

Workshop PG-AST/DIDAS 2017

*Classificação Morfológica e Fotometria Superficial
Como Ferramentas Para o Estudo de Evolução de Galáxias*

4 de Abril-2017 @ INPE

Reinaldo R. de Carvalho
INPE-MCT/Brazil

www.cosmobook.com.br



Main Projects

1 - *Early-Type Galaxies in Compact Groups (Tatiana Moura)*

2 *Surface Photometry of Galaxies Using a Bayesian Scheme (Diego Stalder)*

3 - *Investigating the Relation between Galaxy Properties and the Gaussianity of the Velocity Distribution (André Ribeiro, Diego Stalder, Reinaldo Rosa)*

4 - *Mass Calibration of Galaxy Clusters (Dr. Marcelle Soares - Fermilab)*

5 *Morphological Classification - New Methods and Extension to High-z (Rubens Sautter)*

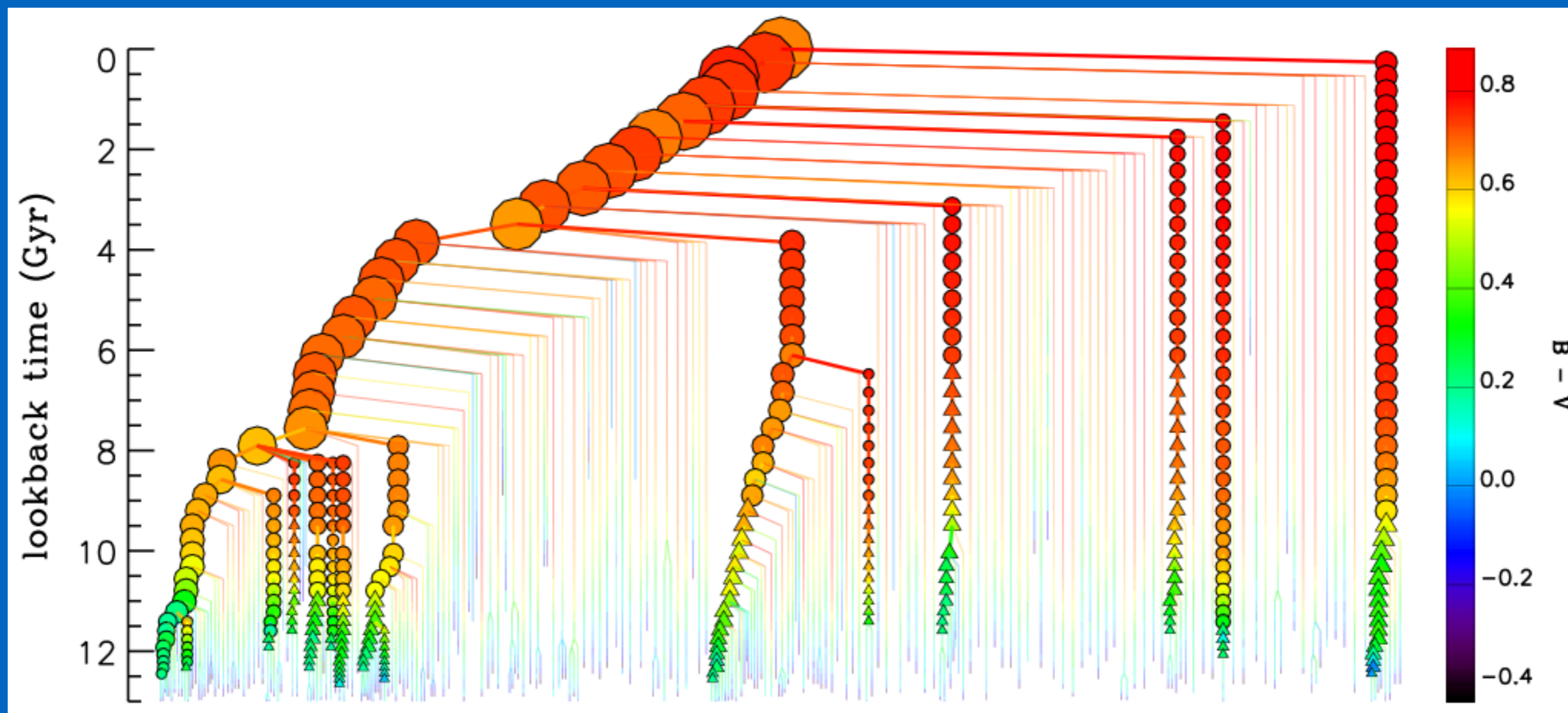
6 - *Environmental Effects on the Properties of Galaxies (Dr. Gary Mamon - IAP)*

