phased array. The Event Horizon Telescope (EHT) project extends VLBI to the shortest radio wavelengths, and preliminary EHT observations have already revealed structure in Sagittarius A* on ~4 Schwarzschild radius scales. This talk will discuss the EHT and several other new experimental directions.

Public Talks (in Portuguese)

Universo (The Universe)

Martin Makler

Durante o século XX foi desenvolvida - pela primeira vez na história da humanidade - uma descrição científica do nosso Universo. Isso foi possível, por um lado, graças a uma quantidade gigantesca de informação trazida por telescópios no solo e sondas espaciais especialmente dedicados à cosmologia – a ciência que estuda a origem, estrutura e evolução do Universo. Por outro lado, os modelos do Universo são baseados em uma síntese de quase toda a física moderna, indo da Teoria da Relatividade Geral de Einstein até a física das partículas elementares. Apesar do sucesso do modelo cosmológico atual, ainda há questões fundamentais em aberto, como por exemplo a composição de cerca de 95% da matéria no Universo ou a própria validade da teoria da gravitação. Nesta apresentação faremos um apanhado das descobertas em cosmologia, de algumas questões em aberto e da pesquisa atual motivada por elas, em teoria e observação, com destaque para a participação brasileira nesse processo.

Buracos Negros: Rompendo os Limites da Ficção (Black Holes - beyond science fiction)

George Matsas

Buracos negros surgiram como uma predição teórica da teoria da relatividade geral de Albert Einstein. Ninguém os levou realmente a sério por décadas e tudo indica que mesmo Einstein morreu acreditando que buracos negros não existiam na natureza. Hoje são poucos (se alguém) os que disputam a existência destes objetos que transcendem a própria ficção. Nesta palestra discutiremos de forma simples e ilustrativa o que são buracos negros e seu papel no Universo que habitamos.

Astrofisica Relativistica: Supernovas, Estrelas de Neutrons e Buracos negros hoje. (Relativistic Astrophysics: SuperNovae, Neutron Stars and Black Holes Today.)

Jorge Horvath

O século 20 deu origem às duas teorias mais interessantes da Física, a Relatividade e Mecânica Quântica, mas também a toda a construção de um quadro geral do Cosmo que inclui a evolução das estrelas e assuntos conexos. Discutimos nesta palestra o fim da evolução estelar e os eventos do nascimento das estrelas de nêutrons e buracos negros. Mostraremos como houve uma simbiose entre as idéias revolucionarias da Física e os sistemas onde estas se realizam, particularmente nas supernovas e objetos compactos remanescentes que deram suporte a estas.

Parallel Sessions

COS-I

A New Era of Cosmology and Astrophysics with Galaxy Clusters

Daisuke Nagai

Recent years have witnessed the emergence of galaxy clusters as powerful laboratories for cosmology and astrophysics. Being the largest and most magnificent structures in the Universe, clusters of galaxies serve as excellent tracers of the growth of cosmic structures. The current generation of multi-wavelength cluster surveys have provided independent confirmation of the cosmic acceleration and significantly tighten constraints on the nature of mysterious dark energy and dark matter as well as new insights into how massive galaxies and black holes form and grow in the Universe. A number of new surveys and large supercomputer simulations are underway to test our understanding of the structure formation and fundamental physics of the cosmos. However, the use of galaxy clusters as sensitive and robust cosmological probes requires solid understanding of the cluster astrophysics. In this talk, I will discuss recent advances and future challenges, with highlights on new insights provided by modern cosmological hydrodynamical simulations. (#1546)

The CFTH/MegaCam Stripe-82 Survey (CS82): Overview and First Results

Bruno Moraes

The CFTH/MegaCam Stripe-82 Survey (CS82) is a joint Canada-France-Brazil project (PIs: J.-P. Kneib, M. Makler, L. Van Waerbeke), covering 170 sq. deg. in the SDSS Stripe-82 area down to magnitude 23.5 in the i band. Its main focus is the study of both weak and strong gravitational lensing, with additional applications in other fields such as galaxy evolution and properties of galaxy clusters. Furthermore, the multitude of existing and future projects in Stripe-82 offers the possibility of exploring synergies with other data sets, thereby enhancing the scientific value of the survey. In this presentation, we will give an overview of the current status of CS82, describe some of the steps in the data analysis and discuss first results. In particular, we will present details of the catalog generation procedure, including the choice of optimal settings for object detection, accurate determination and extraction of the Point Spread Function (PSF) and fitting of single and double-component morphological profiles for galaxies. Additionally, we will discuss tests performed to ensure the quality of the products generated, including comparisons with public SDSS data. First results include the measurement of galaxy-galaxy and cluster lensing signals, the creation of the largest contiguous lensing convergence map to date, the discovery of several new gravitational arc systems and more. (#1513)

Unveiling the QCD phase transition through the eLISA/NGO detector

Victor De Castro Mourão Roque

We study the generation of gravitational waves from hypothetical temperature fluctuations and turbulence present in the early universe at the QCD epoch. Following recent experimental results at RHIC and LHC, we assume that primordial matter behaves as a non-viscous fluid. We solve numerically the relativistic hydrodynamic equations using an equation of state based on recent data obtained from lattice QCD calculations which describes a crossover transition. We show that the velocity spectrum has a quite different behavior from usual Kolmogorov power law. We calculate the spectrum of gravitational waves generated by the fluid motion and compare the signal with the sensitivity curve of eLISA/NGO. Our results show that detectable primordial gravitational waves arise from temperatures inhomogeneities $\Delta T/T < 10^{-2}$ at the beginning of the phase transition. (#1509)

A new gravitational N-body simulation algorithm for investigation of chaotic advection in astrophysical and cosmological systems

Reinaldo Rosa

The gravitational N-body simulations have become a powerful tool for testing the theories of structure formation in astrophysical and cosmological systems [1]. In particular, it has been shown that the statistical characterization of dark matter distribution is an important ingredient in the investigation of large-scale structure formation in the Hubble volume simulated from the GADGET-VC algorithm [2]. Recently, an established statistical method was used to demonstrate the importance of considering chaotic advection (or Lagrange Turbulence) [3] in combination with gravitational instabilities in the Λ - CDM simulations performed from the Virgo Consortium (VC) [4]. However, the GADGET-VC algorithm does not allow the computation of the kinematics of a single particle, information that is necessary for the investigation of the chaotic advection. This limitation appears because the interaction forces are computed by the TreePM scheme [5]. Hence, the LAC - INPE and the IC-UFF develop the COsmic LAgrangian TUrbulence Simulator (COLATUS) to perform gravitational N-body simulations allowing the computation of the velocity of a single particle at every time-step and then the evaluation of its energy power spectrum. To achieve its objective COLATUS compute the gravitational forces by using a direct summation scheme. COLATUS is implemented in a Compute Unified Device Architecture (CUDA) by using the Nvidia graphics processing units (GPUs) to reduce the simulation runtime. We use the simulator for testing a hypothesis of an alternative cosmological scenario where the dark matter is interpreted as spatio-temporal deformations due to an alternative coupled expanding universe [6]. These deformations are included as the action of relativistic potentials. In the present work we show the preliminary simulations including up to 106 particles using 1536 cores of NVIDIA GTX680. The respective energy power spectra are shown for several deformation potentials which are dicussed in the alternative cosmological context. For astrophysical purposes we also discuss the application of this new algorithm in the study of galactic dynamics, highlighting a possible alternative investigation of the bullet cluster. [1] Bertschinger, E. Simulation of Structure formation in the universe. Annu. Rev Astron.Astrophys 36 (1996) 5999-654. [2] Caretta, C.A., R. R. Rosa, H. F. C. Velho, F. M. Ramos, M. M. Evidence of turbulence-like universality in the formation of galaxy-sized dark matter haloes. Astron. Astrophys 487 (2008) 445-451. [3] Aref, H., The development of chaotic advection. Physics of Fluids, 14 (2002) 1315-1325. [4] Rosa, R. R. ; Ramos, F. M. ; Caretta, C. A. ; Velho, H. F. C. Extreme event dynamics in the formation of galaxy-sized dark matter structures. Computer Physics Communications 180 (4) (2009) 621-624. [5] Springel, V. The cosmological simulation code GADGET- 2. Computer Physics Communications, Mon.Not.R.Astron. Soc. 364 (2005) 1105-1134. [6] Rosa, R. An alternative coupled expanding universe without cosmological singularity. In: 38th COSPAR Scientific Assembly. [S.l.: s.n.], 2010. v. 38,p. 3663. arXiv:1208.3444.

FastSound: Testing Gravity at z>1 by Redshift Space Distortion with Subaru/FMOS

Tomonori Totani

We present a status report of the FastSound project, which is a cosmology-purpose galaxy redshift survey at z~1.3 using Subaru/FMOS. The main science goal is to measure redshift space distortion (RSD) for the first time at z>1, and then measure the structure growth rate ($f\sigma8$) to constrain modified gravity as an explanation of cosmic acceleration. FMOS is a 400 multi-fiber near-infrared spectrograph with a 30 arcmin diameter field of view, attached on the prime-focus of the 8m Subaru Telescope. About 10,000 galaxy redshifts will be measured in total survey area of ~30 square degrees, using strong H alpha emission line. 40 nights in 2 years are already approved as a Subaru Strategic Program, and about 30% of the survey has been completed. We will complete the survey by 2014 spring. We expect to measure $f\sigma8$ at z~1.3 with an accuracy of 10-15%. We will report the status and details of this project. (#1455)

COB-I

On globally and locally neutral static and rotating neutron stars

Jorge Rueda

The inconsistency of the condition of local charge neutrality with the equilibrium equations of neutron stars has been recently demonstrated. Thus, the system of equilibrium equations has to change from the TOV equations to the Einstein-Maxwell system of equations, which has to be solved under the constraint of constancy of the generalized particle Klein potentials and global charge neutrality. A remarkable feature of these configurations is the presence of a core-crust interface where a strong electric field develops. The intensity of this field can be as large as thousands times the critical field for vacuum polarization. The density at the edge of the crust can be, in these solutions, lower than the nuclear density leading to a family of neutron stars with crusts of smaller mass and thickness with respect to the ones given by the TOV-like solutions. We show here the consequences of these features on the mass-radius relation of neutron stars both in the static and in the uniformly rotating cases. (#1548)

Hybrid Stars In The Light Of The Massive Pulsar PSR J1614−2230

German Lugones

We perform a systematic study of hybrid star configurations using several parametrizations of a relativistic mean-field hadronic EoS and the NJL model for three-flavor quark matter. For the hadronic phase we use the stiff GM1 and TM1 parametrizations, as well as the very stiff NL3 model. In the NJL Lagrangian we include scalar, vector and 't Hooft interactions. The vector coupling constant g_V is treated as a free parameter. We also consider that there is a split between the deconfinement and the chiral phase transitions which is controlled by changing the conventional value of the vacuum pressure - Ω_0 in the NJL thermodynamic potential by - $(\Omega_0+\Delta\Omega_0)$, being $\Delta\Omega_0$ a free parameter. We find that, as we increase the value of $\Delta\Omega_0$, hybrid stars have a larger maximum mass but are less stable, i.e. hybrid configurations are stable within a smaller range of central densities. For large enough $\Delta\Omega_0$, stable hybrid configurations are not possible at all. The effect of increasing the coupling constant g_V is very similar. We show that stable hybrid configurations with a maximum mass larger than the observed mass of the pulsar PSR J1614-2230 are possible for a large region of the parameter space of g_V and $\Delta\Omega_0$ provided the hadronic equation of state contains nucleons only. When the baryon octet is included in the hadronic phase, only a very small region of the parameter space allows *an explanation of* the mass of PSR J1614-2230. We compare our results with previous calculations of hybrid stars within the NJL model. We show that it is possible to obtain stable hybrid configurations also in the case $\Delta\Omega_0$=0 that corresponds to the conventional NJL model for which the pressure and density vanish at zero temperature and chemical potential. Reference: C. H. Lenzi & G. Lugones; Astrophysical Journal 759, 57 (2012). (#1512)

Estimating pulsars' braking indices

Carlos Frajuca

The rotation periods (P) of many pulsars were measured with high precision in the last decades. They decay slowly, as their first derivative (P') show. For some pulsars the period's second derivative (P") was also determined and it shows that (P') is increasing. In order to explain the decay of P a model was proposed long ago which is still used to estimate several important characteristic parameters of pulsars, as their ages and magnetic fields. In that canonical model it is assumed that the pulsars' rotational energy becomes mainly magnetic energy which is manifested as a torque; eventually, energy is transferred to particles that accelerate along the magnetic field emitting the photons detected on Earth. The pulsar is considered a magnetic dipole in such model, yielding a value of exactly three (3) for the “braking index” (n) of any pulsar. This index is defined as a combination of P, P' and P" and informs on the amount of braking the pulsar has. However, for all the pulsars with known experimental value of the braking index it is found $n < 3$. It is clear that the canonical model lacks some adjustment in order to correctly predict this number. However, so far no better model was found. In this way, estimating the correct values for the pulsar braking index is a open problem. In this work we present the results of this index for some pulsar inspired on the canonical model based on data from seve different pulsars which theri braking indices are found on the literature and were measured by observation. (#1471)

"Black Widow" pulsars and related objects

Jorge Horvath

The existence of millisecond pulsars with planet-mass companions in close orbits is challenging from the stellar evolution point of view. We calculate in detail the evolution of binary systems self-consistently, including mass transfer, evaporation and irradiation of the donor by X-rays feedback, demonstrating the existence of a new evolutionary path leading to short periods and compact donors as required by the observations of PSR J1719-1438 and PSR1311-3430 recently discovered in gamma rays. We show that the high mass of the neutron stars is naturally predicted, along with the rest of the observed parameters. A general assessment of the evolution of black widows and “redback” cousins is given. (#1467)

Poloidal-Field Instability In Magnetized Relativistic Stars

Riccardo Ciolfi

We investigate the instability of purely poloidal magnetic fields in nonrotating neutron stars (NSs) by means of three-dimensional general-relativistic magneto-hydrodynamics simulations, extending the work presented by Ciolfi et al. in 2011. Our aim is to draw a clear picture of the dynamics associated with the instability and to study the final configuration reached by the system, thus obtaining indications on possible equilibria in a magnetized NS. Furthermore, since the internal rearrangement of magnetic fields is a highly dynamical process and has been suggested to be behind magnetar giant flares, our simulations can provide a realistic estimate of the electromagnetic and gravitational-wave (GW) emission that should accompany the flare event. Our main findings are the following: (1) the initial development of the instability meets all the expectations of perturbative studies in terms of the location of the seed of the instability, the timescale for its growth, and the generation of a toroidal component; (2) in the subsequent nonlinear reorganization of the system, ~90% of magnetic energy is lost in few Alfven timescales mainly through electromagnetic emission, and further decreases on a much longer timescale; (3) all stellar models tend to achieve a significant amount of magnetic helicity and the equipartition of energy between poloidal and toroidal magnetic fields and evolve to a new configuration that does not show a subsequent instability on dynamical or Alfven timescales; (4) the electromagnetic emission matches the duration of the initial burst in luminosity observed in giant flares, giving support to the internal rearrangement scenario; and (5) only a small fraction of the energy released during the process is converted into f-mode oscillations and in the consequent GW emission, thus resulting in very low chances of detecting this signal with present and near-future ground-based detectors. (#1442)

COS-II

The quantum-to-classical transition of primordial cosmological perturbations

Nelson Pinto Neto

There is a widespread belief that the classical small inhomogeneities which gave rise to all structures in the Universe through gravitational instability originated from primordial quantum cosmological fluctuations. However, this transition from quantum to classical fluctuations is plagued with important conceptual issues, most of them related to the application of standard quantum theory to the Universe as a whole. In this paper, we show how these issues can easily be overcome in the framework of the de Broglie-Bohm quantum theory. This theory is an alternative to standard quantum theory that provides an objective description of physical reality, where rather ambiguous notions of measurement or observer play no fundamental role, and which can hence be applied to the Universe as a whole. In addition, it allows for a simple and unambiguous characterization of the classical limit. (#1534)

