CMB component separation

Mel Irfan
Building 709, Room 274

14/02/17

About me...

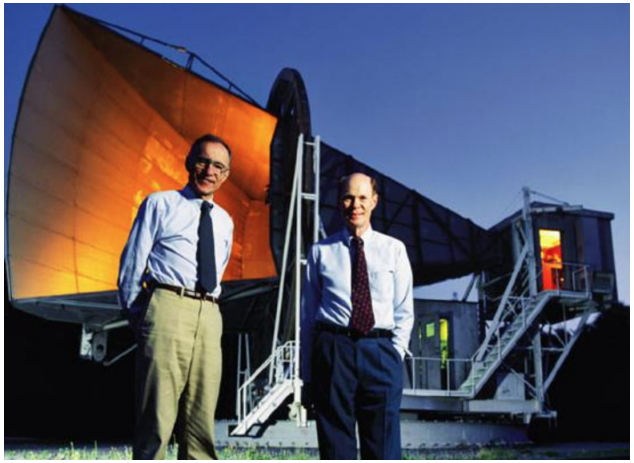
MANCHESTER 1824 The University of Manchester Jodrell Bank Centre for Astrophysics

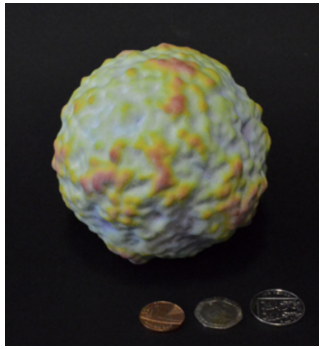
ALTRAN

Overview

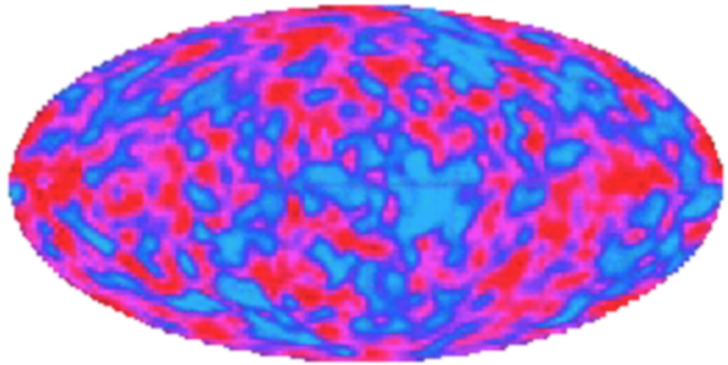
- Introduction to the CMB
- Diffuse foreground emissions
- Data reduction for a typical radio survey
- Early science results from C-BASS

