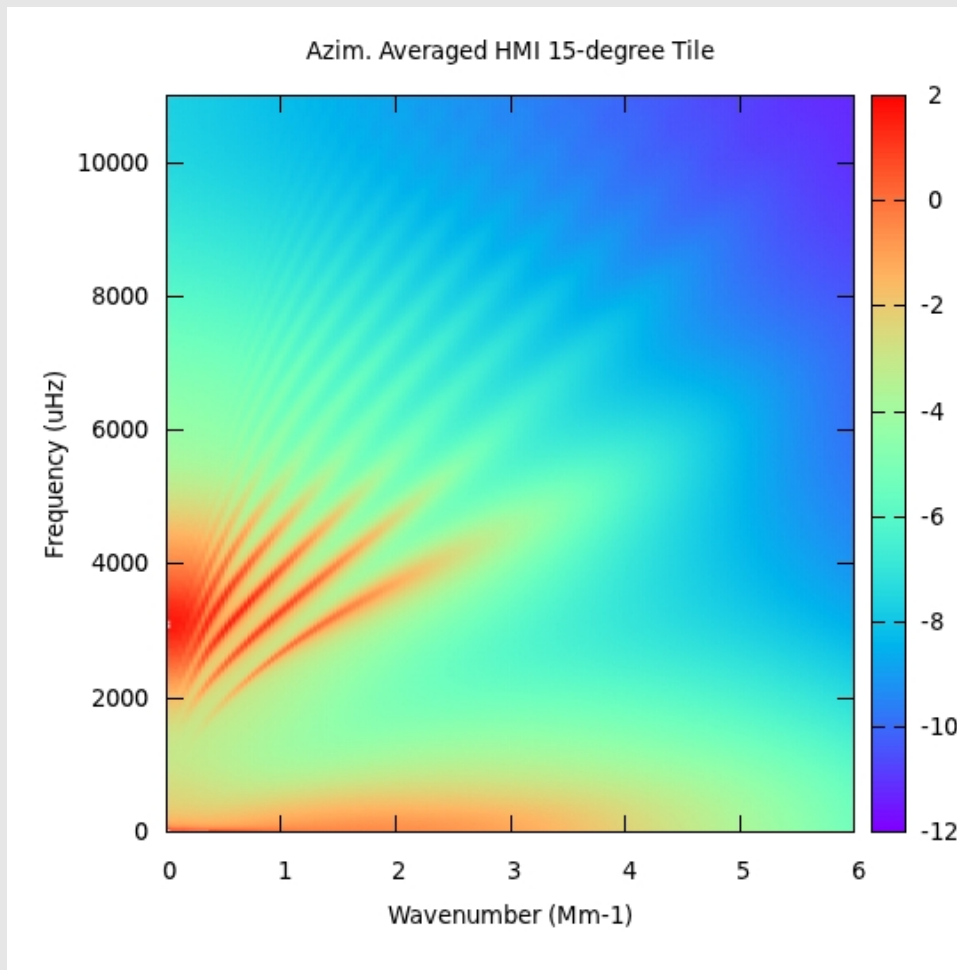


# Multiple Ridge Fitting

Ben Greer, Brad Hindman, Juri Toomre  
JILA, University of Colorado Boulder

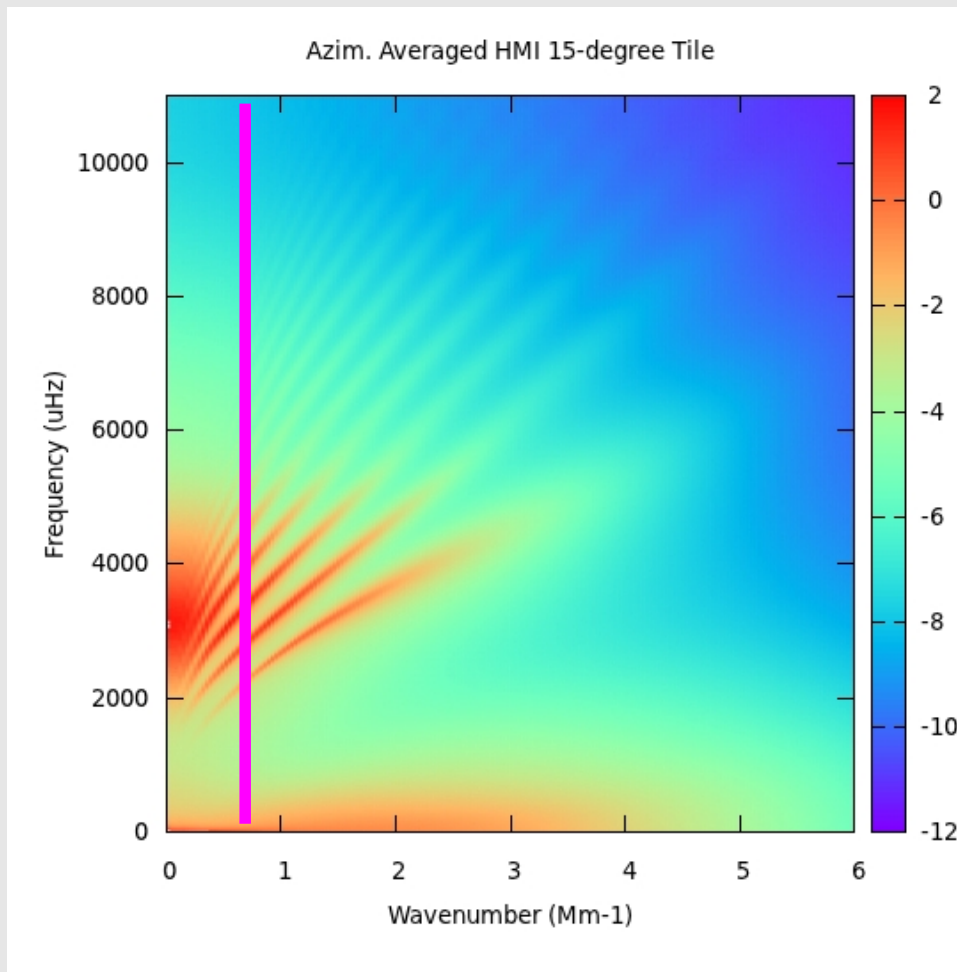
# Old Fitting Code

- Unwrap spectrum into (theta, k, nu)
- Guess where peak is, window around that



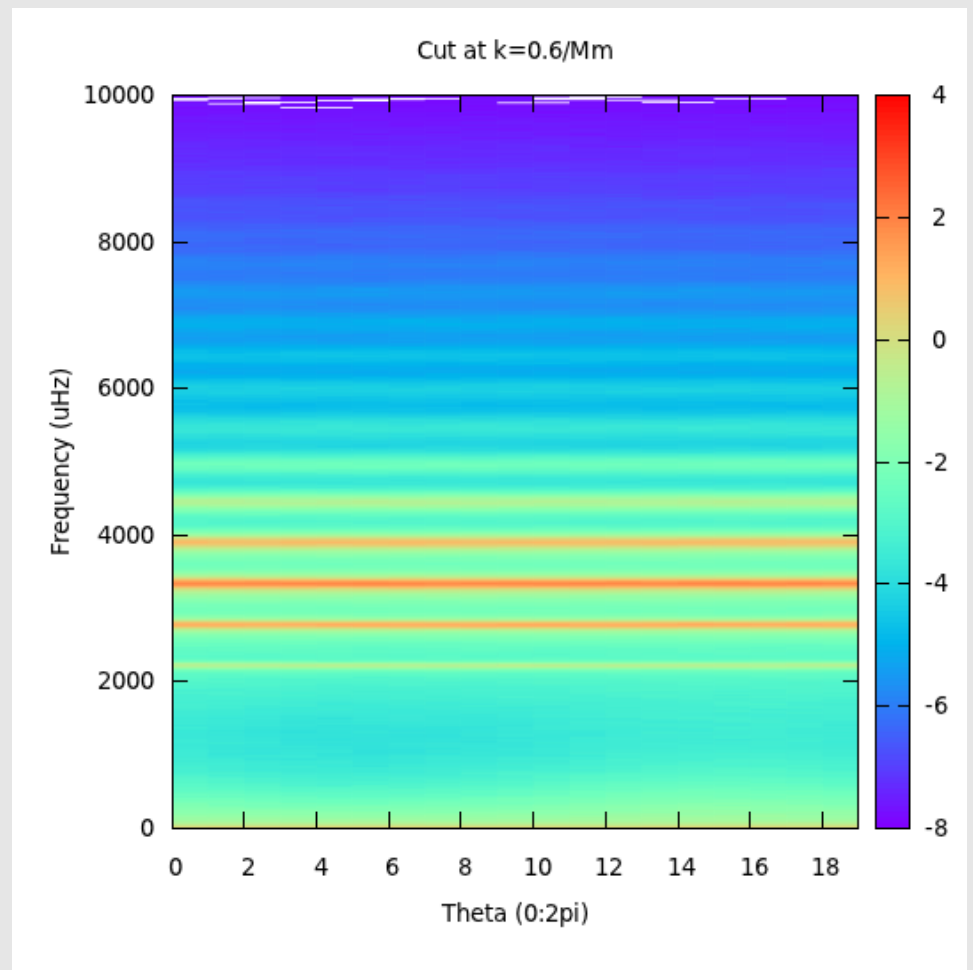
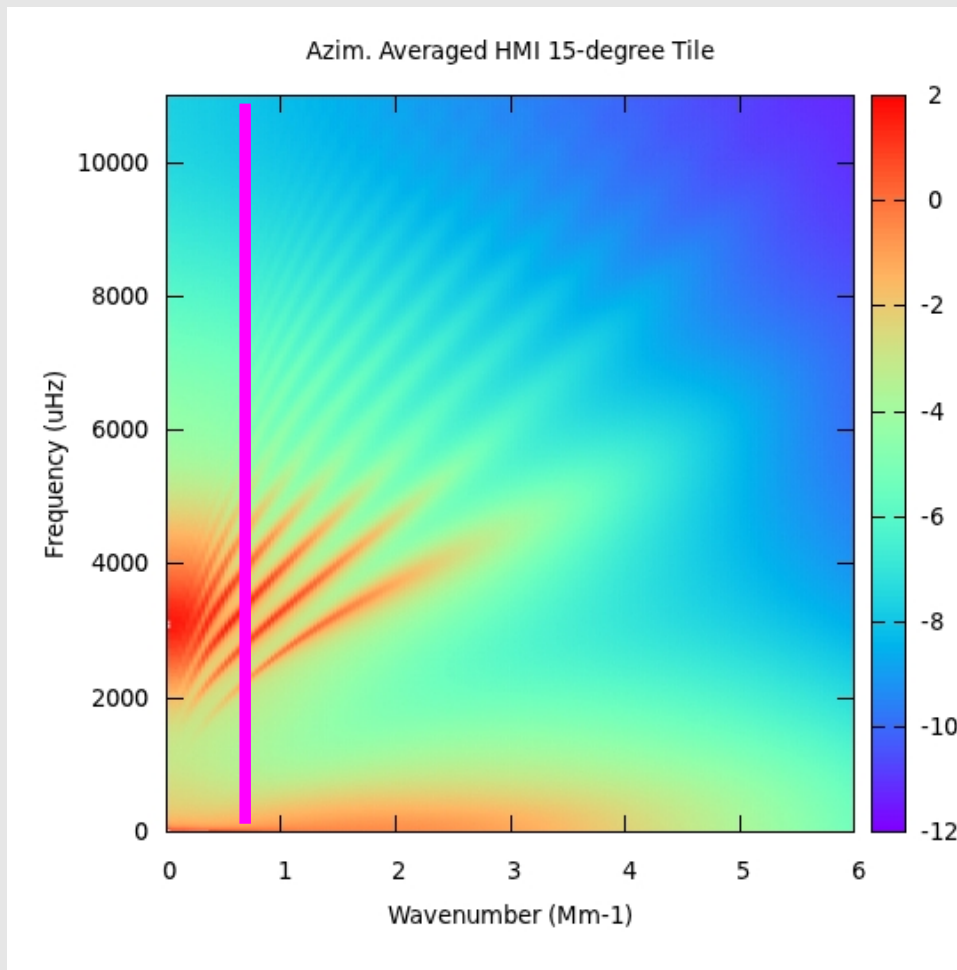
# Old Fitting Code