The Null Cone Observations in Lemaître metric

Alnadhief Hamed Ahmed Alfedeel

We consider the Lemaître metric, which is the inhomogeneous, spherically symmetric metric, containing a non-static, comoving, perfect fluid with non-zero pressure. We use it to generalise the metric of the cosmos algorithm, first derived for the zero-pressure Lemaître Tolman (LT) metric, to the case of non-zero pressure and non-zero cosmological constant. We present a method of integration with respect to the null coordinate w, instead of comoving t, and reduce the Einstein's Field Equation (EFEs) to a system of differential equations (DEs). We show that the non-zero pressure introduces new functions, and makes several functions depend on time that did not in the case of LT. We present clearly, step by step an algorithmic solution for determining the metric of the cosmos from cosmological data for the Lemaître model, on which a numerical implementation can be based. In our numerical execution of the algorithm we have shown that there are some regions which need special treatment : the origin and the maximum in the diameter distance. We have coded a set of MATLAB programs for the numerical implementation of this algorithm, for the case of pressure with a barotropic equation of state and non-zero Λ. Initially, the computer code has been successfully tested using artificial and ideal cosmological data on the observer's past null cone, for homogeneous and non-homogeneous space-times. Then the program has also been generalized to handle realistic data, which has statistical fluctuations. A key step is the data smoothing process, which fits a smooth curve to discrete data with statistical fluctuations, so that the integration of the DEs can proceed. Since the algorithm is very sensitive to the second derivative of one of the data functions, this has required some experimentation with methods. Finally, we have successfully extracted the metric functions for the Lemaître model, and their evolution from the initial data on the past null cone. (#1552)

Phenomenological Approach in the Study of Singularity Problem

Vladimir Strokov

As is long known, singularities are a common place in general-relativistic solutions including the most physical ones, the Friedmann–Robertson–Walker universe and black holes which probably reside in central parts of many galaxies. However, one expects that the Einstein equations will somehow change near the singularity. For example, this change may be due to quantum effects. Unfortunately, the exact form of the quantum corrections remains unknown and the variety of suggested modifications complicates the studies. Under the circumstances it is natural to parametrize properties of gravitational field near the singularity in a way similar to how probable gravity modifications are parametrized by the notions of dark matter and dark energy in cosmology. Thus, we phenomenologically model ultrahigh-curvature processes near the singularity by introducing a Schwarzschild-like metrics a continuous effective mass distribution m(r; t) such that m(r; t) tends to 0 as r goes to 0. Note that we do not discuss physical nature of the mass function m(r; t) while we do study the consequences of the equivalent assumption that metrics potentials become finite near r = 0. We also assume that the mass function m(r; t) has the property that it appears to be point-like at large distances. This treatment leads to the notion of integrable singularity that is, in a sense, weaker than the conventional singularity and allows the effective-matter flow to pass to the white-hole region. The latter fact, in its turn, leads to a possibility of generating there a new universe. (#1452)

Asymmetric dark matter after a cosmological phase transition

Osamu Seto

We propose dark matter models where those relic density are determined by the dark matter asymmetry but the nature of particle at present is Majorana by a late time symmetry breaking after the dark matter annihilation for those symmetric abundance. (#1474)

Alternative cosmology from cusp geometries

Reinaldo Rosa

We study an alternative geometrical approach on the problem of classical cosmological singularity. It is based on a generalized function $f(x,y)=x^2+y^2=(1-z)z^n$ which consists of a cusped coupled isosurface. Such a geometry is computed and discussed into the context of Friedmann singularity-free cosmology where a pre-big bang scenario is considered. Assuming that the mechanism of cusp formation is described by non-linear oscillations of a pre- big bang extended very high energy density field ($>3\times10^{94}$kg/m^3), we show that the action under the gravitational field follows a tautochrone of revolution, understood here as the primary projected geometry that alternatively replaces the Friedmann singularity in the standard big bang theory. As shown here this new approach allows us to interpret the nature of both matter and dark energy from first geometric principles [1]. [1] Rosa et al. DOI: 10.1063/1.4756991 (#1545)

Fractal Analysis Of The Galaxy Distribution In The Redshift Range 0.45 < z < 5.0

Marcelo Byrro Ribeiro

This work performed a fractal analysis of the galaxy distribution and presented evidence that it can be described as a fractal system within the redshift range of the FORS Deep Field (FDF) galaxy survey. The fractal dimension *D* was obtained using galaxy number densities derived from the FDF luminosity function (LF) data recently calculated by Iribarrem *et al*. (2012, A & A, 539, A112) in the spatially homogeneous standard cosmological model with $\Omega_{m0}=0.3$, $\Omega_{\Lambda 0}=0.7$ and $H_0=70$ kms^{-1}Mpc^{-1}. Under the supposition that the galaxy distribution forms a fractal system, the ratio between the differential and integral number densities γ and γ^* obtained from the red and blue FDF galaxies provided a direct method to estimate *D* and implies that γ and γ^* vary as power-laws with the cosmological distances. This provides another method for calculating *D*. The luminosity distance d_L, galaxy area distance d_G and redshift distance d_z were plotted against their respective number densities to calculate *D* by linear fitting. It was found that the FDF galaxy distribution is better characterized by two fractal dimensions, implying in a bi-fractal system. Two straight lines were fitted to the data, whose slopes change at *z* ~1.3 or *z* ~1.9 depending on the chosen cosmological distance. The average fractal dimension calculated using γ^* changes from <*D*>=1.4+0.7-0.6 to <*D*>=0.5+1.2-0.4 for all galaxies. Besides, *D* evolves with *z*,decreasing as the redshift increases, tending to zero and possibly reaching negative values at the tail of the distribution. Small *D* at high z means that in the past galaxies were clustered and distributed much more sparsely. A negative *D* means that the galaxy distribution ceases being governed by a power-law and no longer possesses fractal features. (#1555)

COB-II

Shell Flashes on H/He Accreting CO White Dwarfs

Joseph Mitchell

Type Ia Supernovae are important tools for high precision cosmological measurements. There are currently two suggested progenitor systems for SNe Ia, the double degenerate (DD) and single degenerate (SD) scenarios. An open question with the SD system is whether it is possible for the white dwarf to approach the Chandrasekhar mass, without succumbing to shell flashes that may result in the white dwarf losing some of the mass it has accreted. We will present 1-D hydrodynamical models of various white dwarf masses and accretion rates, and discuss our results. (#1465)

Accretion disc-corona connection in AGN

Patricia Arevalo

The central engine of AGN, comprising the accretion disc and X-ray corona, is too compact to observe directly and so progress in the understanding of this region has been made through spectral and timing studies. Long term monitoring campaigns of AGN in the optical and X-ray bands have shown that although rapid optical fluctuations are probably produced by reprocessing of the highly variable X-rays, long term optical fluctuations are inconsistent with this picture. On long timescales the optical fluctuations are larger than those of the X-rays and a comparison between power spectral properties and the time delay measured between optical and X-ray bands shows that the optical emitting region must be varying intrinsically. Since the source of optical/UV emission in AGN is expected to be the optically thick accretion disc, these long term fluctuations allow us to probe the variability timescales of the disc itself. It has recently been shown that BHXRBs display a very similar behaviour, where the disc emission is shifted to the soft X-rays, drawing one more connexion between stellar mass and supermassive black holes. In this talk I will review the evidence for intrinsic disc variability and discuss whether the comparison of AGN and BHXRBs complies with simple theoretical expectations. (#1503)

Short timescale variations of the H alpha double-peaked profile of the nucleus of NGC 1097

Jaderson Schimoia

The broad (FWHM ~ 10,000 km/s) double-peaked H alpha profile from the LINER/Seyfert 1 nucleus of NGC 1097 was discovered in 1991, and monitored for the following 11 years. The profile showed variations attributed to the rotation of gas in a non-axisymmetric Keplerian accretion disk, ionized by a varying radiatively inefficient accretion flow (RIAF) located in the inner parts of the disk. We present and model 11 new spectroscopic observations of the double-peaked profile taken between 2010 March and 2011 March. This series of observations was motivated by the finding that in 2010 March the flux in the double-peaked line was again strong, becoming, in 2010 December, even stronger than in the observations of a decade ago. We also discovered shorter timescale variations than in the previous observations: (1) the first, of ~7 days, is interpreted as due to reverberation of the variation of the ionizing source luminosity, and the timescale of 7 days as the light crossing time between the source and the accretion disk; this new timescale and its interpretation provides a distance between the emitting gas and the supermassive black hole and as such introduces a new constraint on its mass; (2) the second, of ~ 5 months, was attributed to the rotation of a spiral arm in the disk, which was found to occur on the dynamical timescale. We use two accretion disk models to fit theoretical profiles to the new data, both having non-axisymmetric emissivities produced by the presence of an one-armed spiral. Our modeling constrains the rotation period for the spiral to be ~18 months. This work supports our previous conclusion that the broad double-peaked Balmer emission lines in NGC1097, and probably also in other low-luminosity active nuclei, originate from an accretion disk ionized by a central RIAF. (#1499)

Stellar Winds and the Infalling Cloud in the Galactic Centre

Jorge Cuadra

We recently discovered a cloud of gas, G2, quickly approaching the Galactic centre super-massive black hole, SgrA*. G2 will reach a pericentre distance of only ~ 2000 Schwarzschild radii by the end of 2013. By this time we expect the cloud to be strongly perturbed by both the tidal field of the black hole and the hydrodynamical interaction with the hot accretion flow. This event will likely increase the Galactic Centre luminosity, and will constrain the properties of the accretion process. After briefly discussing the observations and some basic predictions, we will concentrate on the cloud origin. G2 is in a Keplerian orbit with apocentre in a region populated by Wolf-Rayet stars. As such, its origin is likely associated with the mass lost by these stars. We present numerical simulations of the gas dynamics in the inner parsec of the Galaxy, including the stars that produce copious amounts of stellar winds, and the gravitational potential of SgrA*. As expected, wind-wind collisions create a number of cold, dense gas clumps, qualitatively similar to the observed cloud. From the simulations we present preliminary results on the mass and orbital distribution of the clouds that reach the black hole vicinity, and discuss how often an event such as the G2 infall occurs. (#1502)

Proof of the no-hair theorem for the OJ287 primary black hole

Mauri Valtonen

The quasar OJ287 is powered by the most relativistic binary system known, with orbital speeds ~ 0.1 c. Therefore it is the most suitable case for testing the no-hair theorem of black holes, i.e. proving that the compact objects usually referred to as black holes are really Kerr space-time singularities. In OJ287 the primary is ~ 130 times more massive than the secondary; thus the orbit of the secondary tests effectively the space-time around the primary. OJ287 is the only system where this test has been carried out rigorously. In order to prove the no-hair theorem, we have to show that the quadrupole moment of the primary is connected to the mass and the spin of the primary in the exact way calculated for the Kerr singularities e.g. by Thorne. The three quantities are determined from the binary orbit solution. The secondary impacts on the accretion disk of the primary twice during each orbit, and each impact is detected as a prominent bremsstrahlung flash in optical/UV region of the spectrum. The optical light curve of OJ287 has been observed since 1891, and with the 12 year orbital period we have now data covering 10 orbital periods of the binary. This is sufficient to determine uniquely not only the three parameters above, but also six other key parameters of the system. As to accuracy, we may mention that the timing of the 2007 Sept 13 outburst was predicted and verified at the same level of accuracy as the return of Halley's comet in 1986. The binary orbit is not seen directly as yet, but with future improvements in resolution it may become possible. At present the most clear signature of the binary motion is seen in the resolved radio jet which has followed the binary model exactly since the beginning of the radio VLBI observations in early1980's. The mass of the primary is presently determined with 1% accuracy, while the spin is known with 20% accuracy, using several different methods. The spin value will become much more accurate at the end 2015 when the next, very spin-sensitive, bremsstrahlung flash is due. The quadrupole moment is currently known at 30% accuracy; this may be improved by a factor of 2-3 in July 2019 when the next quadrupole-sensitive flash takes place. At present the no-hair theorem has been proved at 30% level, in 7 yrs from now we may get the 10% accuracy. (#1422)

Multi-messenger emission from Neutron star internal phase transition

M. Angelez Perez-Garcia

Work in collaboration: M. A. Perez-Garcia (1), K. Kotera (2), J. Silk (2), F. Daigne (2) (1) University of Salamanca & IUFFyM, Spain (2) IAP, Paris ---- In this contribution we present a mechanism that is based on the transition of a Neutron star (NS) to a more compact astrophysical object, a (hybrid) quark star, driven by an external dark matter component. In a regular NS, matter attains densities in the core central regions beyond nuclear saturation density at about 10^{14} g/cm^3. It has been hypothesized that a phase transition deconfining the quark content of regular nuclear matter could be possible in the context of quark bubble nucleation due to temperature and density fluctuations. We propose that the gravitational accretion of a self-annihilating Majorana dark matter particle in the GeV-TeV mass range could lead to such a transition [1]. Additionally, this macroscopic transition would have an observable counterpart under a series of multi-messenger channels, namely, i) the emission of a short gamma ray burst [2] ii) change in the rotational pattern [3] iii) possible acceleration mechanism of lumps of strange-quark-matter [4] iv) gravitational wave emission. Relativistic ejection of this peculiar type of matter under this mechanism is possible and it could become a central engine model as another source of UHECRs. Bounds on the nuclearite search performed by several current experiments may lead to constrain the rate and nature of these events. [1] M. Angeles Perez-Garcia, Joseph Silk and Jirina R. Stone, PRL 105,(2010) 141101 [2] M. Angeles Perez-Garcia, Joseph Silk, Physics Letters B 711 (2012) 6–9 [3] M. Angeles Perez-Garcia, F. Daigne, Joseph Silk, submitted for publication [4] K. Kotera, M. Angeles Perez-Garcia, Joseph Silk, submitted for publication. (#1432)

HEA-I

From gamma rays to radio waves: the extremes of gamma-ray bursts

Alexander Van Der Horst

Gamma-ray bursts (GRBs) are extreme explosions and emit radiation across the entire electromagnetic spectrum. Broadband observations and detailed modeling constrain the GRB physics, and can be used to determine the energetics of GRB explosions, properties of their environment, and the microphysics of the particles which emit the radiation. I will show how the various spectral regimes probe different elements of GRB explosions, in particular the high-energy gamma rays and the low frequency radio waves, and also recent progress that has been made in broadband GRB modeling. Furthermore, I will discuss the role of the radio regime in broadband studies of GRBs, and how this role will become larger in the coming years with new radio facilities and the upgrade of current observatories. (#1543)

Simulating tidal disruptions of stars by supermassive black holes: extracting black hole spin

Lixin Dai

A star orbiting a supermassive black hole (SMBH) is disrupted when its distance from the hole is smaller than the tidal radius. Many previous studies focused on studying tidal disruption of stars on parabolic orbits using Newtonian mechanics. Such disruptions, however, can also happen near the innermost stable circular orbit of the hole, where general relativity (GR) plays an important role. The energy distribution of the stellar debris is different from the that under a Newtonian potential. The orbits of debris have apsidal and Lense-Thirring precessions due to GR effects. The pattern of debris returning to the hole and the structure of the accretion disk formed by these materials also highly depend on the black hole spin. We performed a three-dimensional GR particle simulation on tidal disruptions of stars not only on parabolic orbits but also on elliptic orbits near Schwarzschild and Kerr SMBHs, and investigated interesting cases where the simulated results can be used to test general relativity and constrain SMBH spin. (#1497)

The tidal disruption of an extrasolar planet detected at hard X-rays

Roland Walter

The core of NGC 4845 featured a bright hard X-ray flare discovered in 2011 by INTEGRAL. Its X-ray flux increased by a factor of almost 1000 in two weeks and decreased over several months.Together with follow-up observations with XMM-Newton and Swift, the monitoring of INTEGRAL indicates that the hard X-ray flare was triggered by the tidal disruption of a super Jupiter exoplanet by a 1e5 solar mass black-hole in the core of an almost quiet nearby galaxy. The hard X-ray emission is probably not emitted by a jet, but by some type of coronal emission accompanying thermal emission of the matter accreted by the massive black-hole. (#1421)

