

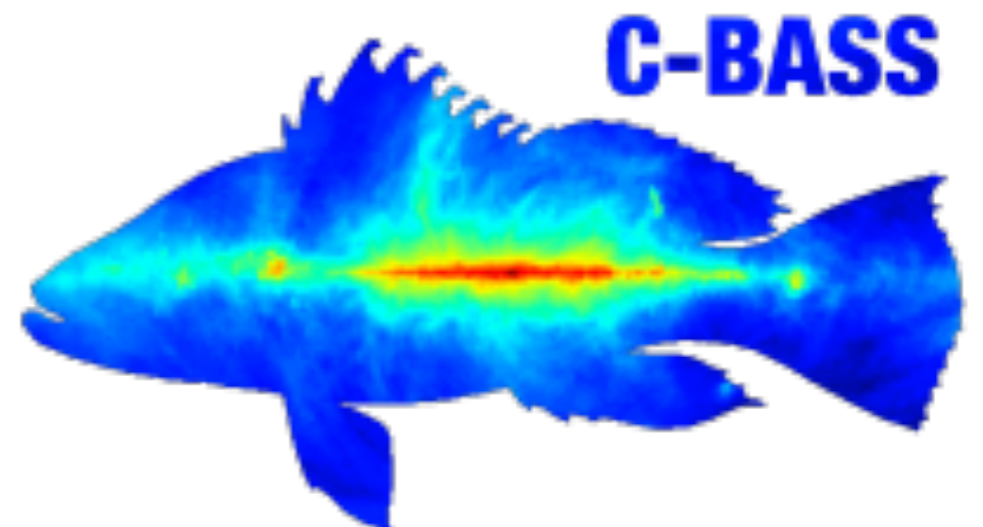
Template Fitting Analysis with C-BASS

Stuart Harper
on behalf of the C-BASS collaboration

Radio Foregrounds Conference, IAC, 2018

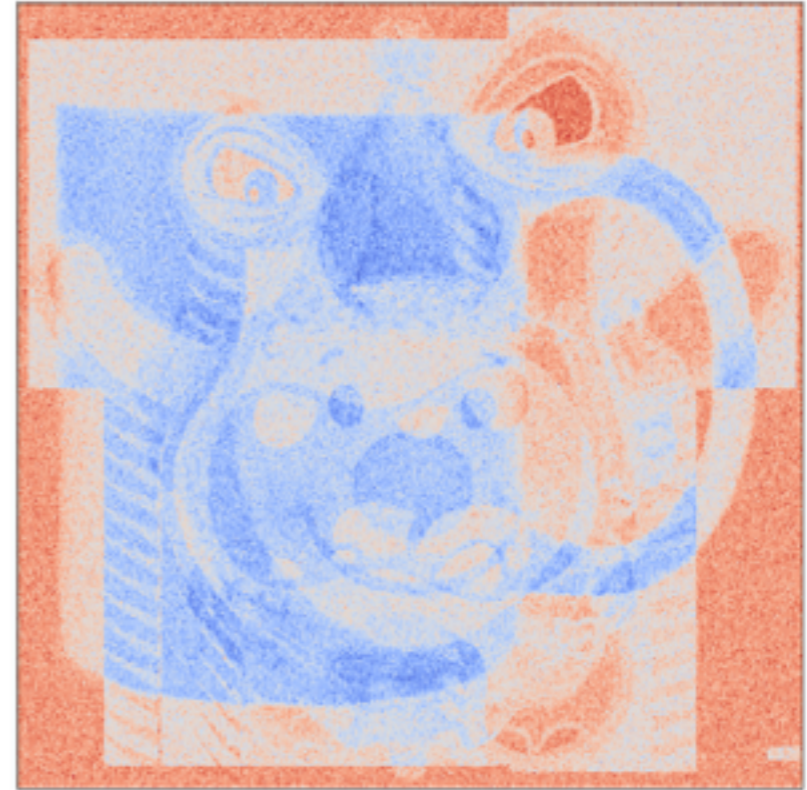
MANCHESTER
1824

The University of Manchester



Template Fitting Overview

We have an observation:



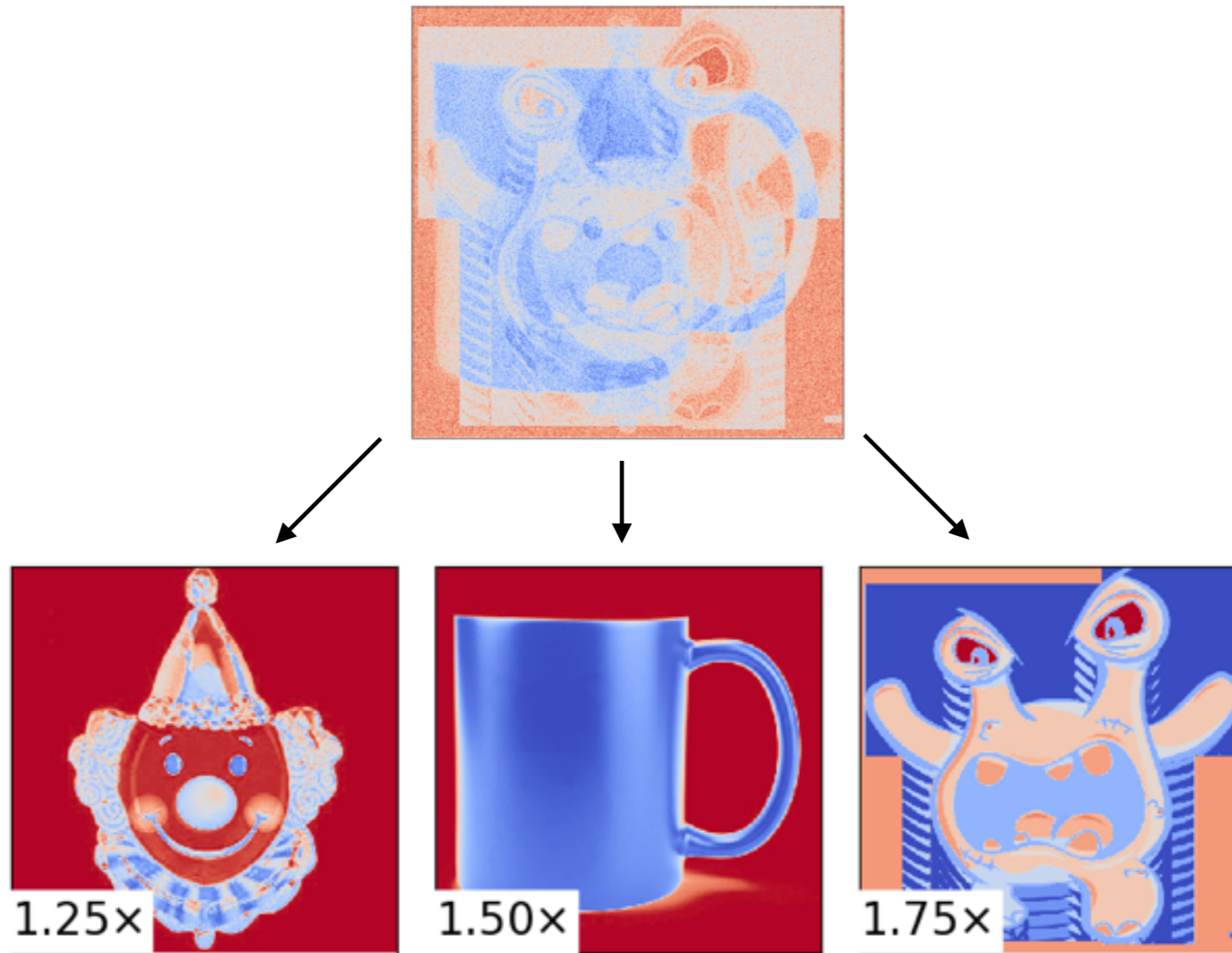
That can be decomposed into two components:

$$d = s + n$$

Signal → s n ← **Noise**

Signal composed of templates/matched filtered

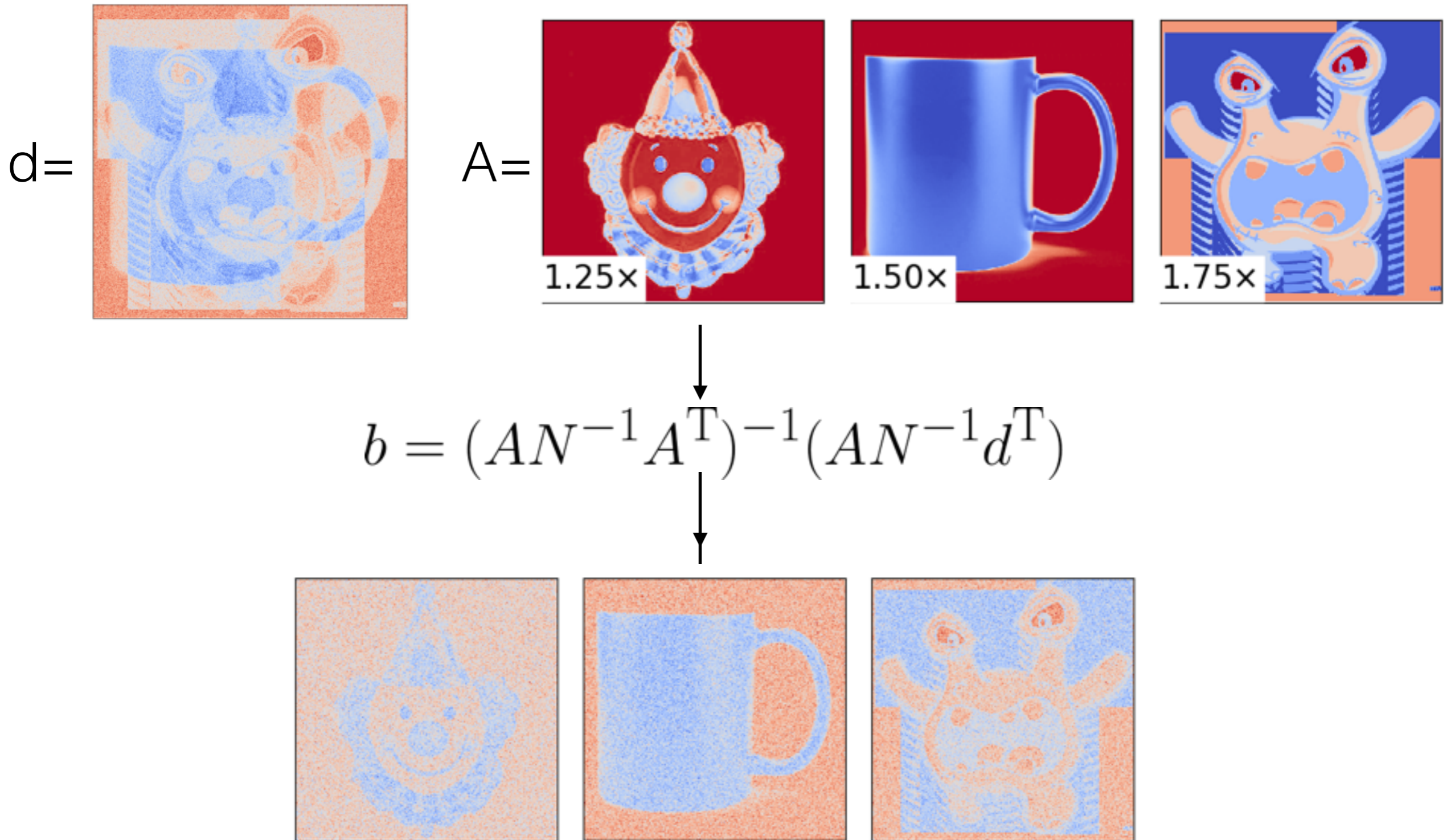
Template Fitting Overview



Signal can be decomposed into: $s = Ab$ Coefficient amplitudes

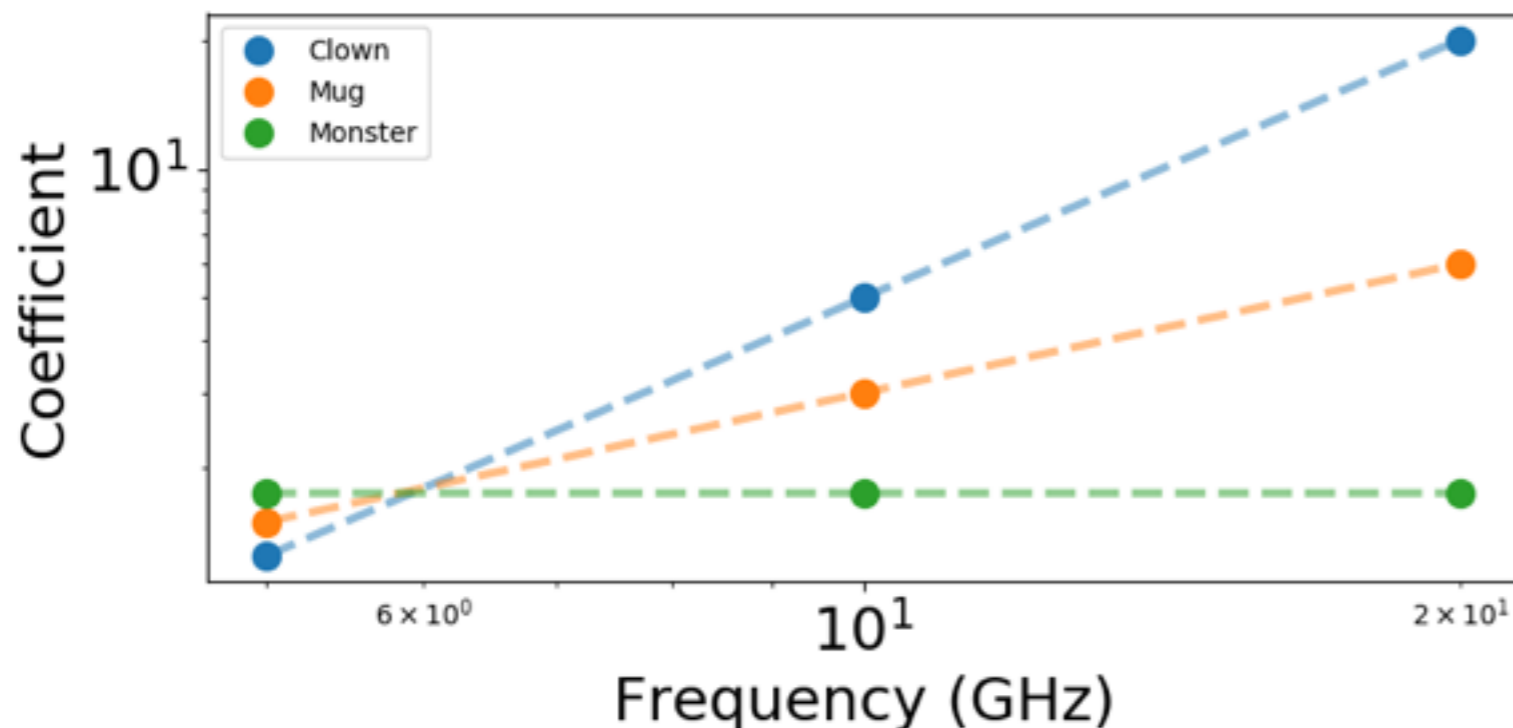
Matched filters/templates

Template Fitting Overview



Template Fitting Overview

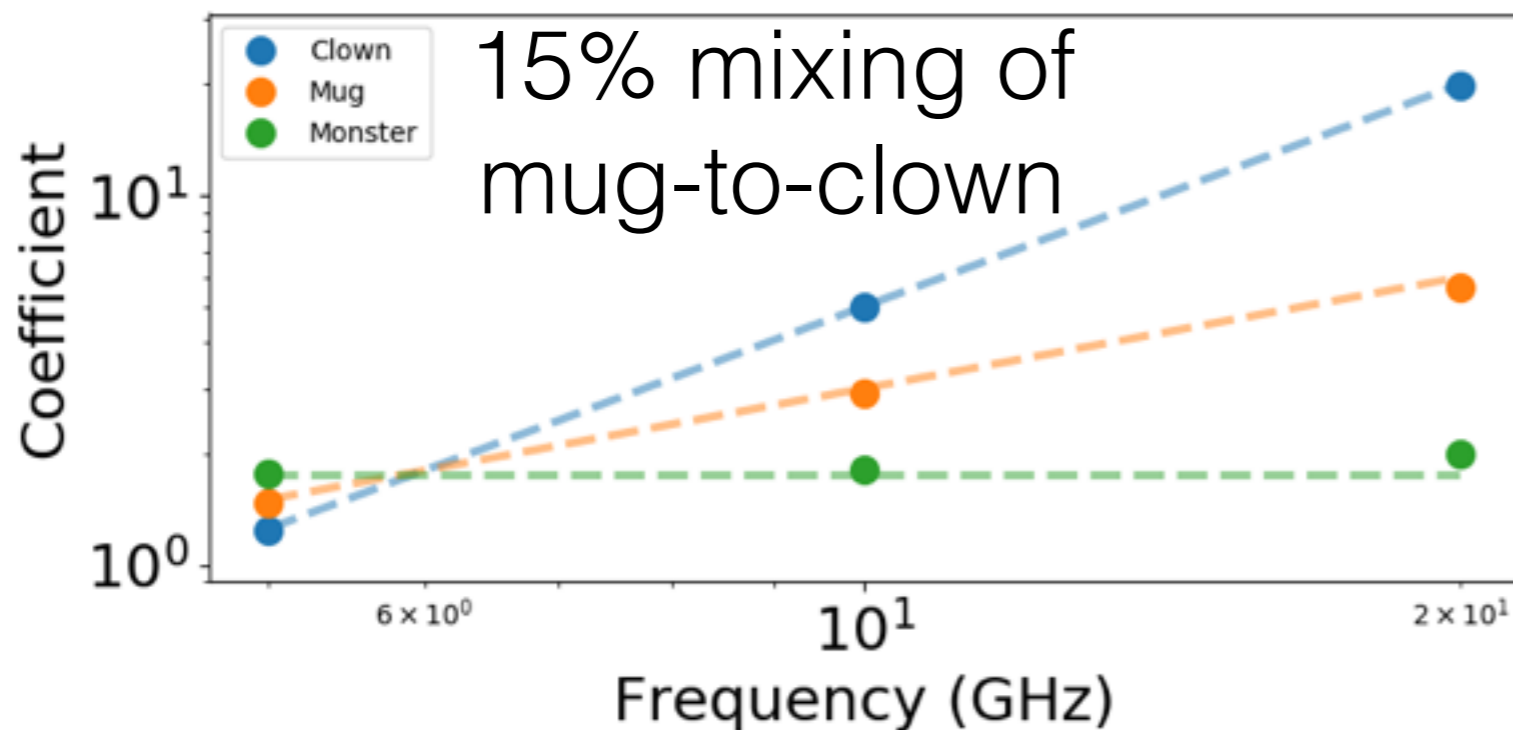
Spectral variation in components can be captured:



Coefficients carry the same spectral variation as original data...

Template Fitting Overview

Spectral variation in components can be captured:

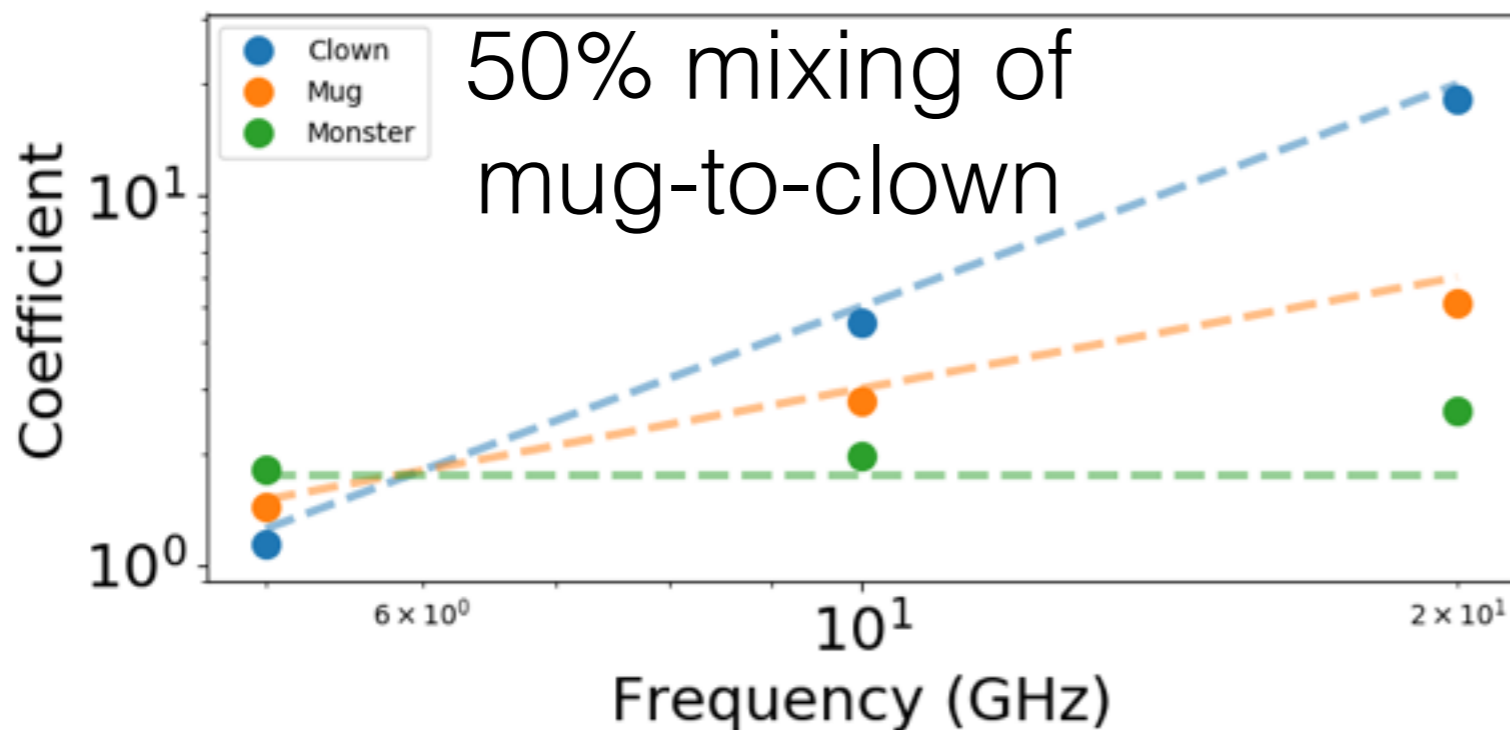


Bias' from:
template correlations
template defects
gradients
spectral variations

...

Template Fitting Overview

Spectral variation in components can be captured:

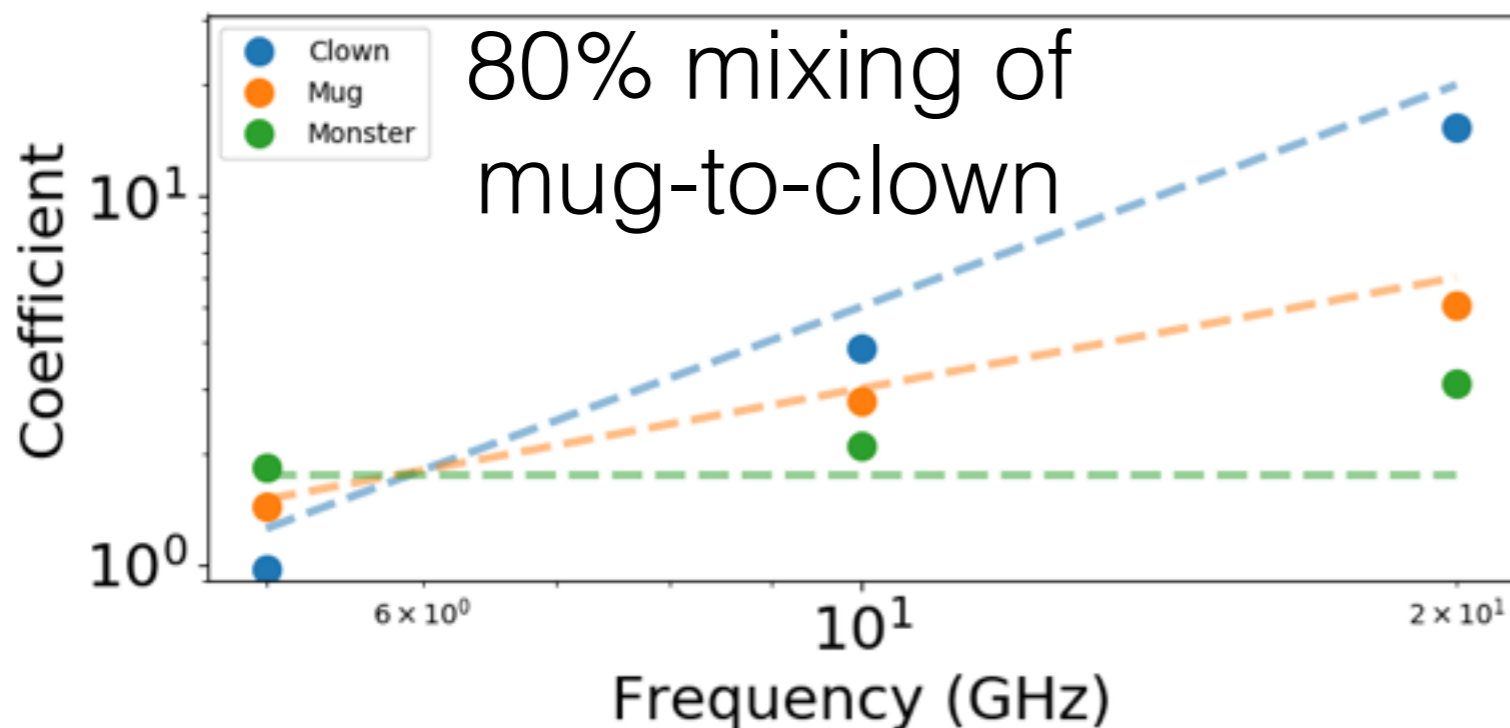


Bias' from:
template correlations
template defects
gradients
spectral variations

...