- Unwrap spectrum into (theta, k, nu)
- Guess where peak is, window around that



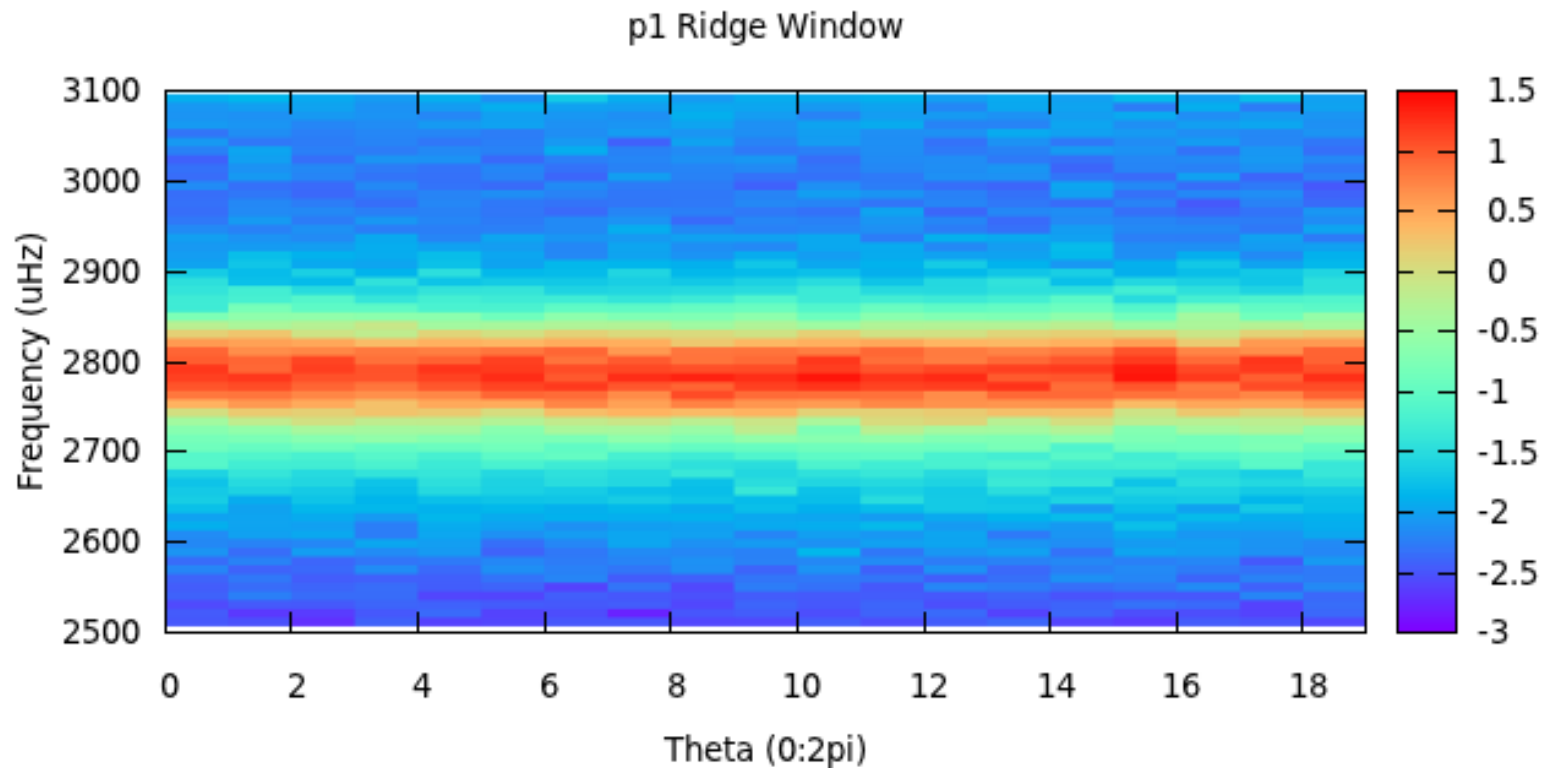
# Old Fitting Code

- Unwrap spectrum into (theta, k, nu)
- Guess where peak is, window around that



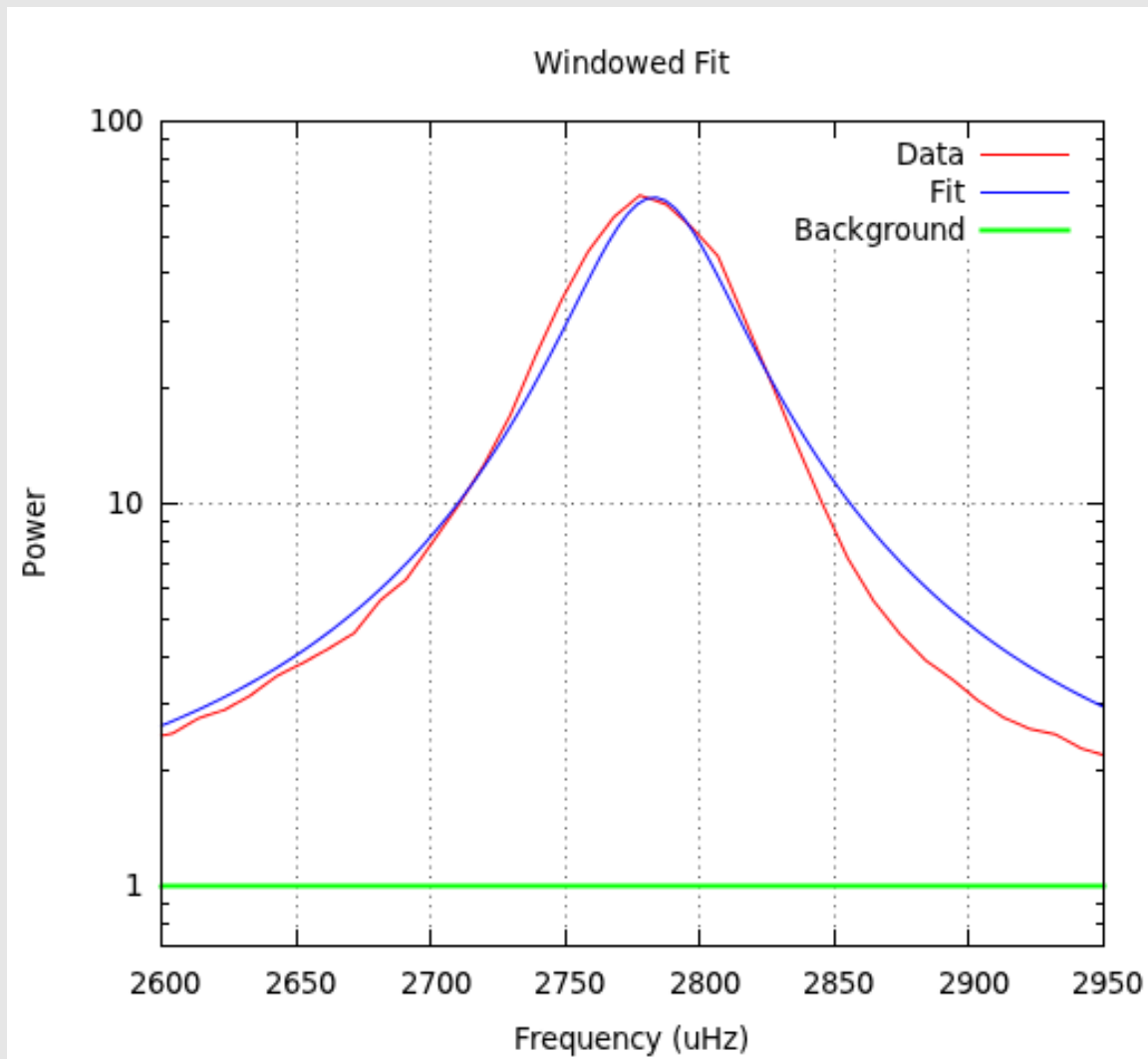
# Old Fitting Code

- Unwrap spectrum into (theta, k, nu)
- Guess where peak is, window around that

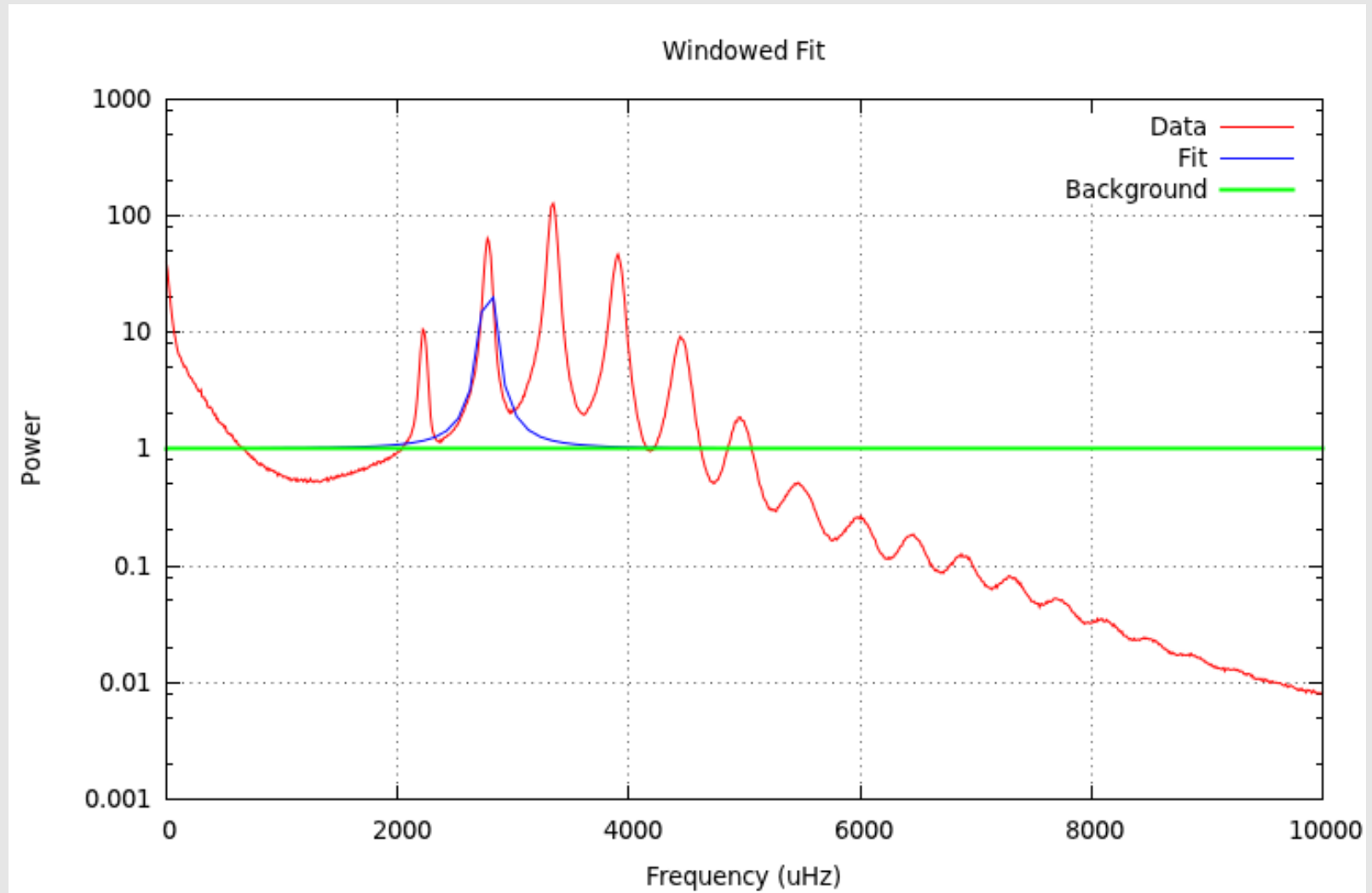


# Old Fitting Code

- Problems: window, background

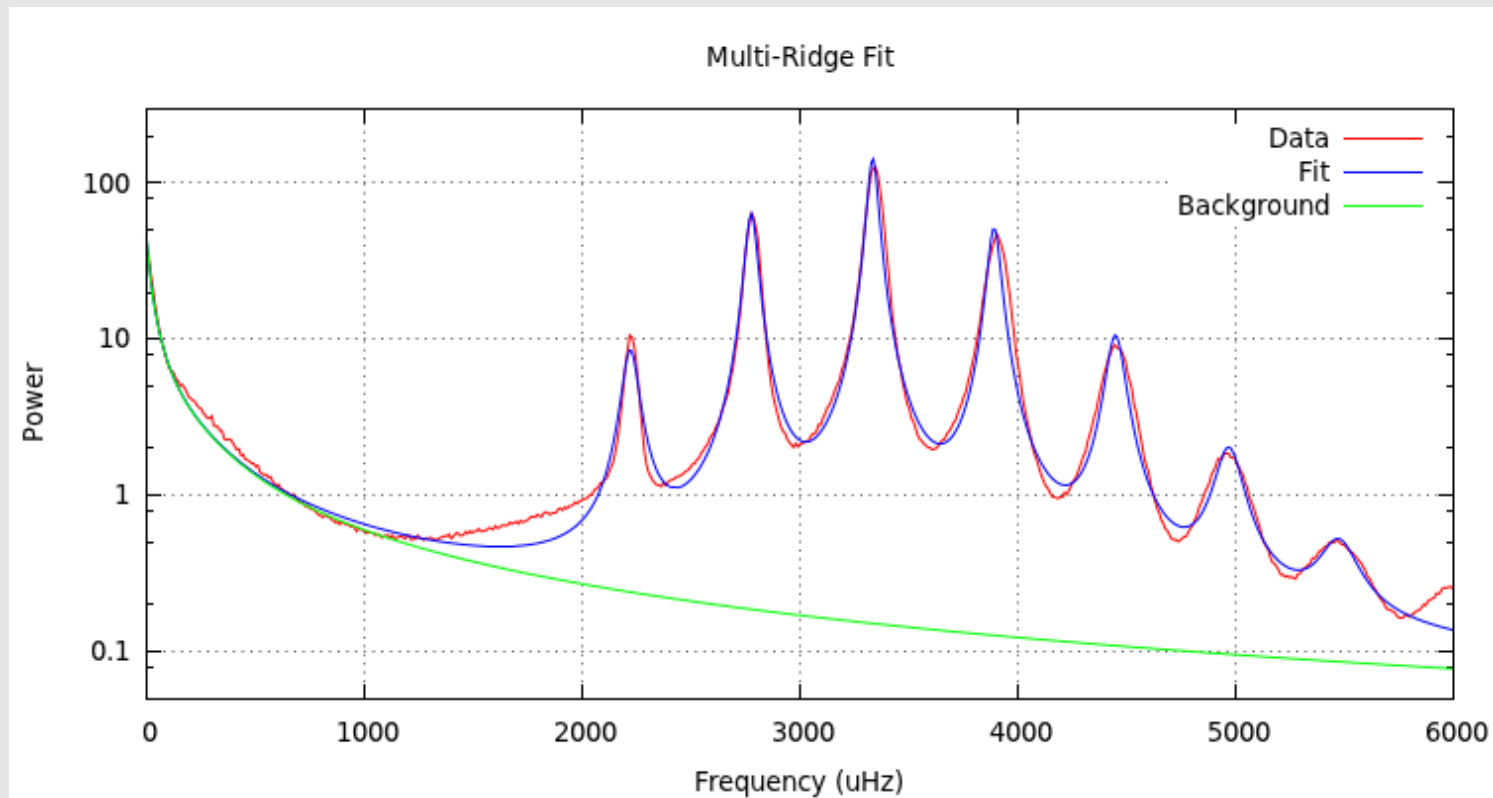