Luminosity Function Of GRBs

Luis Juracy Lemos

The luminosity function (LF) statistics applied to the BATSE GRBs (sources of GUSBAD catalog, Schmidt, 2004, ApJ, vol 616, pg 1072) is the theme approached in this work. The LF is a strong statistical tool to extract useful information from astrophysical samples, where the key point of this statistical analysis is in the detector sensitivity, where we have performed careful analysis. We applied the tool of the LF statistics to three GRB classes predicted by the Fireshell model (Ruffni et al., 2009 arXiv:0907.5517v1). One of the main differences between the Fireshell and Fireball models (Piran 2005, RvMP, vol 76, pg 1143 and Meszaros 2006, RPPh, vol 69, pg 2259) is the explanation of the GRB prompt emission, where the first claims that it is divided in two physical processes: 1 - transparency of a optically thick fireshell producing the P-GRB emission and 2 - interaction of a relativistic shell (composed by baryons e^{-} e^{+} γ) against the CBM (circumburst medium), producing the emission so-called extended afterglow peak (EAP), Ruffni et al. (2009 arXiv:0907.5517v1). However, the Fireball model, the most quoted one, claims that the prompt emission is caused by interactions among several relativistic shells (composed by e^{-} e^{+} γ) with different Lorentz γ-factors, a process called internal shocks. The transparency produces a strong short emission in the first few seconds, called P-GRB. Thus, to the Fireshell model, the prompt emission is P-GRB+ EAP. We produced, by LF statistics, predicted distributions of: peak flux N(Fph pk), redshift N(z) and peak luminosity N(Lpk) for the three GRB classes predicted by Fireshell model; we also used three GRB rates. We looked for differences among the distributions, and in fact we found. We performed a comparison between the distributions predicted and observed (with and without redshifts), where we had to build a list with 220 GRBs with known redshifts. We also estimated the effects of the Malmquist bias in all samples, and we looked for a correlation between the isotropic luminosity and the Band peak spectral energy, Band et al. (1993, ApJ, vol 413, pg 281). (#1556)

GIA-I

Fermionic Dark Matter and galactic structures at all scales

Carlos Raúl Argüelles

Within the paradigm of particle Dark Matter (DM), the nature and mass value of the candidate is studied. We use a model of self-gravitating fermions at finite temperature in General Relativity to describe dark matter (DM) in galaxies. We explore the maximum possible range of the free parameter space of the model, when compared with observations of central dark objects and galactic halos. In particular, we show that for very high values of the degeneracy parameter, central objects in galaxies with masses up to the Oppenheimer-Volkoff critical mass can be formed. Nontheless, for these cases no halo is present. Instead, when considering low values of this parameter, we can have a condensed central object serving as an alternative to Super massive Black Holes, and a halo in agreement with observations. From this phenomenological analysis applied to the Milky Way, the mass of the DM candidate is fixed in some KeV. Once with a value of the particle mass, we found for a narrow range of the temperature, that increasing the central degeneracy from values near zero to much higher ones, the model explain all the main core and halo characteristics with good accuracy for dwarf galaxies, to the big elliptical ones with some core discrepancies, reaching the extreme case of AGN nucleus mass of ~10^9 solar masses. Finally, a natural extension of the Fermi statistics to Fermi fluids is proposed, to enrich the model in views of saving those controversies. (#1539)

A third integral of motion for nearly equatorial orbits in axisymmetric thin disks

Ronaldo Vieira

Analytical razor-thin disk models for spiral galaxies are widely present in the literature. Nevertheless, the study of vertical stability of equatorial circular orbits in razor-thin disks is still in its beginnings. We present analytical results for the vertical stability of circular orbits in Newtonian axisymmetric thin disks (surrounded by smooth halos) and compare these results to the corresponding stability criterion in smooth density distributions. We also give an analytical expression for an approximate third integral of motion, valid for nearly equatorial orbits. This third integral determines the "envelope" of the orbit (in the meridional plane) in terms of the mass surface density of the thin disk. The analytical results are compared to numerical simulations, showing good agreement in regions near the equatorial plane. Extensions to general relativistic thin disks are being analyzed. (#1470)

Self-gravitating disks: aspects of stability

Vanessa Pacheco De Freitas

Disklike configurations are common in gravitational systems. From the astrophysics view, the study of these self-gravitating structures holds great significance, since its results can be applied in the description of galaxies and accretion of matter by massive objects. In a situation where the gravitational field is too strong, we need to use a general relativistic analysis instead of the Newtonian one. A possible way to generate disks from given Einstein solutions is the well known "Displace, Cut and Reflect" method which consists in three basic steps: (i) cut the space-time containing a source of gravitational field in two regions, (ii) eliminate the region with the source and (iii) reflect the field through the hyper-surface that divided the two regions. Our purpose with this work is to apply this method to generate a disk from Gutsunaev-Manko solution of Einstein equations, which represents a massive object endowed with magnetic dipole, and study the stability of circular orbits of test particles using a generalization of Rayleigh Criteria. (#1479)

Dynamical model for the stellar kinematics and determination of the the mass of the supermassive black hole in NGC 4258

Daniel Alf Drehmer

We present a dynamical determination of the mass of the supermassive black hole (SMBH) in the nucleus of the galaxy NGC 4258. The two- dimensional stellar kinematics obtained from observations with the Near-infrared Integral Field Spectrograph (NIFS) at the GEMINI North Telescope shows that the velocity distribution in the central region of the galaxy is dominated by a strong increase in the velocity dispersion at the nucleus. This observation is consistent with the assumption that a SMBH is present there. Assuming that the distribution function that describes the galaxy is a function of three integrals of motion and that the ellipsoid of velocity dispersion is aligned with a cylindrical coordinate system, we constructed a Jeans Anisotropic Model to fit the observed velocity distribution. Our dynamical model assumes that the galaxy has axial symmetry and is constructed using the Multi-Gaussian Expansion method (MGE) of Cappellari to parametrize the observed surface brightness distribution. The model has three free parameters: the mass of the central SMBH, the mass- luminosity ratio (M/L) of the galaxy and the anisotropy in the velocity distribution. Modeling the kinematics of the galaxy without considering the contribution of the SMBH, we obtain a velocity profile dominated by rotation. By adding the contribution of a central SMBH, and systematically increasing the value of its mass, the modeled velocities increase considerably in the central region, passing from a velocity field dominated by rotation to one dominated by velocity dispersion, consistent with the observations. From the fit of the best model, we obtain the values for the free parameters which best reproduce the observed kinematics and determine the mass of the SMBH. (#1507)

Tidal disruption by spinning supermassive black holes

Michael Kesden

A supermassive black hole can disrupt a star when its tidal field exceeds the star's self-gravity, and can directly capture stars that cross its event horizon. For black holes more massive than 10^7 solar masses, tidal disruption of main- sequence stars occurs close enough to the event horizon that a Newtonian treatment of the tidal field is no longer valid. The fraction of stars that are directly captured is also no longer negligible. We calculate generically oriented stellar orbits in the Kerr metric, and evaluate the relativistic tidal tensor at the pericenter for those stars not directly captured by the black hole. We combine this relativistic analysis with previous calculations of how these orbits are populated to determine tidal-disruption rates for spinning black holes. We find, consistent with previous results, that black-hole spin increases the upper limit on the mass of a black hole capable of tidally disrupting solarlike stars to $\sim 7 \times 10^8$ solar masses. More quantitatively, we find that direct stellar capture reduces tidal-disruption rates by a factor $\sim 2/3$ (1/10) at masses of 10^7 (10^8) solar masses. This strong dependence of tidal-disruption rates on black-hole spin implies that future surveys by the Large Synoptic Survey Telescope that discover thousands of tidal disruption events can constrain supermassive black-hole spin demographics. We also investigate the time dependence of the black-hole mass accretion rate for individual tidal disruption events. We find that for orbits with pericenters comparable to the radius of the marginally bound circular orbit, relativistic effects can double the peak accretion rate and halve the time it takes to reach this peak accretion rate. The accretion rate depends on both the magnitude of the black-hole spin and its orientation with respect to the stellar orbit; a maximal black-hole spin anti- aligned with the orbital angular momentum leads to the largest peak accretion rate. (#1490)

HEA-II

The MIRAX Mission on the Lattes Satellite

João Braga

MIRAX (Monitor e Imageador de RAios X) will the first Brazilian space mission dedicated to astrophysics. The experiment basically comprises 4 hard X-ray imagers operating in the 5-200 keV range with a very wide field-of- view (60 x 60 degrees) and a 5 arcmin angular resolution. The instrument will carry out an unprecedented survey of transient sources associated with black holes and neutron stars. It will be capable of studying in detail General Relativity effects in the strong gravitational field regions in the vicinity of compact objets. This will be accomplished by observing both the time and spectral variability of the X rays emitted by these objects. MIRAX will be placed onboard INPE's Lattes satellite, which is based on a Multi-Mission Platform and will be launched in 2017. In this presentation, I will describe the Lattes satellite and the MIRAX experiment, with emphasis on the scientific objectives that this mission should reach in the field of relativistic astrophysics. (#1431)

Axion-like particles and emission of very high energy gamma rays in blazars

Fabrizio Tavecchio

The discovery of very high energy (E>100 GeV) emission from flat spectrum radio quasars went as a surprise. In fact, the nuclear environment of these blazars, characterized by prominent broad emission lines in the optical spectra (produced in the so-called broad line region), is expected to by highly opaque to gamma rays of these energies. A possible explanation is that the emission occurred well outside the inner blazar region (distances larger than 0.1-1 pc), although the vary rapid VHE flux variation (~ten minutes) displayed by the source PKS 1222+216 is very difficult to explain in this view. We present the alternative model (Tavecchio et al. 2012, Phys. Rev. D 86, 085036) based on the assumption that the photon escape is allowed by photon-ALP conversions before the BLR and subsequent re-conversion in the host galaxy. An acceptable shape of the intrinsic spectrum can be obtained for values of the ALP-photon coupling of the order of 10^11 GeV, close to values testable with the upgraded photon regeneration ALPS experiment at DESY. Possible extensions and improvements of the model will also be discussed.(#1441)

Relativistic astrophysical sources: New results from MAGIC

Ulisses De Almeida

During the past year MAGIC has detected six new Active Galactic Nuclei (AGN - e.g., PKS 1222+21, NGC 1275, B3 2247+381) at very-high energies (E > 100 GeV). The observatory has also made significant contributions to the high-energy astrophysics within the Galaxy. For example, MAGIC studied in detail the morphology of the W 51 region, which provides the best Galactic candidate source to date for a site of hadronic particle acceleration to ~ 100 TeV. The Collaboration has also recently measured the phase- resolved energy spectra of the Crab pulsar from 40 to 500 GeV. All of these results were obtained with the stereo system, recently upgraded with new read-out electronics and a new camera for the MAGIC-I telescope. In this talk we will present a summary of the most significant results recently obtained by the MAGIC collaboration and describe the recent hardware upgrades that have contributed to the current performance of the instrument. (#1476)

Search for Very-high-energy gamma-ray emission from Galactic globular clusters with H.E.S.S.

Peter Eger

Globular clusters (GCs) are established emitters of high-energy (HE, 100 MeV – 100GeV) gamma- ray regime, judging from the recent detection of a signal from the direction of Terzan 5 with the H.E.S.S. telescope array. To search for VHE gamma-ray sources associated with other GCs, and to put constraints on leptonic emission models, we systematically analyzed the observations towards 15 GCs taken with the H.E.S.S. array of imaging atmospheric Cherenkov telescopes. We searched for point-like and extended VHE gamma-ray emission from each GC in our sample and also performed a stacking analysis combining the data from all GCs to investigate the hypothesis of a population of faint emitters. Assuming IC emission as the origin of the VHE gamma-ray signal from the direction of Terzan 5, we calculated the expected gamma-ray flux from each of the 15 GCs, based on their number of millisecond pulsars, their optical brightness and the energy density of background photon fields. We did not detect significant VHE gamma-ray emission from any of the 15 GCs in either of the two analyses . Given the uncertainties related to the parameter determinations, the obtained flux upper limits allow to rule out the simple IC/msPSR scaling model for NGC 6388 and NGC 7078. The upper limits derived from the stacking analyses are factors between 2 and 50 below the flux predicted by the simple leptonic scaling model, depending on the assumed source extent and the dominant target photon fields. Therefore, Terzan 5 still remains exceptional among all GCs, as the VHE gamma-ray emission either arises from extra- ordinarily efficient leptonic processes, or from a recent catastrophic event, or is even unrelated to the GC itself. (#1484)

VERITAS Extragalactic Gamma-ray Observations

Amy Furniss

Remarkable progress has been made in very high energy (VHE; E > 100 GeV) gamma-ray astrophysics in the last decade. The VHE source catalog has increased tenfold and now includes a wide variety of source classes. The Very Energetic Radiation Imaging Telescope Array System (VERITAS) has observed numerous targets, both galactic and extragalactic, including more than 130 galaxies. Recent hardware upgrades combined with the collaboration's ongoing efforts in advanced analysis techniques have resulted in a continued increase in the observatory's sensitivity since its completion in 2007. VERITAS has detected 21 blazars, the radio galaxy M87 and the starburst galaxy M82. These results have consequences for the modeling of relativistic jets and the environment near supermassive black holes and are directly applicable to cosmological and fundamental physics studies. Highlights from the VERITAS extragalactic observation program, including VHE blazar discoveries, non-detections and broadband coverage of recent rapid VHE blazar flaring will be presented. (#1489)

COB-III

Failure Conditions of the Elastic Crust of Neutron Stars

Claudia Aguilera Gómez

Neutron stars are compact objects and one of the possible remnants of stellar evolution. Their high density and huge magnetic fields are some of the many extreme conditions found in neutron stars that we cannot emulate on Earth. All this means that studying neutron stars gives us unique insight into aspects of physics that would remain unknown to us otherwise. The outer layer of the neutron star, the crust, forms when the outer part of the liquid neutron star solidifies, so initially it does not have any shear deformation. Then as the forces evolve in the star, they produce stresses that strain the solid, which accumulates energy until the intrinsic properties of the material make it impossible for the crust to withstand an additional deformation, and thus the solid breaks, releasing the energy it had accumulated. If the magnetic field is the stressing agent, this process may explain the emission in form of repetitive outbursts of soft gamma repeaters. If the stressing agent is rotation instead, it is possible that crust failure is somehow involved in the sudden increases in frequency of pulsars known as glitches, even if by itself this process fails to reproduce observations. During this work, we express the equations for the equilibrium of forces in the crust of neutron stars when it is being stressed by external forces. Newtonian theory of elasticity was used to describe the crust and then the axially symmetric case was analyzed, for which we have established a failure criterion and estimated that the preferred direction for the crust to break is the azimuthal. Furthermore, given the dependence of the components of the force with the displacement field, we find that poloidal forces like rotation, will be less likely to make the crust fail than force fields which do have an azimuthal component, like the magnetic field. (#1478)

Modulating the emission of magnetars - neutron star seismology with QPOs of SGRs

Michael Gabler

We compute numerically the magneto-elastic oscillations of a highly magnetized neutron star (magnetar). The magnetic field that extends to the exterior, couples these QPOs to the magnetosphere. The charge carriers that conduct the currents that maintain this twisted field can resonantly Compton scatter (RCS) the photons from the surface. This process changes the spectrum, and the magneto-elastic QPOs can modulate the light curve. The magneto-elastic QPOs are computed with a 2D, general-relativistic MHD code MCoCoA/CoCoNuT that includes a description for the elastic crust of the neutron star. Purely shear modes of the crust are damped efficiently into the core, and coupled magneto-elastic oscillations reach the surface at magnetic field strengths of B~10^15 G. For very high magnetic fields the frequencies of the predominantly Alfven QPOs have integer relations and can explain some of the observed QPOs. We study different magnetic field configurations that give richer spectra and thus may explain additional QPOs. Magnetic fields confined to the crust are not favored, because it is not possible to explain the lowest frequency QPOs (f<~30Hz). The magnetic field in the exterior is computed in the force-free approximation consistently with the interior evolution. To compute the spectra in the magnetosphere we developed a new Monte-Carlo radiation transport code (MCMaMa) for RCS which includes a consistent calculation of the momentum distribution of the magnetospheric plasma that is given by the charge carriers of the twisted magnetic field. The momenta are calculated by performing particle-in-a-line calculations of electrons and positrons which interact with a background photon field. The photons are scattered by the charges and their spectrum is changed. This again changes the momentum distribution of the charges. We apply an iterative procedure to compute the spectrum and the momentum distribution of the charge carriers. This model allows to compute the spectrum at a given instant of time and can be applied to improve the current models regarding the quiescent emission of magnetars. For the dynamic changes related to the QPOs we calculate quasi-static sequences of equilibira and integrate over the spectrum to obtain the light curve. In first simplified simulations we find that the magneto-elastic QPOs can modulate the light curve significantly for realistic surface amplitudes of less than 1km. (#1447)