7 - *Galaxy Cluster Mass Reconstruction (Dr. Lyndsay Old - Univ. of Nottingham)*

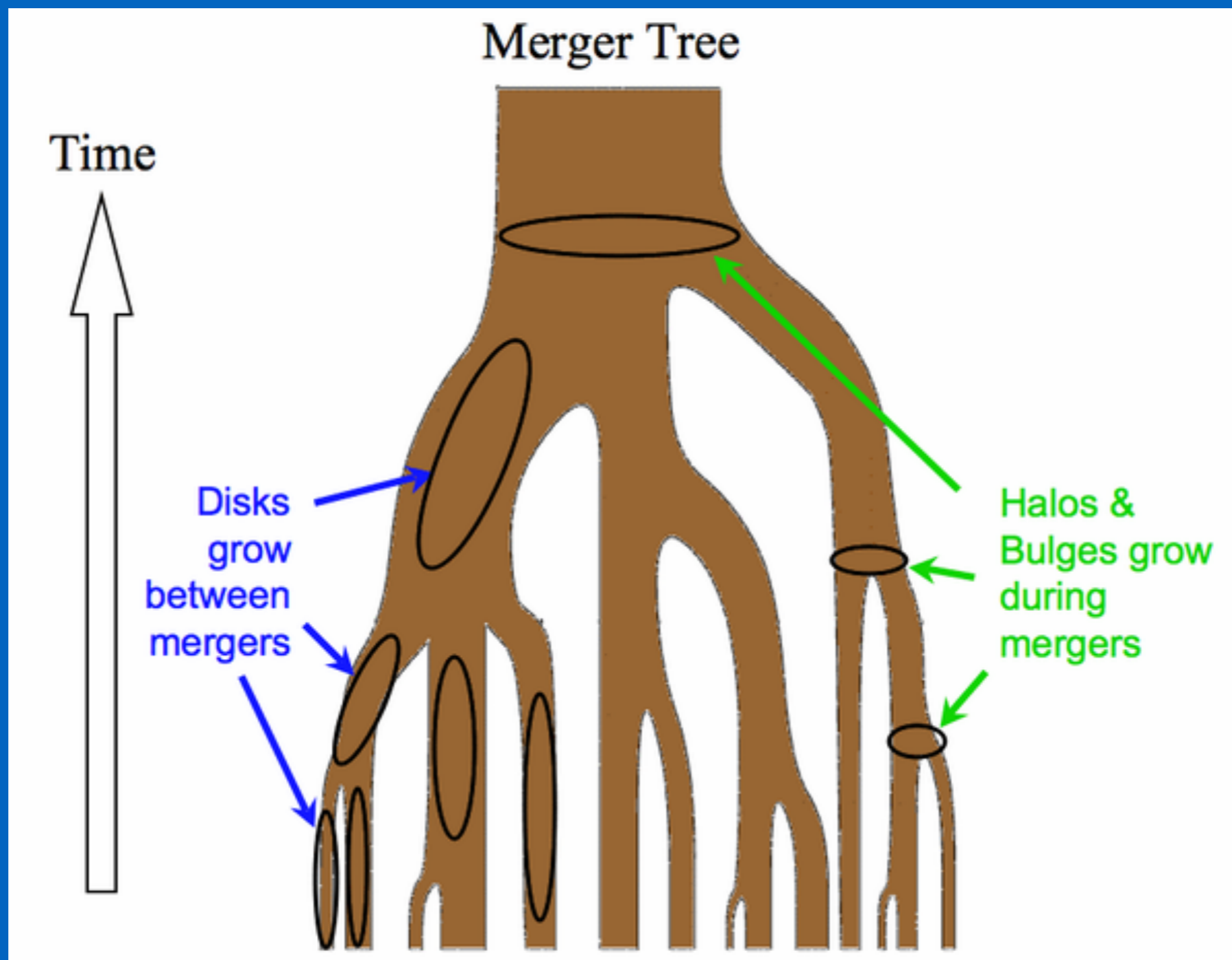
8 - *The Initial Mass Function in ETGs (Dr. F. La Barbera/OAC, Dr S. Rembold/UFSM)*



Evolução de Estruturas no Universo - Sua construção hierárquica



Evolução de Estruturas no Universo - Sua construção hierárquica



Que Processos ocorrem durante a construção hierárquica ?

"Efficient star formers" - as a result of their large dark matter halo masses, these galaxies can support large star formation rates without losing much of their gas.