Template Fitting Overview

Spectral variation in components can be captured:

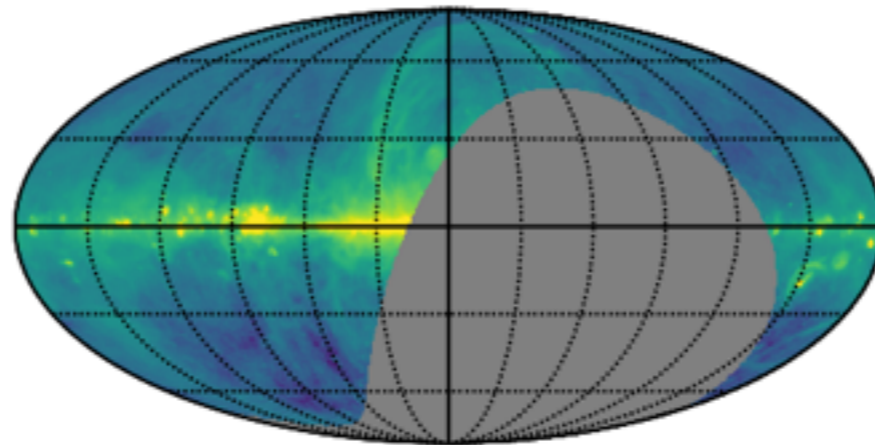


Bias' from:
template correlations
template defects
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spectral variations

...

Template Fitting Overview

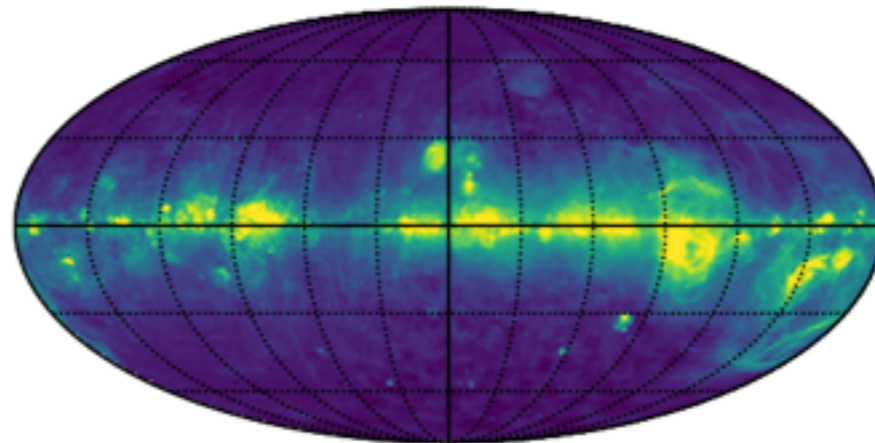
Synchrotron



Haslam
C-BASS

...

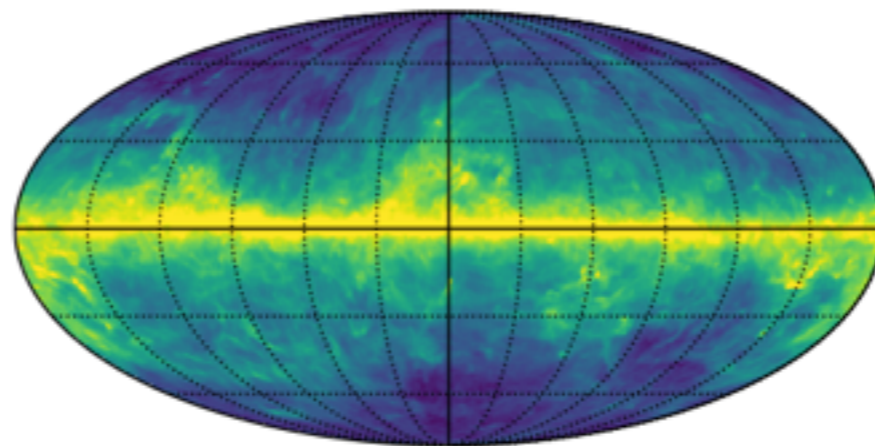
Free-Free



WHAM
SHASSA

...

Dust



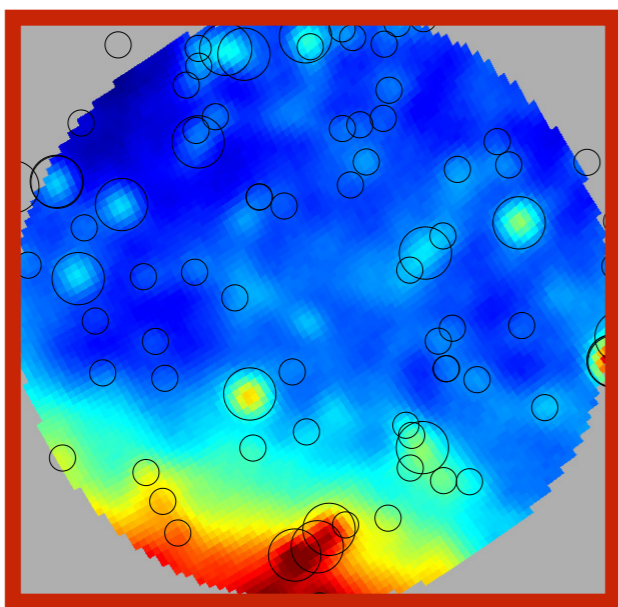
FIR Maps
Dust Opacity
Radiance

...

NCP

C-BASS: Constraining diffuse Galactic radio emission in the North Celestial Pole region, Dickinson, C. + C-BASS Collaboration, 2018