# Old Fitting Code



# New Fitting Code

- Fit multiple ridges at constant wavenumber simultaneously
- Window from 0 to acoustic cut-off frequency
- Include background terms, anisotropies





# Background Terms

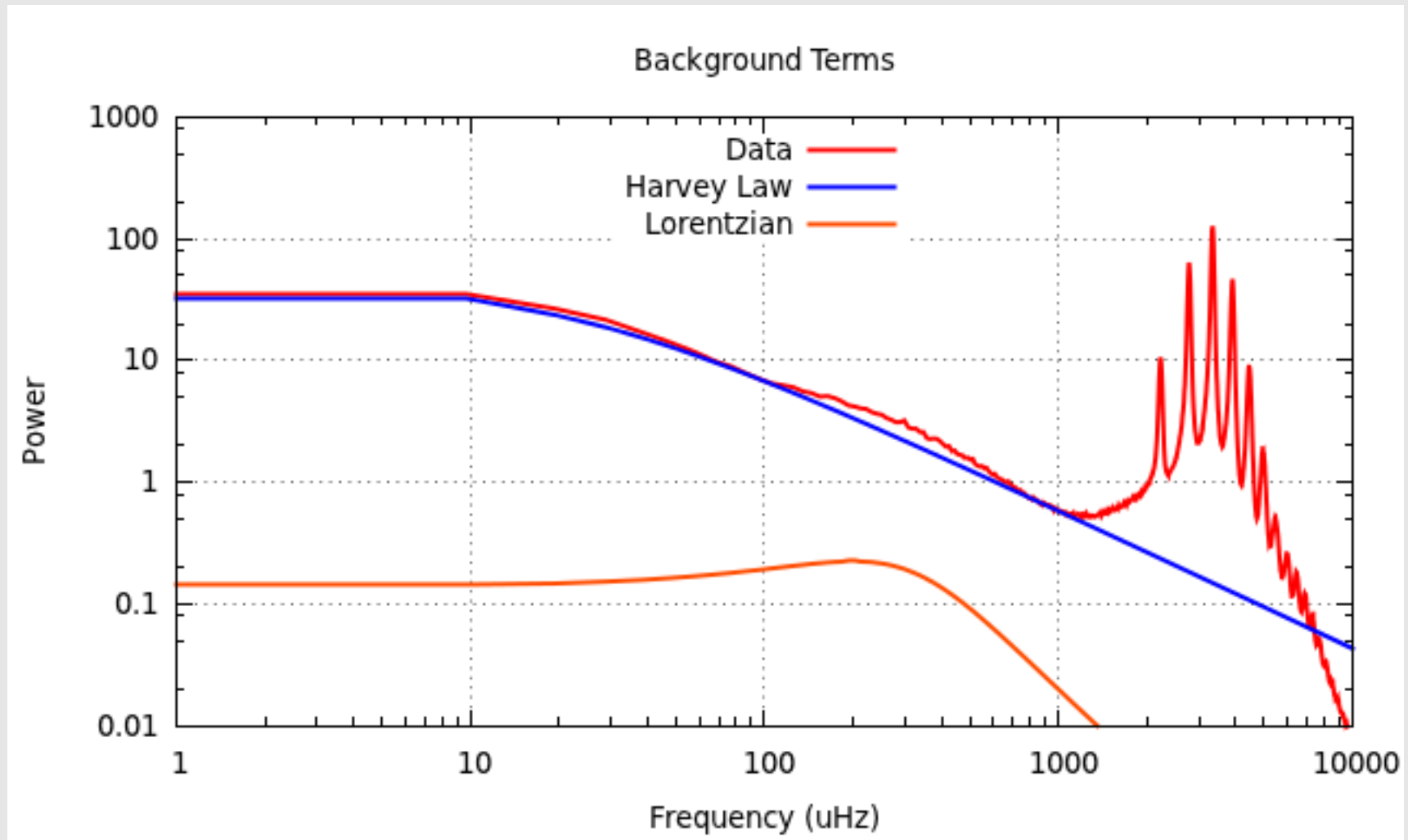
- Harvey power law

$$\frac{A}{1 + (\nu/\nu_0)^b}$$

- Extra lorentzian to describe oscillations

$$\frac{1}{2\pi} \frac{A \cdot \Gamma}{(\nu - \nu_0 + \vec{u} \cdot \vec{k})^2 + \left(\frac{\Gamma}{2}\right)^2}$$