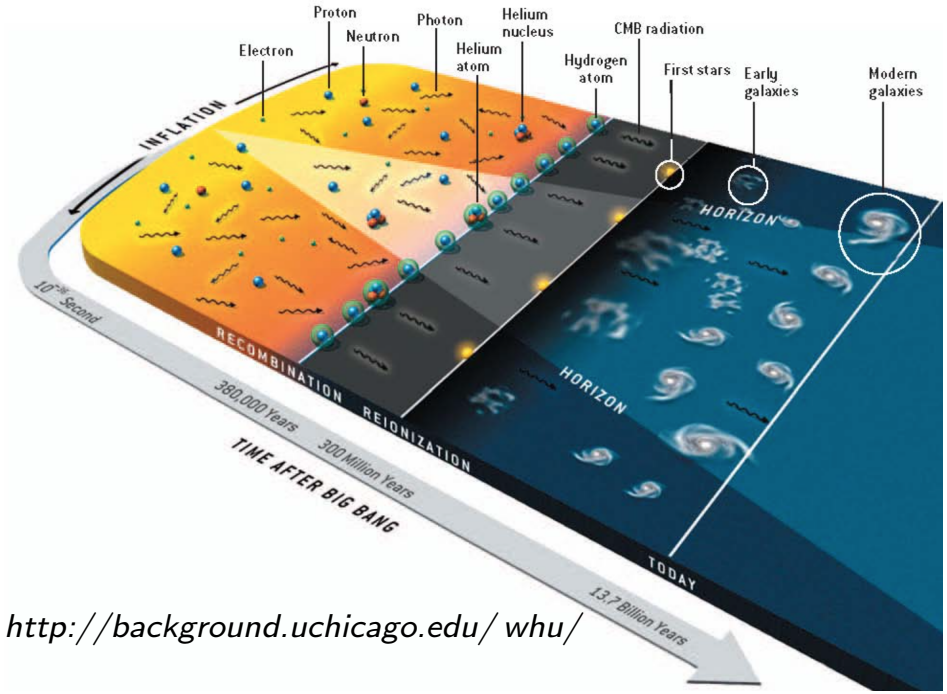
The CMB



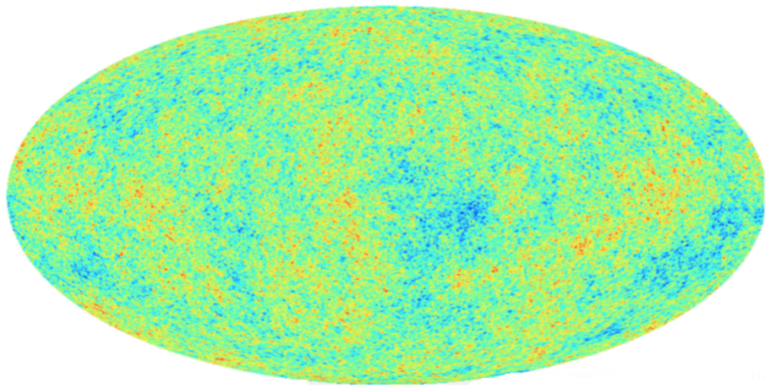


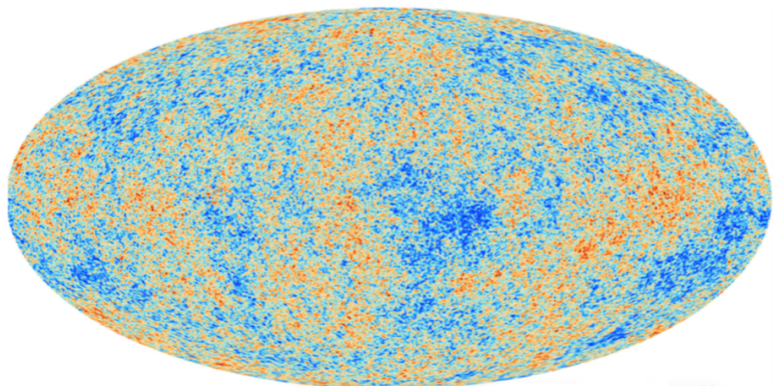
Clements et al. 2016



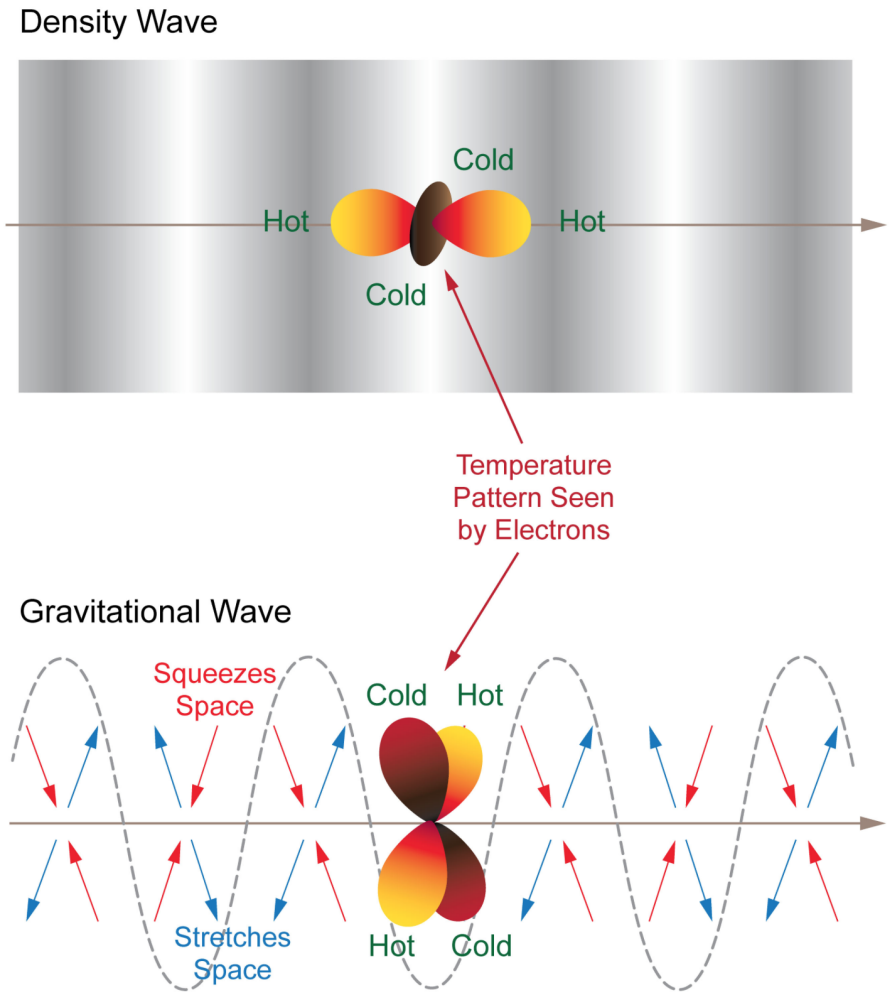


http://background.uchicago.edu/ whu/