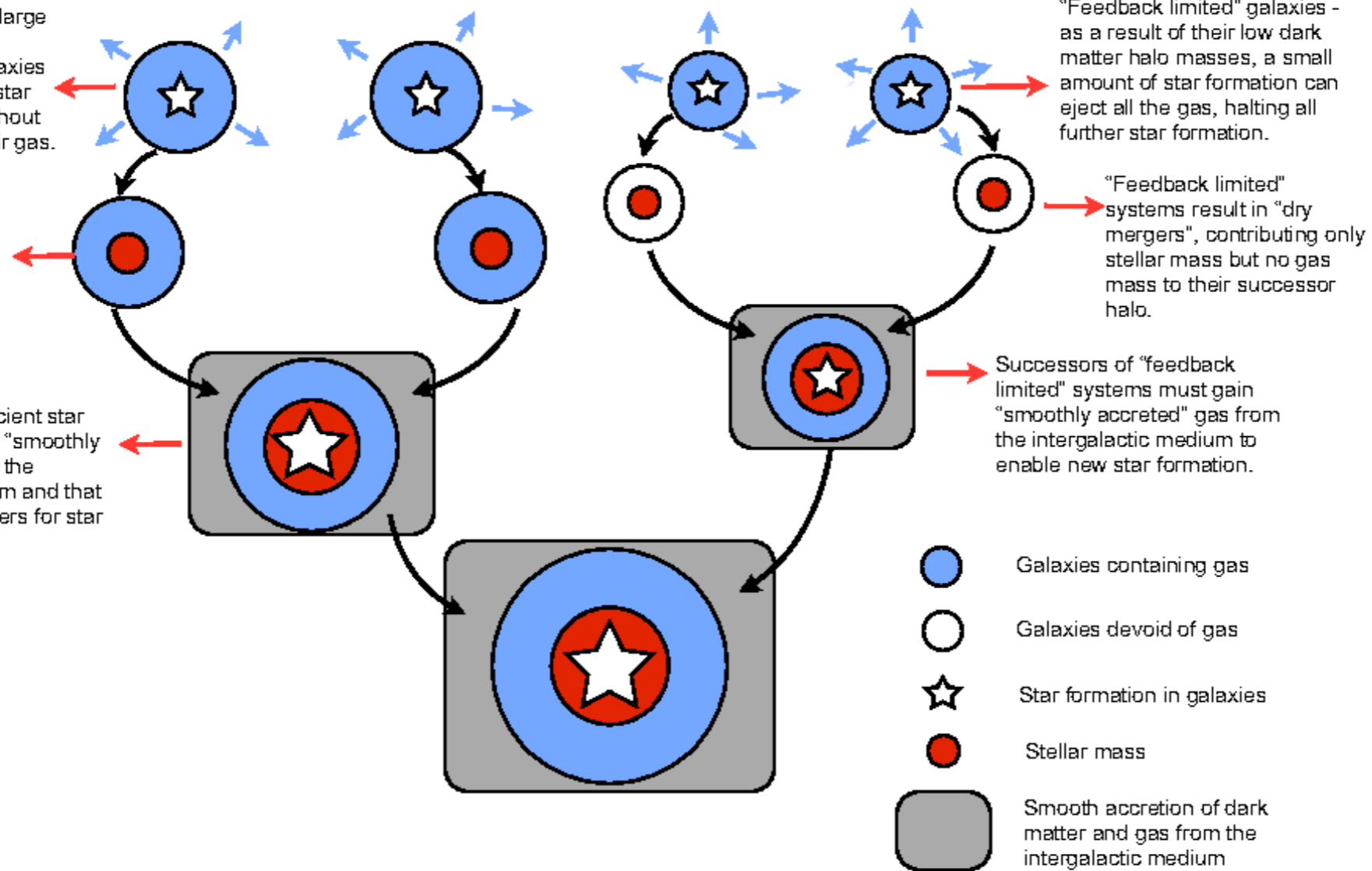
"Efficient star formers" lead to "wet mergers", contributing both stellar mass and gas mass to their successor halo.

Successors of "efficient star formers" have both "smoothly accreted" gas from the intergalactic medium and that brought in by mergers for star formation.

"Feedback limited" galaxies - as a result of their low dark matter halo masses, a small amount of star formation can eject all the gas, halting all further star formation.

"Feedback limited" systems result in "dry mergers", contributing only stellar mass but no gas mass to their successor halo.

Successors of "feedback limited" systems must gain "smoothly accreted" gas from the intergalactic medium to enable new star formation.



Como Classificar Galáxias em Geral

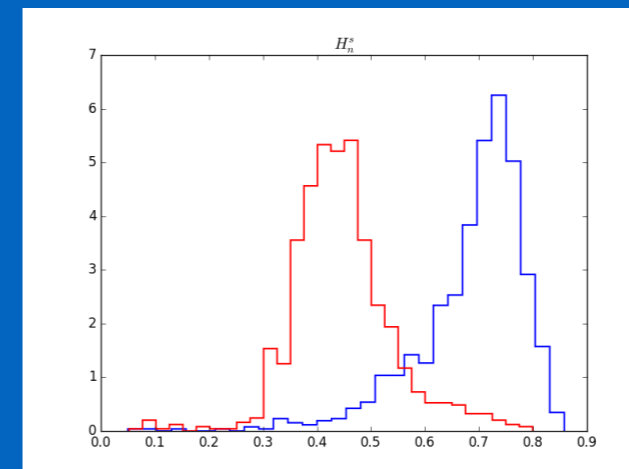
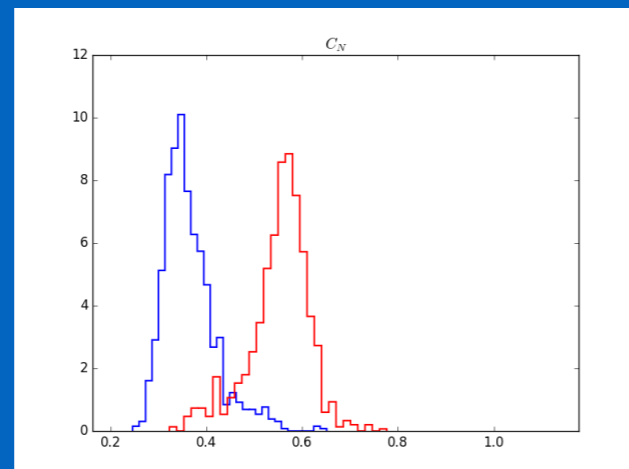
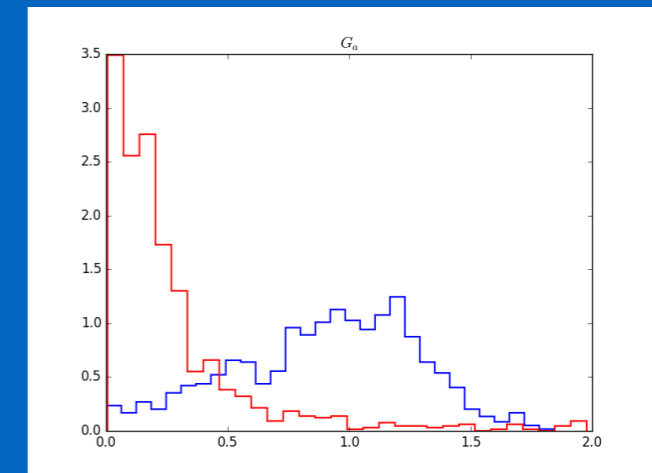
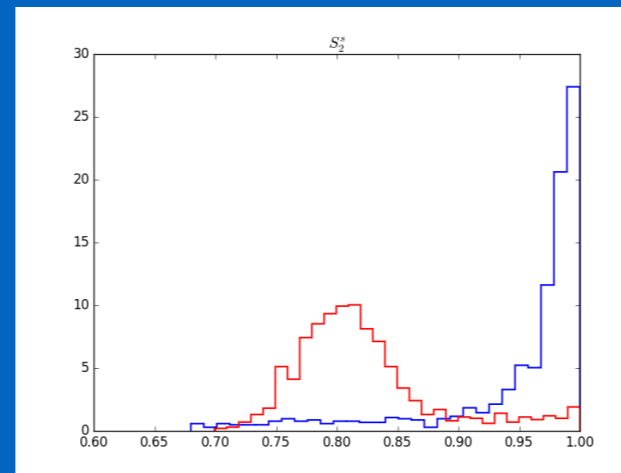
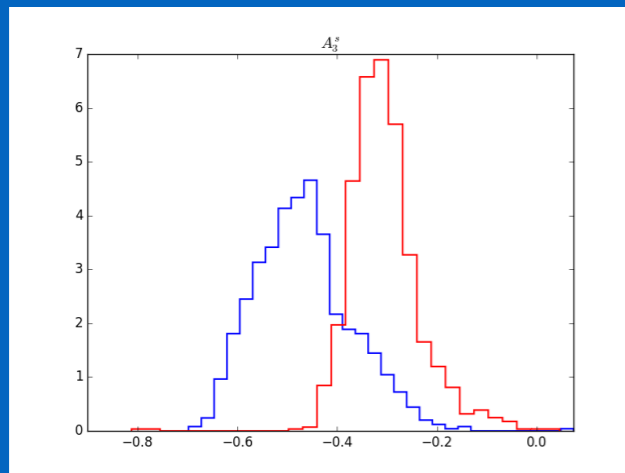
Métodos paramétricos e não-paramétricos foram utilizados até então (e.g. Ferrari et al. 2015)