# Background



# Anisotropy

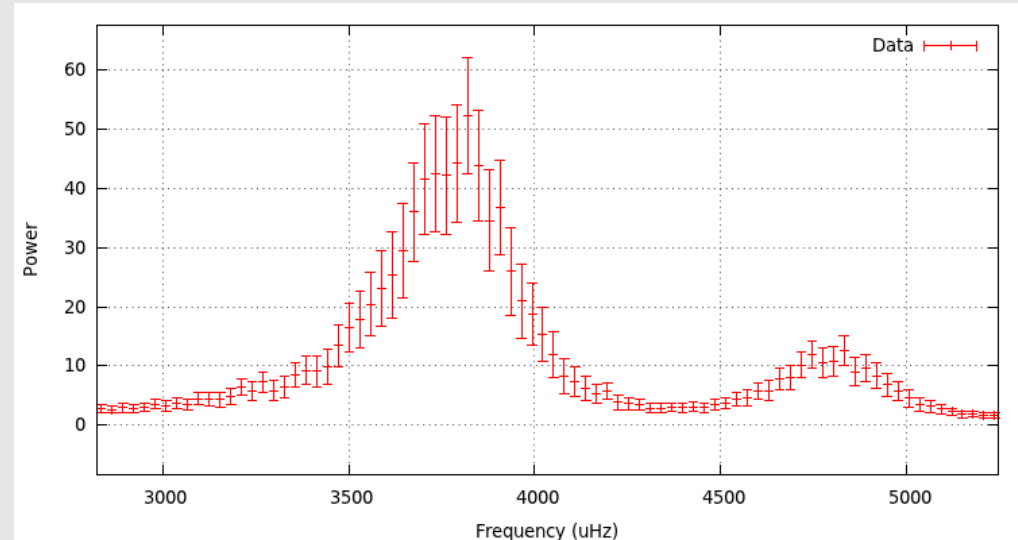
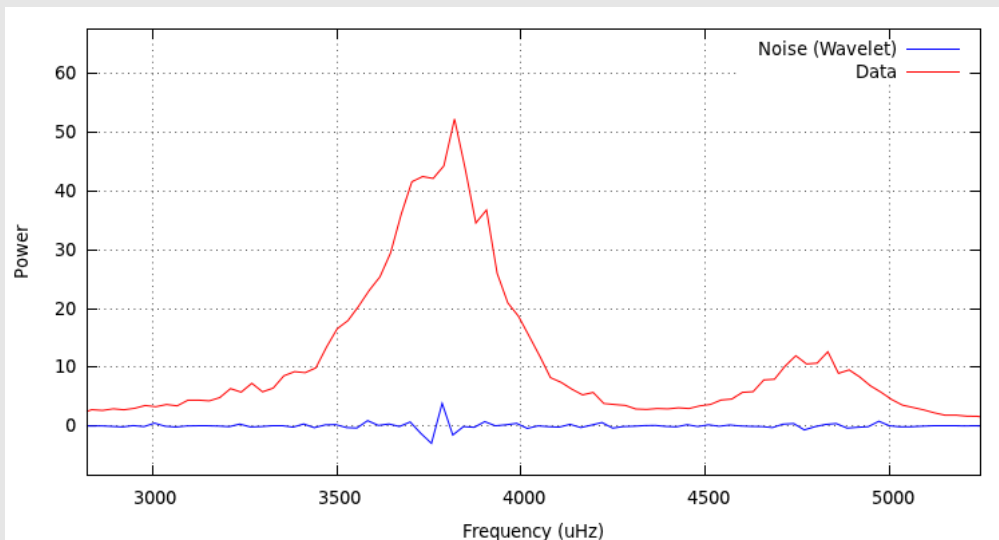
- Allow for power variation along theta
- Separate fit for peaks, background

$$\frac{A}{1 + (v/v_0)^b} [1 + B \cos(2(\theta - \theta_0))]$$

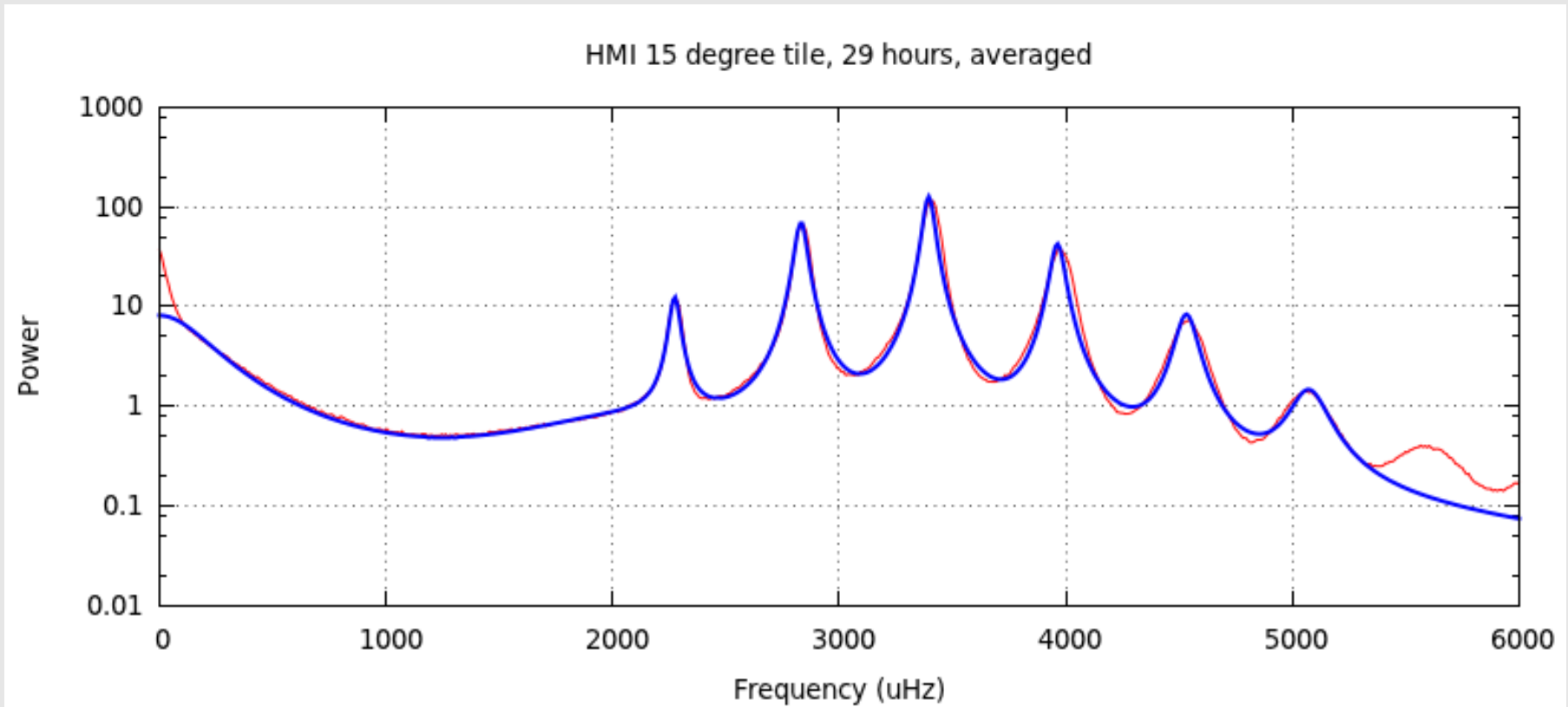
$$\frac{1}{2\pi} \frac{A_i \cdot \Gamma_i}{(v - v_{0_i} + \vec{u}_i \cdot \vec{k})^2 + (\frac{\Gamma_i}{2})^2} [1 + B_i \cos(2(\theta - \theta_{0_i}))]$$

# Noise Estimation

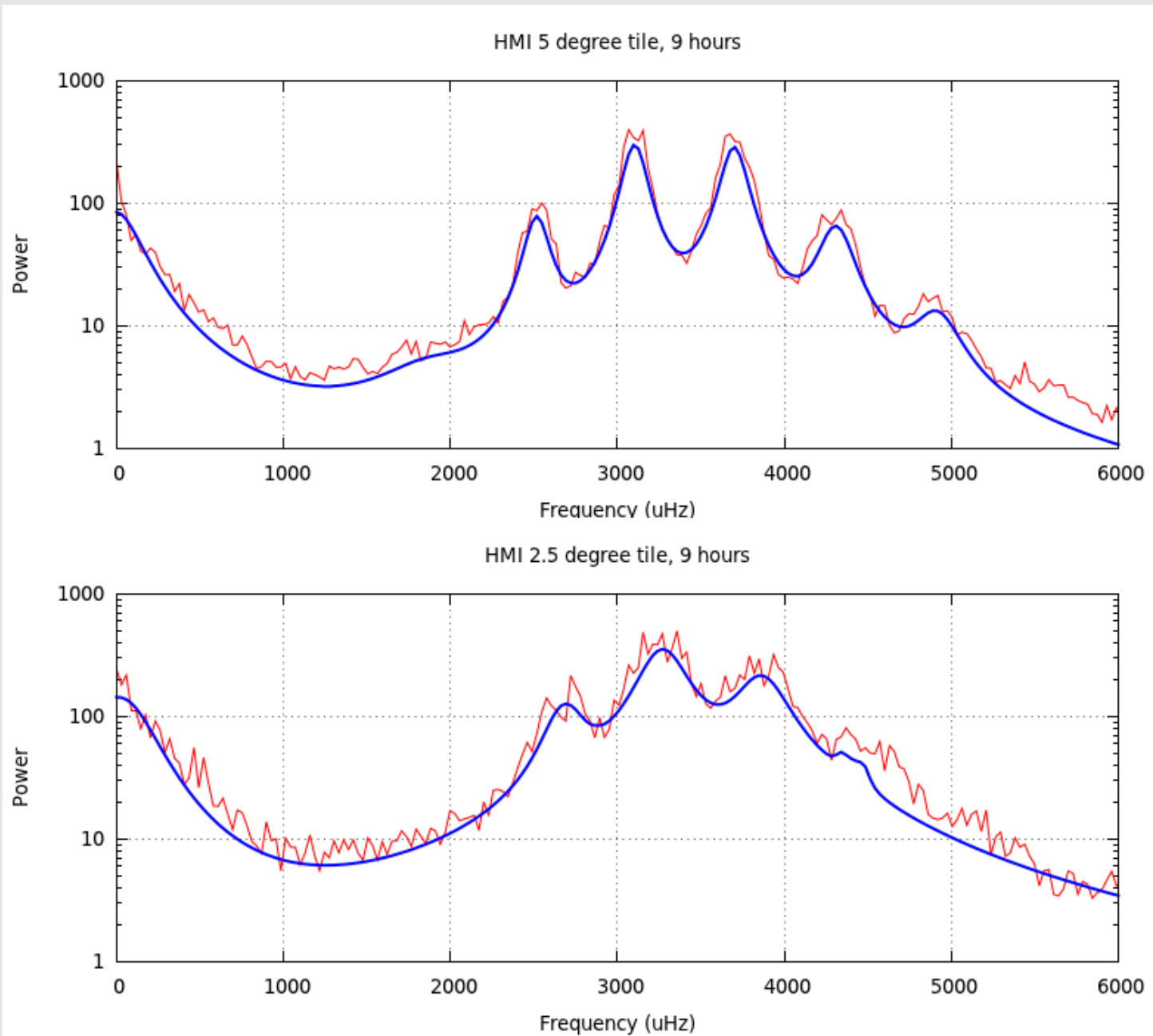
- Chi-squared fit required accurate noise estimation
- Wavelet transform used to estimate small-scale fluctuations in spectrum



