

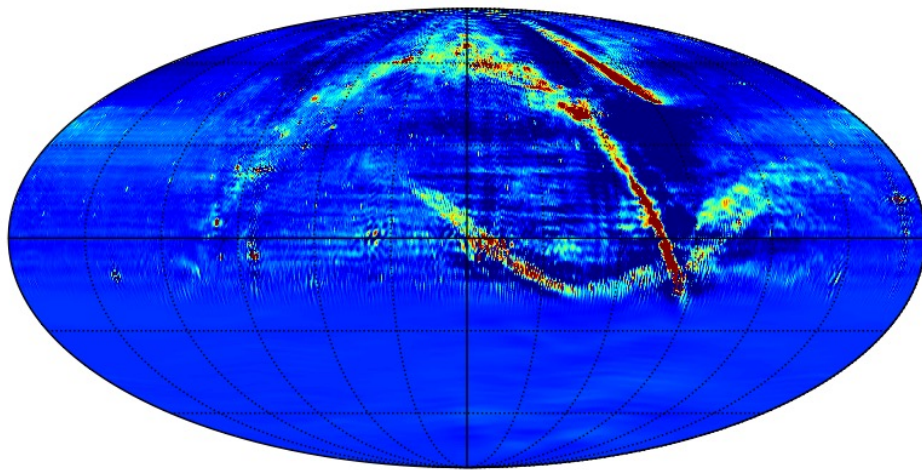
Tianlai HI Stacking Analysis

Shifan Zuo

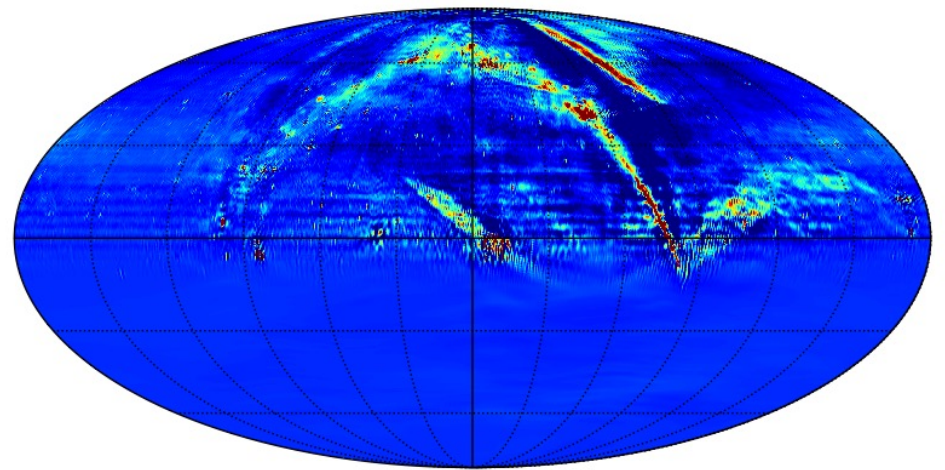
2026/3/31

Maps

14 days data start from 2018.1.21



XX



YY

Foreground Subtraction with GPR

$$y = f_{\text{sky}}(x) + f_{\text{mix}}(x) + f_{\text{ex}}(x) + f_{21}(x) + \epsilon. \quad (4)$$