???

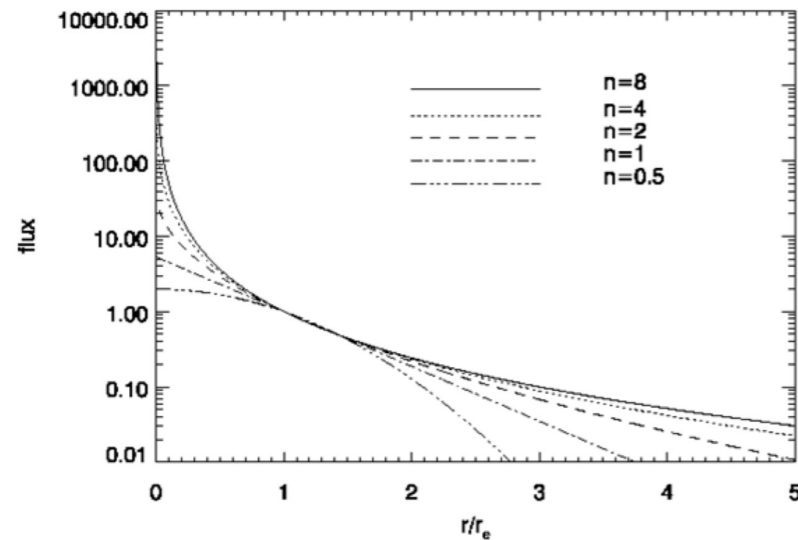


Medimos os seguintes parâmetros: Assimetria, Smoothness, Concentração, Entropia e GPA (Rubens et al 2017).



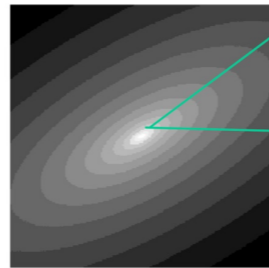
GALPHAT (GALaxy PHotometric ATtributes)

Model: Surface Brightness Profile (Sersic, 1963).



8 Parameters

Mag $\rightarrow I_e = \text{flux}$
 $r_e = \text{effective radius}$
 $n = \text{shape parameter}$
 $q = \text{axis ratio}$
 $PA = \text{position angle}$
 $x, y = \text{Center}$
 $\text{Sky} = \text{Background}$