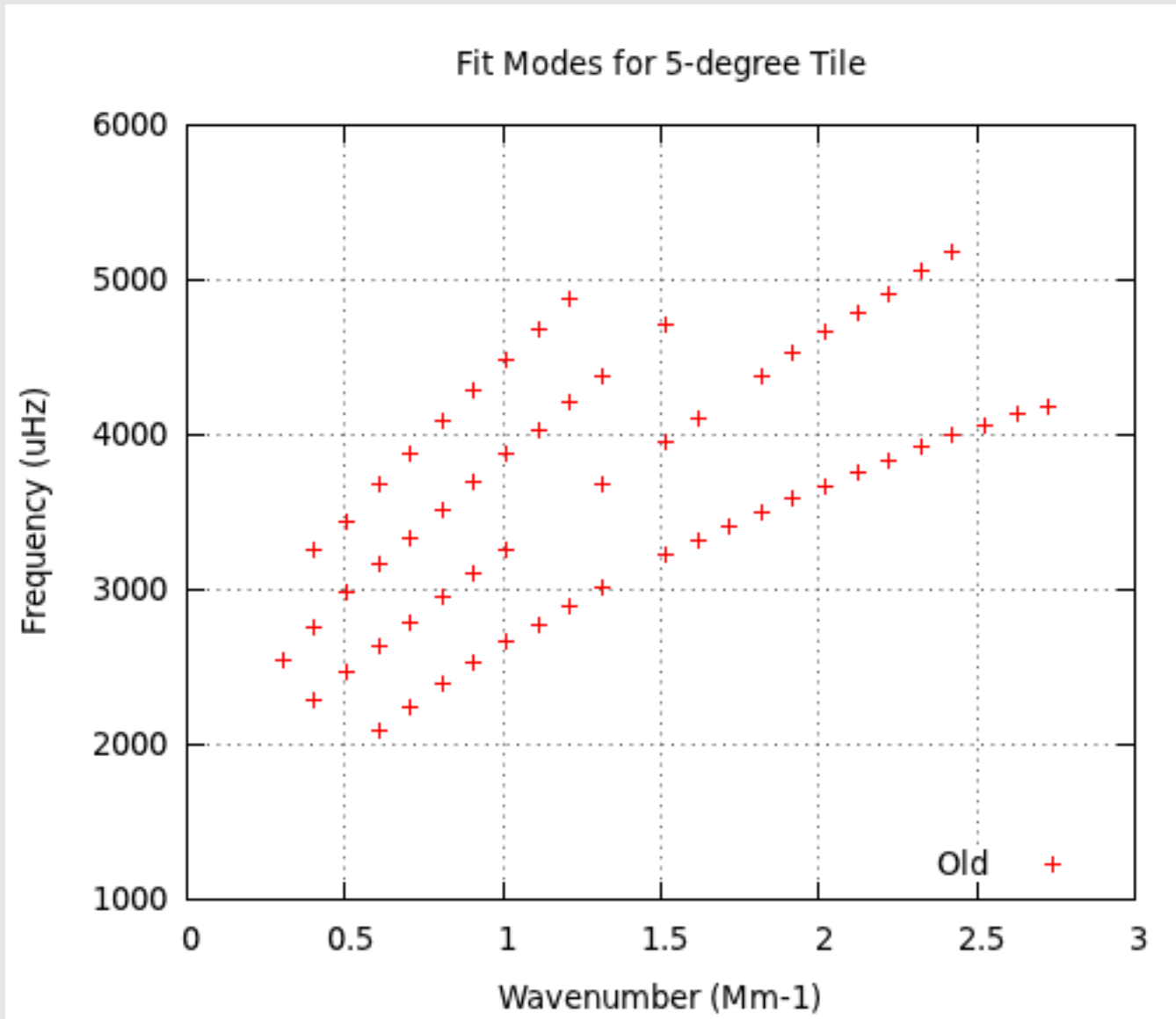
# Example Fits



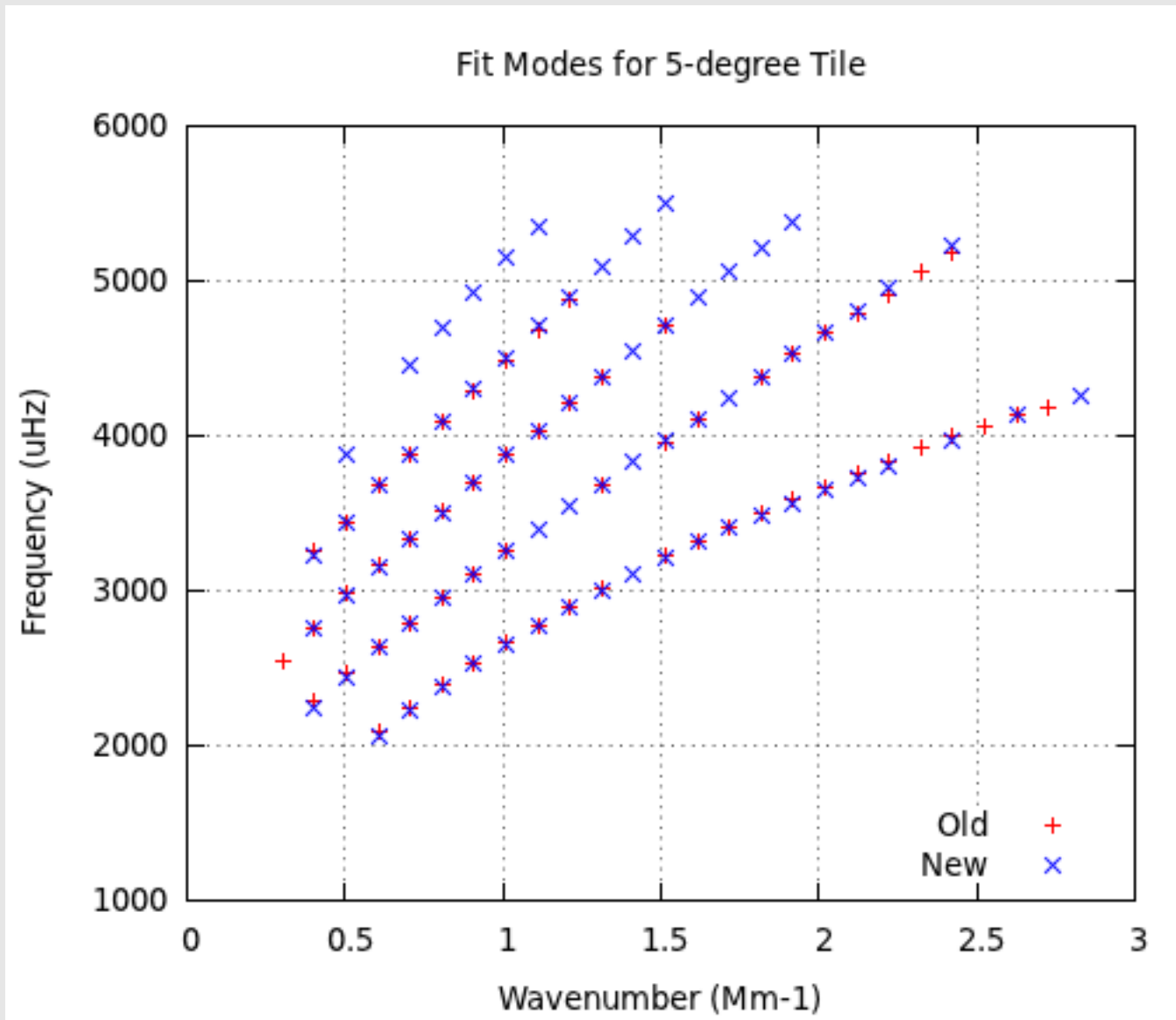
# Example Fits



# Mode-set Comparison

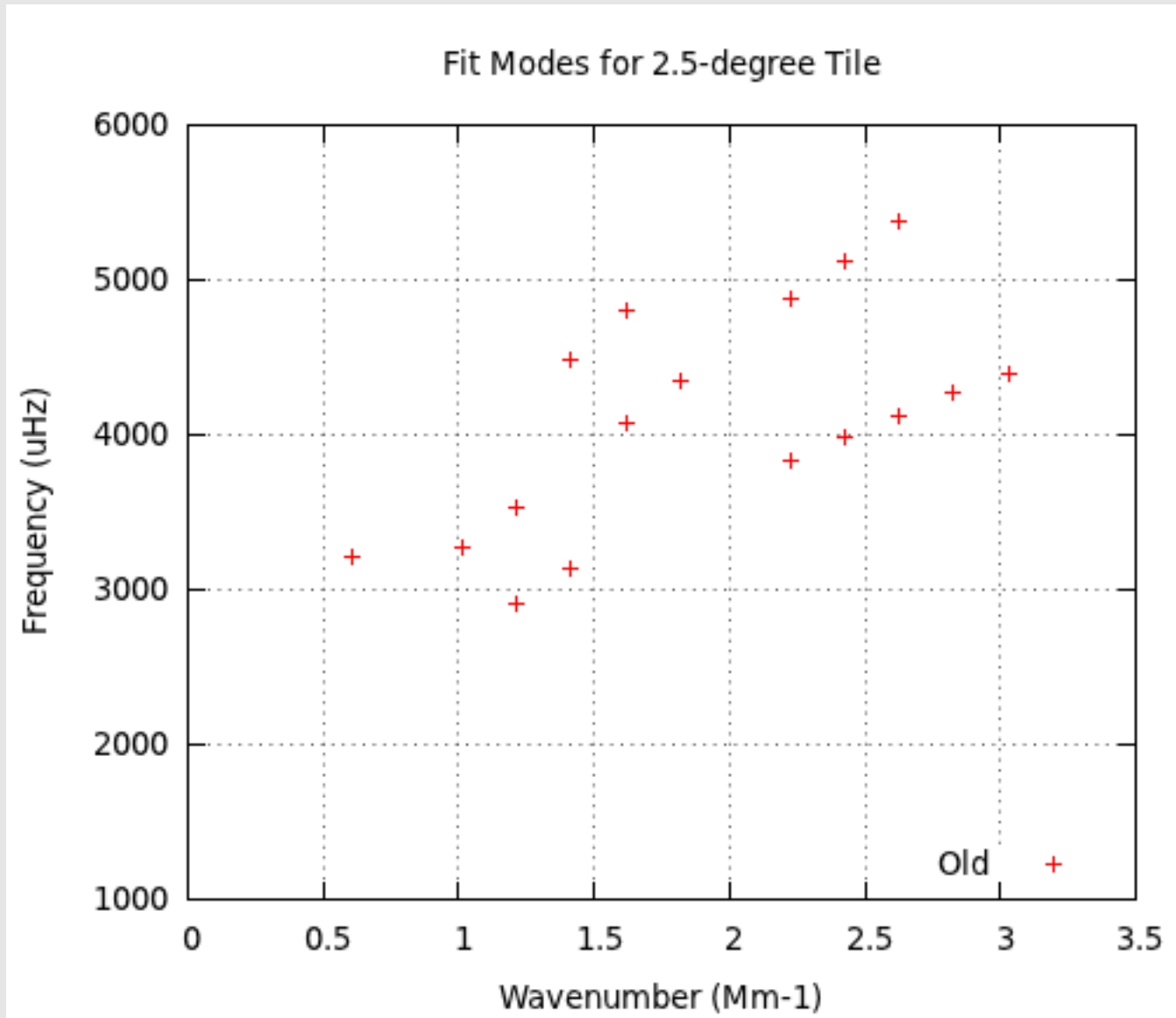


# Mode-set Comparison

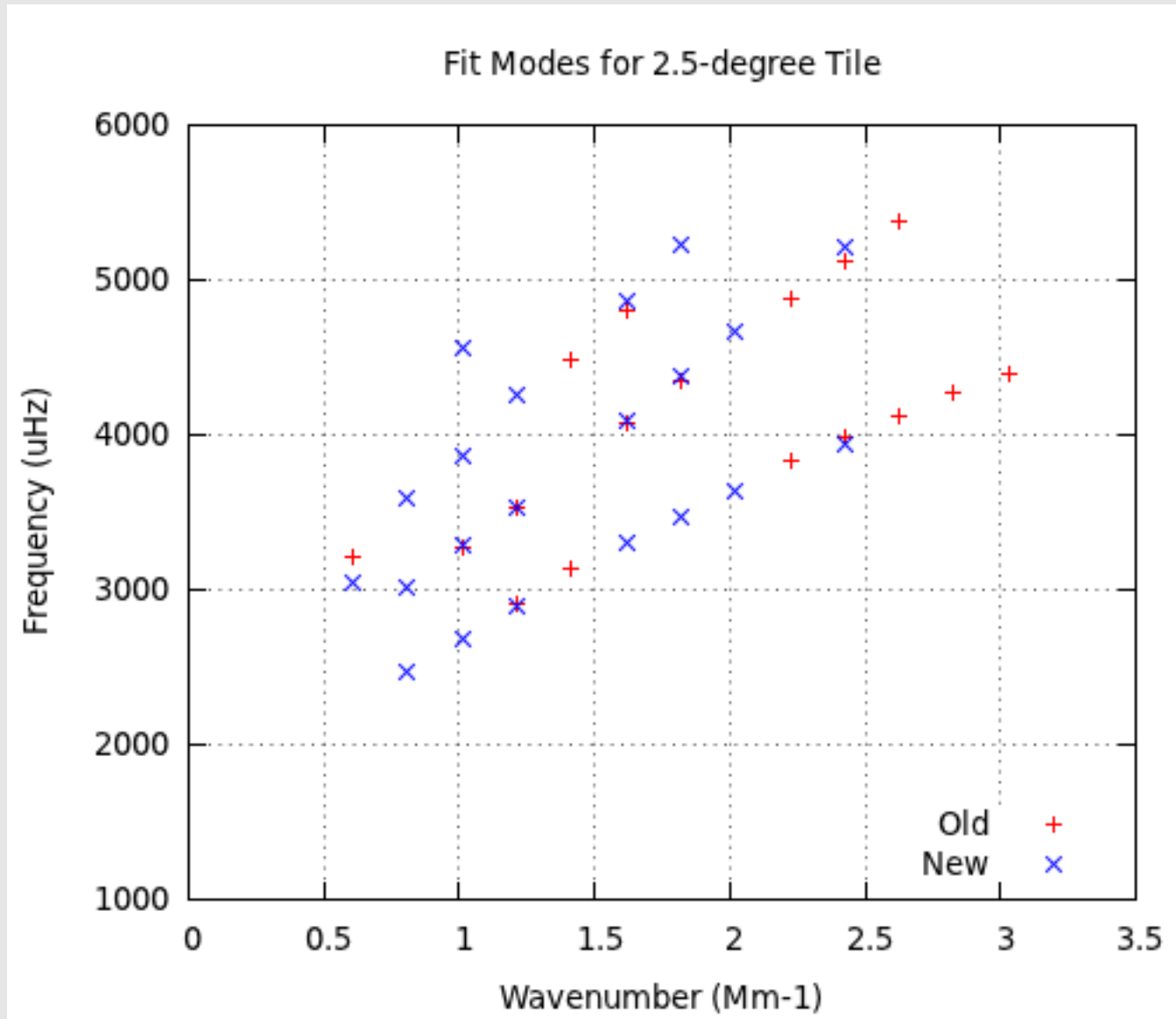