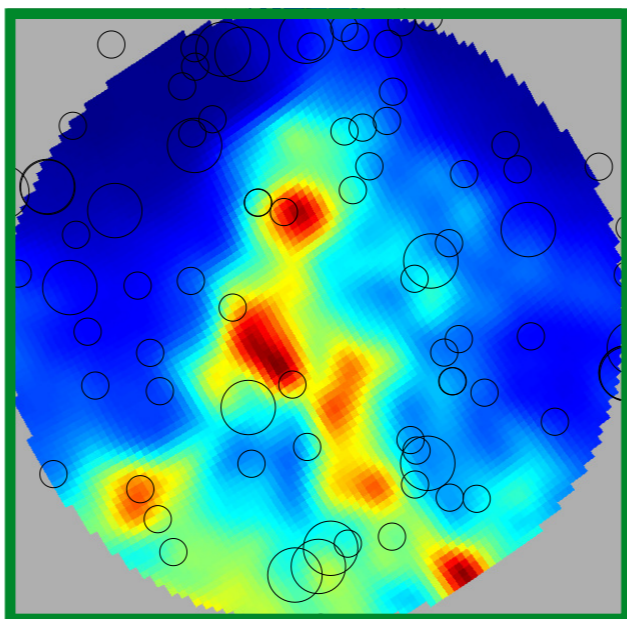
**Synchrotron
C-BASS**



4.6 23.3 mK
(0.0, 90.0) Equatorial

22.8 GHz

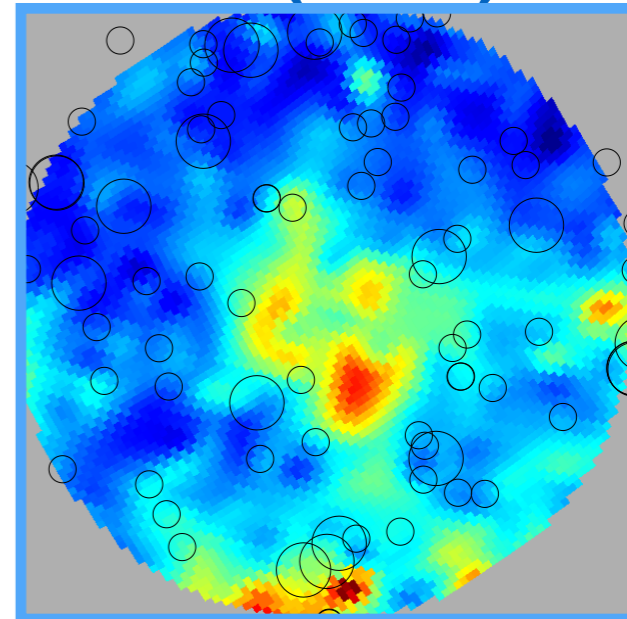
**Dust
 τ_{353}**



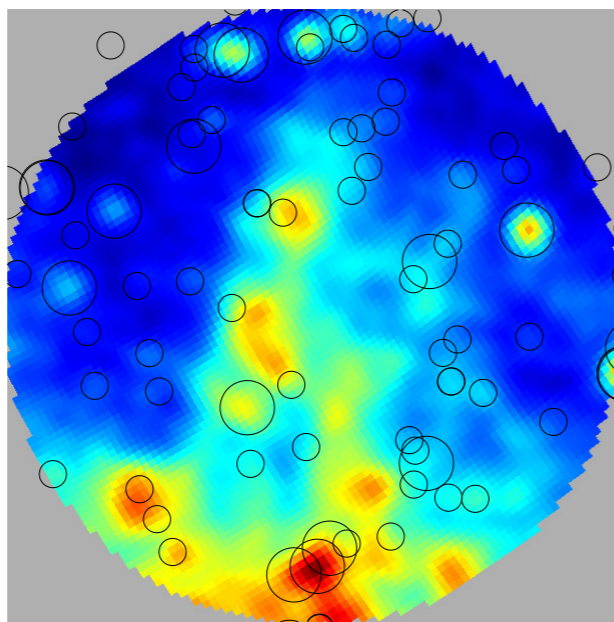
1.6 29.3
(0.0, 90.0) Equatorial

44.1 GHz

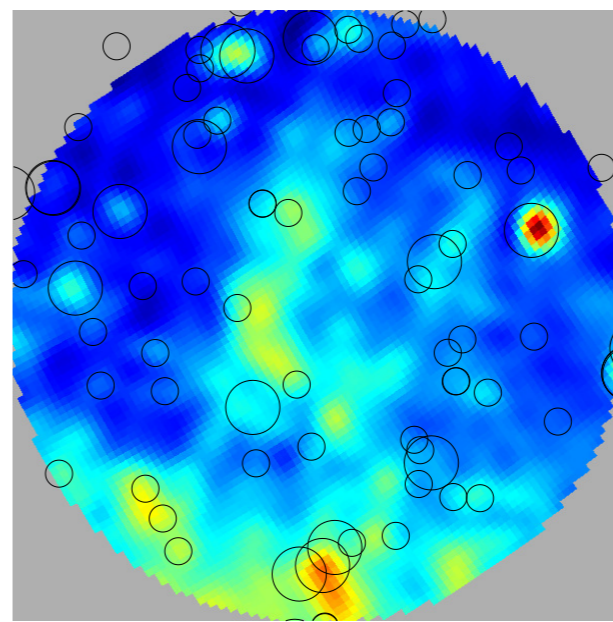
**Free-Free
 $H\alpha$ (DDD)**



0.49 4.2 R
(0.0, 90.0) Equatorial



0.050 0.49 mK
(0.0, 90.0) Equatorial

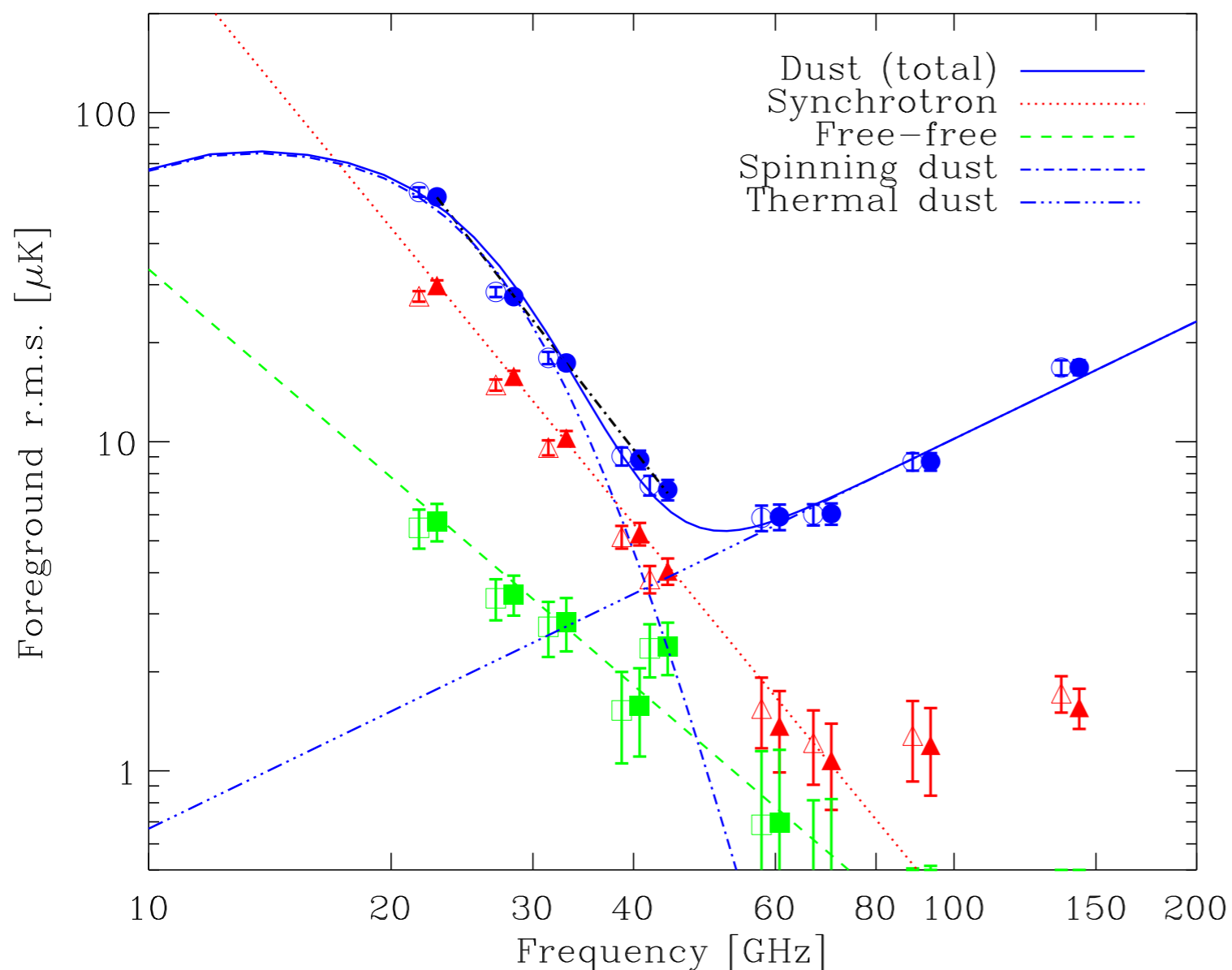


0.018 0.12 mK
(0.0, 90.0) Equatorial

NCP Results

C-BASS: Constraining diffuse Galactic radio emission in the North Celestial Pole region, Dickinson, C. + C-BASS Collaboration, 2018

RMS of individual NCP components



Comparison with **Commander** expected values (22.8GHz)

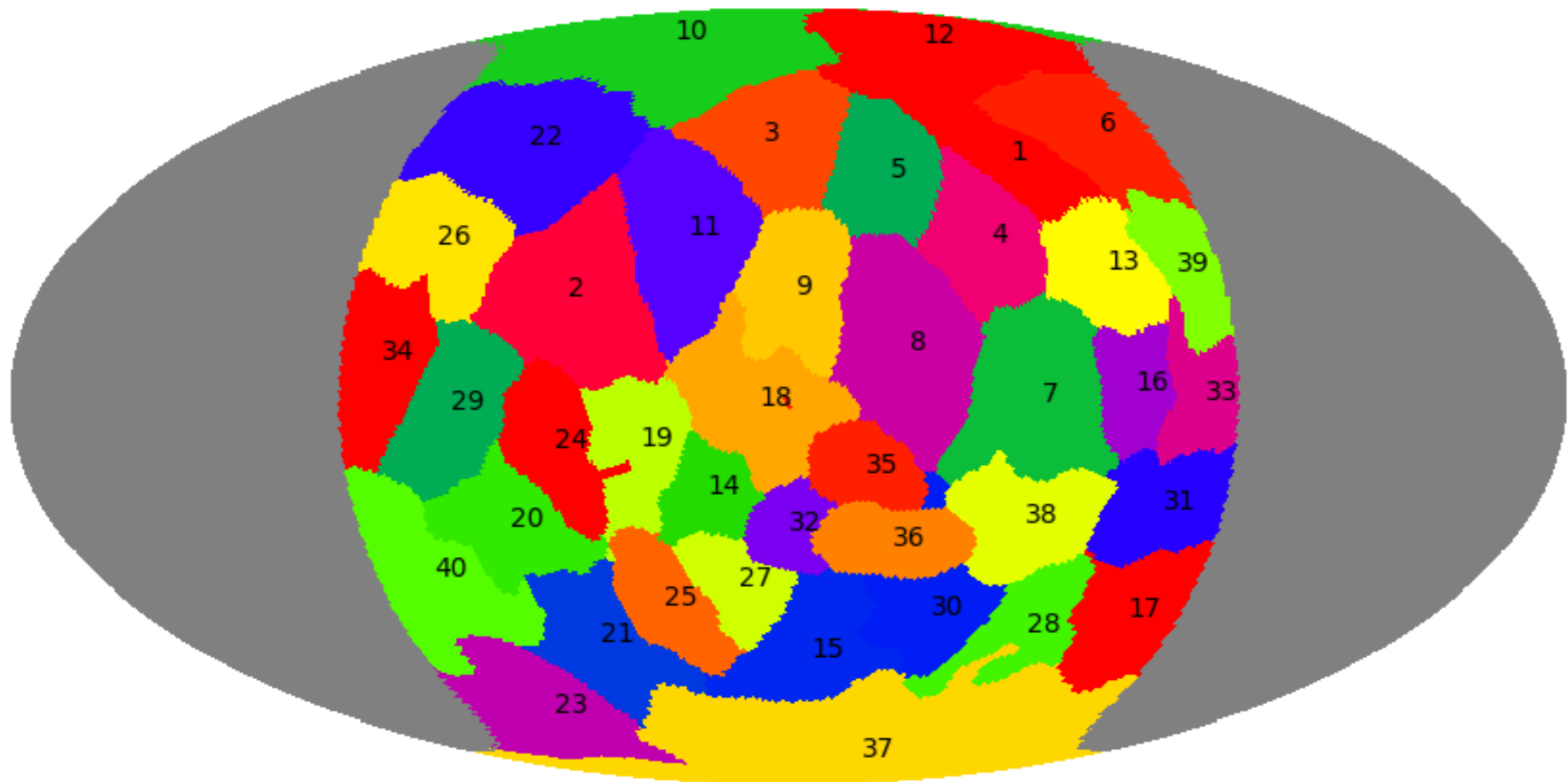
Component	CC	<i>Planck</i> 2015
Synchrotron	29.9 ± 1.1	11.8
Free-free	5.7 ± 0.7	46.9
AME / dust	55.4 ± 1.8	45.4
Thermal dust	...	1.2
Total foreground	88.8 ± 3.6	84.0

Larger AME component...
60% of total emission

$$b_{\text{dust}} = 9.59 \text{ K}/\tau_{353}$$

Looking at the whole sky

Break sky up into distinct regions (see Luke's talk)...



Mollweide project looking down on the NCP

Spectral Indices

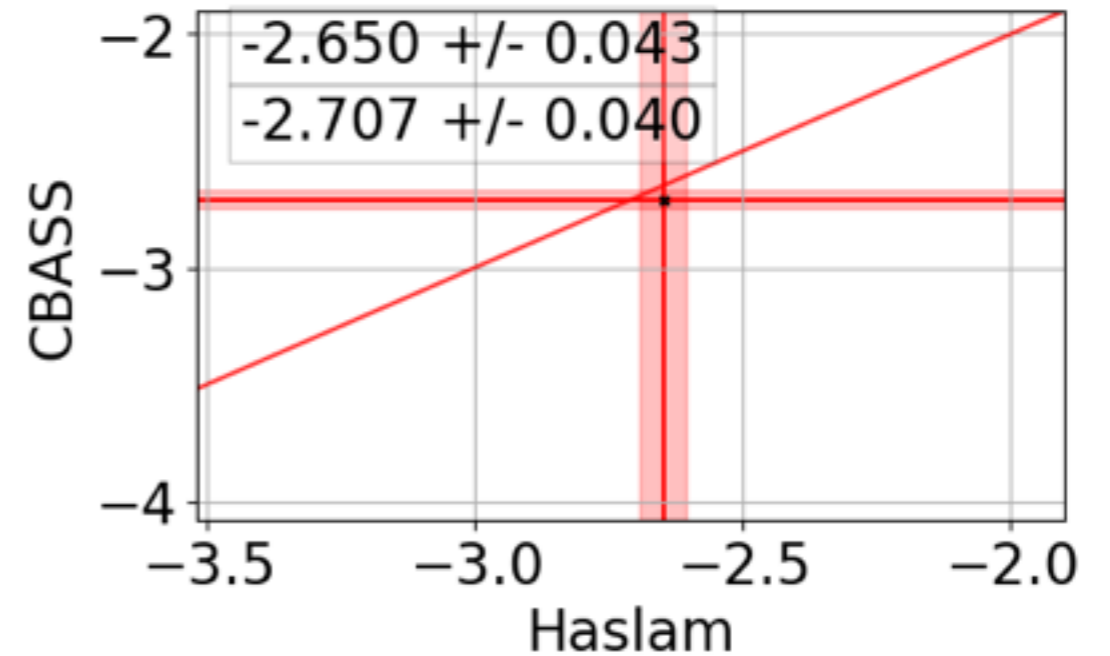
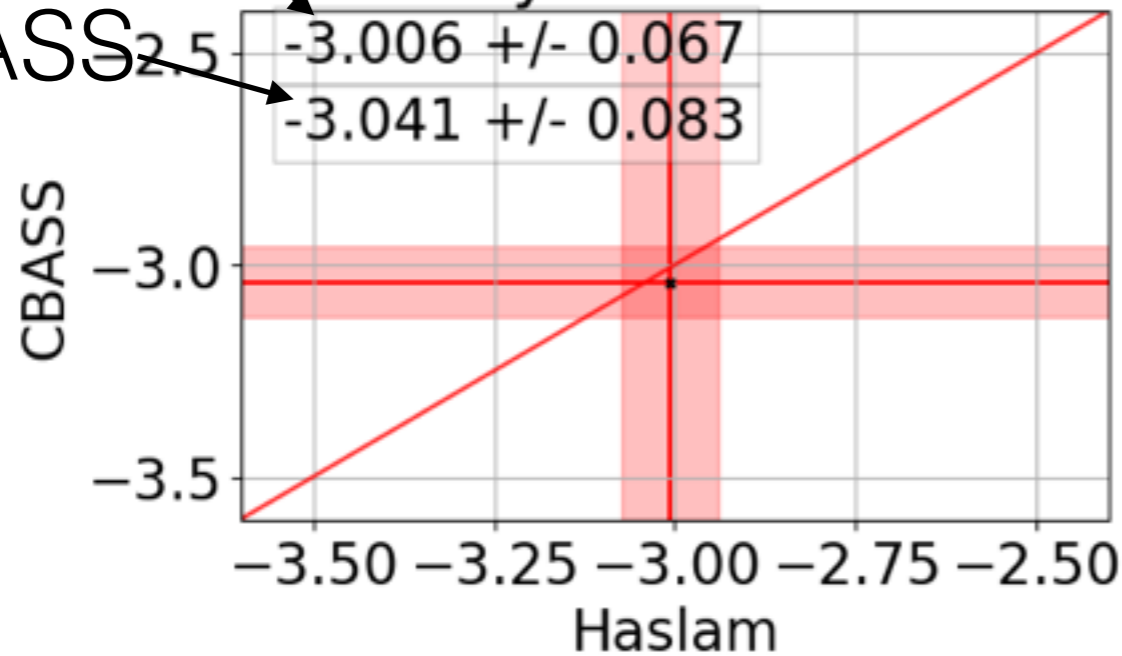
Global fit to high latitudes

