

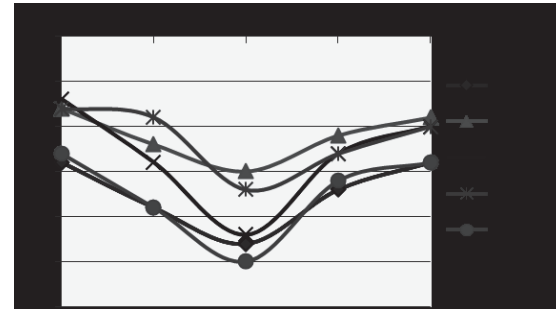
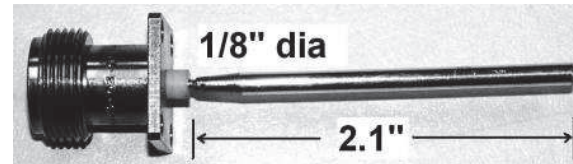
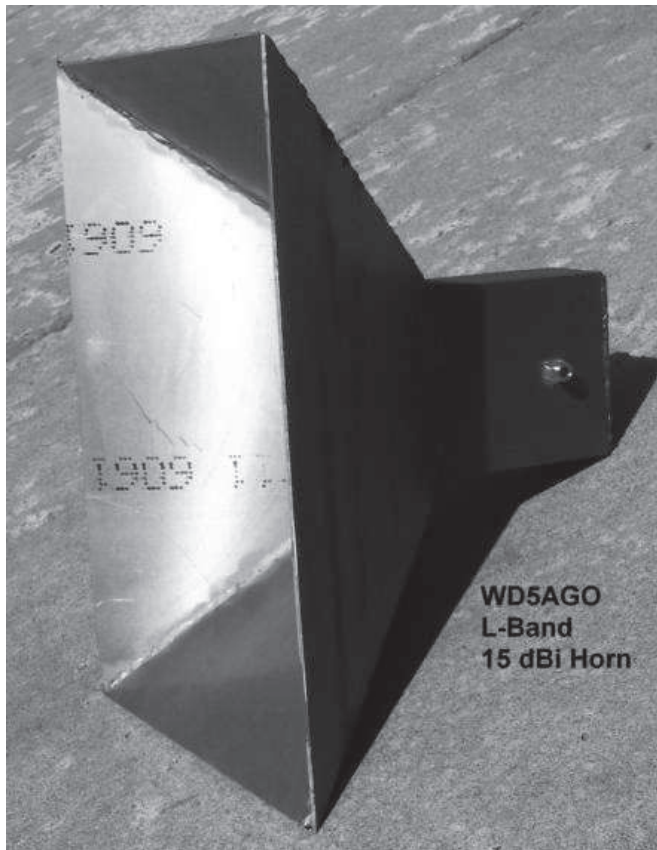
# A selected tutorial on Single Dish Radio Astronomy (specific to Bingo)

- 1D blackbody radiation
- Radiometer Equation
- Blackbody calibration
- Radiometry (remotely mapping brightness temp)
- Flux measurements and antenna 'gain'
- Telescope optics
  - On-Axis Prime focus
  - Cassegrain
  - Gregorian
  - Off-axis designs
  - Crossed Dragone
- You can try 21 cm astronomy yourself with Software Defined Radio

# References

- Essential Radio Astronomy (Condon and Ransom)
- Radio Astronomy (Krauss)
- Single Dish Basics (Casper) [concise but buggy]
  - [https://casper.berkeley.edu/astrobaki/index.php/Single\\_Dish\\_Basics](https://casper.berkeley.edu/astrobaki/index.php/Single_Dish_Basics)
- Radio Astronomy Fundamentals (John Reynolds) [accurate but wordy]
  - *[www.atnf.csiro.au/.../radio.../Radio\\_Astronomy\\_Fundamentals\\_-\\_John\\_Reynolds.pdf](http://www.atnf.csiro.au/.../radio.../Radio_Astronomy_Fundamentals_-_John_Reynolds.pdf)*