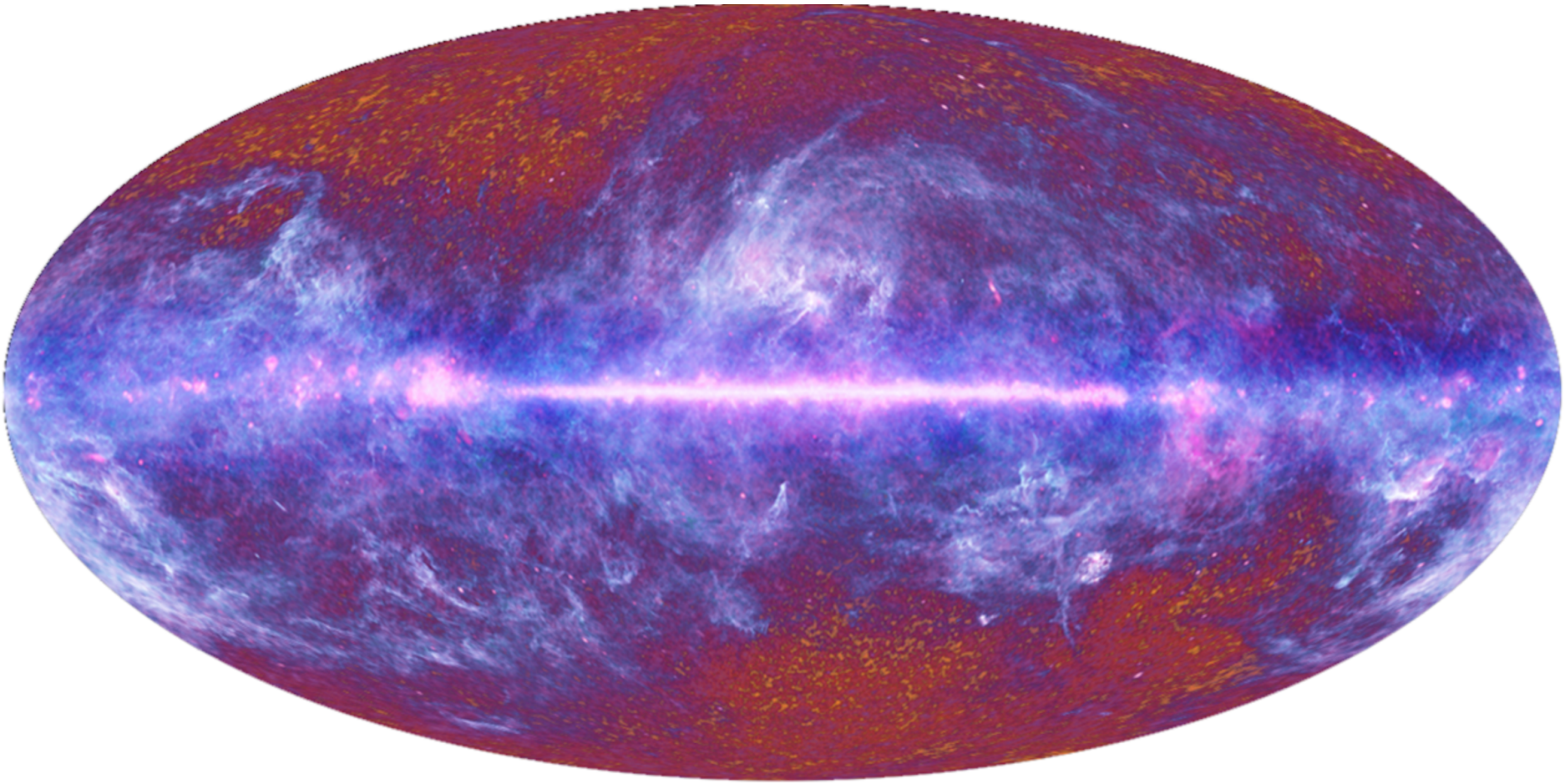


CMB anisotropies

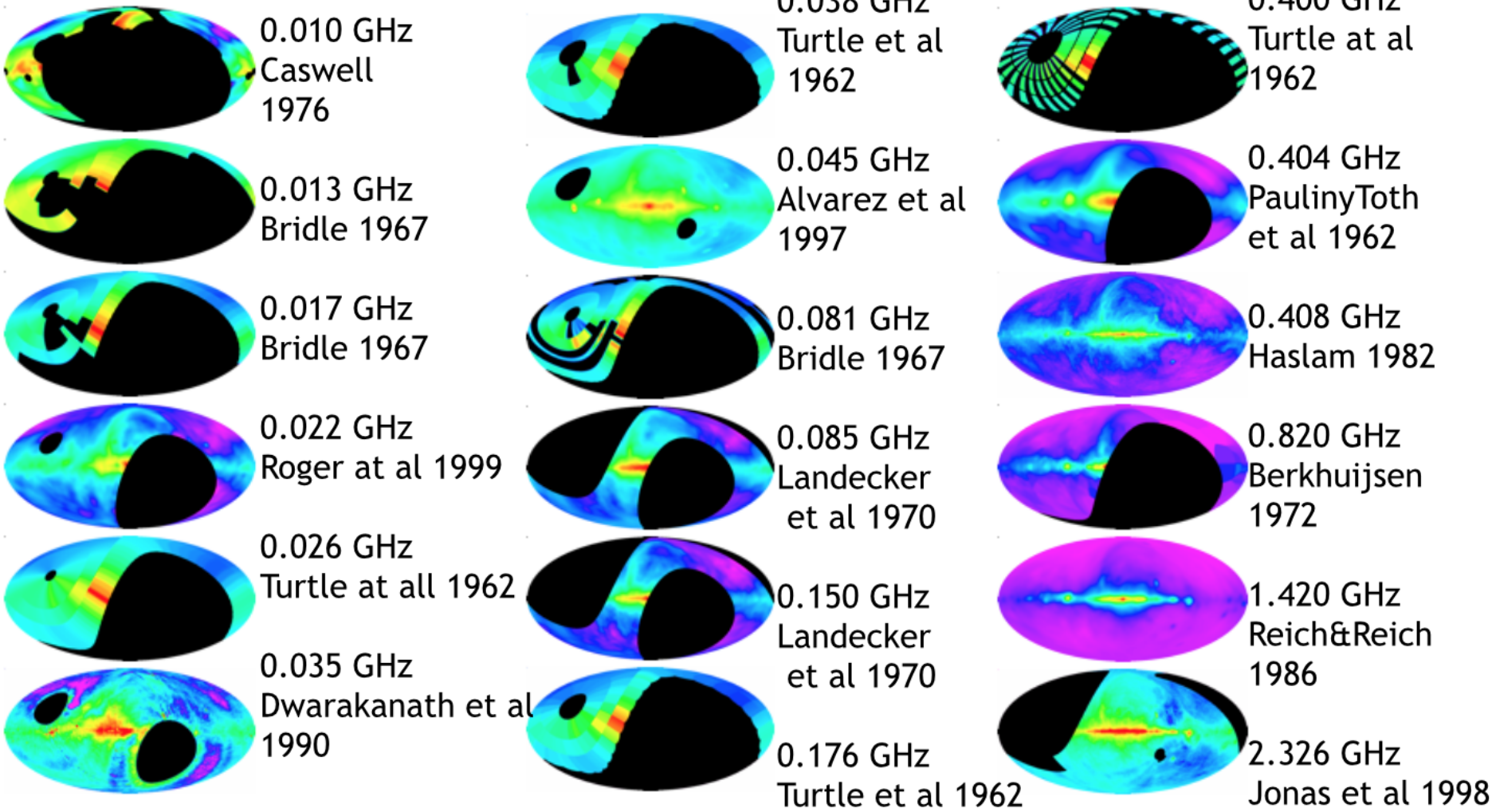


http://bicepkeck.org/

What you actually see...

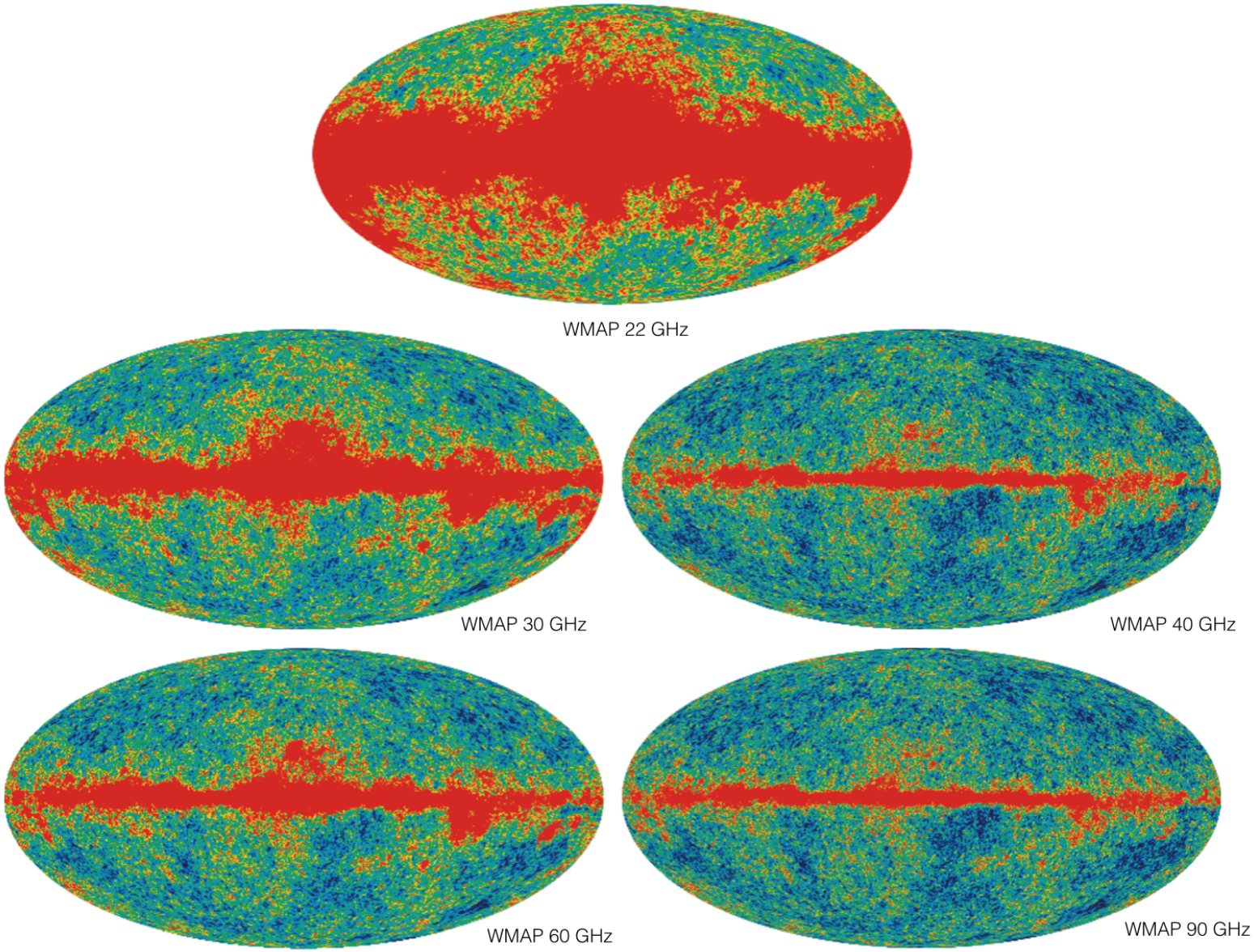


The solution...