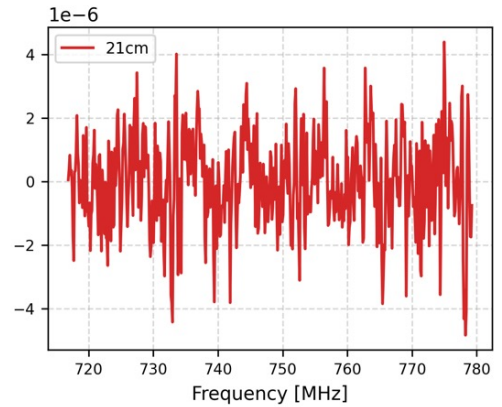
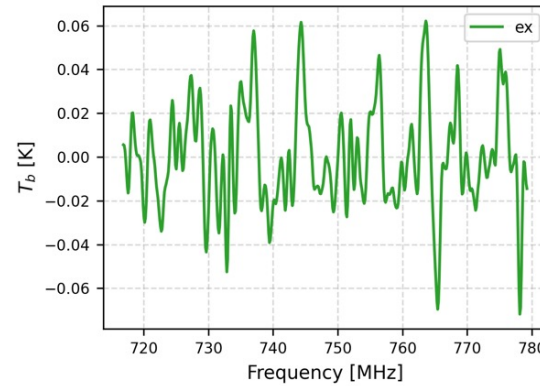
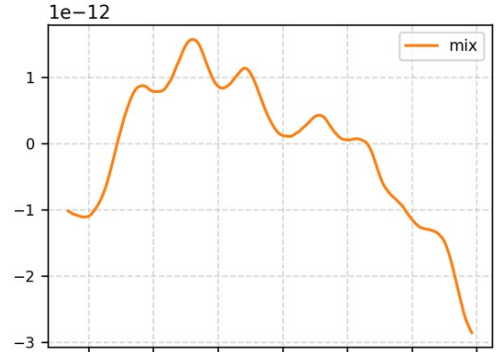
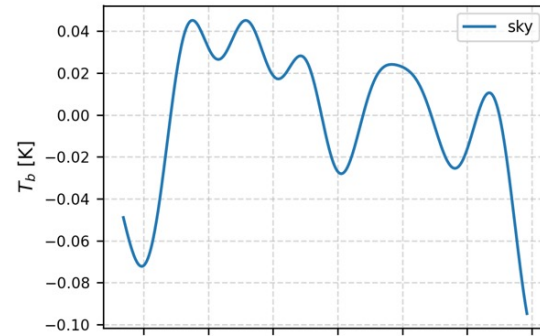
For the sake of simplicity and utilizing the additive property of matrices, we can reduce equation (4) to $y = f(x) + \epsilon$, and represent $f(x)$ with its corresponding covariance kernel K (from equation 2) as

$$K = K_{\text{sky}} + K_{\text{mix}} + K_{\text{noise}} + K_{\text{ex}} + K_{21}. \quad (5)$$

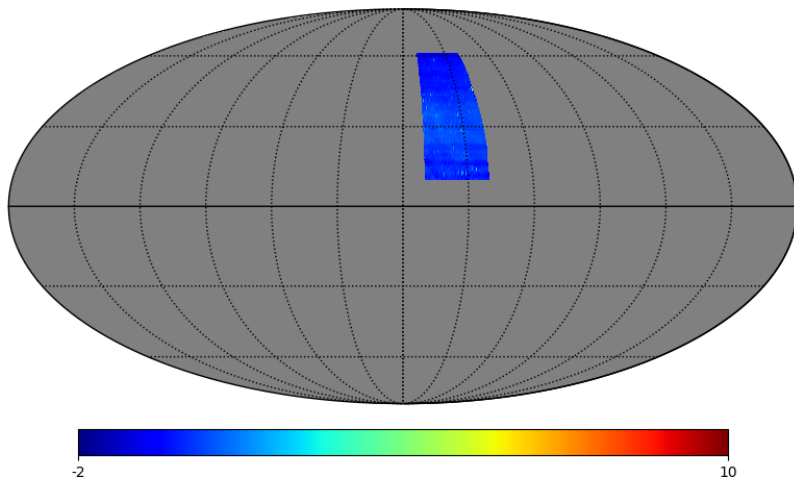
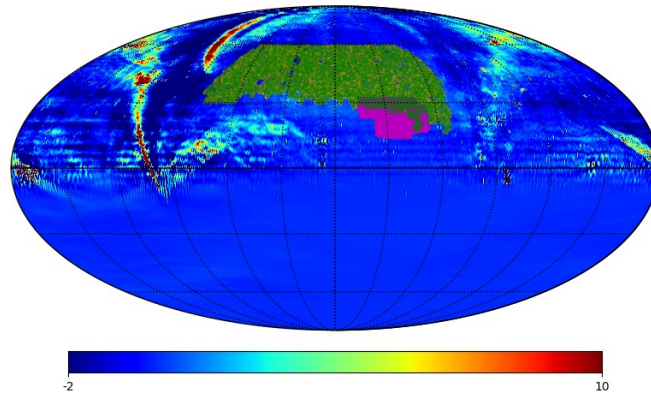
M20 modelled each of these kernels using the best possible fit Matern-class functions (equation 6, Stein 1999):