Haslam

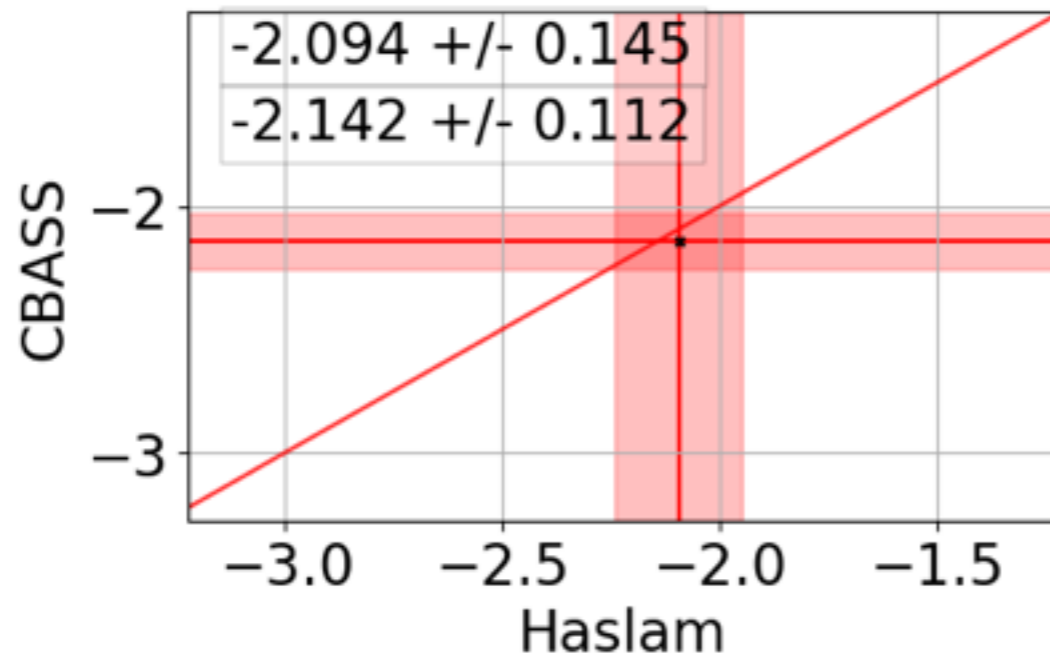
C-BASS

Synchrotron

Dust



Free-Free

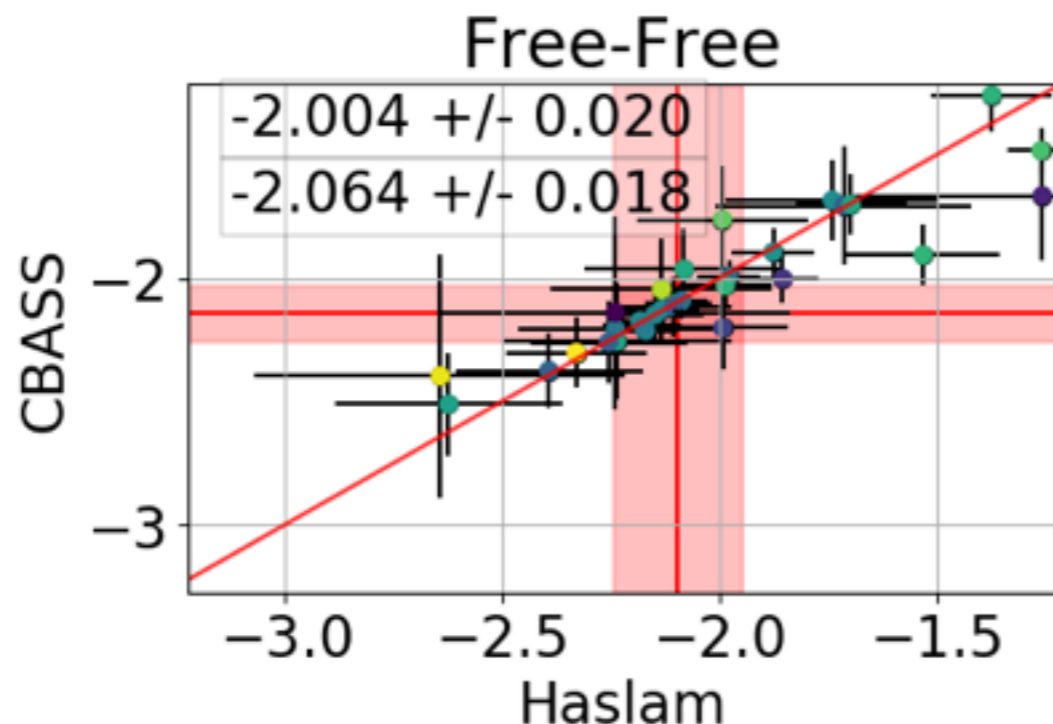
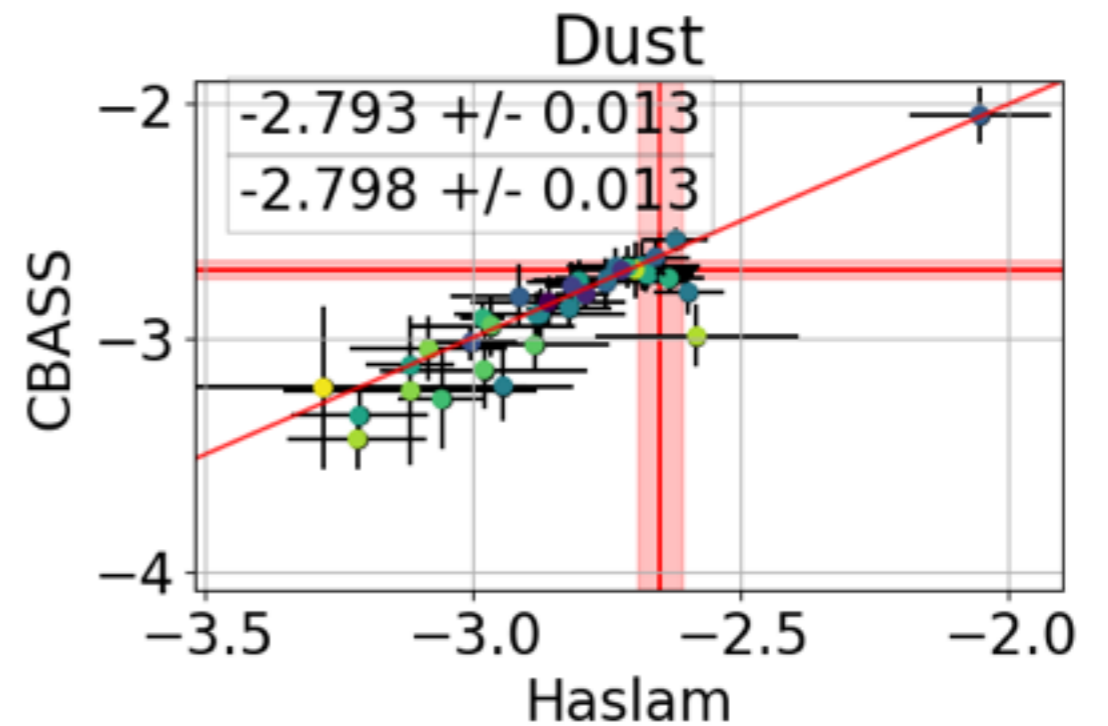
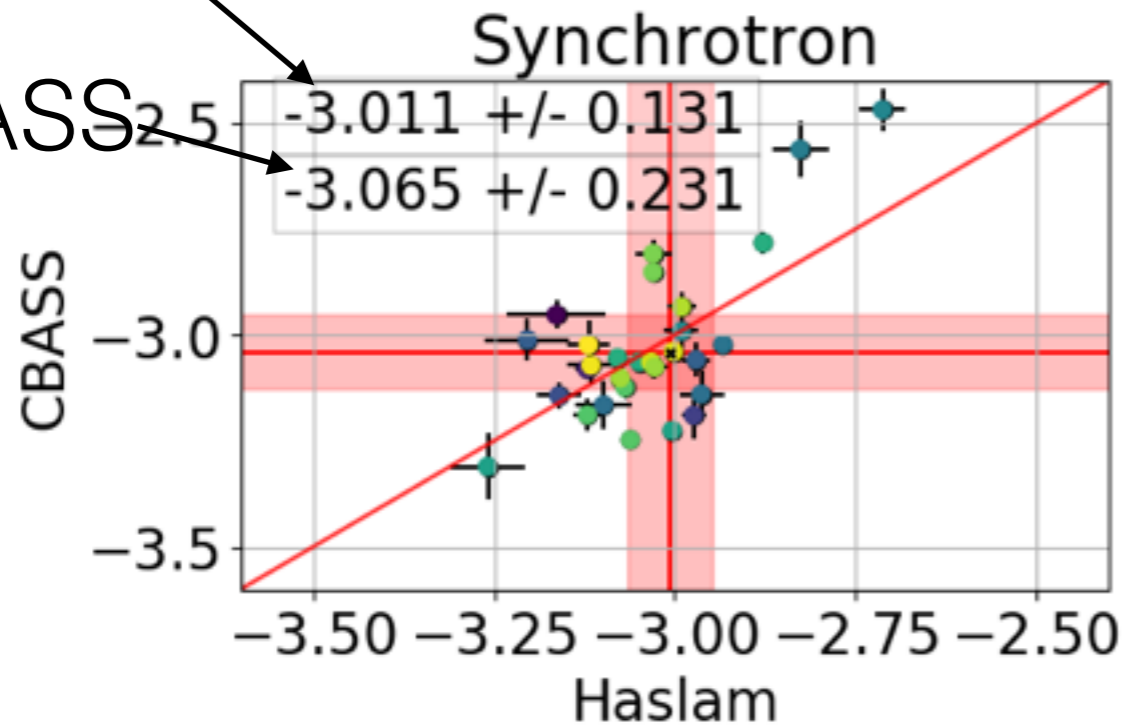