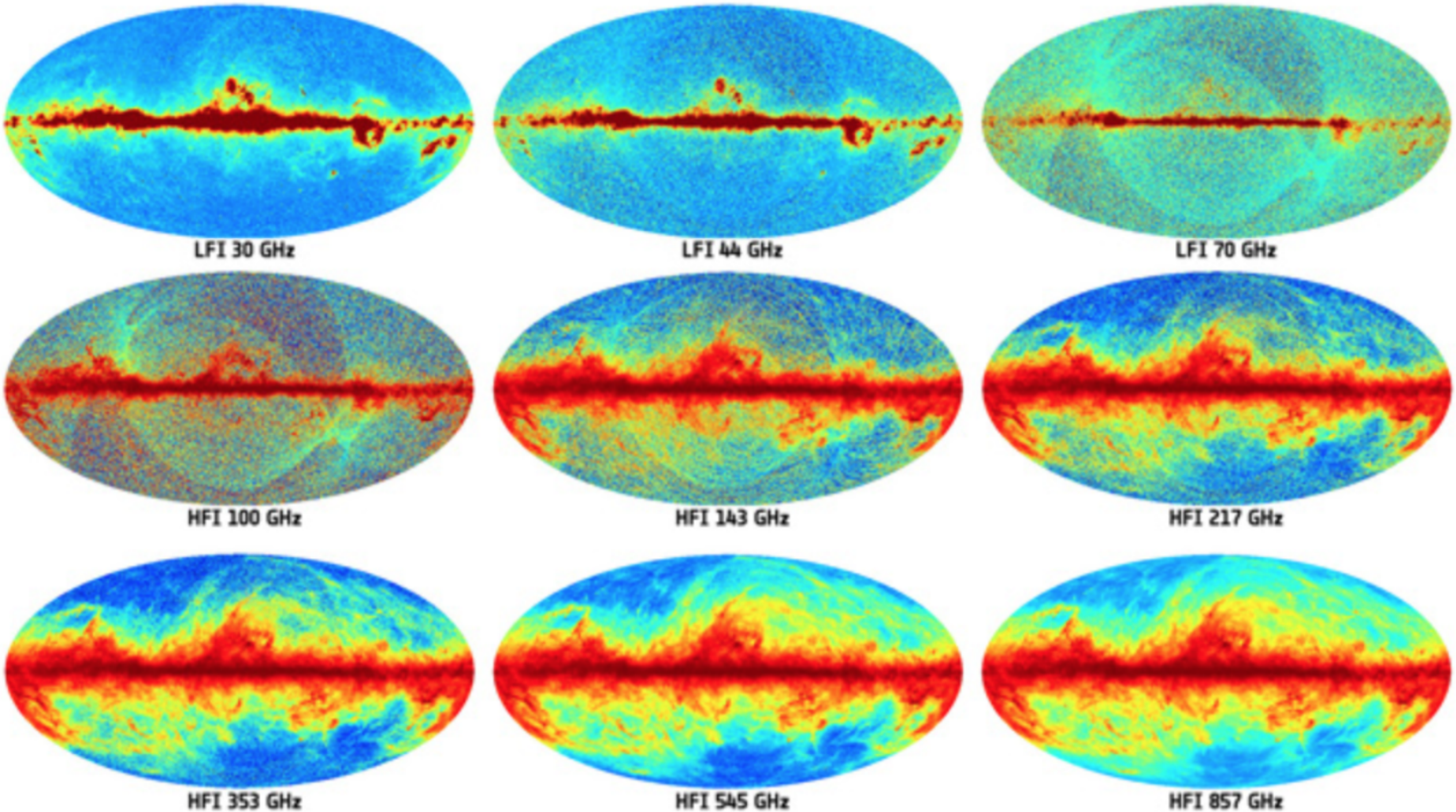


De Oliveira-Costa 2008

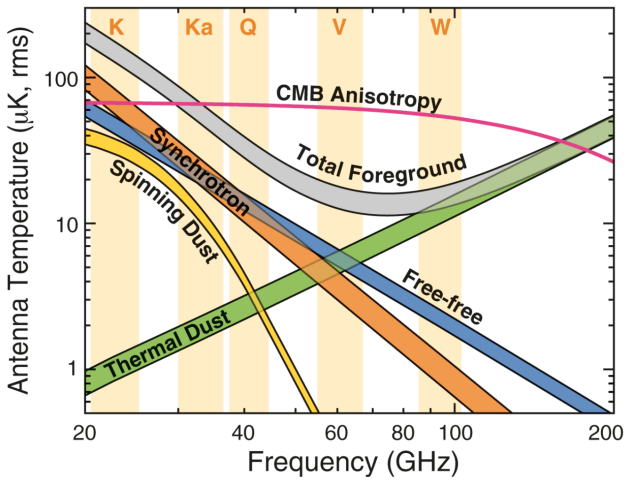
The solution...

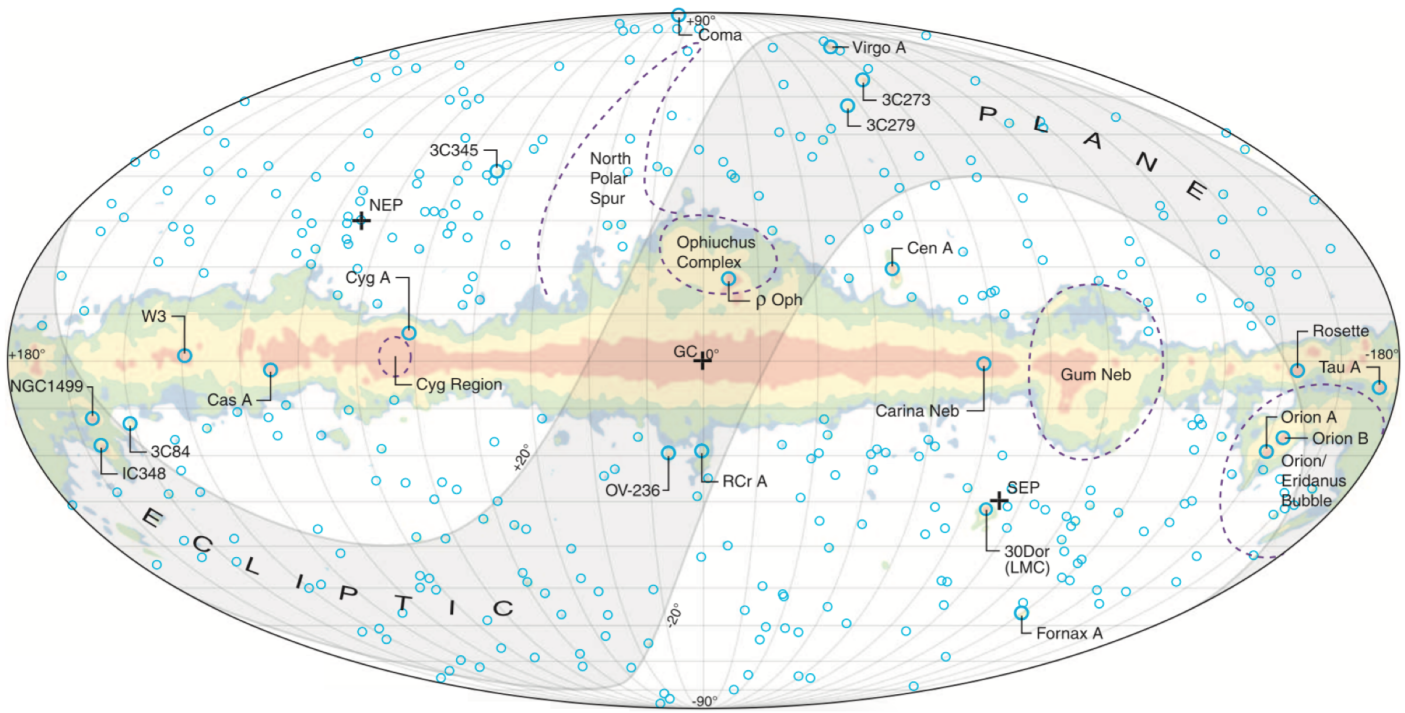


The solution...