$$K_{\text{Matern}}(r) = \sigma^2 \frac{2^{1-\eta}}{\Gamma(\eta)} \left(\frac{\sqrt{2\eta}r}{l} \right)^\eta \kappa_\eta \left(\frac{\sqrt{2\eta}r}{l} \right). \quad (6)$$

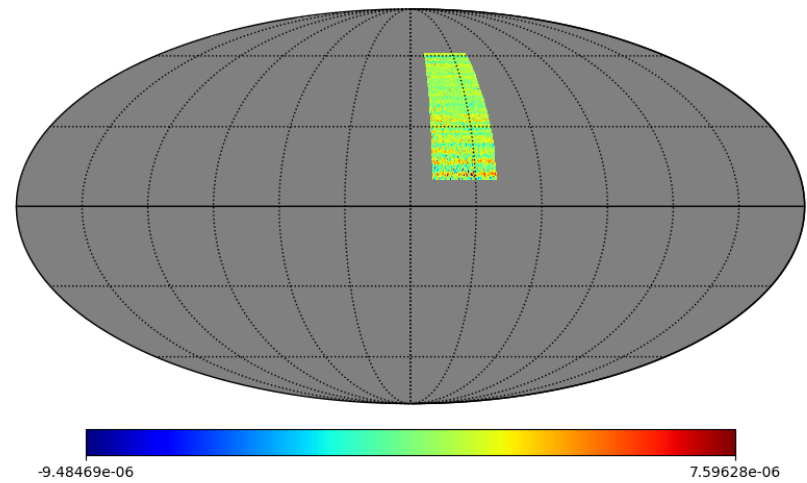
η_{sky}	$+\infty$	$K(\mathbf{x}, \mathbf{x}') = \exp\left(-\frac{\ \mathbf{x}-\mathbf{x}'\ ^2}{2\sigma^2}\right)$
η_{mix}	$3/2$	
η_{ex}	$5/2$	
η_{21}	$1/2$	$K(\mathbf{x}, \mathbf{x}') = \exp\left(-\frac{\ \mathbf{x}-\mathbf{x}'\ }{l}\right)$