Spectral Indices

Global fit to high latitudes

Haslam

C-BASS



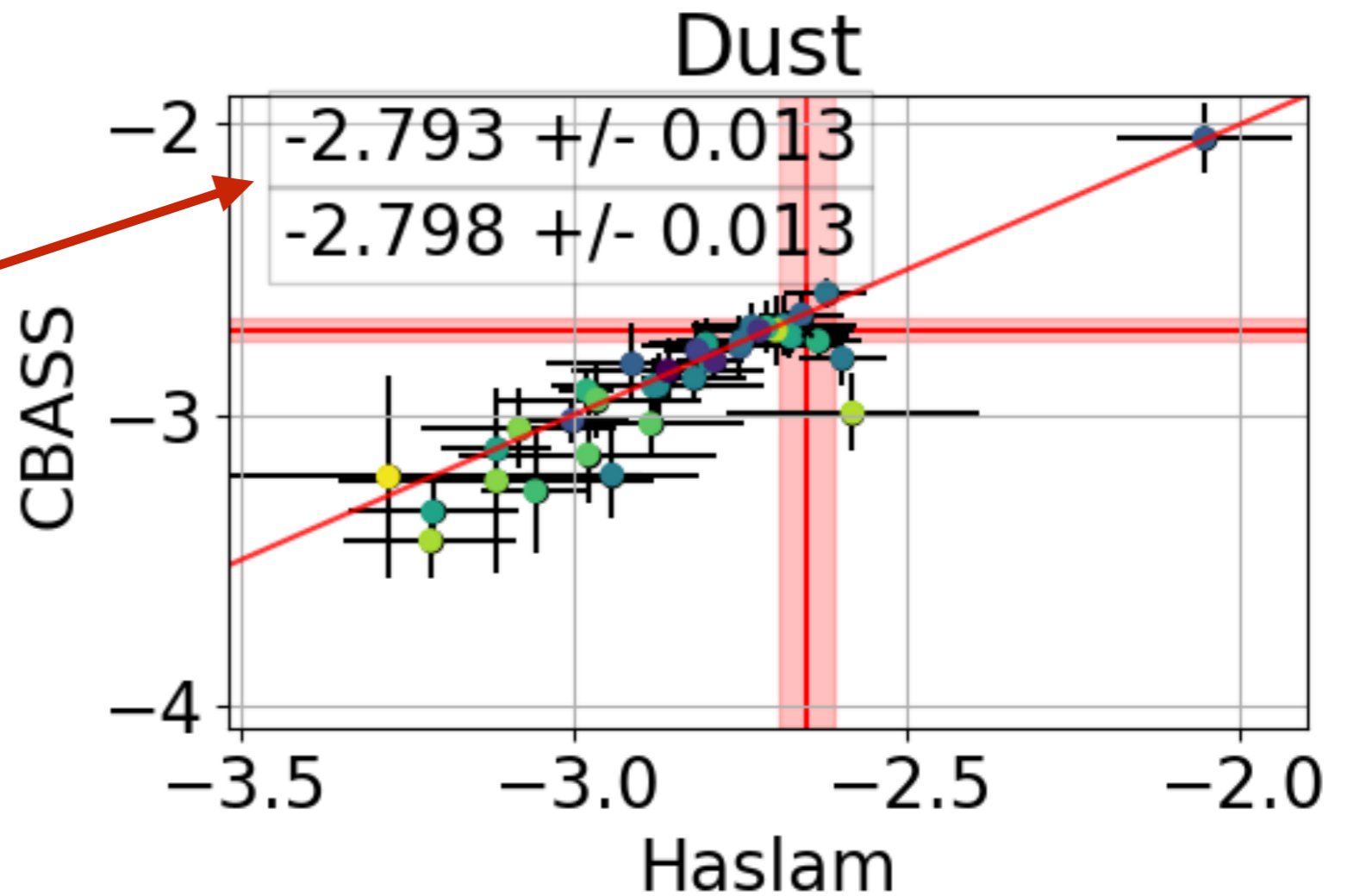
Fits per region

**Spectral indices
(generally) agree between
Haslam and CBASS**

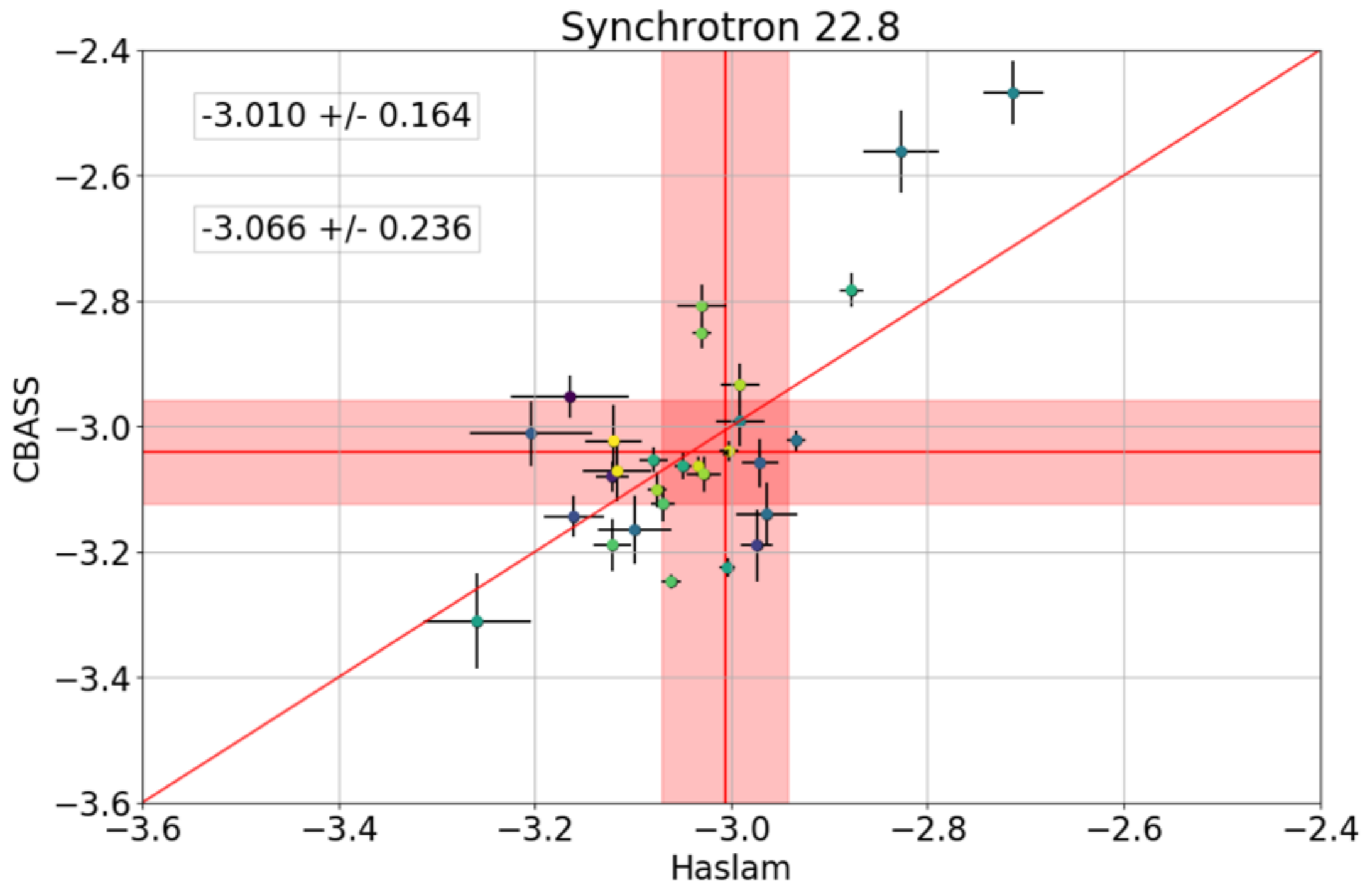
Spectral Indices

Global fit to high latitudes

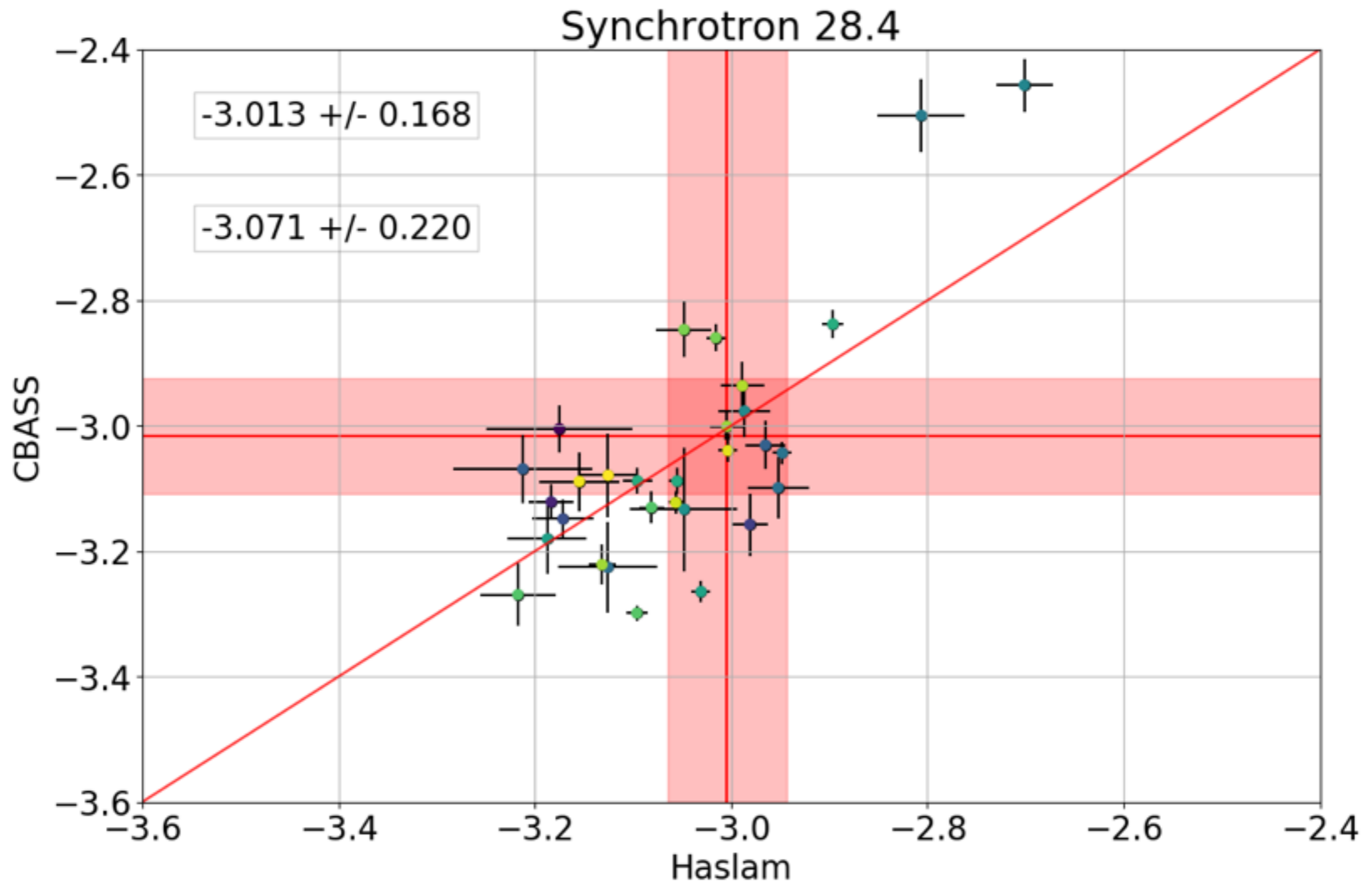
**Dust indices
robust to choice
of synchrotron
template...**