F-modes of slowly and differentially rotating stars

Cecilia Chirenti

Newly born neutron stars can present differential rotation, even if later it should be suppressed by viscosity or a sufficiently strong magnetic field. And in this early stage of its life, a neutron star is expected to have a strong emission of gravitational waves, which could be influenced by the differential rotation. We present here a new formalism for modeling differentially rotating neutron stars: working on the slow rotation approximation and assuming a small degree of differential rotation, we show that it is possible to separate variables in the Einstein field equations. The dragging of inertial frames is determined by solving three decoupled ODEs. After we establish our equilibrium model, we explore the f-modes of oscillation of the neutron star in the Cowling approximation. (#1424)

A numerical eigenmode analysis of rotating relativistic stars

Shinichiro Yoshida

Oscillations of rotating neutron stars are ones of the important astrophysical sources of gravitational wave targeted by the current and future detectors. Despite their importance, development of their theory has been hindered by difficulties in computing them, especially in taking account relativistic gravity as well as fluid motion under it. To improve this situation, we present a new numerical code to compute non-axisymmetric eigenmodes of rapidly rotating relativistic stars by spatially conformally flat approximation (CFA) of general relativity (GR). Computed frequencies of low-order f- and p-modes of slowly rotating stars are shown to be in good agreement with the quasi-normal frequencies of the full GR problem. We obtain sequences of the low-order counter-rotating f- modes, which may become unstable due to a coupling with gravitational radiation (Chandrasekhar-Friedman-Schutz instability). The neutral points of the instability are in good agreement with those obtained by full GR analysis. (#1425)

Magnetic moments of SGRs and AXPs as white dwarfs pulsars

Manuel Malheiro

Some of the most interesting types of astrophysical objects that have been intensively studied in the recent years are the Anomalous X-ray Pulsars (AXPs) and Soft Gamma-ray Repeaters (SGRs) seen usually as neutron stars pulsars with super strong magnetic fields. However, in the last two years two SGRs with low magnetic fields have been detected. Moreover, three fast and very magnetic WD pulsars have also been observed in the last years. Based on these new pulsar discoveries, white dwarf pulsars have been proposed as an alternative explanation to the observational features of SGRs and AXPs [1]. We discuss here the pulsar magnetic dipole moment when a model based on a massive fast rotating highly magnetized white dwarf is considered. We show that the values for m obtained are in agreement with the observed range of isolated and magnetic white dwarfs. This supports the understanding of SGRs and AXPs as belonging to a new class of very fast and magnetic white dwarfs, in accordance to the recent astronomical observations of white dwarfs pulsars. [1] M. Malheiro, J. A. Rueda, and R. Ruffini, Publications of the Astronomical Society of Japan, Vol.64, No.3, Article No.56 (2012) (#1553)

HEA-III

Particle Acceleration by Magnetic Reconnection: from solar flares to AGNs and GRBs

Elisabete De Gouveia Dal Pino

Cosmic Ray acceleration still challenges the researchers. Fast particles are accelerated in astrophysical environments by a variety of processes. In particular, acceleration in magnetic reconnection sites has lately attracted the attention of researchers not only for its potential importance in the solar context and the Earth magnetotail, but also in other astrophysical environments, like compact stellar sources, AGNs and GRBs, and even in more diffusive media like the ISM and the IGM. In this talk we discuss this mechanism by means of three-dimensional MHD simulations with the injection of thousands of test particles and show from the evolution of their energy spectrum that they can be efficiently accelerated by magnetic reconnection through a first-order Fermi process within large scale current sheets as those present in compact sources (specially when local turbulence is present making the acceleration region thicker) and also through a second-order Fermi process in pure turbulent environments as in the ISM and IGM. (#1454)

Gamma-ray burst neutrino limit from IceCube and Fermi observations

Zhuo Li

If gamma-ray bursts (GRBs) produce high energy cosmic rays, neutrinos are expected to be generated in GRBs due to photo-pion productions. The detection of HE neutrinos will help to identify the origins of HE cosmic rays. The IceCube is believed to reach the sensitivity of GRB neutrino detection. The continuous non-detection starts to put interesting constraint. However our careful calculation, in particular the normalization of the GRB neutrino flux, shows that the predicted neutrino flux is smaller than that predicted by IceCube by a factor of ~5, thus the current non-detection is still consistent with the GRB model and does not challenge GRBs as the origin of HE cosmic rays. (Reference: Li, Z. Physical Review D, vol. 85, Issue 2, id. 027301) Moreover, we stress that the same process that produce neutrinos also generates electromagnetic (EM) emission induced by the production of secondary electrons and photons, and that the EM emission is expected to be correlated to the neutrino flux. Using the

Fermi observational results on gamma-ray flux from GRBs, the GRB neutrino emission is limited to be below ~20 GeV/m^2 per GRB event on average, which is independent of the unknown GRB proton luminosity. This neutrino limit suggests that the full IceCube needs stacking more than 370 GRBs in order to detect one GRB muon neutrino. The Fermi observations of GRBs also imply that the ratio between energy in the accelerated protons and electrons is f_p<~10. (Reference: Li, Z. submitted, arXiv:1210.6594) (#1456)

Indirect Dark Matter Detection in the Light of Sterile Neutrinos

Arman Esmaili

The recent global fit of short baseline neutrino oscillation data favors the presence of one (or more) sterile neutrino state which leads to new mass splitting Δm^2 ~1 eV^2. We consider the effect of this new states on the evolution of neutrinos from the dark matter annihilation inside the Sun. We show that neutrinos with energy E_ν > 100 GeV undergo resonant active-sterile oscillation which depletes the flux of neutrinos arriving at the Earth. As an example of this effect, we present the oscillation probabilities for the case of monochromatic neutrinos from the direct annihilation of dark matter particles to neutrinos and the depletion due to the presence of sterile neutrinos. (#1516)

Self-gravitating system of fermions as dark matter halos and central objects in galaxies

Bernardo De Oliveira Fraga

Dark Matter (DM) is believed to be one of the main constituents of the universe today. Despite several lines of evidence, it is not clear yet what DM is and its properties. We propose a model of self-gravitating fermions in general relativity to describe the dark matter halos and the central objects in galaxies. We obtain a universal density profile composed by a flat core for small radii and a plateau and a tail that decreases with the square of the radius for the halo region. We fit the free parameters of the model using galactic observables such as the constant rotation velocity, the mass of the central object and the halo radius, concluding that the particle mass should be tens of keV. We also show that our model is in agreement with the universality laws recently proposed and we compare our model with other profiles commonly used in the literature. Since the particle mass is in the keV region the sterile neutrino is a natural candidate. (#1536)

SNR W44, the first unambiguous evidence of gamma-rays emission from neutral-pions decay

Andrea Giuliani

The SNR W44 is an ideal system for studying cosmic-ray production. It is a middle-aged SNR expanding in a dense medium whose environment and shocked material configuration favor a detailed testing of hadronic versus leptonic emission. We will present the AGILE observations of W44 in the energy range 50 MeV-10 GeV , extending the gamma-ray spectrum of this source to energies substantially lower than previous measurements. The gamma-ray emission matches remarkably well both the position and shape of the inner SNR shocked plasma. Combining gamma-rays and radio observations of this source we can demonstrate that lepton-dominated models fail to explain simultaneously the well-constrained multi-wavelength spectrum. Hadron-dominated models are instead consistent with all the constraints derived from radio, optical, X-ray, and gamma-ray observations. This is the first unambiguous evidence of gamma-rays emission from neutral-pions decay in a SNR, as recently confirmed by Fermi observations. The hadron energy spectrum is well described by a power-law with index 3.0 ± 0.1 and a low-energy cut-off at 6 ± 1 GeV. (#1495)

COB-IV

Vacuum awakening in spheroidal configurations

Raissa Mendes

In [1,2] it has been shown how quantum fluctuations of a free scalar field properly coupled to the curvature can drive an instability of the spacetime configuration. This mechanism might have observable astrophysical implications, for instance, in the formation of compact stars. Also, the observation of relativistic stars with certain mass-radius ratios could in principle be used to discard an entire range of field-to-scalar-curvature couplings as physically reasonable. For this latter purpose, it is relevant to know if the main features described in Ref. [2] are preserved when assumptions such as spherical symmetry or staticity are relaxed. In this presentation we discuss this mechanism in the context of spheroidal thin shells, exploring the consequences of deviations from spherical symmetry on the triggering of the effect. [1] W.C.C. Lima and D.A.T. Vanzella, Phys. Rev. Lett. 104, 161102 (2010). [2] W.C.C. Lima, G.E.A. Matsas, and D.A.T. Vanzella, Phys. Rev. Lett. 105, 151102 (2010). (#1491)

Awaking the vacuum in relativistic stars

William Lima

Void of any inherent structure in classical physics, the vacuum has revealed to be incredibly crowded with all sorts of processes in relativistic quantum physics. Yet, its direct effects are usually so subtle that its structure remains almost as evasive as in classical physics. Here, in contrast, we exhibit a novel effect according to which the vacuum is compelled to play an unexpected central role in an astrophysical context. We show that the formation of relativistic stars may disturb the vacuum of a quantum field in a way which leads its energy density to an exponential growth. The vacuum-driven evolution which would then follow may lead to unexpected implications for Astrophysics. (#1429)

Particle creation due to tachyonic instability in relativistic stars

André Landulfo

It was recently shown that relativistic stars may become unstable due to quantum-field effects. The so called vacuum awakening effect occurs for a free scalar field properly coupled to the spacetime curvature. This effect is characterized by an exponential point-dependent increase and decrease of the vacuum expectation value of the stress- energy-momentum tensor. This is caused by a tachyonic-like instability, which induces an exponential growth of the vacuum fluctuations. Once the effect is triggered, the star energy density would be overwhelmed by the vacuum energy density in a few milliseconds. This demands that eventually geometry and field evolve to a new configuration to bring the vacuum back to a stationary regime. Here, we show that the vacuum fluctuations built up during the unstable epoch lead to particle creation in the final stationary state when the tachyonic instability ceases. The amount of created particles depends mostly on the duration of the unstable epoch and final stationary configuration, which are open issues at this point. We emphasize that the particle creation coming from the tachyonic instability will occur even in the adiabatic limit, where the spacetime geometry changes arbitrarily slowly, and therefore is quite distinct from the usual particle creation due to the change in the background geometry. (#1428)

Time evolution of non-symmetric Robinson-Trautman spacetimes

Rodrigo Macedo

We extend our work published in Phys. Rev. D78 104025, (2008) [arXiv:0809.3039] for non-symmetric configurations. We employ a Galerkin approximation and show that regular initial data evolve generically into a final configuration corresponding to a Schwarzschild black-hole moving with constant speed. The relation with the gravitational wave recoil is discussed. (#1538)

No Evidence For Bardeen-Petterson Alignment In Conservative GRMHD Simulation Of Moderately Thin, Tilted Accretion Disk

Danilo Teixeira

In this work we present our latest numerical simulations of accretion disks that are misaligned (tilted) with respect to the rotation axis of a Kerr black hole. In this work we use a new, fully conservative version of our general relativistic magneto-hydrodynamics (GRMHD) code, coupled with an ad hoc cooling function designed to control the thickness of the disk. Together these allow us to simulate the thinnest tilted accretion disks ever using a GRMHD code. In this way, we are able to probe the regime where the dimensionless stress α and scale height H/r of the disk become comparable. We also introduce the first results that use data extracted from numerical simulations as inputs to the analytic twisted disk model of Zhuravlev & Ivanov. The simulated disk shows no sign of Bardeen-Petterson alignment, consistent with our earlier work, but contrary to common expectations for thin disks. Importantly, we also find that the dimensionless stress resulting from the MRI-generated turbulence in our simulations is not isotropic, also contrary to common assumptions. Finally, we find that the predictions from the Zhuravlev & Ivanov model for the dynamics and stationary configuration of the disk agree quite well with the simulations. The implication is that the parameter space associated with Bardeen-Petterson alignment may be quite small, only including very thin disks $H/r \ll \alpha$. (#1532)

HEA-IV

Pulsars, supernovae, and ultrahigh energy cosmic rays

Kumiko Kotera

Young isolated millisecond pulsars have been scarcely discussed as sources of ultrahigh energy cosmic rays (UHECR) in the literature. However, the production of UHECRs in these objects could give a picture that is surprisingly consistent with the latest data measured with the Auger Observatory. These pulsars would be born in supernovae that could present interesting specific radiative features, due to the interaction of the pulsar wind with the surrounding ejecta. The resulting supernova could present a high luminosity plateau over a few years, and a bright X-ray and gamma-ray peak around one or two years after the onset of the explosion. If such signatures were observed, they could have important implications both for UHECR astrophysics and for the understanding of core-collapse supernovae. (#1423)

Relativistic AGN jets: The effect of radial stratification on internal shocks and jet integrity

Sander Walg

Current observations have shown that jets reveal strong signs of a radial structure. Evidence suggests an inner region of a jet, called the spine consisting of a low-density and fast moving gas, while the outer region of the jet consists of a denser and slower moving gas, called the sheath. Current observations are not able to fully resolve the radial structure so that little is known about the actual stratification profile. Strong internal shocks within AGN jets, as well as the hot spots that form where the jets impact the intergalactic medium (IGM), are considered efficient cosmic rays accelerators, and should be capable of accelerating particles up to ultrahigh energies ($E \sim 10^{20}$ eV). Given the importance of the radial stratification for jet stability, jet integrity and the formation of internal shocks, a study of jets with different radial structure is clearly called for. We have performed "2.5D" hydro-simulations of relativistic AGN jets on scales up to 400 kpc. We compare the evolution of two spine-sheath structured jets (one with an isothermal equation of state and the other with an adiabatic equation of state), as well as a radially uniform jet. We study the global morphology and evolution of the jet head and surrounding cocoon and we quantify the amount of mixing between spine and sheath material. We find that the effective surface area of the intergalactic medium that interacts with the jet near its head is much larger than was predicted from simple theory, resulting in a significantly lower jet head propagation speed. Due to this large impact area, complex flow patterns form at the jet's heads, causing vortices and turbulence that drive strong mixing of spine- and sheath material and material from the intergalactic medium. Moreover, we find that in case of the adiabatic jet, the spine-sheath structure is lost fairly quickly after jet inlet, whereas the isothermal jet maintains its integrity up to large distances. The marked differences between the evolution of the two structured jet models give us new insights in the influence of jet stratification and provide us with new signatures in jet morphology that can be compared with observations. (#1430)

Possible link between FERMI bubbles and cosmic rays

Dmitry Chernyshov

Fermi bubbles are giant gamma-ray structures extended north and south of the Galactic center with diameters and heights of the order of 10 kpc recently discovered by Fermi Large Area Telescope. Correlation between gamma-ray emission observed by Fermi and radio emission observed by Plank implies the presence of high-energy particles in the area covered by Fermi bubbles. We suggest that the periodic star capture processes by the Galactic supermassive black hole Sgr A* can result in hot plasma injecting into the Galactic and produce a series of shocks. Acceleration of electrons may result in observed gamma- ray and radio emission while reacceleration of protons may contribute to the spectrum of cosmic rays (CR) observed near the Earth. We show that for energy larger than E > 10^15 eV, the acceleration process can be better described by the stochastic second-order Fermi acceleration. We propose that hadronic CR within the ``knee'' of the observed CR spectrum are produced by Galactic supernova remnants distributed in the Galactic disk. Re-acceleration of these particles in the Fermi Bubble produces CRs beyond the knee. The conversion efficiency from shock energy of the bubble into CR energy is about 10%. This model provides a natural explanation of the observed CR flux, spectral indexes, and matching of spectra at the knee. (#1480)

Very High and Ultrahigh Energy Cosmic Ray Nuclei from Pulsars

Ke Fang

Fast-rotating neutron stars can accelerate particles in their pulsar wind to ultrahigh energies. The time-evolving supernova remnant surrounding the pulsar further interacts with the newly born cosmic rays that try to escape from the source. Our simulation of the escape process finds an ultrahigh energy cosmic ray spectrum softer than the injected E^{-1}, accompanied by a composition transition from light to heavy elements due to the presence of secondaries. Both features help to explain the air shower studies reported by the Auger Observatory. In addition, we also study the accumulation of cosmic rays from all pulsars given a pulsar birth distribution. The pulsar population is assumed to be log-normally distributed in magnetic field strength, centered at $10^{12.65}$ Gauss, and normally distributed in spin period, centered at 300 millisecond. With proper injection composition, the sum of extragalactic pulsars can reproduce both observed energy spectrum and atmospheric depth of ultrahigh energy cosmic rays.