Foreground Subtraction with GPR

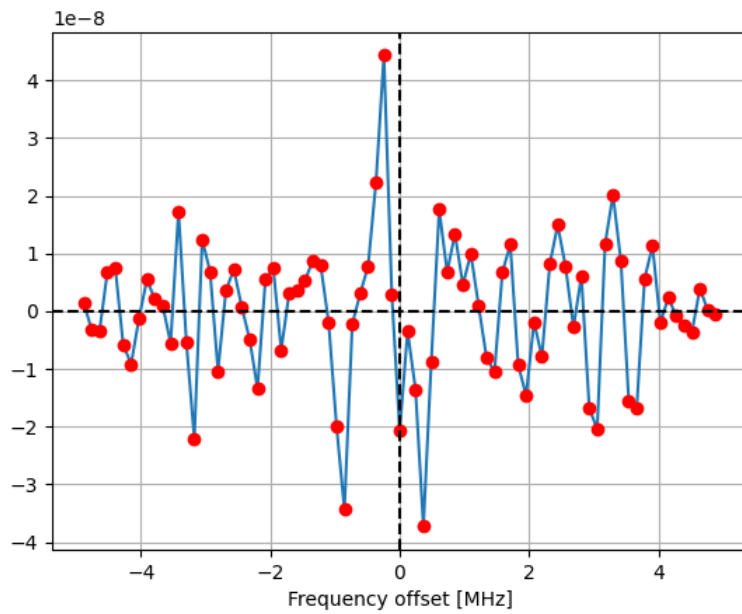


Before GPR

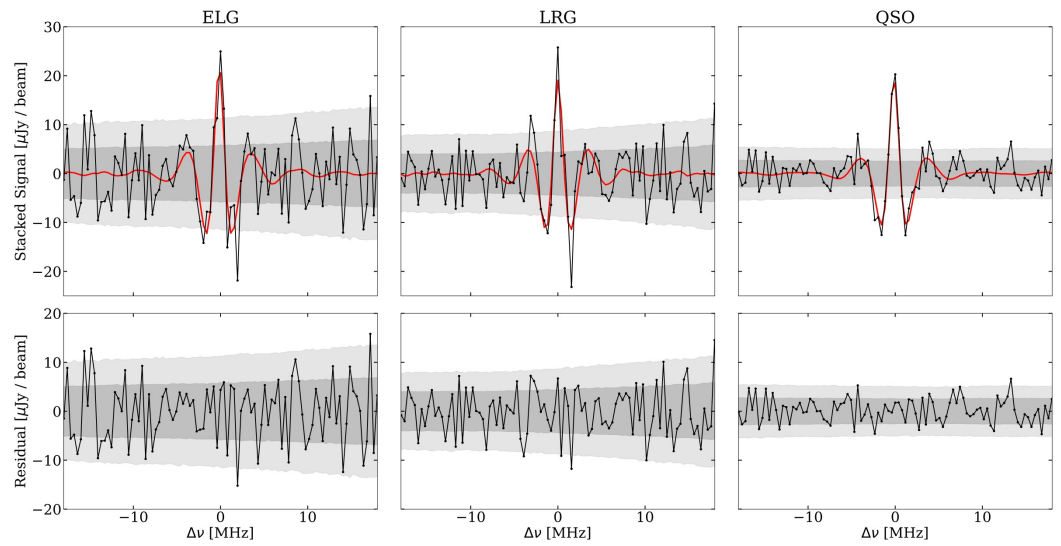


After GPR

Stacked Signal

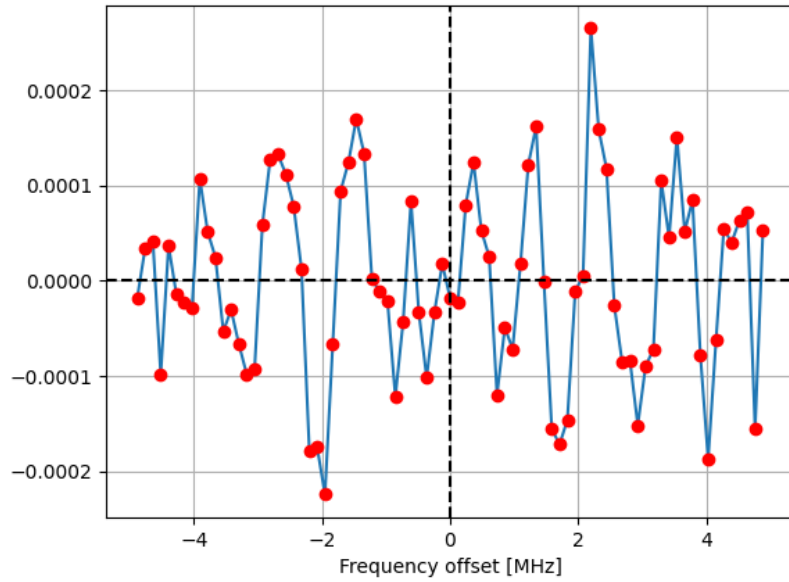


Tianlai ELG stacking result (YY only)