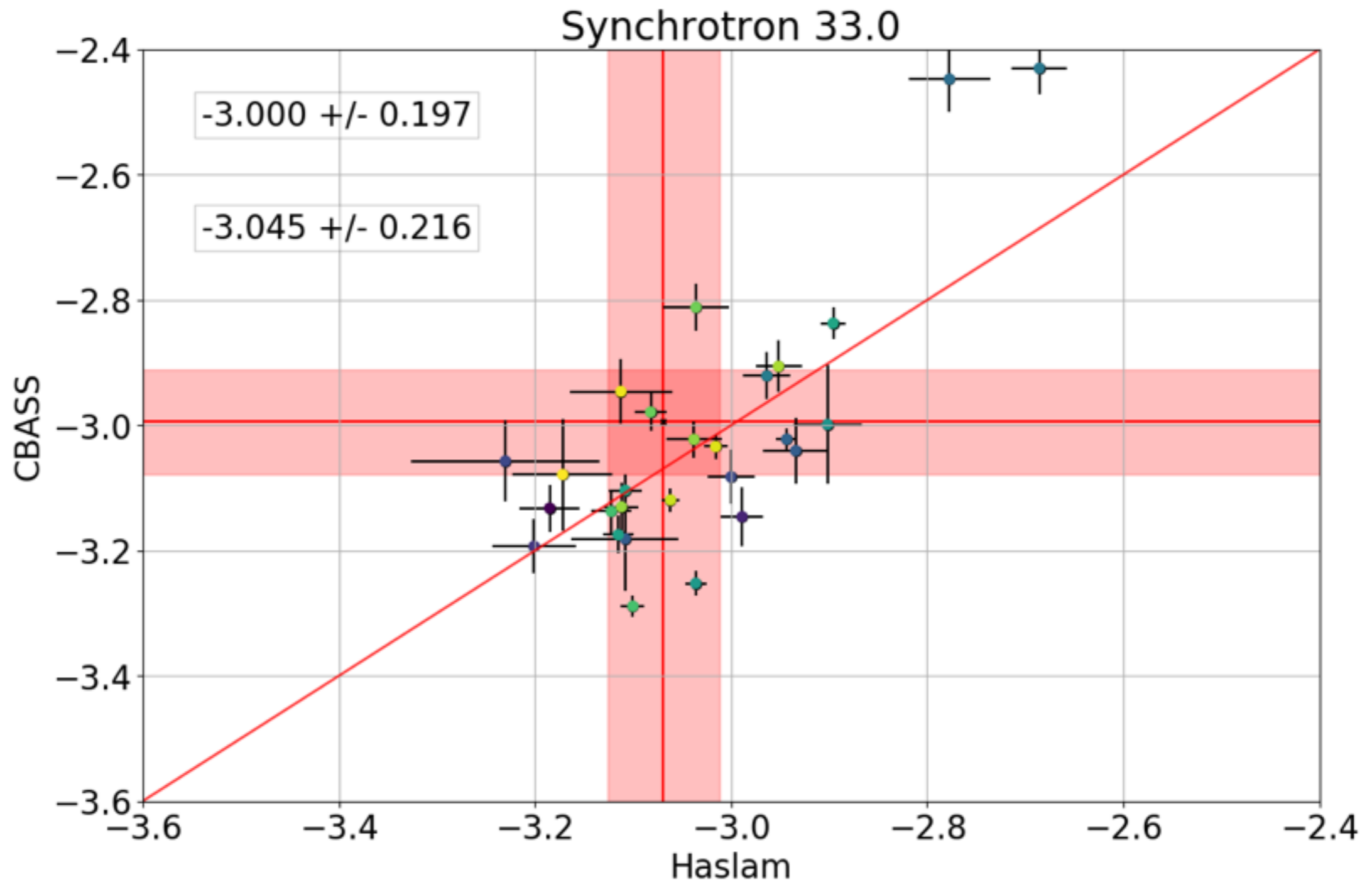
Spectral Indices



Spectral Indices



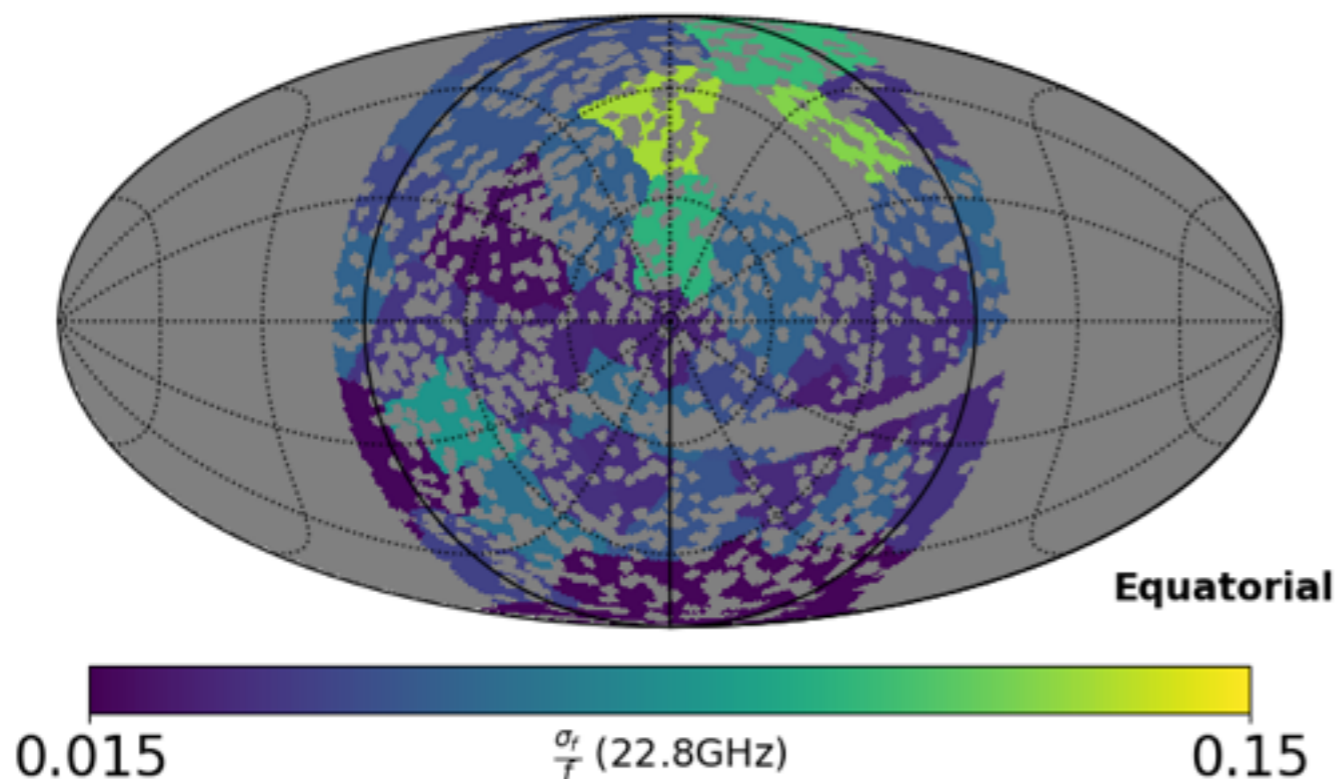
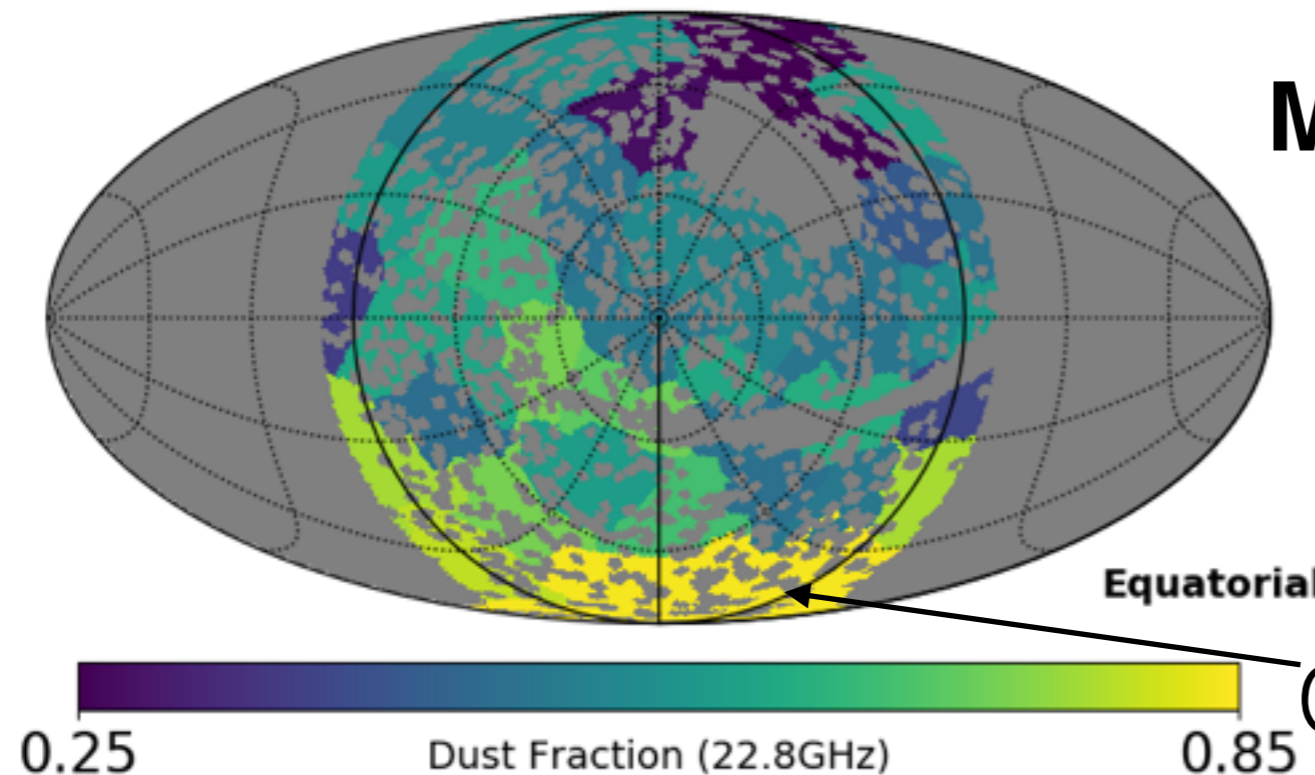
Spectral Indices



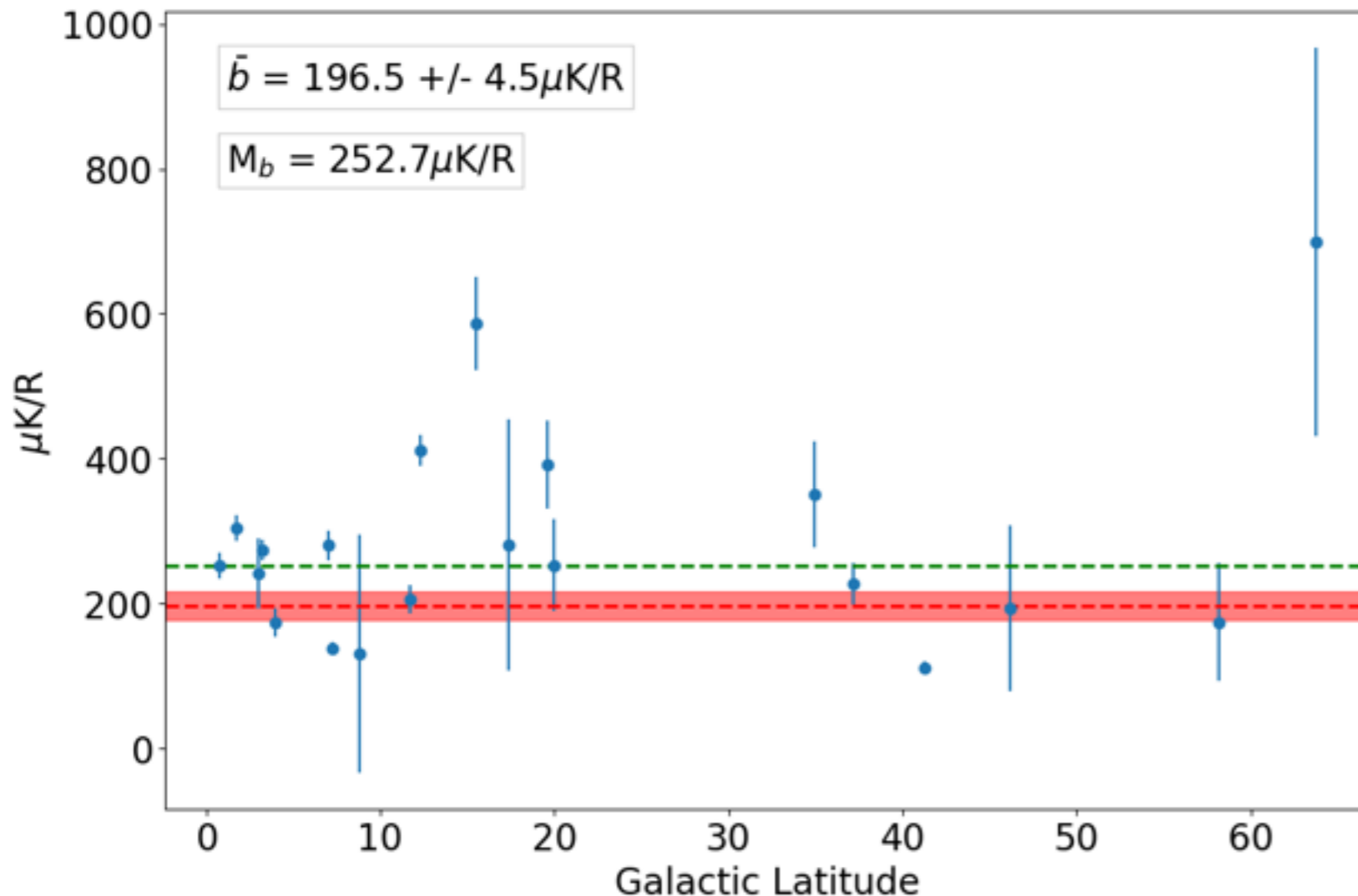
AME Fractions

**Mean AME/Total at 22.8GHz
~ 50%**

Some regions at low
Galactic latitudes approach
85%!



H α Ratios



Fitting Haslam to C-BASS to derive free-free coefficients...

...average (weighted and median) coefficients are low relative to 300 $\mu\text{K/R}$