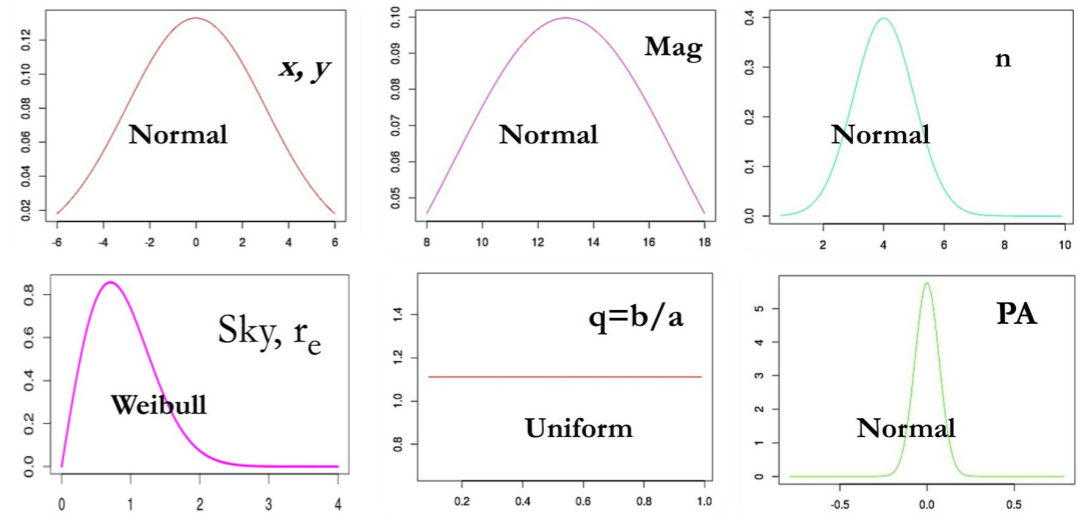


$$I(r) = I_e e^{-\kappa \left\{ \left(\frac{r}{r_e} \right)^{\frac{1}{n}} - 1 \right\}}$$

Posterior Distribution (via MCMC)

$$P(\theta|D) = \frac{L(D|\theta)\pi(\theta)}{\int L(D|\theta)\pi(\theta)d\theta}$$

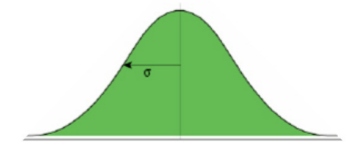
Priors $\pi(\theta)$



Likelihood

Model: m_i = the model predicts the flux m_i for i^{th} pixel.
Data: d_i = the measured flux d_i for i^{th} pixel. (FITS)
Probability: $P(d_i | m_i) = \exp(-m_i) m_i^{d_i} / d_i!$, for each pixel.

$$L(D|\theta) = \prod_{i=1}^{N_{\text{pix}}} P(d_i | m_i),$$



N_{pix} : is the total number of pixels.
 θ : is the set of parameter of the Sérsic model.