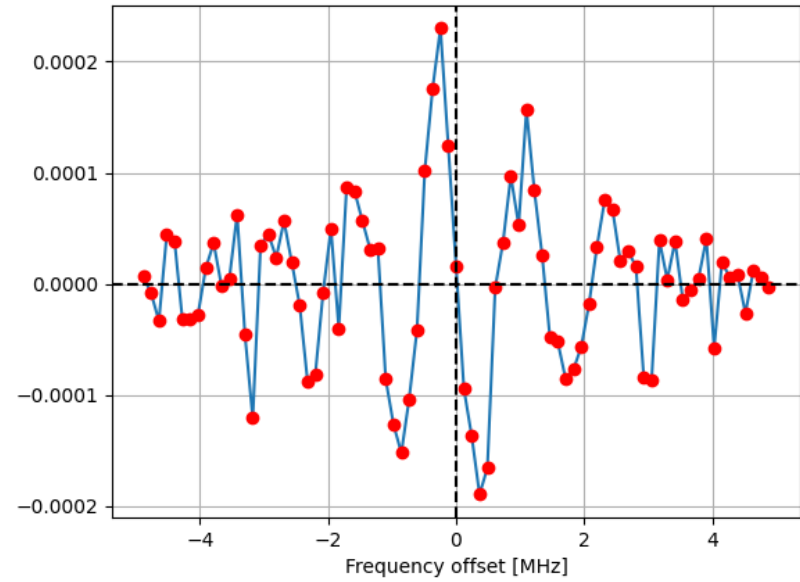


CHIME result

PCA 1-mode



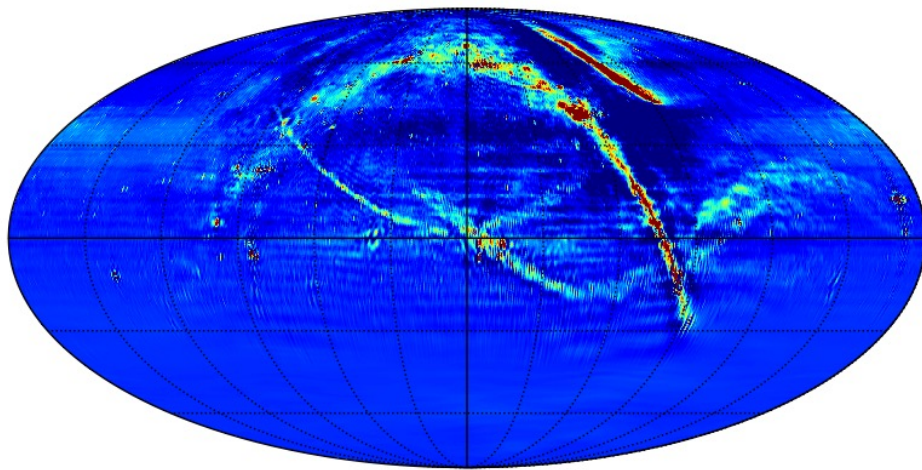
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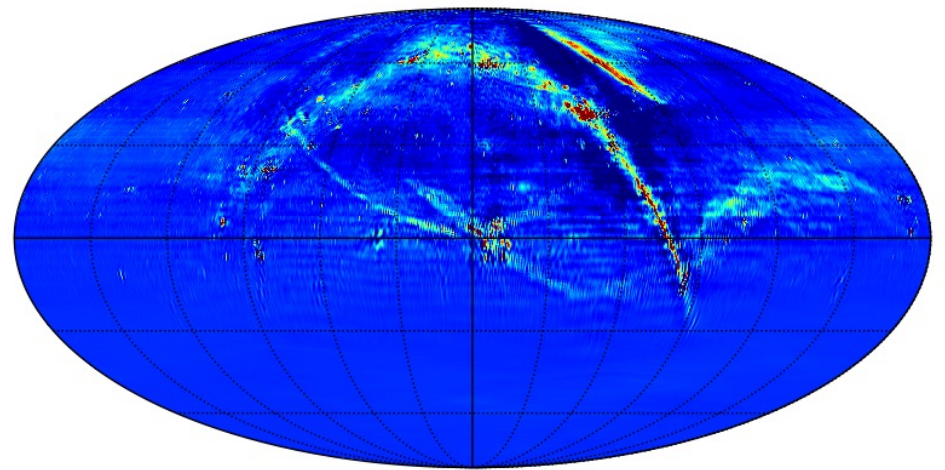
YY