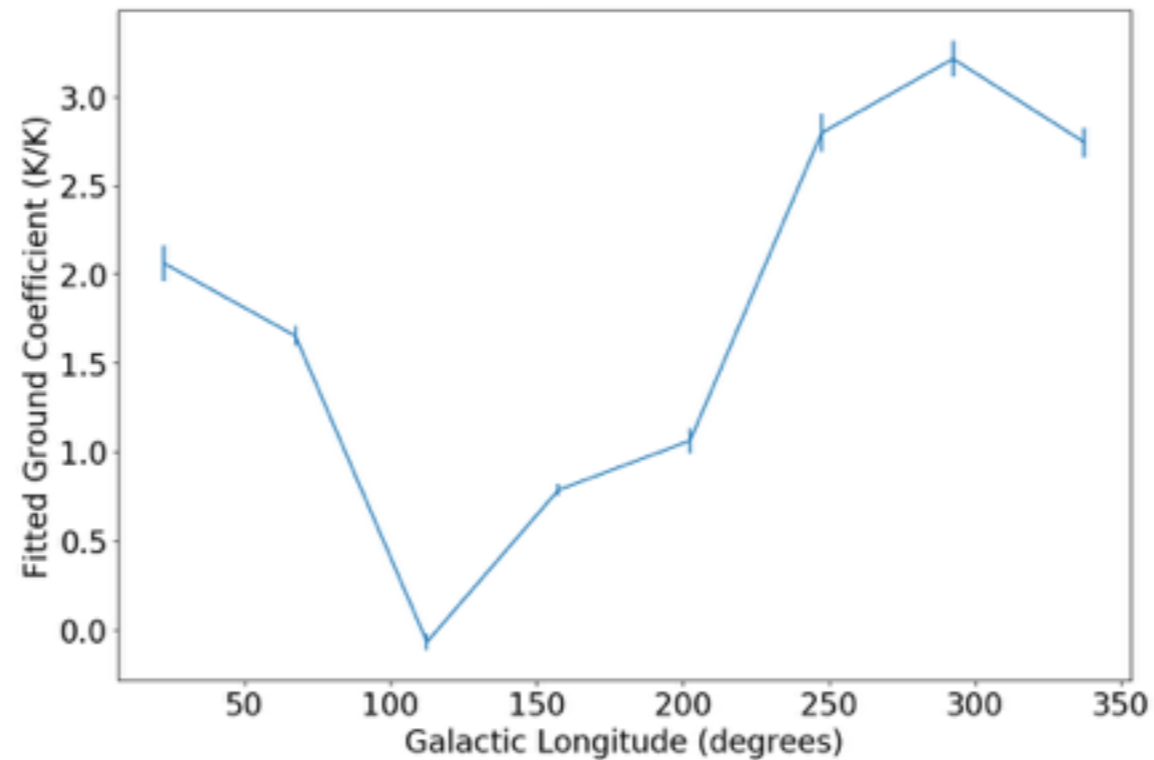
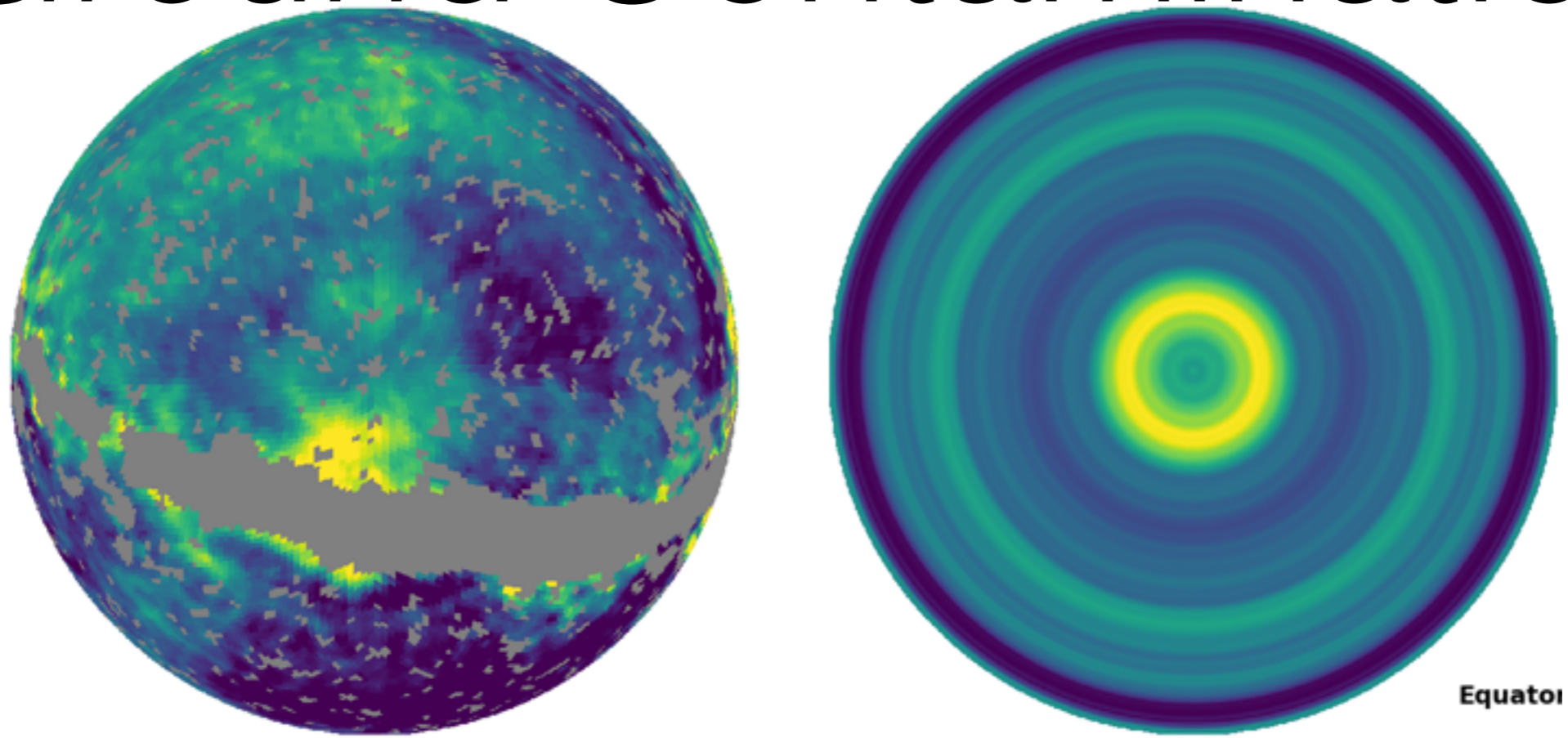
Possible evidence for **H α light dust scattering at the 15 to 30% level** at low to medium latitudes...

Conclusions

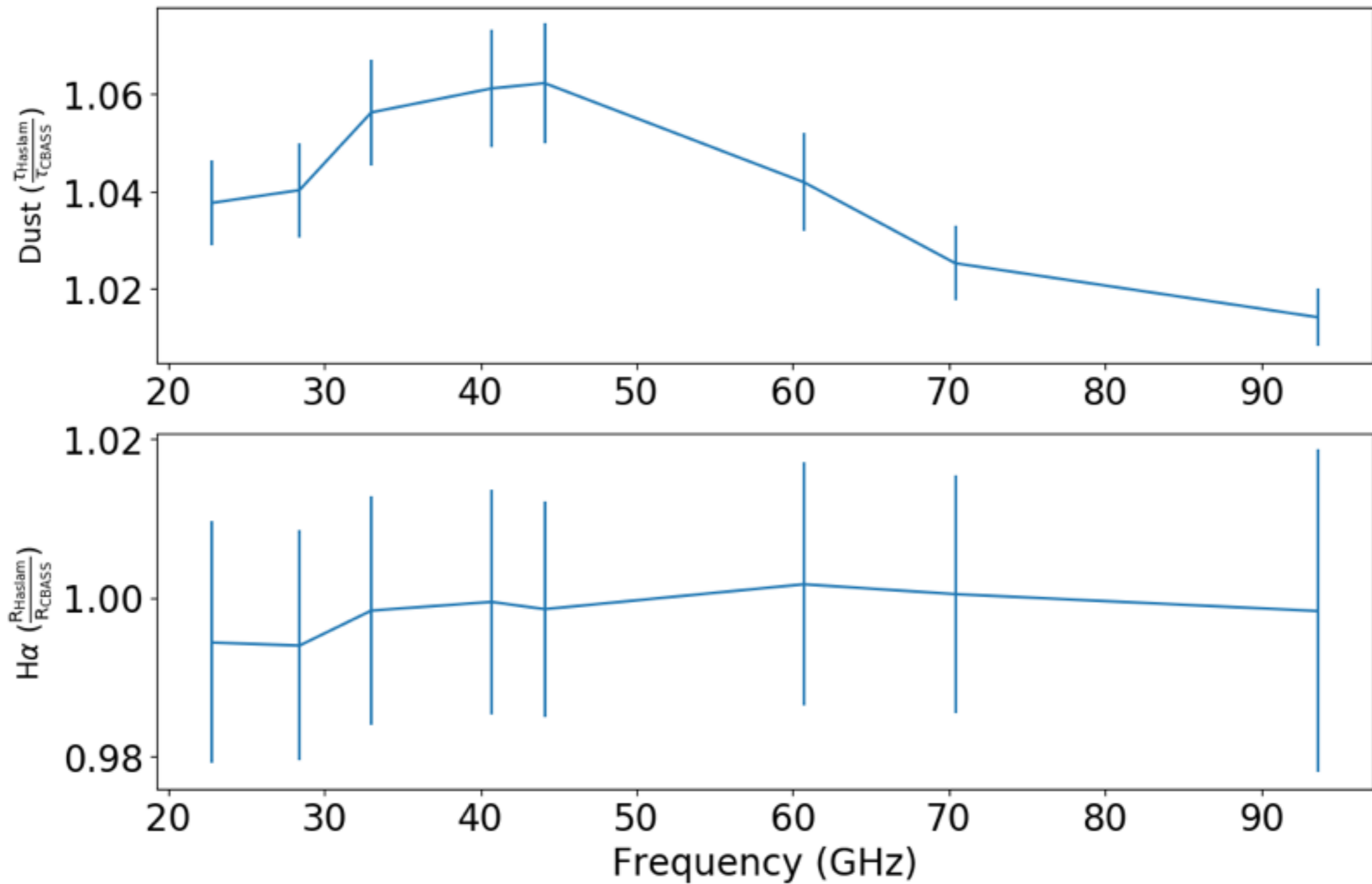
- Template fitting is a robust method for studying foreground emission on large scales (subject to caveats!)
- C-BASS, on average, as a synchrotron template is consistent with Haslam
- However, there are lots interesting individual regions that deviate up to the 10% level in dust and synchrotron.
- $H\alpha$ scattering up to the 30% level with lots of regional variability

Extra Slides

Ground Contamination

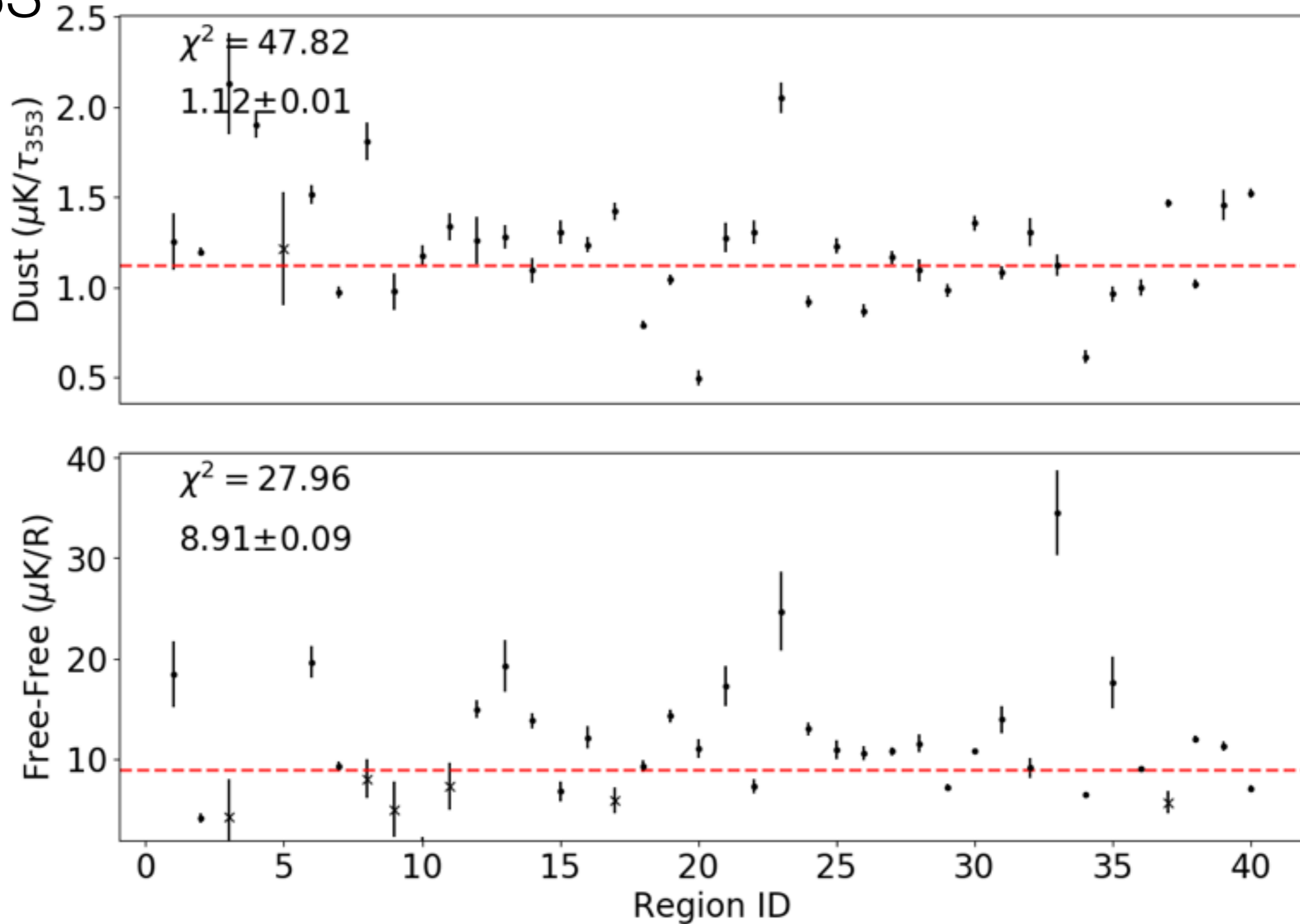


Ratios of Coefficients



Ratios of Coefficients

C-BASS



Ratios of Coefficients

Haslam