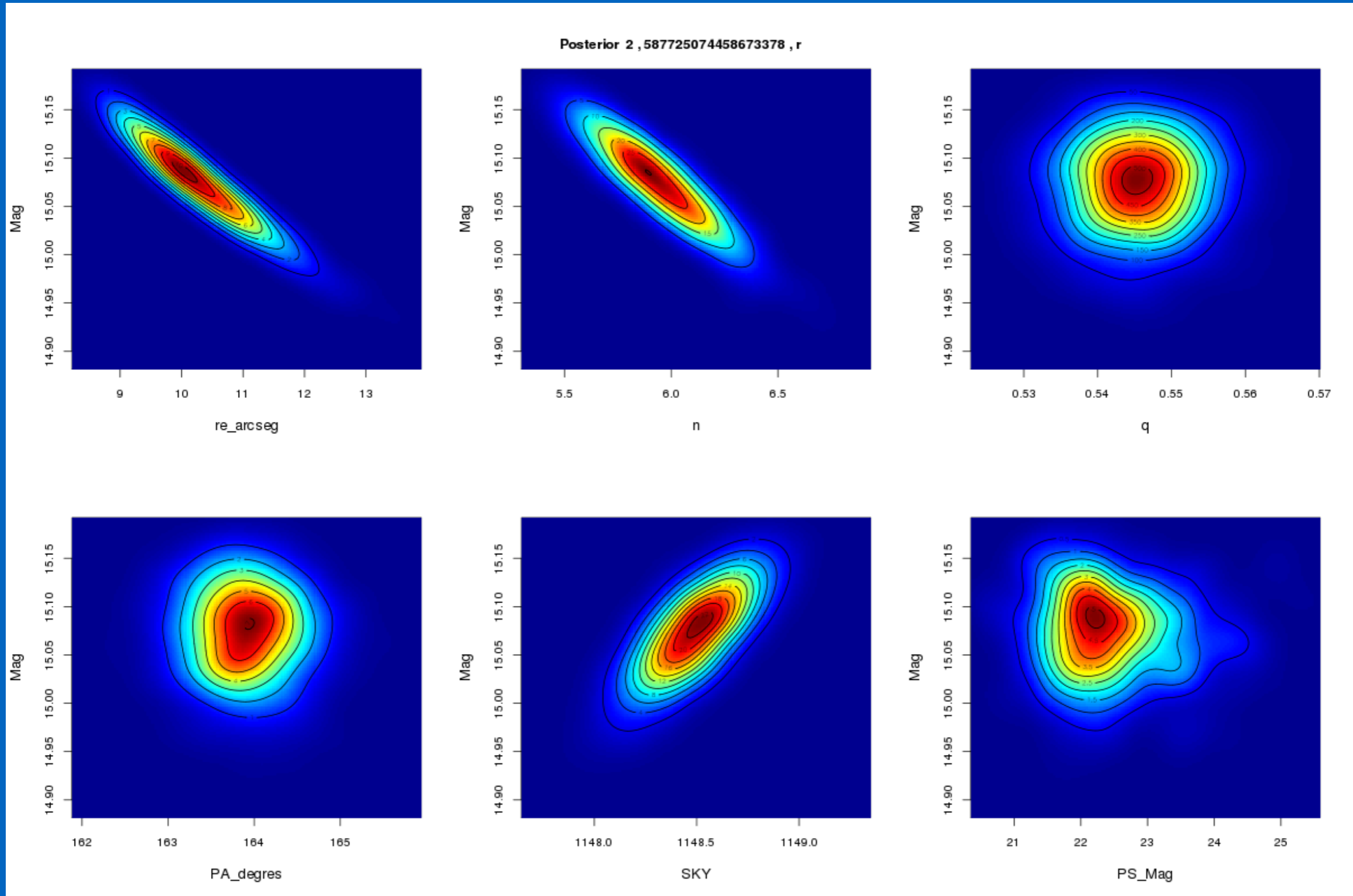
Yoon, Weinberg and Katz 2011

BIE - Bayesian Inference Engine, <http://www.astro.umass.edu/BIE/>

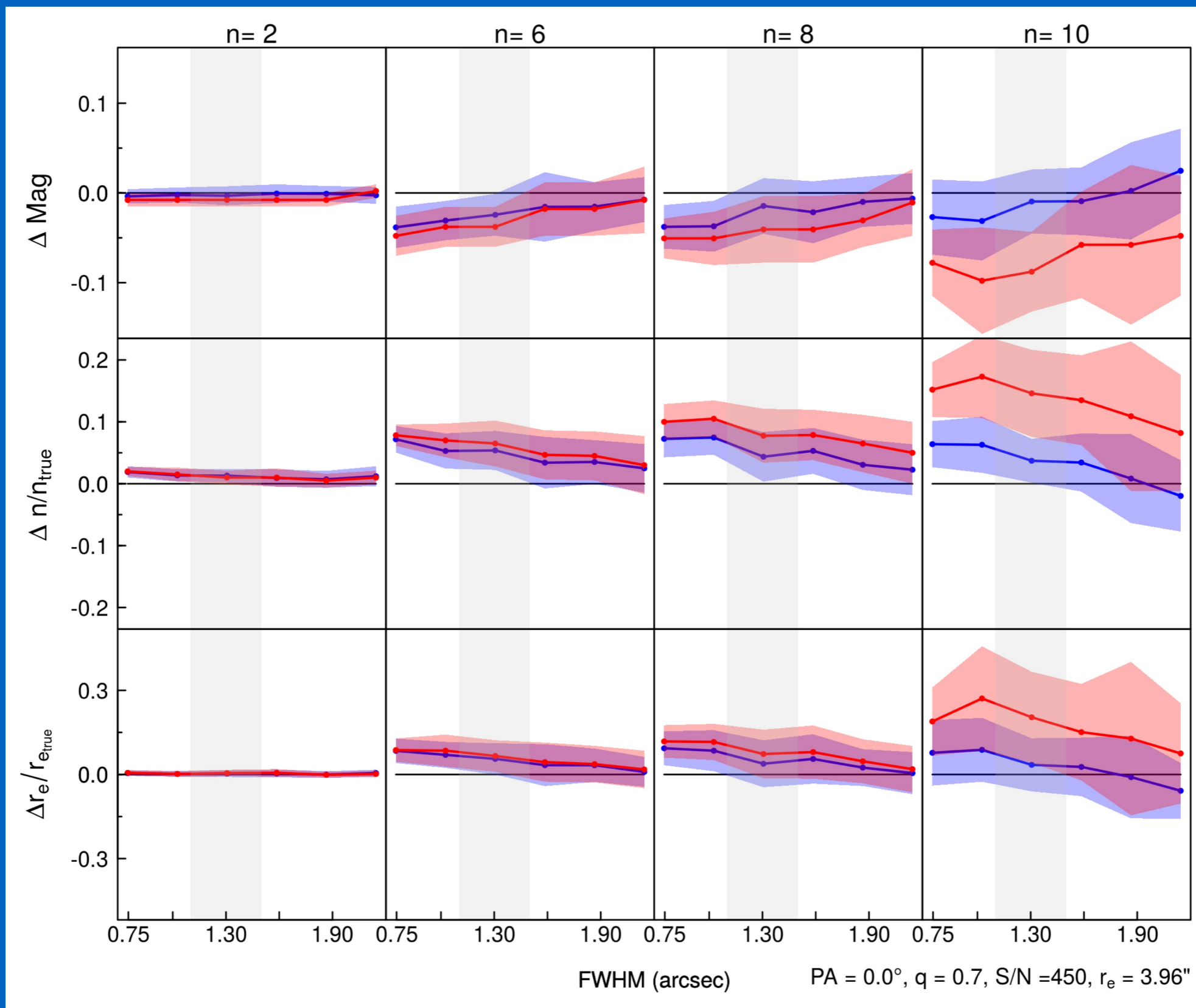
is a research product of the Astronomy and Computer Science Departments of the University of Massachusetts at Amherst. It is a result of the UMass Galaxy project led by Martin Weinberg.