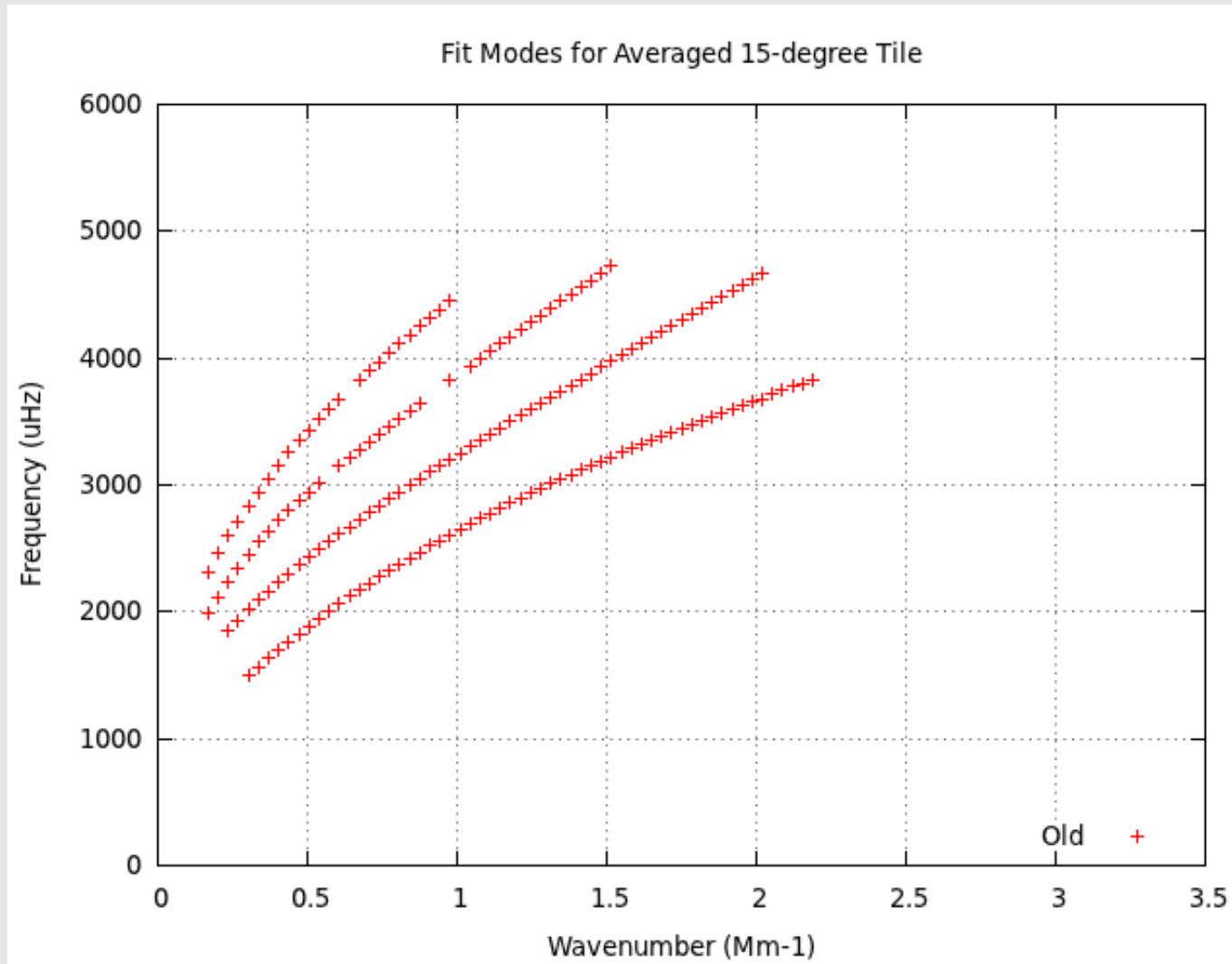
# Mode-set Comparison



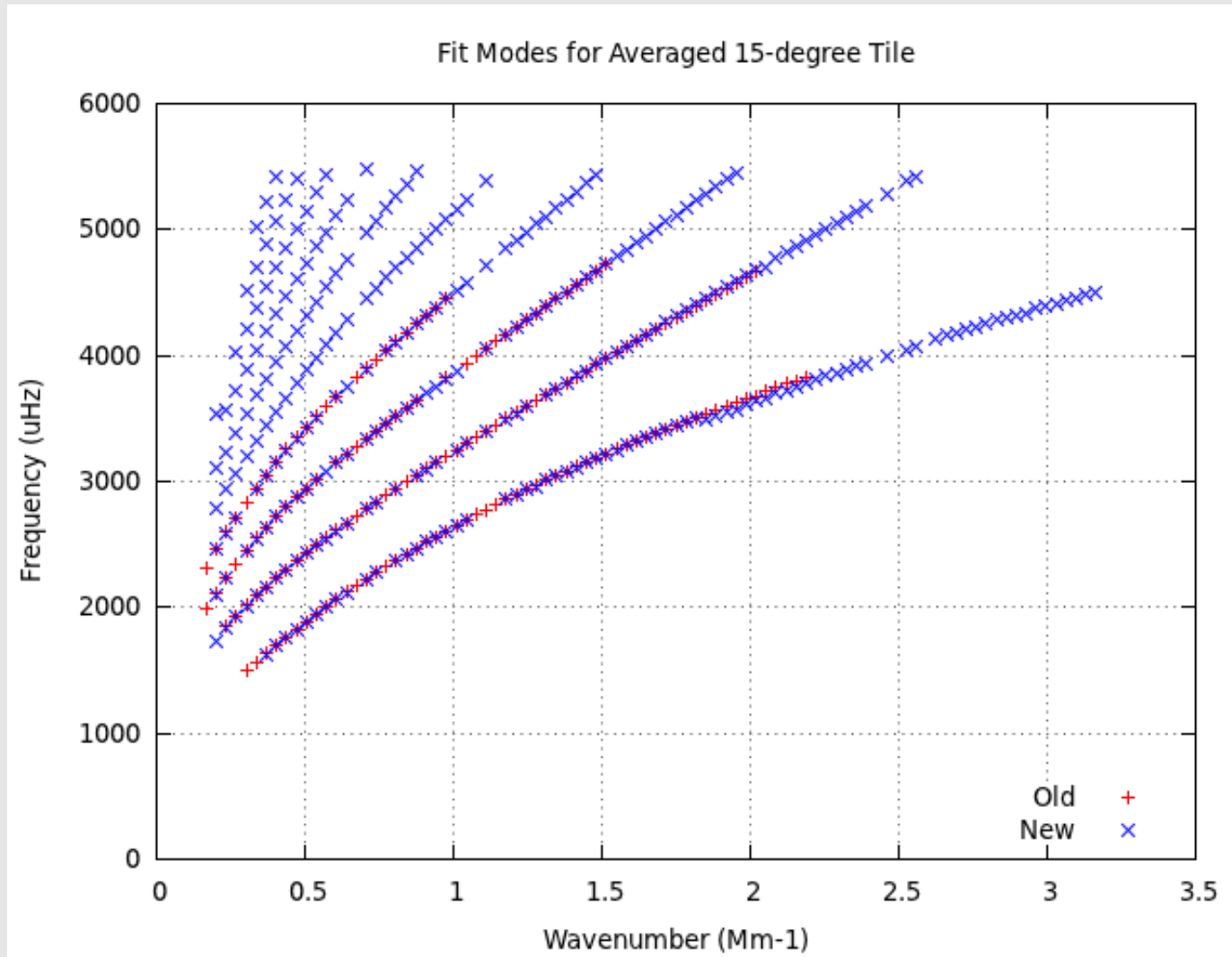
# Mode-set Comparison



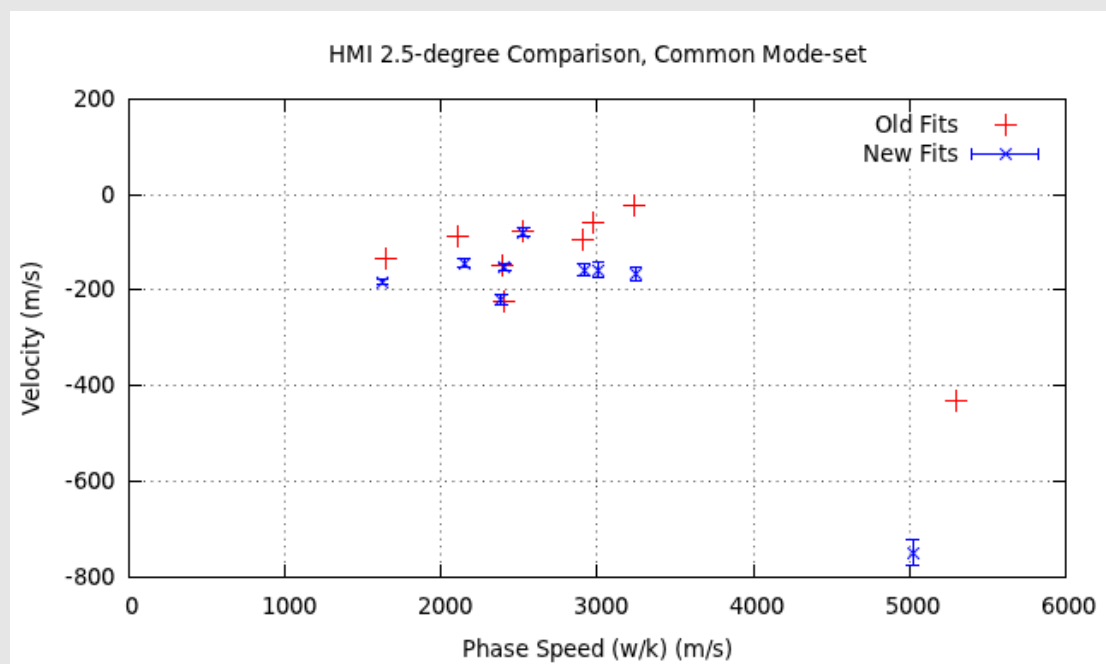
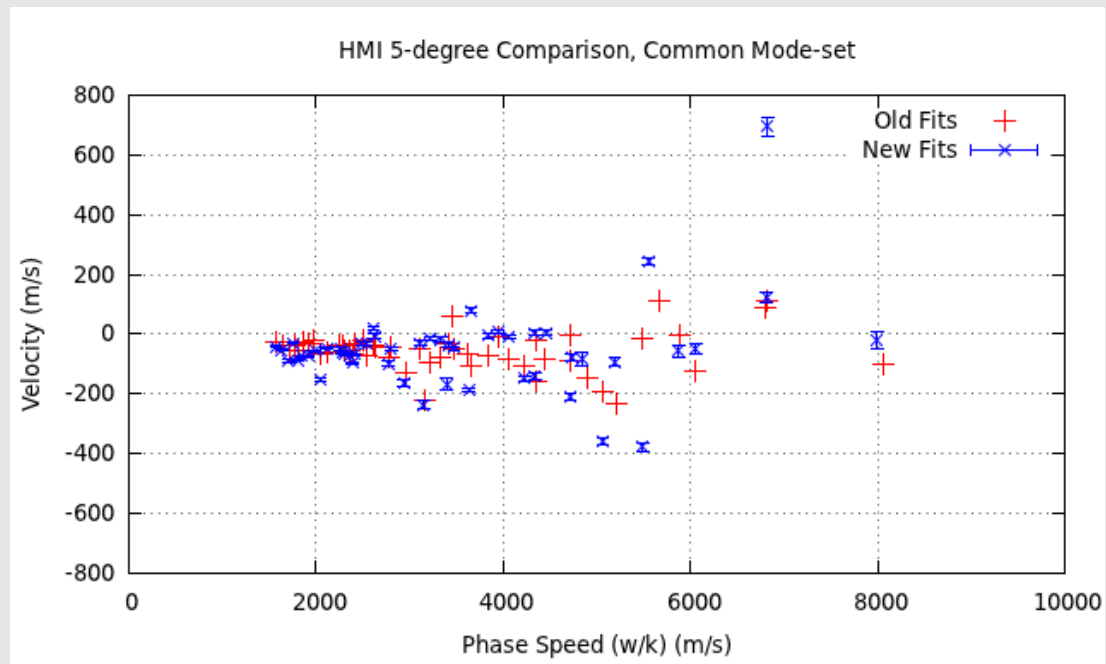