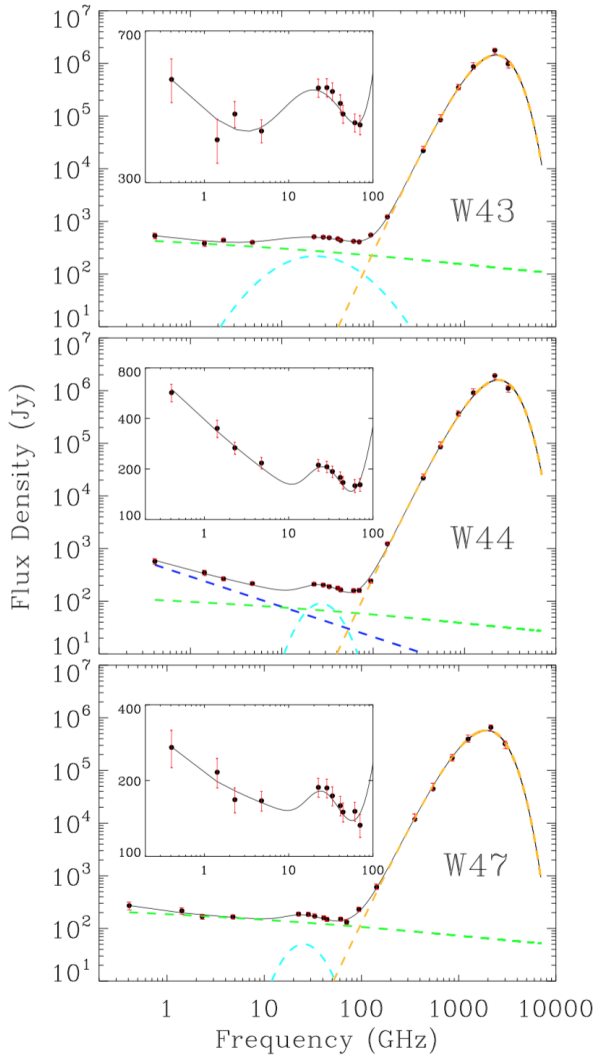
Spectral and spatial behaviour





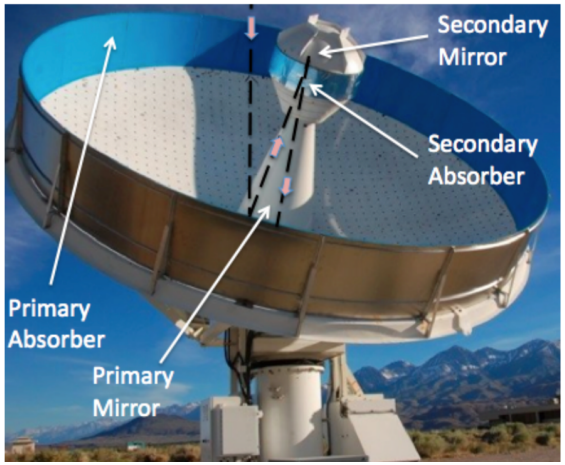
Bennett 2013

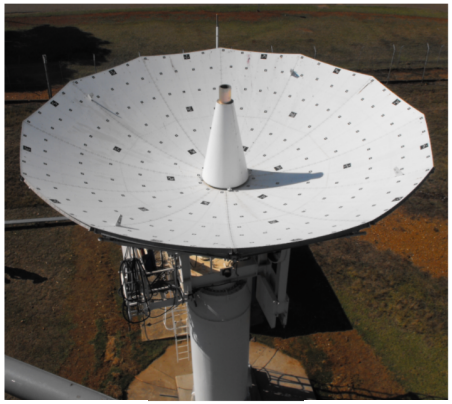
Physics of the ISM – AME



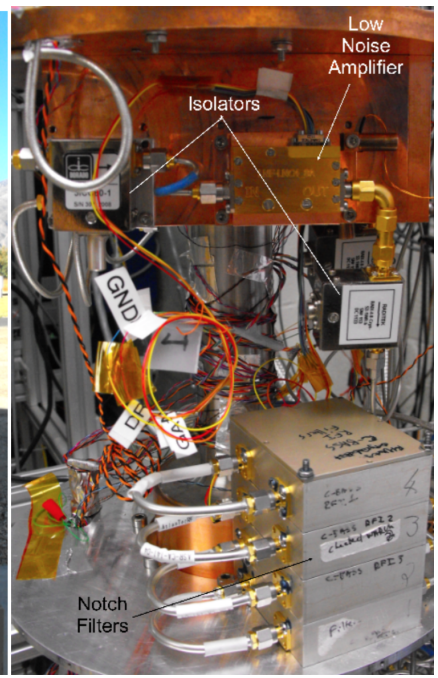
Irfan et al. 2015

C-BASS

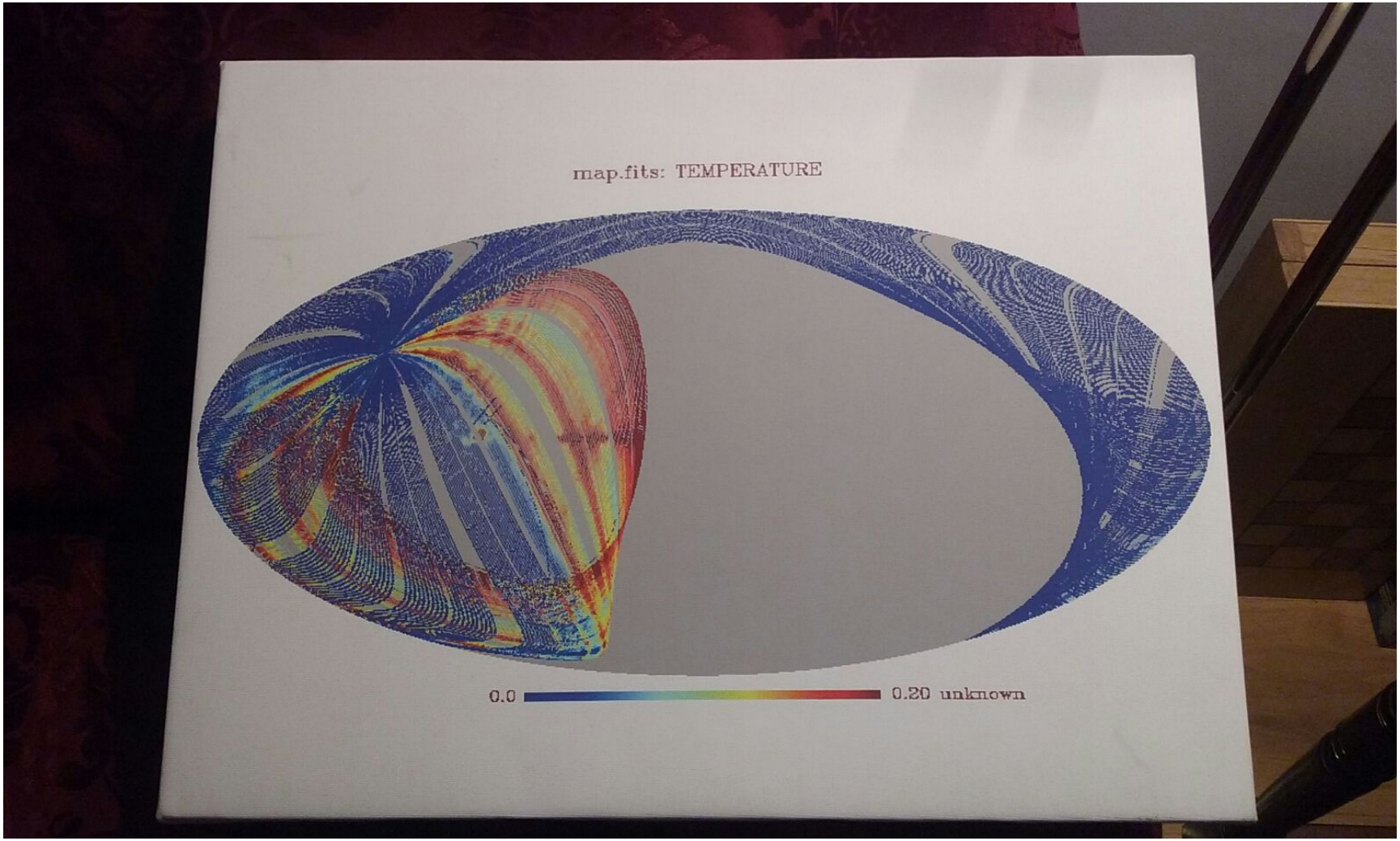




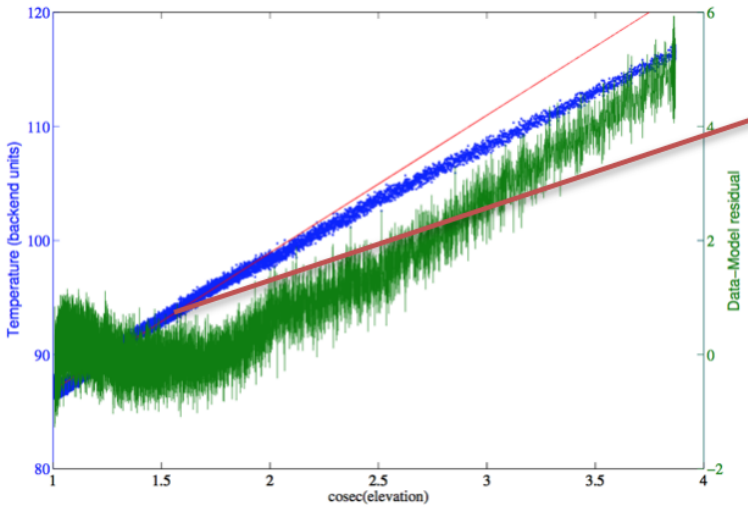
	Northern	Southern
Latitude	37°.2	−30°.7
Antenna type	Gregorian	Cassegrain
Diameter	6.1 m	7.6 m
FWHM	0°.73	0°.73
Main Beam Efficiency	80.0%	80.0%