# A simple horn antenna



# On-axis prime-focus dish HIRAX, Tianlai-dish



# On-Axis cassegrein (sat uplink)



# On-Axis Gregorian (satellite uplink)



# Off-Axis prime focus dish (sat TV)



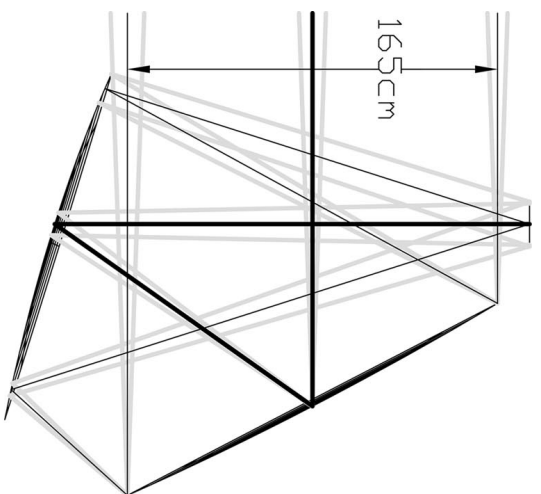


Off-axis  
Gregorian  
(Meerkat)

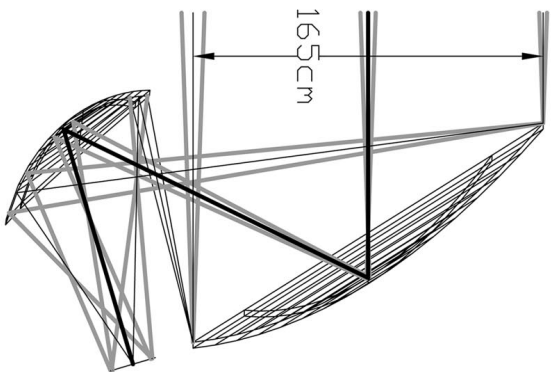
Also Green  
Bank



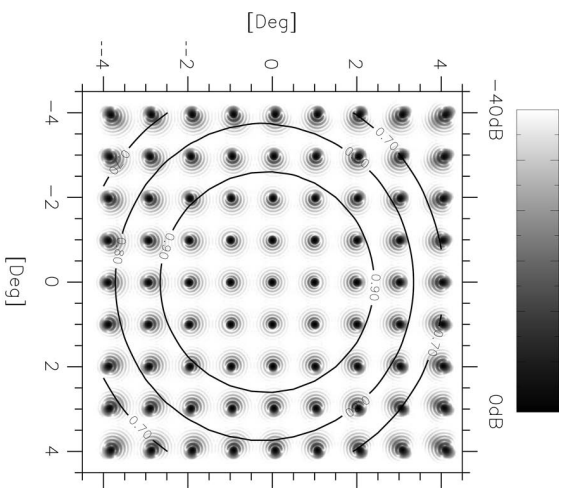
# Gregorian vs crossed Dragone



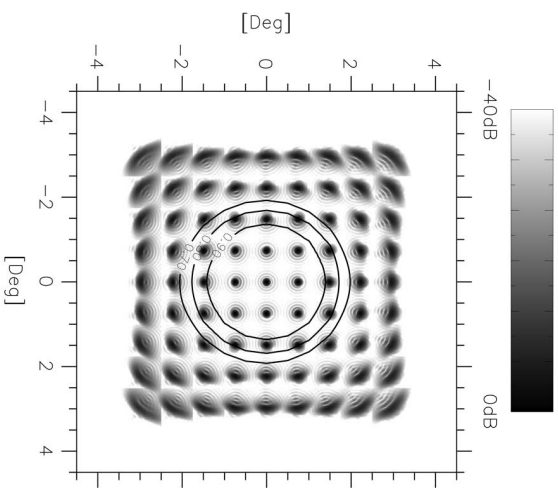
(a) Crossed



(b) Gregorian



(a) Co-polarized beams for the Crossed



(b) Co-polarized beams for Gregorian

# Try it yourself



SLN1420A from [www.ssb.de](http://www.ssb.de)



# Summary

- One D Black body power spectrum  
 $P_{\nu} = kT$
- Radiometer equation  
 $\sigma_T = T_{\text{rad}} / \sqrt{\text{BW} \times \text{Time}}$
- Antenna gain  
Gain in (K/Jansky) =  $A_{\text{eff}} / (2k * 10^{26}) = A_{\text{eff}} / 2760$   
GBT: 2 K/Jy...Arecibo: 6 K/Jy....Bingo: 0.5 (?)
- Single Mode Throughput  
 $A_{\Omega} = \lambda^2$
- Galactic Minimum Sky brightness (Frank Briggs)  
180K at 180 MHz ( $T \sim \nu^{-2.5}$ )