# Mode-set Comparison



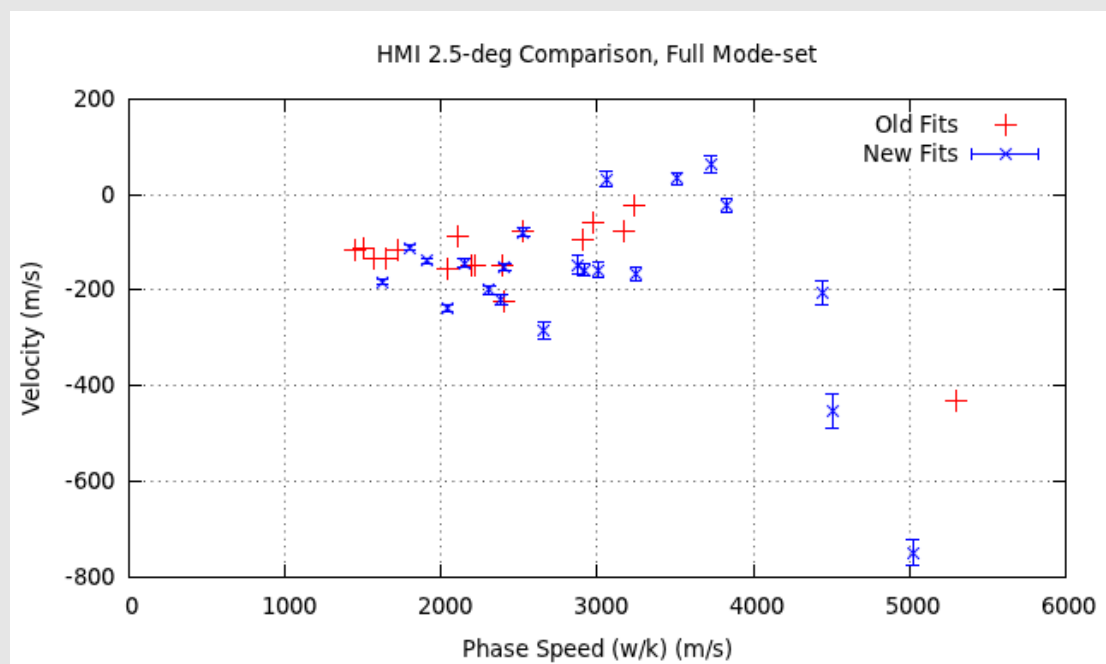
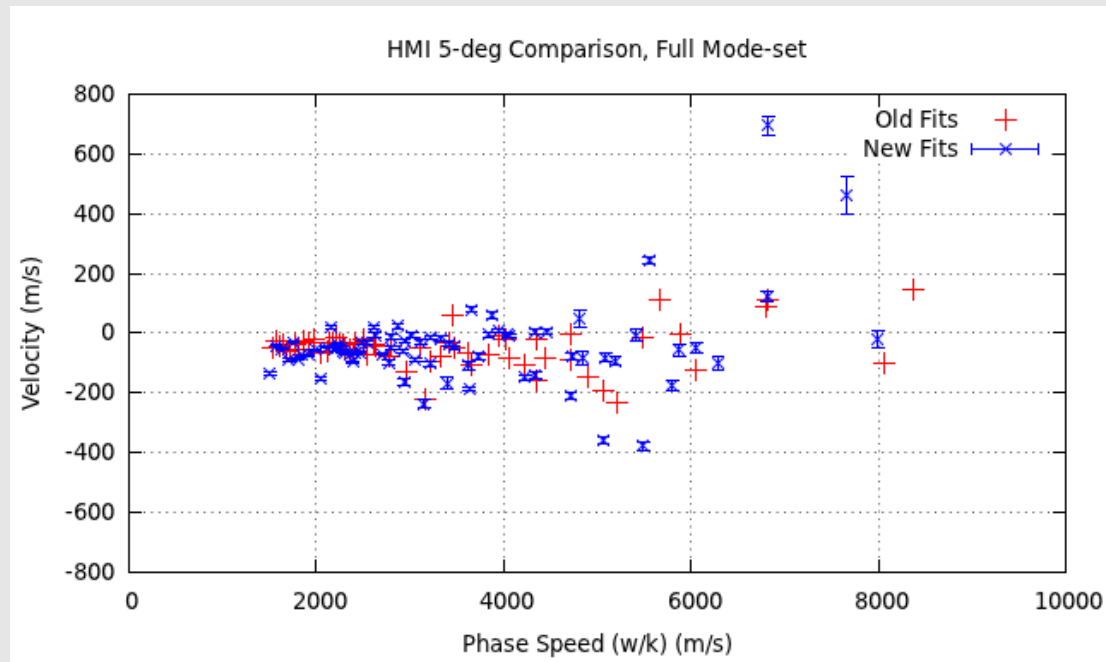
# Mode-set Comparison



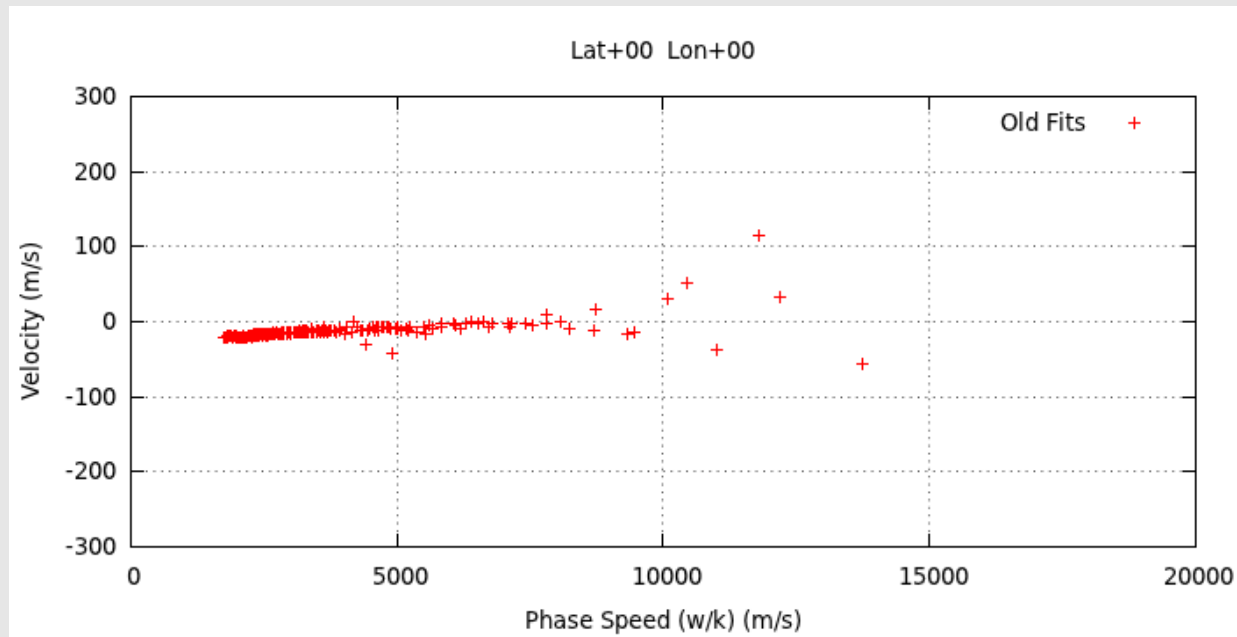
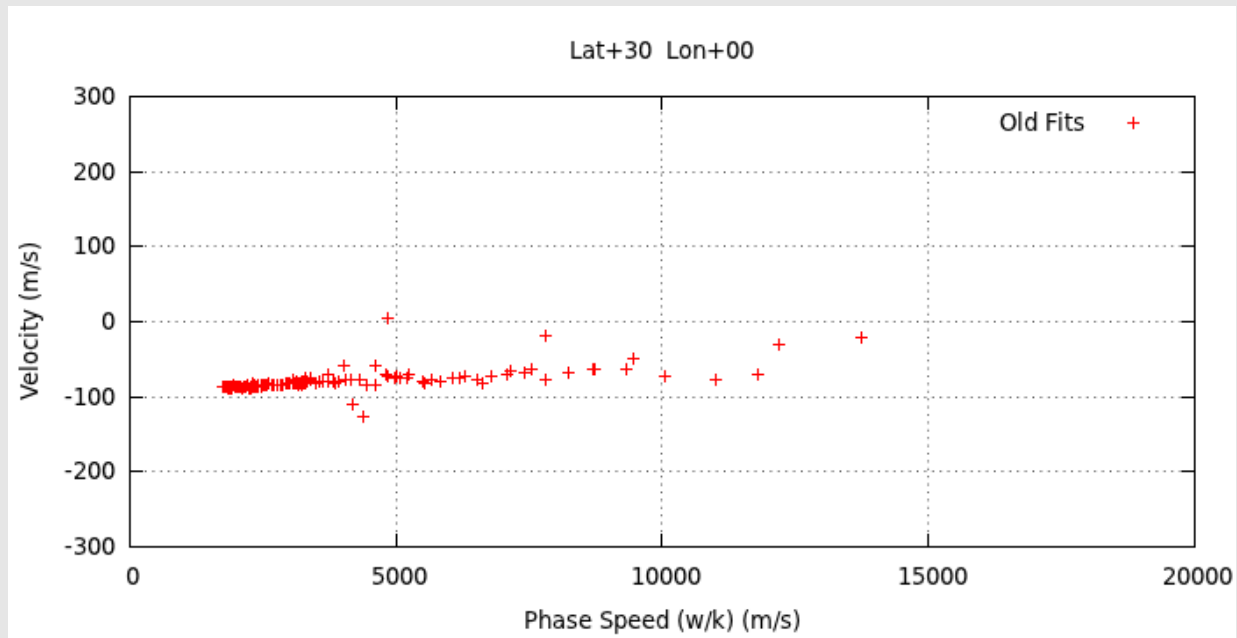
# Flow Comparison