Posteriores

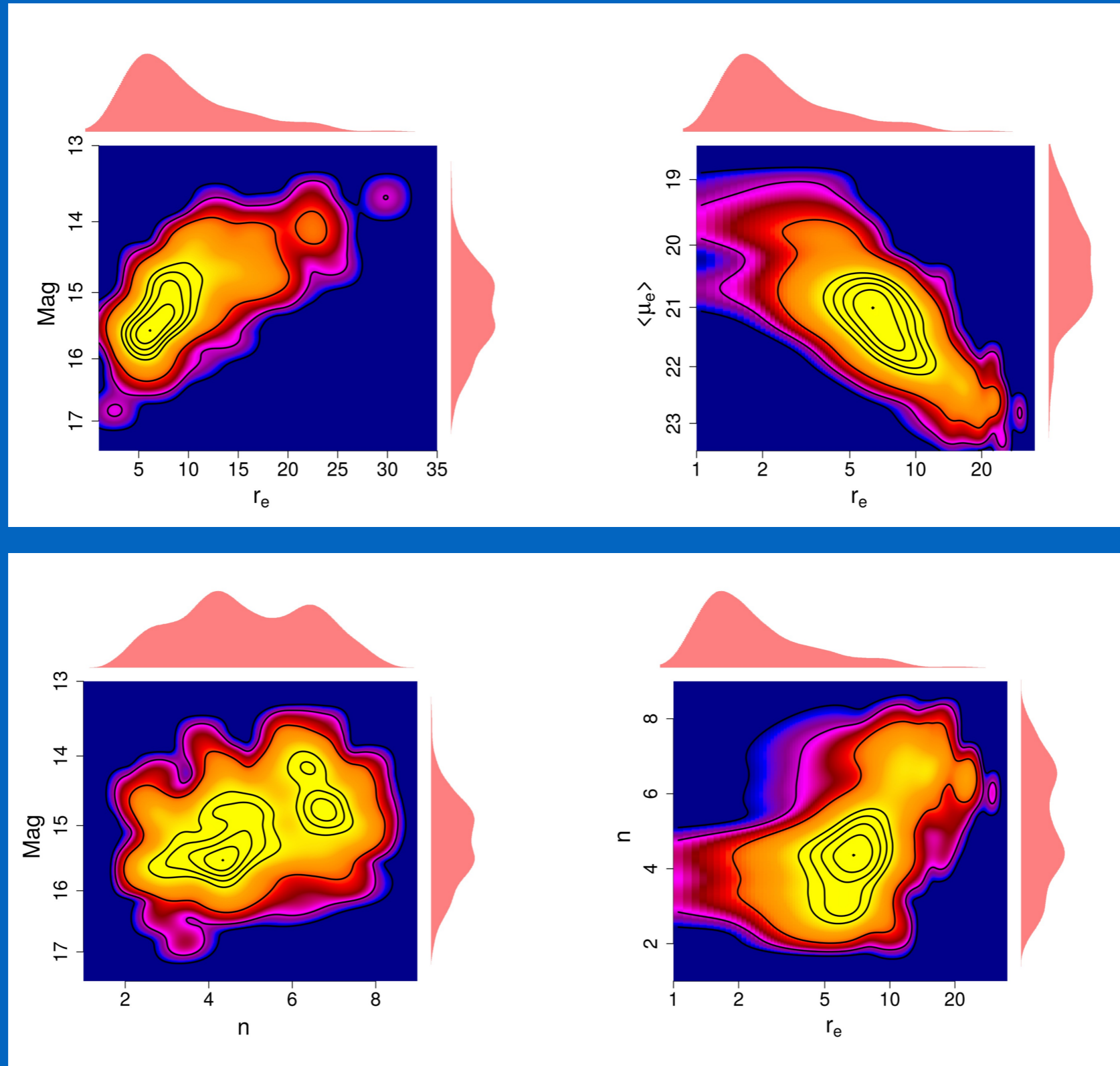
Ajustando Sersic



Medindo o "bias" (diferença entre verdadeiro e medido)



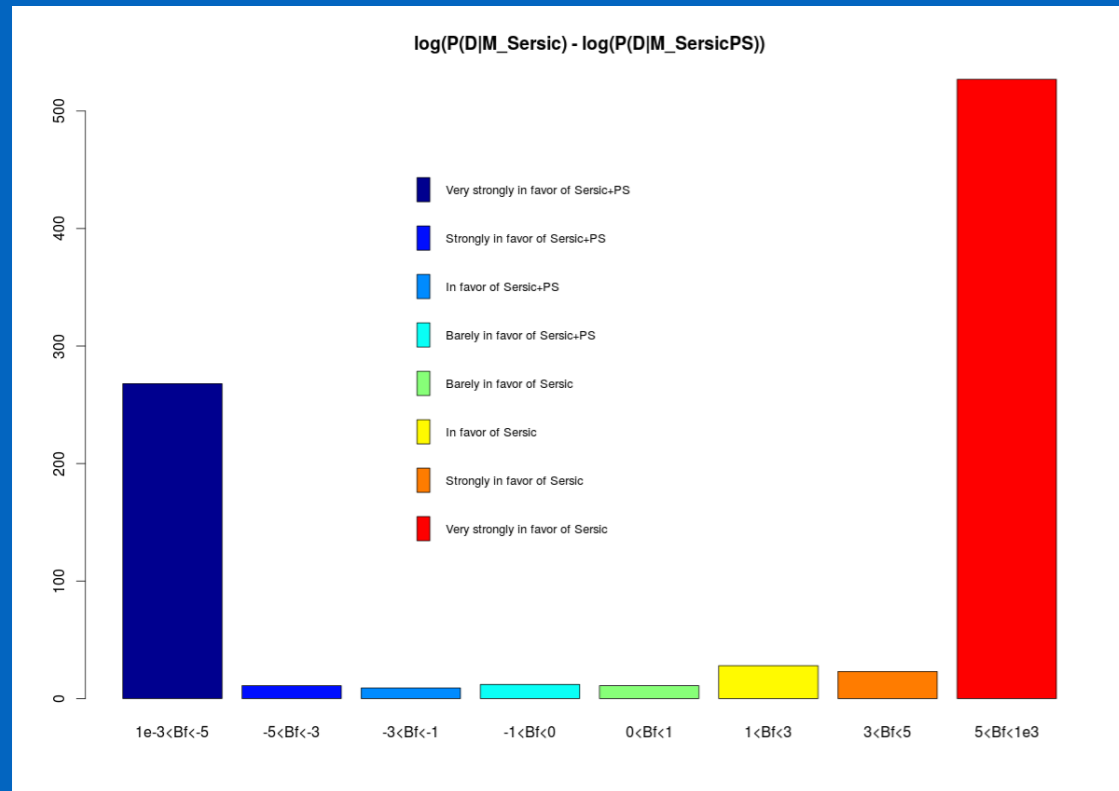
Correlações Importantes no Estudo das Propriedades Estruturais de Galáxias