Full Beam Efficiency	91.9%	91.3%
Intensity central frequency	4.76 GHz	–
Intensity Bandwidth	489 MHz	–
Total System Temperature	40 K	–



First ever map...



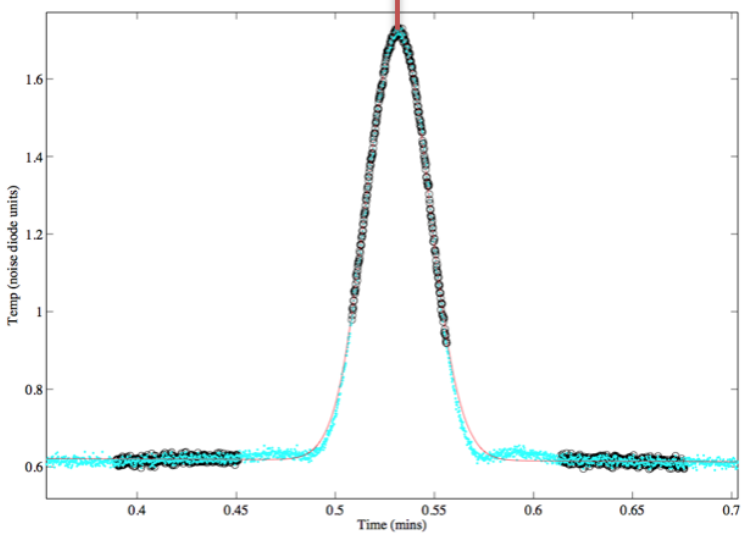
Calibration



$$m_{ND} = \frac{T_{\text{atmos}} - T_{\text{Sky}}}{T_{ND}} \times \tau_0$$

$$y = \frac{T_{sky,NDon} - T_{sky,NDoff}}{T'_{src}}$$

$$y = \frac{T_{ND}}{T_{src} e^{-\tau}} = \frac{T_{ND}}{T_{src}} e^{\tau} = \frac{T_{ND}}{T_{src}} \left(1 + \frac{\tau_0}{\sin(\theta_{\text{el}})}\right)$$