Maps

14 days data start from 2018.1.21 + 6 days data start from 2018.3.22

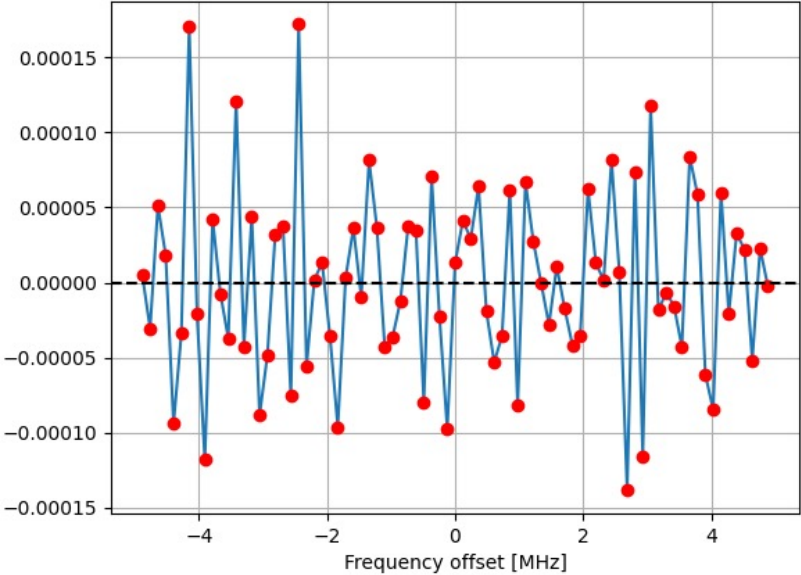


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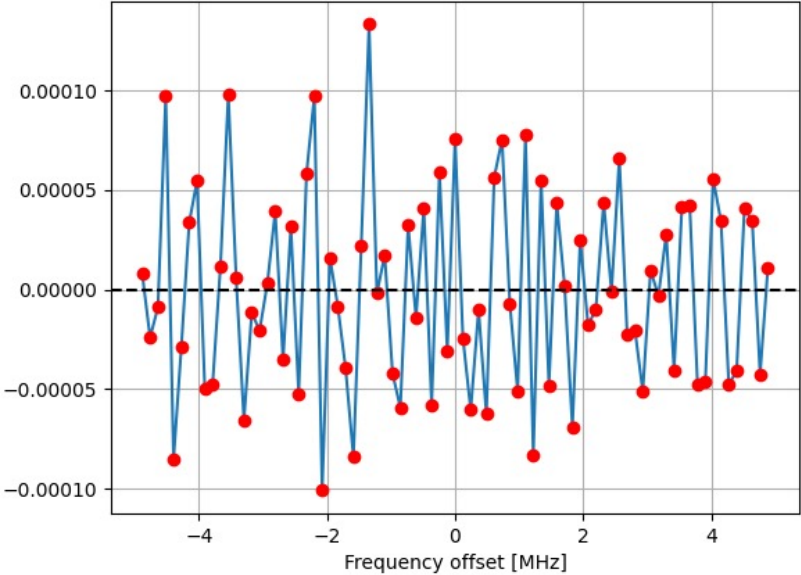


YY

Stacking Result



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