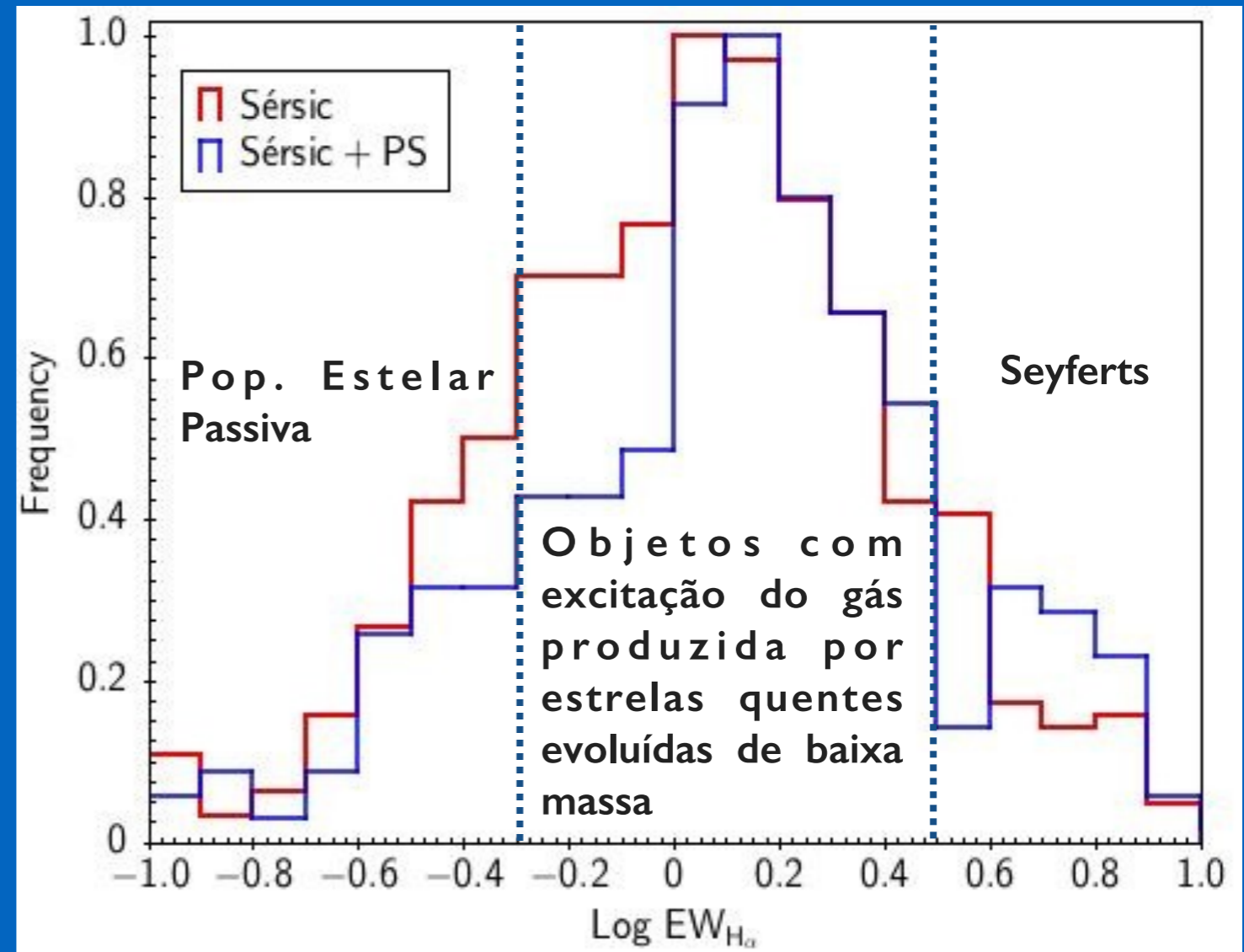
Associação com Análise Espectral

H α de Tremonti et al 2004 e Brinchmann et al 2004

Fator de Bayes



As distribuições são distintas com um nível de significância > 99.9% segundo AD.



Fortemente Sérsic+PS

Fortemente Sérsic