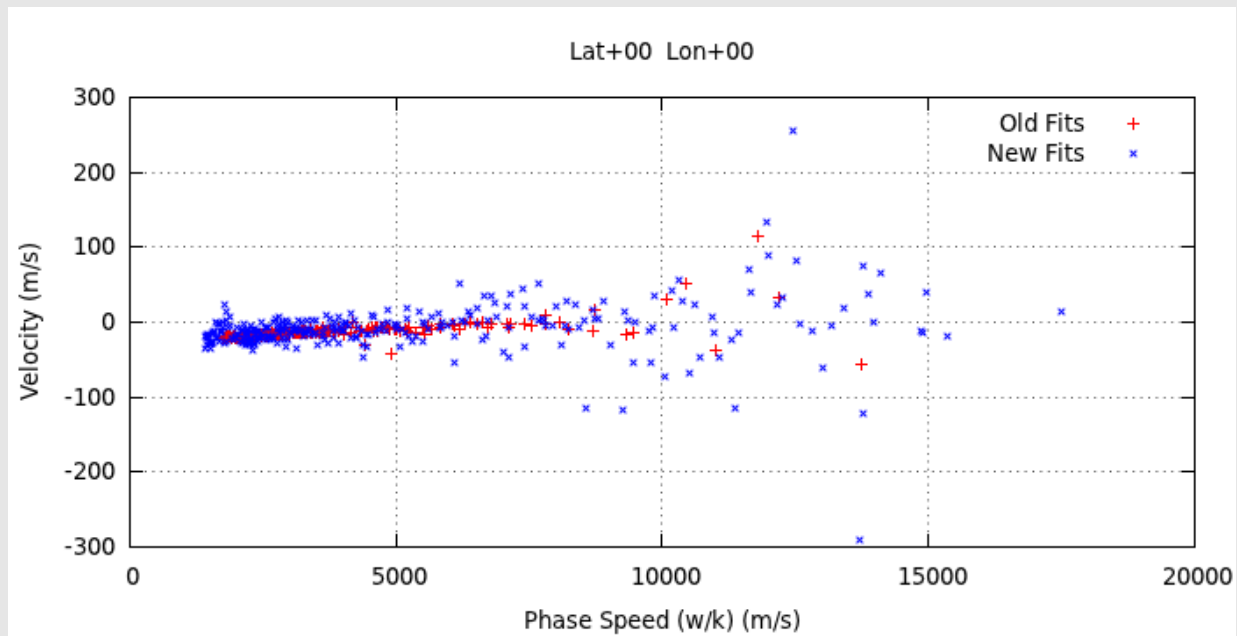
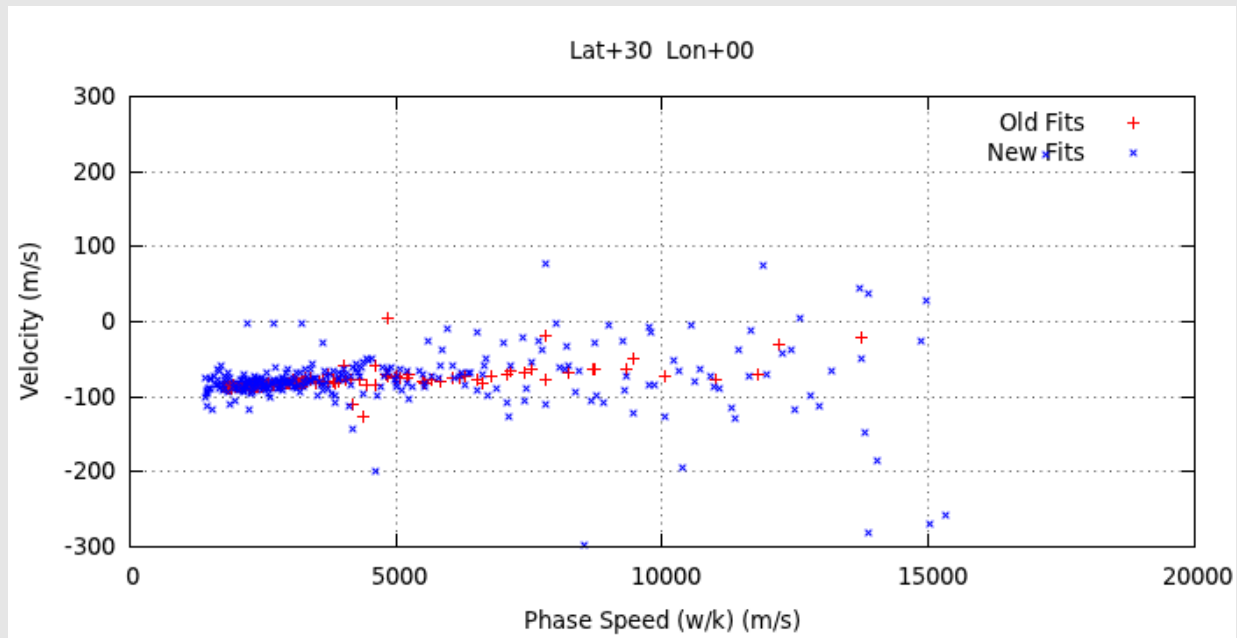
# Flow Comparison



# Flow Comparison

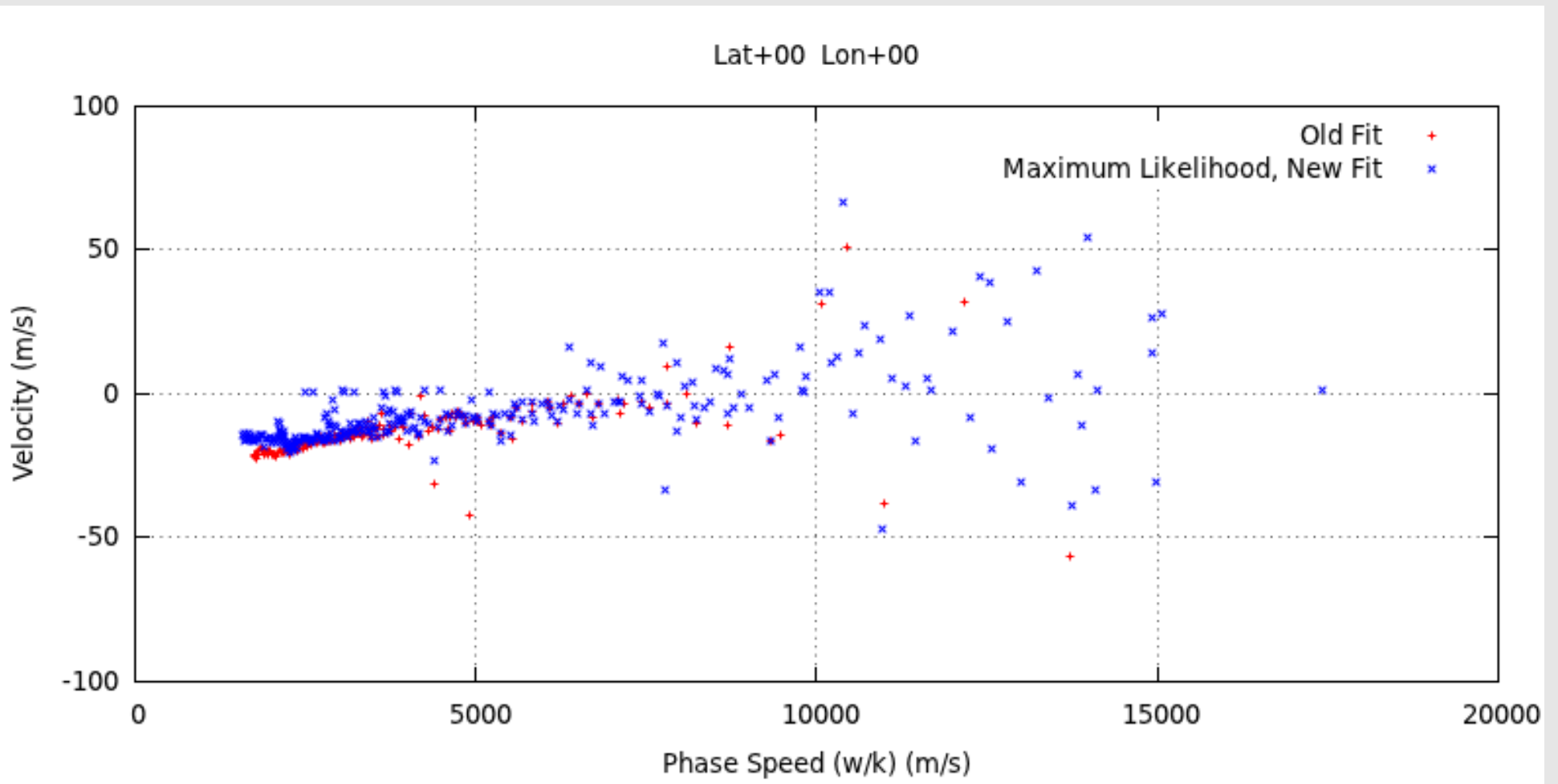


# Flow Comparison





# Flow Comparison



# Issues

- No model for modes as they move above acoustic cut-off frequency
- Noise estimation is good, not perfect
- Larger scatter in velocities