Meanwhile, their Galactic counterparts contribute to very high energy cosmic rays at 10^{16} -10^{18} eV, which could bridge the gap between predictions of cosmic rays from supernova remnants and the observed spectrum just below the ankle. We show the results fitting to different sets of data and their dependence on Galactic diffusion parameters. In particular, we discuss the tension between the ankle-like spectrum and light composition measurement at 10^{18} eV and its implication to the pulsar sources. (#1494)

NGW-I

Schenberg Gravitational Wave Antenna: Status Report

Odylio Denys Aguiar

Here we present a status report of the Schenberg antenna. In the past four years it has gone to a radical upgrading operation, in which we have been installing a 1K pot dilution refrigerator, cabling and amplifiers for nine transducer circuits, designing a new suspension and vibration isolation system for the microstrip antennas, and developing a full set of new transducers, microstrip antennas, and oscillators. We are also studying an innovative approach, which could transform Schenberg into a broadband gravitational wave detector. (#1510)

Searching for gravitational wave signals from rotating neutron stars with the LIGO and Virgo detectors

Andrezj Krolak

A brief overview of basic mechanisms of gravitational radiation from rotating neutron stars will be given with emphasis on the most recent results. Basic types of searches for gravitational wave signals - targeted searches from known pulsars, directed searches from known locations on the sky, wide parameter searches for unknown rotating neutron stars will be presented. Data analysis methods used in all these types of investigation will be discussed. Finally the most recent results of quest for gravitational wave signals from neutron stars in the data collected by LIGO and Virgo detectors will be summarized. (#1434)

Searching for Gravitational Waves with a Geostationary Interferometer

José C. N. De Araújo

We analyze the sensitivities of a geostationary gravitational wave interferometer mission operating in the sub-Hertz band. Because of its smaller arm-length, our proposed Earth-orbiting detector will be less sensitive, by a factor of about seventy, than the Laser Interferometer Space Antenna (LISA) mission in the lower part of its accessible frequency band (10^{-4} - 2×10^{-2} Hz), while it will outperform it by the same factor in the higher-part of it (2×10^{-2} Hz - 10 Hz). By being able to probe the higher region of the sub-Hertz band with higher sensitivity, our proposed interferometer will observe a larger number of super-massive black holes (SMBHs) with masses smaller than ~10^6 M_{sun}, thereby probing more accurately the astrophysical scenarios that account for their formation. (#1550)

Capitalizing on GW polarization bias for a pair of interferometric detectors to increase parameter estimation speed and the potential implications for cosmological models

Cristina Valeria Torres

The first generation of gravitational-wave (GW) detectors have reached their initial goals for sensitivity and produced interesting upper limits. While these detectors did not detect a GW, the next generation of detectors are poised to make such detections in the not-too-distant future. Determining source parameters quickly and accurately is useful for the multi-messenger astronomy community and these measured parameters will also likely impact cosmological and population modeling. We will discuss our preliminary investigation, a single case study, on the effects on parameter estimation and source bias when detecting a compact binary coalescence (CBC) signal using two Advanced LIGO (aLIGO) detectors. For that suspected gamma-ray burst source, it appears that the observable source polarization angles are non-uniform across the sky. This bias can be used to speed up parameter studies, and possibly impact source selection of CBC objects in the observable volume of aLIGO detectors. We present our case study and offer motivation on how properly considering these effects on observable source polarizations across the sky may be beneficial to analysis and modeling efforts.

Improved versions of the F-statistic for more efficient GW pulsar searches

Curt Cutler

The F-statistic is the optimal (frequentist) statistic for the detection of gravitational-wave (GW) pulsars. However, in "all-sky" searches for previously unknown GW pulsars, it would be computationally intractable to calculate the (fully coherent) F-statistic at every point of a (suitably fine) grid covering the parameter space. Here we describe improved versions of the F-statistic that lead to greater sensitivity at fixed computational cost. Some of the ideas here should also be useful for improving the efficiency of searches for gamma-ray pulsars in Fermi data and searches for short-period binary radio pulsars in radio data. (#1519)

HEA-V

No asymptotically highly damped quasi-normal modes without horizons?

Jozef Skakala

We explore the question what happens with the asymptotically highly damped quasi-normal modes (ℓ fixed, $|\omega_I|\to\infty$) in case spacetime has no horizons. In particular we work with the characteristic oscillations of a scalar field in a generic asymptotically flat spherically symmetric static spacetime without horizons. The question what in such case happens with the asymptotic quasi-normal modes might be interesting from the point of view of the currently popular conjectures, such that link the behavior of the asymptotic quasi-normal modes to the quantum properties of spacetime horizons. We prove for a large class of such spacetimes that the asymptotically highly damped modes do not exist. This provides in our view additional evidence that there is a close general link between the asymptotically highly damped modes and the existence of spacetime horizons (and the properties of spacetime horizons). (#1445)

Bowshocks of runaway stars as gamma-ray sources

Maria Victoria Del Valle

Runaway massive stars can produce bowshocks in the surrounding ISM. These bowshocks develop as arc-shaped structures, with the bows pointing to the same direction as the supersonic stellar velocity. The piled-up shocked matter emits thermal radiation and a population of locally accelerated relativistic particles is expected to produce non-thermal emission over a wide range of energies. The recent detections of non-thermal radio emission from the bowshock of BD +43◦3654 and of non-thermal X-ray radiation from the bowshock of AE Aurigae, confirm the capability of some of runaway stars to accelerate at least electrons up to relativistic energies. We present a model for the non-thermal radiation produced by the relativistic particles accelerated at the bowshock. The presence of rich infrared photon fields locally generated by the heated dust provides a suitable target for inverse Compton interactions, that might yield, in some cases, detectable gamma-ray fluxes.

Effect of Diquark-Diquark Repulsion in the EoS of Strongly Interacting Systems

Efrain Ferrer

The BCS-BEC crossover at sufficiently strong coupling will be analyzed in a simple model that mimic a dense quark matter system. Considering the EoS of this strongly interacting system, I will show that to avoid the BEC system to collapse into a pressureless gas at zero temperature, a diquark-diquark repulsion has to be self-consistently taken into account. The existence of a diquark-diquark interaction strength beyond which the tendency to condense at zero temperature of the diquark gas is compensated by the repulsion between diquarks will be discussed. Possible implications of the diquark-diquark interaction for the astrophysics of compact stars will be discussed. (#1531)

Recent progress on the Induced Gravitational Collapse Model

Ana Virginia Penacchioni

We describe the Induced Gravitational Collapse scenario, recently developed to explain the sub-class of long GRBs associated with a SN explosion. We propose as a progenitor a binary system formed by a CO core and a NS companion. The CO core explodes as a SN producing a thermal emission in the keV range that evolves in time following a broken PL. The SN ejecta is then accreted by the NS, which reaches its critical mass and collapses to a BH, producing the canonical GRB. We apply this model to a sample of long GRBs, describing every episode of emission. We also compute the relevant parameters of the binary system. In addition, we apply a phenomenological method to estimate the redshift of this sub-class of GRBs by analyzing their X-ray light curves. (#1537)

COB-V/NGW-II

Bigrade Orbits Around Kerr Black Holes

Gabriel Perez-Giz

There exists a subclass of stable bound Kerr geodesics whose azimuthal motion switches from prograde to retrograde and back repeatedly throughout the orbit. These orbits, which we call "bigrade orbits", always have negative azimuthal angular momentum and are highly inclined but constitute a set of nonzero measure in the orbital phase space. Bigrade orbits, which can be interpreted as another manifestation of frame-dragging, exist at arbitrarily large orbital radii and for arbitrary small black hole spins. Far from the black hole, such orbits are restricted to a tiny range of orbital inclinations near 90 degrees (polar) and have a "wrong-way" prograde phase of vanishingly small amplitude and duration. For large black hole spins and periapsis of order a few Schwarzschild radii, however, both the range of inclinations over which bigrade motion occurs and the magnitude of the effect are more pronounced. This talk details the anatomy of bigrade orbits and discusses whether they could be observationally important. (#1540)

Nonlinear effect of r-mode instability in uniformly rotating stars

Motoyuki Saijo

We investigate the r-mode instability of uniformly rotating stars by means of three dimensional hydrodynamical simulations in Newtonian gravity with radiation reaction. We propose a nonlinear anelastic approximation in the rotating reference frame, which kills the propagation of sound speed, in order to evolve the system beyond the acoustic timescale. We succeed in evolving uniformly rotating stars up to at least around several hundred rotation period with our new scheme, which is at least 10 times longer than the previous standard hydrodynamical simulations. In order to verify our developed code, we impose the harmonic index of l=m=2 perturbation of an incompressible unstable r-mode eigenfunction to the equilibrium velocity, and find that the characteristic frequency of the unstable r-mode is excited throughout the evolution. We discuss the features of nonlinear r-mode instability with our newly developed code, such as saturation amplitude and the breaking wave effect of its instability. (#1468)

Network of interferometric gravitational wave detectors sensitivity for identifying the metric theory of gravity

Carlos Frajuca

Although general relativity (GR) has presented remarkable experimental results as a theory for gravity, other theories have not been ruled out because they yield the same results of GR for many phenomena. One way to exclude candidate theories is by detecting the gravitational waves emitted by astrophysical sources since the predictions of the theories on this phenomenon may vary. In this work we report results of a research on ways to generate distinctive observations regarding different metric theories of gravitation. To this end we propose the combination of the data of a network of interferometric gravitational wave detectors in such a way that the identification of the metric theory of gravitation is possible. The results use current and planned detectors, the two LIGO, VIRGO, LCGT, AIGO and GEO600, because six detectors are necessary to identify all possible metric theories of gravitation. We present that a network of at least six interferometric gravitational wave detectors is needed to allow discrimination among metric theories of gravitation and how these detectors should be positioned for the network to reach maximum sky coverage by analyzing actual and planned detectors. (#1473)

Electromagnetic and Gravitational Wave emission from merger of supermassive black holes in force-free plasma

Daniela Delia Alic

I will present a recent study of the electromagnetic and gravitational wave emission produced during the inspiral and merger of supermassive black holes immersed in a force-free plasma threaded by magnetic field. Due to the recent progress in the field of numerical relativity, this type of astrophysical scenarios can now be studied through complex numerical simulations and the resulting estimates are important for future multi-messenger astronomy. Our results show that although a dual-jet structure is present in the electromagnetic emission, its associated luminosity is smaller than the one associated with the non- collimated emission, which is predominantly quadrupolar. The three-dimensional charge distribution produced as a consequence of the binary inspiral possesses a complex but ordered structure, which traces the motion of the two black holes. I will provide quantitative estimates of the scaling of the electromagnetic emission with the orbital frequency of the binary, which show that the diffused part has a dependence that is the same as the gravitational- wave one, and discuss the impact of these results on the potential detectability of dual jets from supermassive black holes and the steps necessary for more accurate estimates. (#1439)

Posters

Alternative Models and Theories

Cosmology from Kaluza-Klein gravitational model

Pedro Ribeiro Da Silva Moraes

In this work we present a cosmological model derived from Kaluza-Klein theory, identifying the functional form of the parameter associated to the fifth dimension in such a way that it produces a solution that mimetizes the effects of the cosmological constant in the scope of General Relativity. (#1485)

Reducing the parameter space for unparticle-inspired models using white dwarf masses

Rodrigo Alvares De Souza

Many proposals for explaining the apparent shortcomings of the Standard Model have been advanced. The Unparticle Model proposed by Howard Georgi aimed to include in the Standard Model massive but scale-invariant particles, sharing the same physics of the scale-dependent counterparts. These objects, called 'unparticles', could play an important role in low-energy physics, since the model implies that unparticles can be exchanged between massive particles, leading to a new force called 'ungravity'. This “fifth”' force would add a perturbation term to the newtonian gravitational potential, although the exact potential can not be obtained because the distance at which the perturbed potential matches the Newtonian expression needs to be known. Based on astrophysical constraints derived from Chandrasekhar's mass limit for white-dwarfs, we study the effects of the model on the parameters of unparticle-inspired gravity, on scales of energy beyond 1 TeV and the anomalous dimension parameter dU near 1, in order to constrain the mass of the interaction (un)particle. (#1482)

Fractal Characteristics in the Lemaître-Tolman-Bondi Cosmology

Felipe Gomes Nogueira

Recent observations indicate that the Universe may not be homogeneous at high redshifts where density variations of cosmological sources are observed. Assuming that those density variations can be described by inhomogeneous cosmological models, this work intends to model these variations by using the most studied of these models, the Lemaître-Tolman-Bondi (LTB) spacetime. The generality of this model, which includes the standard cosmology as a particular case, allows its arbitrary functions to be specified in a way that the density variations can be modeled as a fractal distribution. We intend to generalize Ribeiro's (1992) work by using the technique developed by Mustapha, Ellis \& Hellaby (1998) which probes the past light cone using the single null geodesic concept and obtaining analytic solutions of the radial past null geodesic in this cosmology, unlike the numerical approach of Ribeiro (1992). Then we obtain inhomogeneous solutions with a fractal behavior that can be compatible with observations from type Ia supernovae without assuming the existence of a dark energy. This is so because the LTB model can determine various mass and energy distributions due to the arbitrariness of undetermined functions freedom in a spacetime without a cosmological constant. The particular solutions obtained for these functions are used to derive observational quantities in the LTB parabolic model, using the single null geodesic approach, and an analytic expression for the redshift as a function of the comoving radial coordinate is obtained. Finally, a discussion of specific fractal dimension values in each redshift range is presented. (#1457)

Calculating Vacuum Energy from a Universal Background

Antônio Carlos Amaro De Faria Júnior

In this paper we discuss a model for calculating the vacuum energy based on the standard model of infinite harmonic oscillators with n oscillation modes. As is known to add up these oscillators on all modes of oscillation the result is a divergence. This divergence is based on the residual energy or zero-point energy, which through a simple technique of renormalization or ordering circumvents the problem of divergence. However if we consider an absolute reference and relative to it a minimum speed consistent with the uncertainty principle we can show that it is possible to remove the divergence of the vacuum energy, without the renormalization technics. References: [1] D W Sciama, On The Origen of Inertia, Monthly Notices of the Royal Astronomical Society 113, 34, (1953). [2] C.Nassif, A.C.Amaro de Faria Jr.,Phys.Rev.D 86,027703,(2012). (#1449)

Compact Objects

On The Relativistic Feynman-Metropolis-Teller Equation of State at Finite Temperatures and its Applications to White Dwarfs