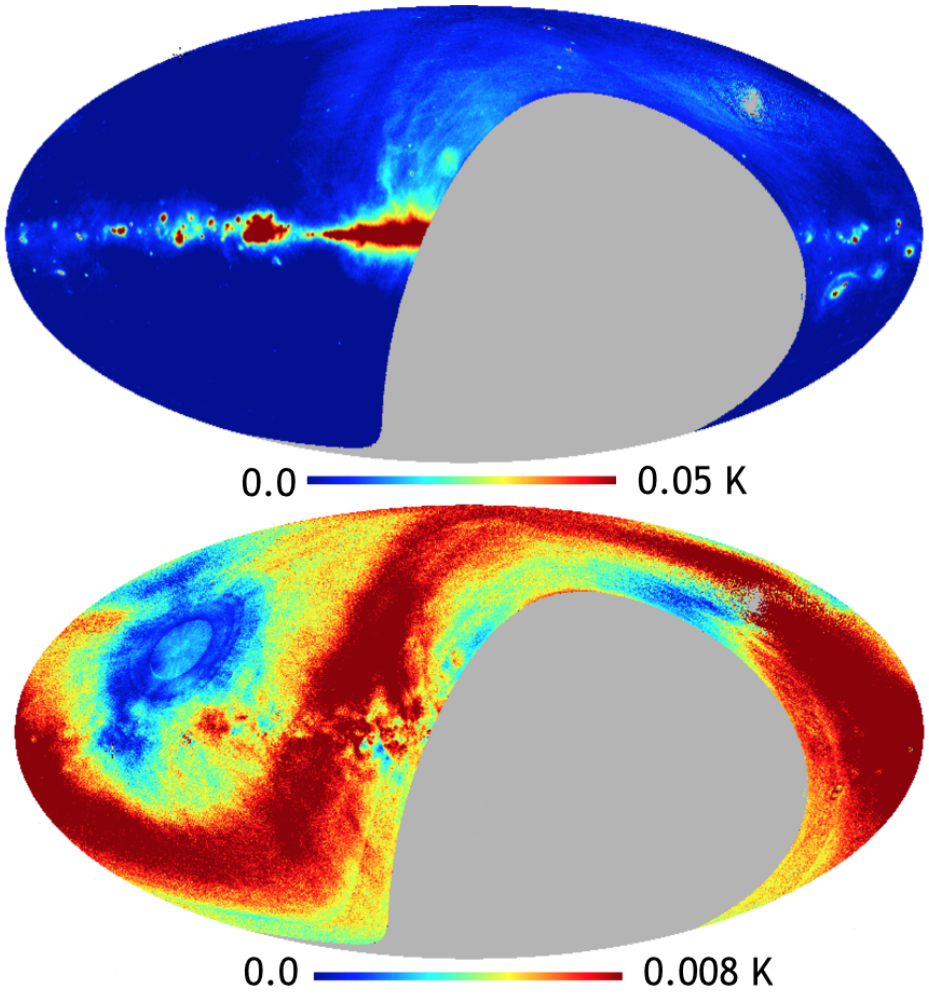


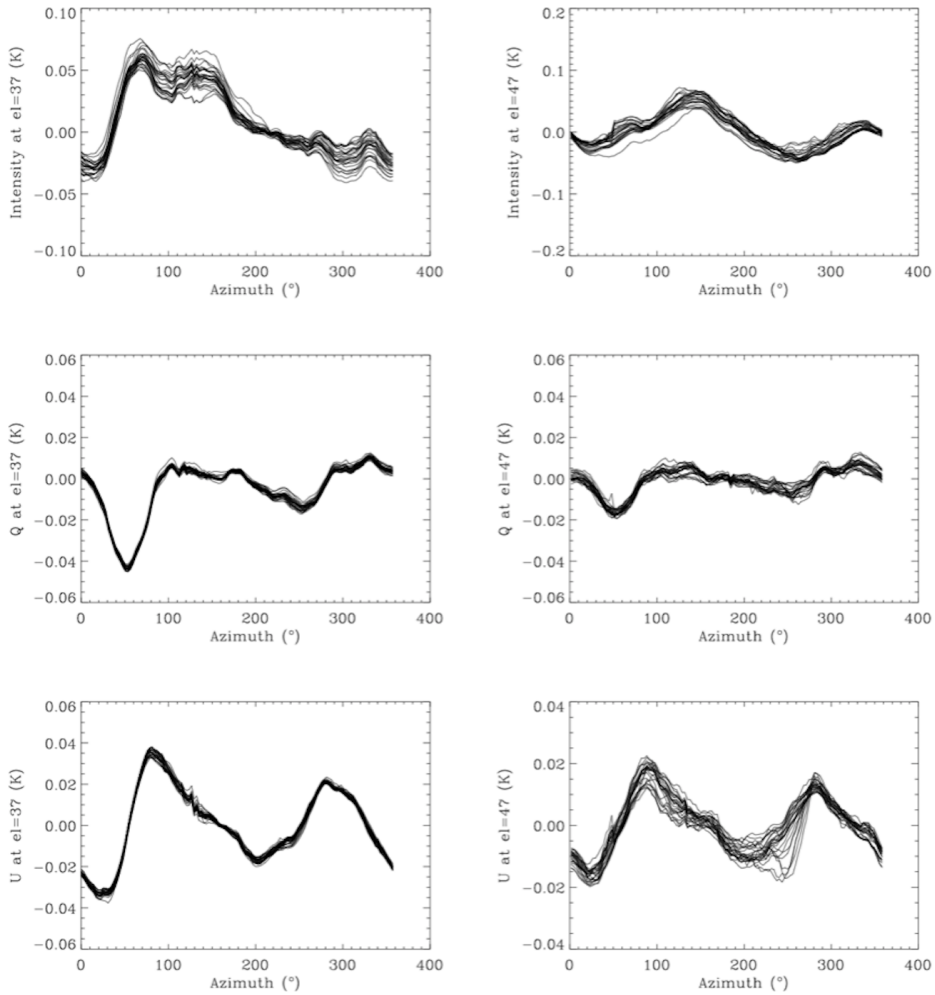
$$T_{ND} = \frac{-\beta + \sqrt{\beta^2 - 4\alpha\gamma}}{2\alpha}$$

where $\alpha = \frac{m_{ND}}{T_{\text{atmos}} - T_{\text{Sky}}}$, $\beta = \sin\theta_{\text{el}}$ and $\gamma = -y T_{src} \beta$