Sheyse Martins De Carvalho

The Feynman-Metropolis-Teller (FMT) treatment considering a classic non-relativistic Thomas-Fermi model confined in a Wigner-Seitz cell has been recently generalized to relativistic regimes and applied to the description of non-rotating white- dwarfs in general relativity. We are extending the FMT treatment to the case of finite temperatures for white dwarfs with different nuclear compositions. Our aim is to understand the effects of finite temperatures on the structure of white dwarfs, constructing and analyzing their equation of state and mass-radius relation. (#1554)

Collapse of a cloud of matter to form a polytropic star in the characteristic formulation of general relativity

Carlos Cedeño Montaña

An attractive point of view to study gravitational radiation provided by compact objects or binary compact systems, it is the characteristic formulation of general relativity that is based on radiation coordinates. In that formulation the space-time can be foliated in null cones oriented to the future. Currently, there are characteristic numerical codes capable to solve the Einstein's field equations coupled, for example, with a massive Klein-Gordon scalar field without any symmetry. They are based on finite difference schemes using the eth formalism, and on the non-conformal mapping decomposition of the angular manifold using the gnomonic or stereographic projections. However, there is another approach to deal with these problems, namely, the spectral decomposition. In that approach the metric functions, the density, and the pressure of a distribution of matter can be decomposed using the spin-weighted spherical harmonics. We adopt that approach to write the Einstein's field equations for the problem of the gravitational collapse of a cloud of matter to form a fermionic, and polytropic star. To achieve this, we develop an algebraic and parallelised Mathematica package that is able to write the system of equations in the characteristic form using the tensor, the eth formalism, and the spin-weighted spherical harmonics. (#1526)

Initial Data for Binary Neutron Stars with Arbitrary Spin and Orbital Eccentricity

Pedro Marronetti

The starting point of any general relativistic numerical simulation is a solution of the Hamiltonian and momentum constraint that (hopefully) represents an astrophysically realistic system. One characteristic of the Binary Neutron Star (BNS) initial data problem is that, unlike the case of binary black holes, there are no formalisms that permit the construction of initial data with stars with arbitrary spins. For many years, the only options available have been systems either with non-spinning stars (irrotational fluid) or with stars that are tidally locked (corotating). Ten years ago, Marronetti & Shapiro (2003) introduced an approximation that would produce such arbitrarily spinning systems. More recently, Tichy (2012) presented a new formulation to do the same. However, all these data sets are bound to have a non-zero eccentricity that results from the fact the stars' velocity have initial null radial components. We present here a new approximation for BNS initial data for systems that possess arbitrary spins (and, of course, arbitrary masses) and arbitrary radial and tangential velocity components. The latter allows for the construction of data sets with arbitrary orbital eccentricity. Through the fine-tuning of the radial component, we were able to reduce the eccentricity by a factor of several compared to that of standard helical symmetry data sets such as those currently used in the scientific community. (#1524)

An overview of the generalizations of the Birkhoff theorem

José Arbañil

The interest of the present work is to generalize the Birkhoff theorem to include different kind of field sources, with particular interest in compact objects. A modern form of stating the original Birkhoff theorem is, for instance, as follows: let the geometry of a given region of spacetime (1) be spherically symmetric, and (2) be a solution to the Einstein field equations in vacuum; then that geometry is necessarily a piece of the Schwarzschild geometry. There a several generalizations of such a theorem in the literature. We start by briefly reviewing the historical facts related to theorem in the literature, which, as far as we know, already include electromagnetic fields, cosmological term, and some kind of scalar fields. In each case the associated geometry is a piece of different known spacetimes, e.g., Reissner-Nordström, Reissner-Nordström-de Sitter, an so on. Our first aim is to put forward a generalized version of the theorem which includes all the known results in four and higher dimensional spacetimes. For it is assumed the spacetime can be split in two regions along a specific (spherical) direction. One region, called the interior region, may contain any kind of matter-energy, while the exterior region contains only the specified matter and fields. Assuming further that the spacetime admits a particular Killing vector we show that it is possible to put together several generalized versions of the theorem. In particular, we consider an electrically charged perfect fluid, with cosmological constant, in a spacetime with arbitrary number of spacelike dimension, and show that the conditions of validity of the theorem hold independently of the special geometry and of the number of extra dimensions. We then analyze particular cases of compact objects with different energy content in the exterior region. (#1483)

Compact objects in General Relativity: testing the Buchdahl limit for charged spheres

Vilson Tonin Zanchin

The aim of the present work is to investigate the bounds for the degree of compactification of relativistic compact objects. A classical result by Buchdahl (Phys. Rev. 116, 1027 (1959)) establishes that for static solutions of the spherically symmetric Einstein-matter system, the total ADM mass M and the area radius R of the boundary of the body obey the inequality 2M/R < 8/9. Generalizations of such a result for Einstein-Maxwell-matter systems, to include the effects of the electric charge, were worked out by several authors. A sharp result was found by Andreasson (Commun. Math. Phys. 274, 399 (2007)). Extrapolating such a result we find that the quasiblack hole limit, for which R=M=Q, Q being the electric charge of the sphere, is the minimum radius to mass ratio that can be reached, i.e., R/M=1. With this result in mind, we study several models of charged static fluids that admits such an extreme limit of compactification. In particular, we study a charged perfect fluid sphere with a polytropic equation of state under the assumption that the charge density of the fluid sphere is proportional to the energy density. Using the Tolman-Oppenheimer-Volkoff equation we find equilibrium solutions and by varying the parameters of the equation of state, and the central density of the sphere, we look for the minimum radius to mass ratio. We show that under certain conditions the quasiblack hole limit, R/M=1, can be attained. (#1469)

MHD equilibria in barotropic stars

Cristóbal Armaza

Barotropic equations of state, where pressure is a function solely of density, are usually assumed to describe the matter within magnetic stars in ideal magnetohydrodynamical equilibrium. Barotropy strongly restricts the range of possible equilibrium configurations, and strictly does not represent the realistic stably stratified matter within these objects. Stable stratification is likely to be an essential ingredient to suppress the magnetic instabilities. Thus, it is interesting to verify if barotropic equilibria are stable or not, so that they can have a chance to be used in modeling the known long-lived magnetic fields present in some stellar objects. These equilibria, involving both poloidal and toroidal magnetic field components, are described by the so-called Grad-Shafranov equation, a nonlinear, partial differential equation with two free functions. Here, we present a new finite-difference code developed in order to solve this equation for arbitrary choices of these functions. Dynamical stability of the new numerical equilibria found could be analyzed using either a perturbative analysis or the time-evolution of such configurations. (#1466)

Time lags in the kilohertz quasi-periodic oscillations of the low-mass X-ray binaries 4U1608-52 and 4U1636-53

Marcio Bronzato de Avellar

The kilohertz quasi-periodic oscillations (kHz QPOs) in neutron stars (NS) low-mass X-ray binaries (LMXB) are the fastest variability so far observed from any astrophysical object and are characterized generally by two relatively narrow peaks in the power density spectra of these sources. Since (part of) the high-energy radiation emitted from the surface of the NS in LMXBs is reprocessed and re-emitted at lower energies in the accretion disk or in a region not far from the surface of the neutron star, one can constrain the size of the (re-)emitting region measuring the (energy-dependent) time (or phase) lags and the Fourier coherence between low- and high-energy photons of the kHz QPOs. The time (phase) lags and Fourier coherence are Fourier-frequency-dependent measures of, respectively, the time (phase) delay and the degree of linear correlation between two concurrent and correlated time series, in this case light curves of the same source, in two different energy bands. Although most of the observational and theoretical studies in the past 15 years concentrated on the frequencies and, to a lesser degree, the amplitude and the coherence of the kHz QPOs, almost no work has been done on the energy-dependent time (or phase) lags and the Fourier coherence of the kHz QPOs. Since the Keplerian frequency close the innermost stable circular orbit (ISCO) around a ~15km and ~1.4M⊙ NS is ~1300 Hz, several models have been proposed in which the kHz QPOs, especially the one at higher frequency (the upper kHz QPO), reflect the Keplerian frequency of matter orbiting at the inner edge of an accretion disc, very close to the NS surface. We studied the systems 4U1608–52 and 4U1636–53, in which the frequency of the kHz QPOs ranges from 540 to 1060 Hz in the former and from 550 to 1240 Hz in the later. We find a significant dependence of the time lags with energy (−0. 026 msec at 5 keV to −0.095 msec at 18 keV for 4U 1608-52 and −0. 0009 msec at 6 keV to −0.051 msec at 19 keV for 4U 1636-53), but a weak (if any) dependence with frequency and we use these results to constrain the location at which these QPOs are produced. Based on our results, we concluded that the size of the emitting region should be small (~1km) and very near the neutron star if we use a down-scattering model for the delays. (#1460)

Models of Pulsars Binary Systems and Emission of Gravitational Waves

Renan Santos

Neutron stars are the current laboratories of General Relativity. Even though they have been predicted by the theory as solutions of the Einstein's Field Equations, these fascinating objects still challenge the entire scientific community by having intrinsically many physical features in high energy level such as strong magnetic field (1e9 G~1e15 G), central density near to the nuclear density (1e14 g / cm^3), source of neutrinos, superfluidity, high angular frequency (1000 revolutions per second) and so on. Currently, in astrophysics, the study of stellar structure comes primarily from an equation of state inferred by numerous methods. Information can be obtained by analysing the redshift effects within binary systems. Nevertheless, the luminosity detection of these compact stars is not so trivial. Thus, this physics doesn't fully work, especially on modern issues with strong gravitational and magnetic fields. On the other hand, a pulsar binary system allows us to observe the emission of gravitational waves indirectly; the period of the pulsar decreases due to the emission of gravitational waves which are propagated in the speed of light as a transversal wave with small amplitude h (~1e-21) and frequency (1 mHz~1000 Hz). Firstly, by solving the famous Tolman– Oppenheimer–Volkoff (TOV) equations using numerical methods (Runge-Kutta) on MatLab, this project aims to describe the structure of a neutron star assuming that is equivalent to a spherically symmetric body of isotropic material which is in hydrostatic equilibrium; secondly, we use the quadrupole approximation to model the gravitational radiation emitted by a binary system. At last, we conclude that the quadrupole method is an accurate tool to investigate the gravitational waves from relativistic stars in a binary system. (#1443)

Cosmology

Integrated Sachs-Wolfe effect as probe dark energy

Fabio Cabral Carvalho

Evidences for late-time acceleration of the Universe are provided by multiple complementary probes, such as observations of distant Type Ia supernovae (SNIa), cosmic microwave background (CMB) anisotropies, baryon acoustic oscillations (BAO), clusters of galaxies, and the integrated Sachs-Wolfe (ISW) effect. Following the former, a number of authors investigated the properties dynamical of the dark energy (DE) component. In this work we shall focus on the latter, which consists of small secondary fluctuations in the CMB which are produced whenever gravitational potentials are evolving, as happens at late times in the case of the Universe undergoing a transition to a curvature or dark energy-dominated phase. Thus, if we assume a flat universe as supported by the primary CMB data, then a detection of the ISW represents a measurement of dark energy and its properties. We estimated the parameters of a few quintessence models from ISW effect and investigated if the dynamical comportment of these models is consistent with SNIa, CMB and BAO data. (#1547)

Weak Gravitational Lensing and Cosmological Perturbation Theory

Leonardo Castañeda Colorado

Weak Gravitational Lensing is nowadays a powerful tool to understand the underlying physics of galaxy formation and clustering of dark matter in the Universe. In particular, the shear signal is a priceless source of richness in different probes in cosmology and astrophysics. During the last decades, different approaches to understand non linear effects in cosmology have been developed and one of the most widely used is the halo model. Within the model, in order to compute the two point statistics, several generalizations of the two halo term are available in the literature. In this work, I use non standard cosmological perturbation theory, specifically the Halo-Perturbation theory approach (R. Smith et al. PRD 75, 063512, 2007) to study the galaxy-galaxy lensing signal using the tangential shear to compute the galaxy-halo correlation function . The results are compared with the standard Halo-Model and the effects of non linear effects are disentangled in the shear signal. The main result expected from this method is to provide a deeper understanding of the halo-halo correlation function, until now this function is modeled only with the linear matter power spectrum. However, is well known that non linear clustering should affect the lensing shear signal. Different effects as scale dependent bias of the dark matter halos and dark matter halo shapes are strong functions for the shear signal, it makes this probe an excellent test for different models of structure formation in the Universe. Future applications of this new approach are discussed. (#1520)

Notes on the use of curvature scalars in order to identify singularities in quantum cosmology

Gil De Oliveira Neto

In the present work we provide further evidence that the canonical quantization of cosmological models eliminates the classical Big Bang singularity. The usual criterion for absence of the Big Bang singularity in Friedmann-Robertson-Walker quantum cosmologi-cal models is the non-vanishing of the expectation value of the scale factor. Here we make use of the DeBroglie-Bohm interpretation, compute for all FRW models considered the 'local expectation value' of the Ricci and the Kretschmann scalars, and show that they are finite for all time. According to the classification introduced in the literature and the fact that these scalars are elements of general scalar polynomials in the metric and the Riemann tensor, this result indicates that in these quantum models the 'local expectation value' of a general scalar polynomial in the metric and the Riemann tensor is finite everywhere, including what would correspond to the classical Big Bang singularity. (#1492)

Cosmic time evolution of the average galactic mass and luminosity from z=0.5 to z=5

Amanda Reis Lopes

This work aims to estimate the redshift evolution of the average mass and luminosity of field galaxies from luminosity function data derived from galaxy redshift surveys. Ribeiro & Stoeger (2003) presented a relativistic relation between the mass-to-light ratio and two other quantities related to the luminosity function in a relativistic cosmology, namely the selection function and the luminosity density. Analyzing this relation, we verify that the average luminosity as function of the redshift can be obtained using the ratio between the luminosity density and the selection function. Moreover, we develop an approach to obtain the average galactic mass evolution using the stellar mass-to-light ratio and the previously derived average luminosity. For this analysis, we use the Schechter parameters of the luminosity function in the B-band presented by Gabasch et al. (2004) in the redshift range of $0.5<z<5.0$ for the FORS Deep Field galaxy survey and the stellar mass of a sample of 5558 galaxies (Drory et al. 2005). We find that the average luminosity varies as a smooth exponential against the redshift, approximating to L(z) (1+z) for small values of z, a result in agreement with an early suggestion made by Brown & Tinsley (1974). We also discuss how to obtain an analytical expression for the redshift evolution of the average galactic mass. (#1459)

Variation of the speed of light and the invariance of the Fine Structure Constant

Antônio Carlos Amaro De Faria Júnior

From an extended relativistic dynamics for a particle moving in a cosmic background field with temperature T, we aim to obtain the speed of light with an explicit dependence on the background temperature of the universe. Although finding the speed of light in the early universe much larger than its current value, our approach does not violate the postulate of special relativity. Moreover, it is shown that the high value of the speed of light in the early universe was drastically decreased before the beginning of the inflationary period. So we are led to conclude that the theory of varying speed of light should be questioned as a possible solution of the horizon problem. It will be also shown that the fine structure constant has remained invariant since the early universe with Planck temperature. Although the speed of light was initially much higher than its current value according to a previous work [1], and now showing that both the Planck constant and the electron charge were also very large in a distant past, it will be found that the fine structure constant has not been changed with the cosmic time scale. (brief report accepted for publication in Physical Review D on Set 2012). References: [1] D W Sciama, On The Origen of Inertia, Monthly Notices of the Royal Astronomical Society 113, 34, (1953). [2] C.Nassif, A.C.Amaro de Faria Jr.,Phys.Rev.D 86,027703,(2012). (#1453)

Doubly special relativity with an invariant minimum speed and the accelerated expansion of the universe

Claudio Nassif Da Cruz

It will be introduced a new symmetry principle in the space-time geometry through the elimination of the classical idea of rest, by including a universal minimum limit of speed in the subatomic world. Such a lowest limit, unattainable by particles, represents a preferred reference frame associated with a universal background field that breaks Lorentz symmetry. Thus the structure of space-time is extended due to the presence of a vacuum energy density, which leads to a negative pressure at cosmological length scales. The tiny values of the cosmological constant and the vacuum energy density will be successfully obtained, being in good agreement with current observational results of the Nobel prize S. Perlmutter, B. P. Schmidt and A. G. Riess. (#1450)

Screening Mechanisms in Cosmology

André Delvas Fróes

The Standard Cosmological Model "Lambda CDM" has been able to adequately explain currently available experimental data. Still, doubts about it's validity remain on a fundamental level, and many continue searching for options, creating dynamic dark energy with scalar fields or higher spin fields. Many of them are made viable on Solar System scales by means of screening mechanisms, like the Chameleon or Symmetron scenarios, which hide the exotic fields on our neighborhood, but still allowing them to have interesting cosmological effects. In this poster I will present a brief review of screening mechanisms, and also show a possible novel scenario involving vector fields. (#1446)

Evolution of the scale parameter in a universe filled with a van der Waals fluid

Maria Luiza Bedran

It is our goal in this work to show the evolution of the scale parameter of the Robertson-Walker metric in a universe filled with a van der Waals fluid. Initially, we write the thermal van der Waals equation of state in its caloric representation, that is, writing the pressure as a function of volume and entropy. After this step, we construct the PV diagram of the fluid and compare its isothermal evolution with the adiabatic one. We discuss the thermodynamic stability of the van der Waals fluid as well as its limit of stability. The unstable states region, as well as the stable and metastable states regions, are indicated in the PV diagram. Then we combined the Friedmann equations for a flat universe with the appropriate caloric van der Waals equation of state and determined the evolution of the scale parameter R(t). Our results show that this universe can be represented by two different phases, as expected from the classical representation of the van der Waals fluid. Also similar to the classical behavior, there is a forbidden region in the PV diagram defining the unstable states, and another area defining the metastable states for each phase. We have observed that the fluid presents negative pressures and an accelerated expansion only when it is in a metastable state of the phase of lower entropy than the critical value. Moreover, if the scale factor of this universe evolves in a process under these thermodynamic conditions, the universe will expand until it faces forbidden states. In this condition, we should expect the universe to attain a limit of stability and then fluctuate to a new phase with higher entropy.(#1444)

Super-Massive Black Hole accretion of Matter in the Dark -Energy Cosmologies

Eduardo Dos Santos Pereira

Nowadays, it is known that almost all galaxies have into their center a black hole with mass of thousands or billion of solar mass. However, the origin and evolution of these objects is not completely understood. The main focus of this work is to evaluate the range and the physical mean of the parameters for the accretion model presented here, and what is the role of the dark energy for the evolution of the super-massive black holes. We study the mean accretion rate, by redshift and by mass, and its dependency of the Cosmological model adopted. In particular we consider models with cosmological constant, Λ, and Chaplygin Gas. Here it is used a parametric Schechter function in order to describe the evolution of the mean dimensionless luminosity of quasar, weighted by the Eddington luminosity. Also, it is assumed that the mean radiative efficiency, η, of quasar is not constant, but that it is a function of the redshift. As preliminary results, we have observed that for the same group of parameters, the accretion rate considering generalized Chaplygin Gas is higher than Cosmological Constant. For a future work we would like to calculate the mass function of super-massive black holes, having as base the accretion rate of this work, also estimate parameters of our model from observational data. (#1435)

Brownian motion of a test particle coupled to vacuum fluctuations near a reflecting plane

Malu Maira da Silva

We study the Brownian motion of a test particle coupled to scalar vacuum fluctuations near a perfectly reflecting plane boundary. The presence of the boundary modifies the quantum fluctuations of the scalar field, which in turn modifies the motion of the test particle. We calculate the resulting mean squared fluctuations in the velocity and position of the test particle. From these results of mean squared fluctuations in the velocity, we obtain the fluctuation in the kinetic energy and observe that it is singular for a certain time. This might be a result of our initial assumption of a rigid perfectly reflecting plane boundary, and would thus be smeared out in a more realistic treatment. So, we treat the boundary as a quantum object with a nonzero position uncertainty to try to eliminate this singularity in the kinetic energy. Then we do the same study for a charged test particle coupled to electromagnetic vacuum fluctuations near a perfectly reflecting plane boundary. (#1562)

High Energy Astrophysics and Astroparticle Physics

Electric Susceptibilities of Strongly Magnetized Fermion Systems

Vivian De La Incera

In this poster, the influence of a strong magnetic field on the electric susceptibilities of dense quark matter and QED will be presented and compared. The recently found effects of magnetoelectricity of color superconductivity and paraelectricity of QED will be discussed. Possible implications for compact star physics will be outlined. (#1542)

Photonuclear reactions in a gamma ray burst environment

Laura Paulucci Marinho

Photonuclear reactions are usually disregarded in any analysis of radiation effects in astrophysical environments due to small number of high energy photons, low ISM density and low cross section for this process. Nevertheless, in a gamma ray burst the amount of photons in the energy range consistent with the nuclear giant resonance, for which the photonuclear reaction cross section is substantially enhanced, specially for high mass nuclei, is quite significant. We analyze the passage of high energy photons in matter with characteristics similar to the one thought to exist in a gamma ray burst environment. We present preliminary results of the expected change in the relative abundance of elements as a result of the stripping of neutrons, protons and alpha particles caused by the photonuclear interaction and discuss the possibility of secondary observable effects. We compare simple estimates based on the photonuclear cross sections and calculations made using the Geant4 package. (#1506)

The First Fermi-LAT Catalog of Supernova Remnants

Francesco De Palma

The Fermi Gamma-ray Space Telescope has shed new light on many types of galactic objects, including Supernova Remnants (SNRs). With over 15 SNRs identified to date and over 40 candidates in the 2nd LAT Catalog (2FGL), we are beginning to have sufficient numbers of objects to perform GeV SNR population studies. Moreover, with the wealth of multi-wavelength (MW) data available, we can now characterize in a uniform and consistent manner the GeV emission in all regions containing known SNRs. This permits the first systematic study of SNRs including GeV data, allowing us to classify SNRs and to separate effects of evolution and environment. In combination with MW data, we can constrain emission models of the underlying particle populations, allowing us to quantify both SNR characteristics and SNRs' aggregate contribution to Galactic cosmic rays in a statistically significant manner. We have also developed a method to explore some systematic effects on SNRs' properties caused by the modeling of the interstellar emission, which contributes substantially to gamma-ray emission in the regions where SNRs are located. For this purpose we consider different model construction methods, different model input parameters, and independently fitting the model components to the gamma-ray data. We will present progress towards the SNR catalog and preliminary results, including an emerging distinction between young SNRs and those interacting with denser media and indications of a radio-gamma correlation for the latter. The results from this effort are beginning to challenge some of the simple assumptions used for the multi-wavelength modeling so far. (#1504)

Gamma-ray emission from hot accretion flows

Andrzej Niedzwiecki

We study the gamma-ray emission through neutral pion production and decay in two-temperature advection-dominated accretion flows (ADAFs). We refine previous models of such a hadronic gamma-ray emission by taking into account (1) relativistic effects in the photon transfer and (2) absorption of gamma-ray photons in the radiation field of the flow. We use a fully general relativistic description of both the radiative and hydrodynamic processes, which allows us to investigate the dependence on the black hole spin. We point out that the hadronic gamma-ray emission from ADAFs around rapidly rotating BHs, for nonthermal distribution of proton energies, can explain the Fermi-LAT measurements of Centaurus A as well as the Fermi-LAT and HESS measurements of M87. We discuss also a possible increase of the gamma-ray activity of Sgr A* over the following decade, resulting from the fall of the gas cloud into its accretion zone. (#1498)

Co-moving coordinates: bringing low-frequency radio and (V)HE gamma-ray astronomy together

David Ian Jones

That gamma-ray astrophysics will be building its next generation of telescopes (e.g., CTA) at the same time as the low-frequency community will be doing likewise (e.g., LOFAR, ASKAP, SKA) is wonderful serendipity. Although these observational windows are separated by some 20 orders-of-magnitude in the electromagnetic spectrum, there is much science that can come from their combination. I will outline how the Magnetism Key Science Project (MKSP) of the Low Frequency ARray (LOFAR) can be used not just to assist, but to complement source detection and characterisation of sources with gamma-ray telescopes such as Fermi, HESS, Veritas and CTA to continue. For instance, a major part of source detection for (particularly MeV to GeV) gamma-ray telescopes relies on the accurate subtraction of diffuse Galactic emission which arises primarily from the interaction of cosmic-ray protons (and, strictly, nuclei) with ambient molecular material. However, this method relies upon a number of both theoretical and observational assumptions. One key assumption is that the magnetic field of the Galaxy is well modeled, thus giving an accurate representation of how cosmic rays are transported around the Galaxy. Thus improving both the resolution and accuracy of this model is paramount for reliable back/foreground removal and robust source detection and characterisation of gamma-ray sources. The MKSP of LOFAR will probe the magnetic fields of the Universe in manifold ways (such as pulsar rotation measures), including that of our Galaxy. The Milky-Way group in the MKSP - in collaboration with the survey teams of LOFAR - will use LOFAR's unparalleled ability to detect low-intensity total and polarised emission on large scales at low frequencies to probe the Galactic magnetic field in unprecedented detail. I will outline how this will be done and how it will assist the gamma-ray astronomy community in creating better models of the large-scale gamma-ray sky and hence more robust source detection and characterisation. (#1486)

MHD simulations of magnetic reconnection in accretion disk systems

Luís Henrique Sinki Kadowaki

Magnetic reconnection events like those associated to solar flares can be also a very powerful mechanism operating on accretion disk systems (de Gouveia Dal Pino & Lazarian 2005). We have recently found that the magnetic power released in fast reconnection events is more than sufficient to accelerate relativistic plasmons and produce the observed radio luminosity of the nuclear jets associated both to microquasars and low luminous AGNs. The observed correlation between the radio luminosity and the mass of these sources, spanning 10^9 orders of magnitude in mass, is naturally explained in this model as simply due to the magnetic reconnection activity in the corona of the accretion disks of these sources (de Gouveia Dal Pino et al. 2010). A similar process may also explain the observed X-ray flares in young stars. In this work, we present MHD simulations of the interaction of the magnetic field of an accretion disk with the magnetosphere of the rotating central source. Considering conditions that resemble those of YSOs, our simulations evidence the development of reconnection events near the truncation radius of the disk, as expected (e.g. Romanova & Lovelace 2010). However, the energy released and the frequency of the events are very sensitive both to the initial and boundary conditions, as well as, to the disk viscosity and accretion rate of disk. (#1477)

Cosmic Ray Veto Of The Mario Schenberg Gravitational Wave Detector

Luiz Augusto Stuani Pereira

Mario Schenberg is a gravitational wave (GW) detector which uses a spherical resonant mass. It is located at IFUSP, Universidade de São Paulo, and it is now under commissioning. Presently, we are developing a low latency data analysis, which is able to determine the direction of high SNR bursts. Triggers are vetoed to reduce the false alarm rate due to the interaction of cosmic rays with the detector sphere. In December 2011, a cosmic ray veto composed of three particle detectors was added to the Mario Schenberg setup. Each detector contains a scintillator, photomultipliers and a tension divider. The three detector signals are digitalised by a Lecroy ADC which is installed in a CAMAC crate. This cosmic ray veto system was designed to optimise the linear response to high-energy cosmic rays events, allowing measurements up to 23000 particles per square meter. Since the veto setup was installed, it is continuously acquiring We are going to present the calibration procedure and performance of the veto setup. We computed the expected energy deposition in the sphere qudrupolar modes and studied seasonal flux variations of the cosmic radiation in São Paulo city. (#1464)

First Order Fermi acceleration rate in turbulent magnetic reconnection sites

Maria Victoria Del Valle

Fast magnetic reconnection occurs in many astrophysical sources and currently it is being studied as an important process to produce particle acceleration via first-order Fermi process, as originally proposed by de Gouveia Dal Pino & Lazarian (2005). Also, it has been demonstrated that fast magnetic reconnection occurs in the presence of weak turbulence (Lazarian & Vishiniac 1999). Turbulence also increases the acceleration efficiency by a combination of two effects: the presence of a large number of converging small scale current sheets and the broadening of the acceleration region (Kowal, de Gouveia Dal Pino & Lazarian 2012). In this work we analyze the dependence of the acceleration rate and the energy distribution of test particles injected in three dimensional MHD turbulent reconnection sites on the reconnection velocity (which is of the order of the Alfvén speed, V_A (~ V_{rec}) and on the amplitude of the turbulence injected. (#1463)

Non-thermal Emission from the Accretion-Disk/Coronae of AGNs and Particle Acceleration by Magnetic Reconnection

Behrouz Khiali

High energy particles are ubiquitous in astrophysical environments and the origin of ultra high energy cosmic rays (UHECR) is still an open question. Likewise, very high energy observations of AGNs and GRBs with the Fermi and Swift satellites and ground based gamma ray experiments (HESS, VERITAS and MAGIC) are challenging current theories of particle acceleration, mostly based on the acceleration in shocks, which try to explain how particles are accelerated to energies above TeV in regions relatively small compared to the fiducial scale of their sources. It is usually assumed that the emitting high energy particles are accelerated to a power-law distribution at relativistic shocks, via the so-called Fermi mechanism in shocks. Recent magneto-hydrodynamics (MHD) studies have revealed that particle acceleration in magnetic reconnection sites can be rather efficient since a 1st order Fermi process can occur there too. In this poster, we discuss this acceleration mechanism in the framework of AGNs, considering that magnetic reconnection events can be very frequent in the inner regions of the corona of the accretion disks, or in the jets. We compute the corresponding acceleration rate and the relevant loss rates in order to reproduce the observed high energy spectrum of different classes of AGNs. We consider both leptonic and hadronic models and compare the efficiency of such acceleration processes with alternative acceleration mechanisms. (#1461)

Curvature Origin Of The Sub-Tev Pulsed Gamma-Ray Emission From The Light Cylinder Region Of The Crab Pulsar Magnetopshere

Wlodek Bednarek

The sub-TeV tail in the pulsed gamma-ray emission from the Crab pulsar has been recently discovered by the MAGIC and VERITAS Collaborations. We propose that such emission can be caused by electrons accelerated very close to the light cylinder region where the e-p plasma can not saturate induced huge electric fields. Electrons reach energies sufficient for production of hard gamma-ray spectra in the curvature radiation process. Due to different curvature radii of the leading and trailing magnetic field lines, the gamma-ray spectra from separate pulses should extend to different maximum energies. We argue that pulsars with parameters close to the Vela pulsar, and also some millisecond pulsars, should show pulsed emission with the cut-off at clearly lower energies (~50 GeV) than that observed in the case of the Crab pulsar. (#1440)

Neutrino emission from Population III gamma-ray bursts

Florencia Laura Vieyro

Long gamma-ray bursts (GRBs) are associated with the gravitational collapse of massive stars (collapsars). The electromagnetic radiation detected from these sources is produced by highly collimated jets. In models of magnetized collapsars, the gamma rays are created when the jet emerges from the star, probably by particles reaccelerated at the forward and backward shocks. If the jet is baryon-loaded, neutrinos will be produced by hadronic interactions. We study the neutrino emission from Population III gamma-ray bursts. These neutrinos can be the only source of information of the first stars formed in the universe. We estimate the maximum energies of the different kind of particles in the jet and we solve the coupled transport equations for each species. Calculations are made for both the forward and reverse shocked region. Once the particle distributions are known, we estimate the intensity of neutrinos of all flavours for each model. Finally, we include effects of neutrino oscillations that change the relative weight of different flavours. (#1436)

Instrumentation for Relativistic Astrophysics

The Critical Coupling Likelihood method, one approach for linking gravitational wave search software with gravitational wave detector hardware

César Augusto Costa

Advanced gravitational wave (GW) detectors are expected to make regular observations soon. Methods that quickly and confidently can distinguish between instrumental artifacts and potential GW signals will increase the confidence of low latency GW candidates. The Critical Coupling Likelihood (CCL) is one of these proposed methods designed to quantify the operational state of GW detector. We will present a case study showing CCL noise rejection results with multiple analysis configurations, alongside LIGO's current veto methods technique. We will also show that CCL can lead to useful instrumental information, like an approximate transfer function (TF), which can be used to understand the detector's output properties in response to identified input noise sources. (#1493)