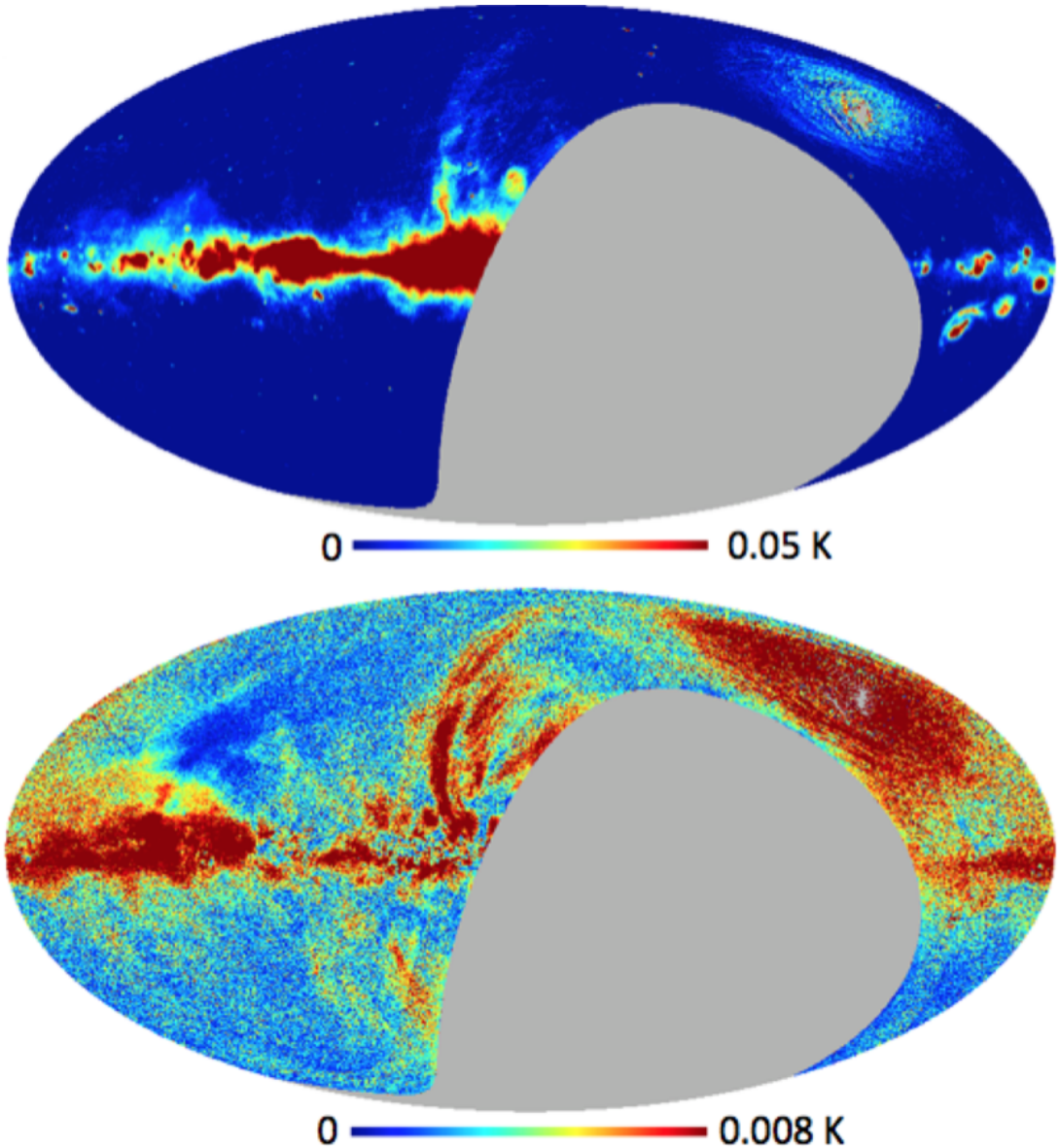
Baars 1977, Weiland et al. 2002

Ground Spillover

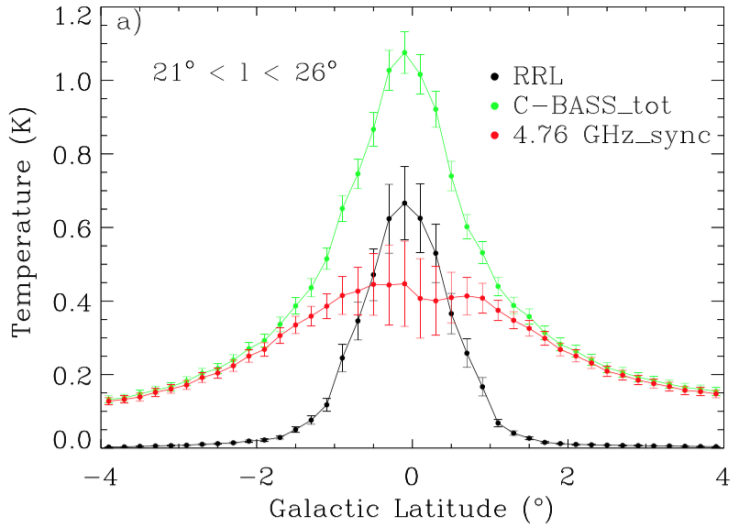


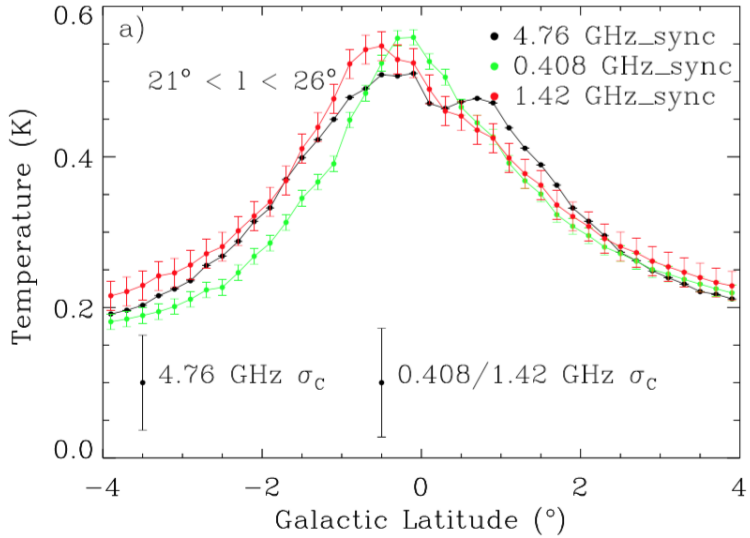


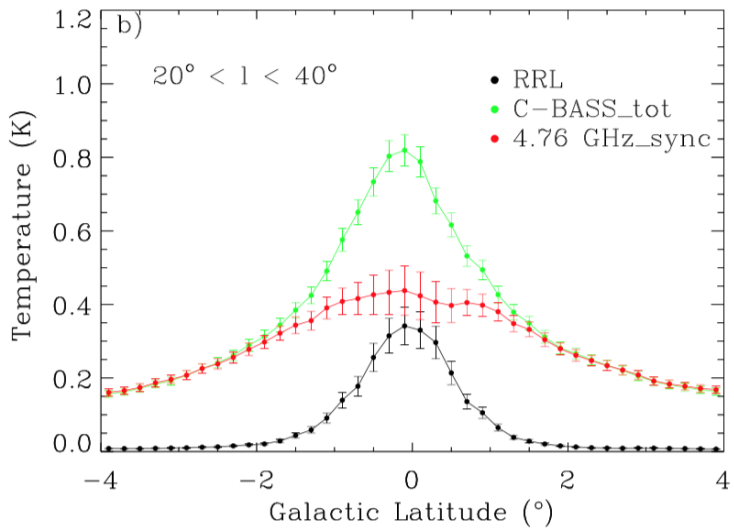
Just solar sidelobes left...

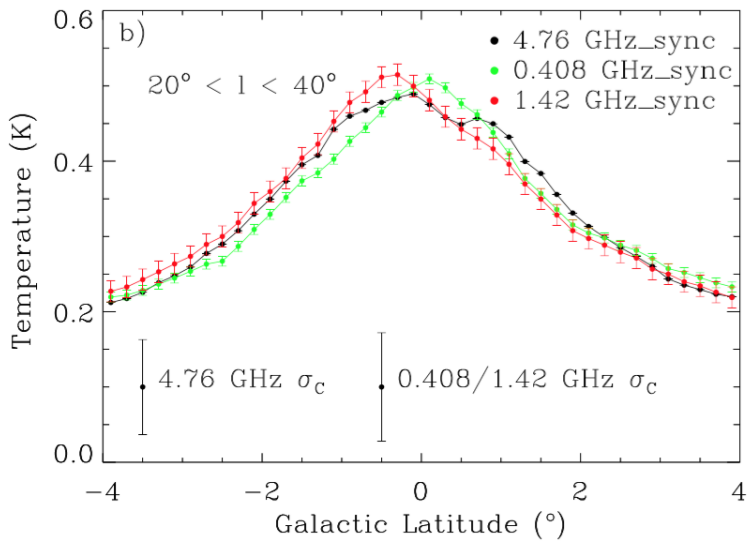


Synchrotron spectral index



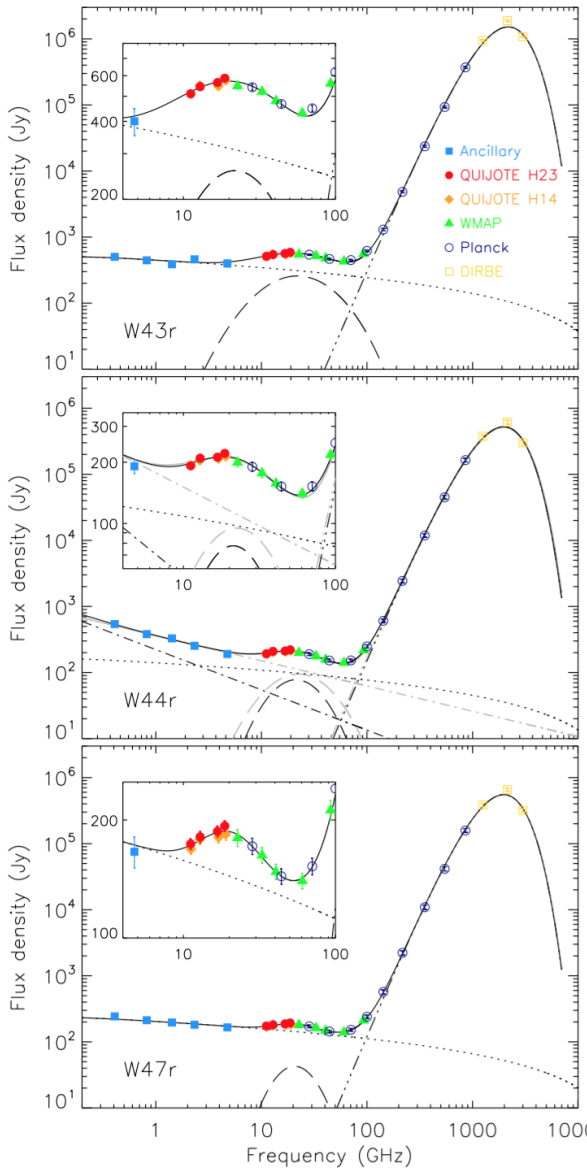






Free-Free template from Alves et al. 2012

Constraining AME



Genova-Santos et al. 2017

Ongoing