Comparison between a Multi-Nested Pendula and a multi-linear pendula system

Marcio Constancio Junior

Gravitational Waves (G.W) are oscillations in the space-time metric which propagates at speed of the light. Its existence is predicted by Einstein's General Relativity Theory and indirect evidences of its existence were first announced in a paper published in 1975 by Russell Hulse and Joseph Taylor. By using two masses and monitoring their relative distances it's possible to build a G.W detector. However, the weak coupling between gravitational waves and matter and the low amplitudes waves requires that the detectors be at 'state-of- art' of the technology concerning noise reduction. This is the objective of the research been developed by Gravitational Waves Group of Instituto Nacional de Pesquisas Espaciais (GWINPE). Trying to minimize seismic noise, a new vibrational isolation system is been developed: the Multi- Nested Pendula (MNP). It's a low pass mechanical filter composed by five cylinders with different diameters disposed in a nested way (one inside the other). Such an assembly allows us to have an adequate vibrational isolation and save vertical space. In this work we present measurements of natural frequencies of the system and compare them to the theoretical results showing that a nested N-stages system presents the same characteristics as a linear N-stages one. (#1487)

A New Design for Mechanical Impedance Matchers for Transducers in Spherical Gravitational Wave Detectors

Carlos Frajuca

A spherical gravitational wave (GW) detector has a heavy ball-shaped mass which vibrates when a GW passes through it. Such motion is monitored by transducers and the respective electronic signal is digitally analysed. One of such detectors, SCHENBERG, will have resonant frequencies around 3.2 kHz with a bandwidth near 200 Hz. "Mário Schenberg" is a spherical resonant-mass gravitational wave detector weighting 1.15ton, being built in the Department of Materials at the University of Sao Paulo. The sphere with 65cm in diameter will be made of a copper-aluminum alloy with 6% Al. The frequencies of running resonant-mass detectors typically lay below 1 kHz, making the transducer development for this higher frequency detector somewhat more complex. In this wok a design of a improved mechanical impedance matcher for the microwave parametric transducer is shown. This design has many capabilities that the present does not have, for instance the capability to change the size of the gap during operation and to operate in lower temperatures. (#1475)

A phase modulator controller of pulsed ion beams

Carlos Frajuca

This work presents design, simulation and construction of an electronic controller of pulsed ion beams. The project is being conducted in Particle Linear Accelerator (LINAC) at the Institute of Physics in University of Sao Paulo in partnership with Federal Institute of Technology in Sao Paulo. Obtaining the sinusoidal electrical signal to control phase is a primary step in order to control pulsed ion beams in LINAC. The mathematical behavior of a phase modulator was studied and modeled using computational numerical simulation. Simulations were conducted in Mathematica (Mathematica, Wolfram Research, Champaign, Illinois) to determine parameters of control. The electronic circuit was designed based on those parameters to control the sinusoidal signal with phase quadrature modulation (I/Q). The proposed controller was assembled with splitter/combiner and mixers (MiniCircuits, Brooklyn, New York). The simulated adaptation was implemented in order to change the operating region (phase difference) circuit. The adaptations made it more suited to the purposes of the signal controlling carried by the modulator. The results point to a circuit with consistent response. The strategy adopted in the simulations and the modulator was considered satisfactory. As future works, we intend to improve the control applied in electronic circuit phase modulator and evaluate its operation "in loco" to control pulsed ion beams. (#1472)

Design and development of coatings for the ATHENA mission

Desiree Della Monica Ferreira

The ATHENA (Advanced Telescope for High Energy Astrophysics) mission is an X-ray observatory under study by ESA. The mission concept is based on Silicon Pore Optics (SPO) mirror modules to focus incoming X-ray photons at low grazing incidence angles. The operational energy range of ATHENA is from 0.1 keV to 10 keV. High throughput in this energy range depends critically on the performance of the mirror coatings. For this reason, it is necessary that both the SPO substrates and coatings perform optimally. The coating recipe adopted as a baseline for ATHENA is a bi-layer of iridium and boron carbide. In this study, we present an optimization of the ATHENA coating design and results of the test campaign performed on SPO substrates. Pre-coating characterization of the substrates is done using Atomic Force Microscopy (AFM), X-ray Reflectometry (XRR) and scatter measurements. Through X-ray tests, the correlation between measured micro-roughness and pre-coating characterization is investigated. The performance of several material combinations is tested using simple bi-layer, simple multilayer and linear graded multilayer coatings. We find that the use of linear graded multilayers can increase the effective area of ATHENA in the energy range between 0.1 keV and 15 keV. (#1541)

New Windows and Gravitational Waves

Resolving polarization modes of gravitational waves in Pulsar Timing experiments

Marcio Eduardo da Silva Alves

The construction of large arrays capable of tracking multiple millisecond pulsars will enable us to go deeper in our knowledge of the universe by first observing gravitational waves in the nano-Hertz frequency band. Pulsar Timing Arrays will also allow us to test Einstein's theory of general relativity by measuring the polarization components of the detected signals. In the most general relativistic theory of gravity, gravitational waves are predicted to have up to six independent polarization modes (the two usual tensor modes predicted by General Relativity plus two vector and two scalar components). When these extra polarization components are taken into account in the evaluation of the single-antenna sensitivity, we find that pulsar timing experiments are significantly more sensitive to waves with longitudinal components (such as scalar and vector waves) than to regular tensor waves. Since the Pulsar timing response to the most general gravitational wave signal is equal to the superposition of the responses of each polarization component, we develop a Bayesian method for detecting, inferring, and reconstructing the polarization components of the signal. Our results imply that a Bayesian method for gravitational wave detection via pulsar timing arrays is a powerful tool for testing the theory of General Relativity. (#1551)

Axisymmetric Core-Collapse Supernova Simulations from First Principles

Stephen Bruenn

Realistic core-collapse supernova simulations depend on neutrino-matter interactions, neutrino transport, hydrodynamics, nuclear equations of state, general relativity, and nuclear reactions. We have built a code named CHIMERA for supernova modeling in 1, 2, and 3D, that includes state-of-the-art algorithms to handle all the micro and macrophysics mentioned above. Here, we discuss our current series of exploding 2D and 3D simulations, detailing the gravitational wave signatures and their detectability by the current and next generations of gravitational wave observatories. Our models span a mass range from 12 to 25 solar masses and the simulations cover 500ms after bounce for all models and 877ms for the 12 solar mass model. At these times, all models exhibit indications of neutrino-driven explosions. (#1525)

Polarization of gravitational waves due propagation in an anisotropic background gravitational field

Juliana Celestino

The eminent detection of gravitational waves will open an unique window for relativistic astrophysics bringing new information about the universe and enabling a multimessenger understanding of the astrophysical phenomena. After an event of emission of gravitational radiation, the waves travel through space and can be changed due the presence of a background curvature generated, for instance, by black holes or neutron stars. In this case, it is well known that the lens effect occurs for gravitational waves in the same way as for electromagnetic waves. But if the wavelength of the gravitational wave is, at least, of the order of the typical scale of variation of the background metric, the geometric optics approximation is no more valid and gravitational waves can exhibit a non-minimal coupling with the background curvature. Consequently, the presence of a spatially anisotropic background metric affects distinctly the evolution equation of each polarization mode, i.e., the background gravitational field behaves like a polarizable medium. We argue that this effect can be used to infer properties about the astrophysical regions the gravitational wave propagates if the upcoming observations are able to resolve the polarization of the wave. (#1517)

The gravitational wave recoil in the merger of two colliding black holes: the non-head-on case

Eduardo Valentino Tonini

We examine numerically the process of gravitational wave recoil in the merger of two black holes in non-head-on collision, in the realm of Robinson-Trautman spacetimes. Characteristic initial data for the system are constructed. The data already presents a common aparent horizon so that the dynamics covers the post-merger phase up to the final configuration of the remnant black hole. Our analysis is based on the Bondi-Sachs conservation laws for the energy- momentum of the system. We evaluate the Bondi-Sachs momentum flux carried out by gravitational waves, the associated impulses and the net kick velocity Vk due to the total impulse imparted to the merged system by the gravitational waves emitted. We introduce a definition of the center-of-mass velocity of the merged system and show that it approaches asymptotically Vk which is the velocity of the remnant black hole in the zero initial-Bondi-momentum frame. Typically for a non-head-on collision the net momentum flux carried out by gravitational waves is nonzero for equal- mass colliding black holes, a consequence of asymmetries of the initial data for this case. The distribution of Vk as a function of the symmetric mass parameter η is well fitted by a modified Fitchett η-scaling law and we give numerical evidence that the additional parameter modifying the law is a measure of the integrated gravitational wave momentum flux for the equal mass case. For an initial infalling velocity $v/c \simeq 0.462$ of the colliding black holes and angle of collision ρo= 21o, we obtain a maximum Vk $\sim$ 121 km/s located at $\eta \simeq 0.226$. For the equal-mass case we obtain Vk $\sim$ 107 km/s. Results for the net kick velocity in the head-on case are compared with numerical relativity calculations, and for a wide range of mass ratios ($0.3 \leq \alpha \leq 0.95$) we have an agreement to 5% − 8% for PN+CLA and to 8% − 18% for full numerical relativity, suggesting a close relation between the head-on initial data and its dynamics and the merger of binary systems. (#1514)

The Bondi-Sachs Four Momentum in Non-Axisymmetric Robinson-Trautman Spacetimes

Ivano Damião Soares

We derive the Bondi-Sachs (BS) four momentum conservation laws that regulate the emission of gravitational waves in non-axisymmetric Robinson-Trautman (RT) spacetimes. We obtain the basic physical quantities of the BS formalism, namely, the news functions and the BS energy-momentum fluxes of the gravitational waves, that are fundamental to the description of the radiative transfer processes involved in the generation and emission of gravitational waves by the system. We discuss some possible applications of the conservation laws in numerical simulations to evaluate the gravitational wave recoil in interacting black hole systems. (#1505)

N-body Choreographies and Gravitational Waves

Gabriela Iunes Depetri

The existence of Gravitational Waves (GWs) is a consequence of Einstein's equations for General Relativity, and since this has proven to be a solid theory through various tests, many experimental attempts have been done in order to detect it. In this context, a relevant question is what patterns of GWs we should expect from periodic stable orbits of celestial bodies. In this work, we obtain those patterns for some special periodic solutions in the quadrupole approximation. (#1500)

Sphere suspension in Schenberg Detector: Vibrational analyses of the attenuation in the seismic noise

Fabio Da Silva Bortoli

A spherical gravitational wave (GW) detector has a heavy ball-shaped mass which vibrates when a GW passes through it. Such motion is monitored by transducers and the respective electronic signal is digitally analysed. One of such detectors, SCHENBERG, will have resonant frequencies around 3.2 kHz with a bandwidth near 200 Hz. “Mário Schenberg” is a spherical resonant-mass gravitational wave detector weighting 1.15ton, being built in the Department of Materials at the University of São Paulo. The sphere with 65cm in diameter will be made of a copper-aluminum alloy with 6% Al. The frequencies of running resonant-mass detectors typically lay below 1 kHz, making the transducer development for this higher frequency detector somewhat more complex. This work simulates the sphere suspension to find the attenuation in the seismic noise obtained by the new suspension implemented in Schenberg detector. The attenuation found of 260 db, what is enough, because the vibration on the sphere surface due to seismic noise is smaller than the vibration due to sphere thermal noise at 50 mK. (#1488)

Schenberg Detector: Vibrational Isolation of Thermal Conection from the Dilution Refrigerator

Fabio Da Silva Bortoli

The Mario Schenberg detector is a resonant mass spherical detector of gravitational waves (GW). It's being built at the Materials and Mechanical Department of the São Paulo University (FMT - IFUSP). The sphere (heavy ball) weighs 1.15ton, measures 65cm in diameter and is made of a copper-aluminum alloy with 6 per cent Aluminum and 94 per cent Copper. As a resonant mass detectors a signal appears after the GW to pass through the detector and to produce vibrations on the resonant mass. The resonant frequencies this system are around 3.2kHz with a bandwidth near 200Hz. Six transducers linked on the surface of spherical resonant mass according a semicosaedric distribution are used to monitor the amplitude of it displacement. The sphere, in a commissioning phase the detector was cooled to 4.2 Kelvin. In the next phase will be cooled down to a lower temperature using a dilution refrigerator, this temperature could reach as low as 50 mK. This refrigerator produces noise because of the Helium evaporation and this noise is transported by the thermal connection to the sphere. In this work we the study such vibration noise and how it could be minimized. The conventional method used in detectors with this kind of refrigerator is to connect the refrigerator to the sphere using thin copper wires, but it reduces the cooling capability by a great factor. In order to improve it, a new kind of connection is propose. The vibration attenuation should make the dilution refrigerator noise lower than the thermal vibration noise on the sphere surface, keeping the temperature as lower as possible and an attenuation higher than 1e10 is found. (#1481)

Low latency data analysis for spherical gravitational wave detectors

Carlos Filipe Da Silva Costa

There are presently two spherical detectors, MiniGRAIL and Mario Schenberg, located respectively at Leiden in Nederland and at São Paulo in Brazil. Both detectors share almost the same features. The Mario Schenberg detector is under commissioning. Its transducers have been redesigned to improve its sensibility and a new run to test its new transducers is planned at the beginning of 2013. Spherical detectors present the possibility of multichannel analysis and therefore they are able to determine gravitational wave direction and polarisation. This was already shown in the offline data analysis pipeline developed for MiniGRAIL. We have developed a low latency data analysis pipeline able to determine the GW direction in less than 13s (for 32s of data). Triggers are vetoed to reduce the false alarm rate. The method is tested on simulated data. A simulator for Mario Schenberg was already developed. We are also testing the adjunction of a Matched Filter to the low latency pipeline. This pipeline could be applied with minor change to MiniGRAIL. We present here the low latency method and its preliminary results. The status of the Mario Schenberg detector will be also briefly commented. (#1458)

Gravitational Waves in Braneworld Scenarios with AdS Background

Antônio Carlos Amaro De Faria Júnior

Braneworld scenarios wherein the observable universe is trapped on a brane, embedded in some higher-dimensional spacetime, can explain the hierarchy problem [1]. Braneworld models also provide alternatives to Kaluza-Klein compactication, where the topology has a compactication radius of the Planck length order. These possibilities come from developments in non-perturbative string theory, wherein the so-called D-branes are elicited and evinced as (D + 1)-dimensional manifolds in which the standard model of particles and fields can be consistently conned. A plausible reason for the weak appearance of the gravitational force, with respect to other forces, can be its dilution in a higher-dimensional bulk, where D-branes [2] are embedded. D-branes are good candidates for braneworlds because among some outstanding features they possess gauge symmetries [3]. In this paper, we investigate gravitational waves as metric perturbations around a general warped 5-dimensional background. We find an analytical solution in Randall-Sundrum braneworld model and analyze the implications of braneworld models in the gravitational waves propagation. References: [1] N. Arkani-Hamed,S. Dimopoulos, and G. Dvali , Phys. Lett. B429 (1998) 263-272 [arXiv:hep-ph/9803315v1]. [2] V. A. Rubakov and M. E. Shaposhnikov, Phys. Lett. B 125 (1983) 136-138. [3] V. A. Rubakov and M. E. Shaposhnikov, Phys. Lett. B 125 (1983) 139-143. (#1448)

Gravitational Wave Data Analysis

Rubens De Melo Marinho Junior

This work is focused on the detection of continuous gravitational wave (GW) signals using data of resonant bar GW antenna. It makes use of a method tailored for the detection of monochromatic signals in the middle of strong noise, which basically it monitor, for a given frequency, the excess power in the power spectrum of the data. An analysis is performed on the frequency of 47 Tucanae pulsars, searching for frequency drifts that might present a pattern similar to the one due to the Doppler modulation. The method is expected to be useful even in the presence of very noisy data, by reducing the noise to a level inferior to the one of the monochromatic signals and performing the Doppler modulation analysis. We tested the method injecting a simulated signal in real data and we were able to detect it. We made a statistical study about the results of this method. The selection of candidate events will then be established according to Neyman-Pearson criterion. (#1427)

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