

The future of fringe fitting for VLBI in CASA

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Fringe fitting

In VLBI, antennas have

- their own clocks
- their own frequency standards
- different data paths between channels
- their own view of atmosphere

Compensating for these delays is crucial !

This functionality is now included in the data reduction package CASA, which can now be used for VLBI

Next-generation VLBI receivers

VGOS receivers for next generation geodetic VLBI have frequency coverage from 2 to 14 GHz

EVN BRAND receiver for next-generation astronomical VLBI has a frequency range from 1.5 to 15.5 GHz

Data processing and calibration needs to keep up! Fringe fitting needs to accommodate wide bands possibly with large spectral gaps.

Dispersive effects are unavoidable at these bandwidths.

The ionosphere

Cold magnetized plasma layer of atmosphere, 75–300 km above earth surface. Characterised by total electron content along line of sight

$$\Delta\phi = -8.45 \left(\frac{\text{TEC}}{1 \text{ TECU}} \right) \left(\frac{\nu}{1 \text{ GHz}} \right)^{-1}$$

Introduces an additional delay term to the model we need for phase

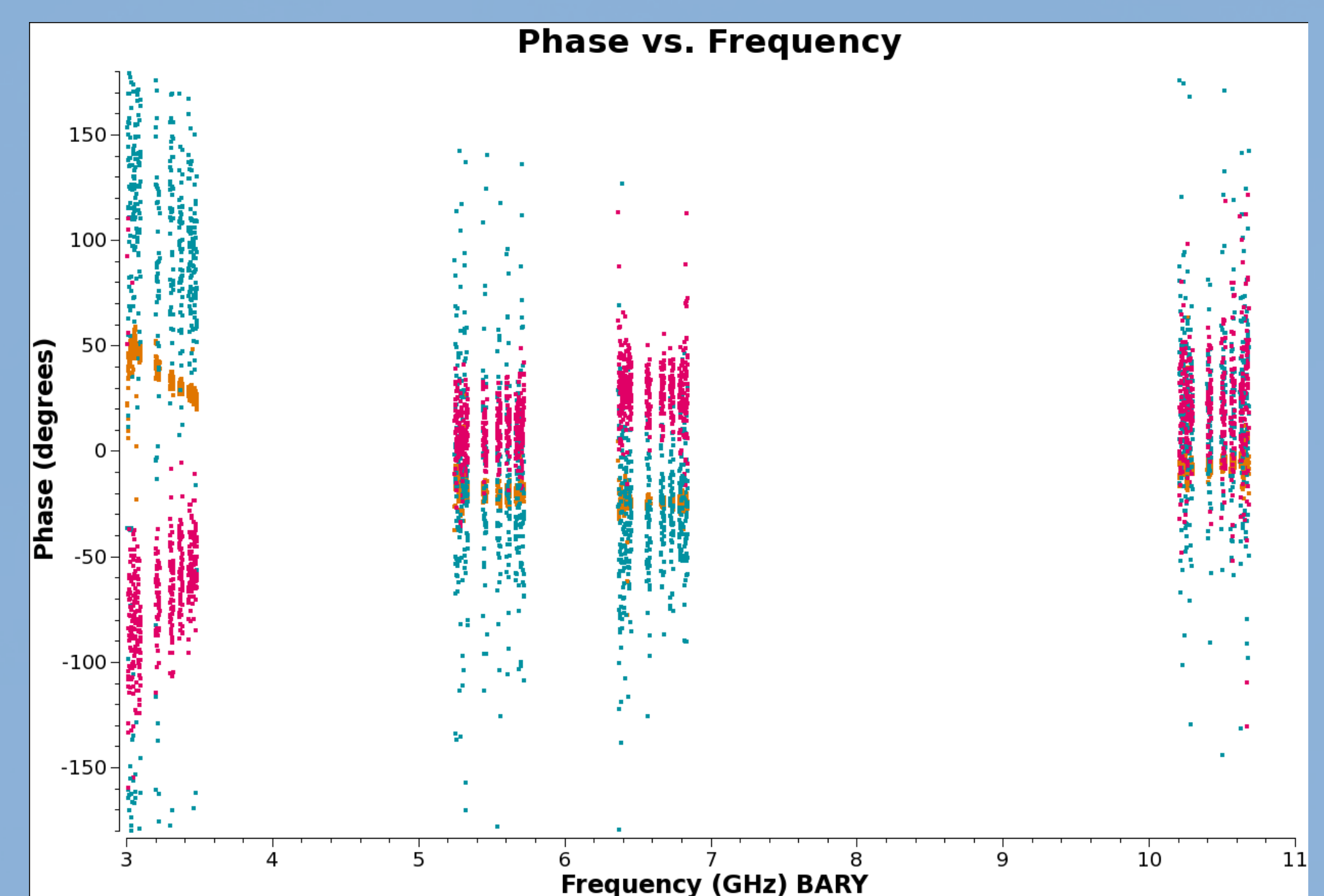
$$\phi(\nu, t) = \phi_0 + 2\pi \left[\tau(\nu - \nu_0) + r(t - t_0) + \tau_{\text{disp}}\nu_0 \left(\frac{\nu_0}{\nu} - 1 \right) \right]$$

Important at low frequencies and for wide bandwidths

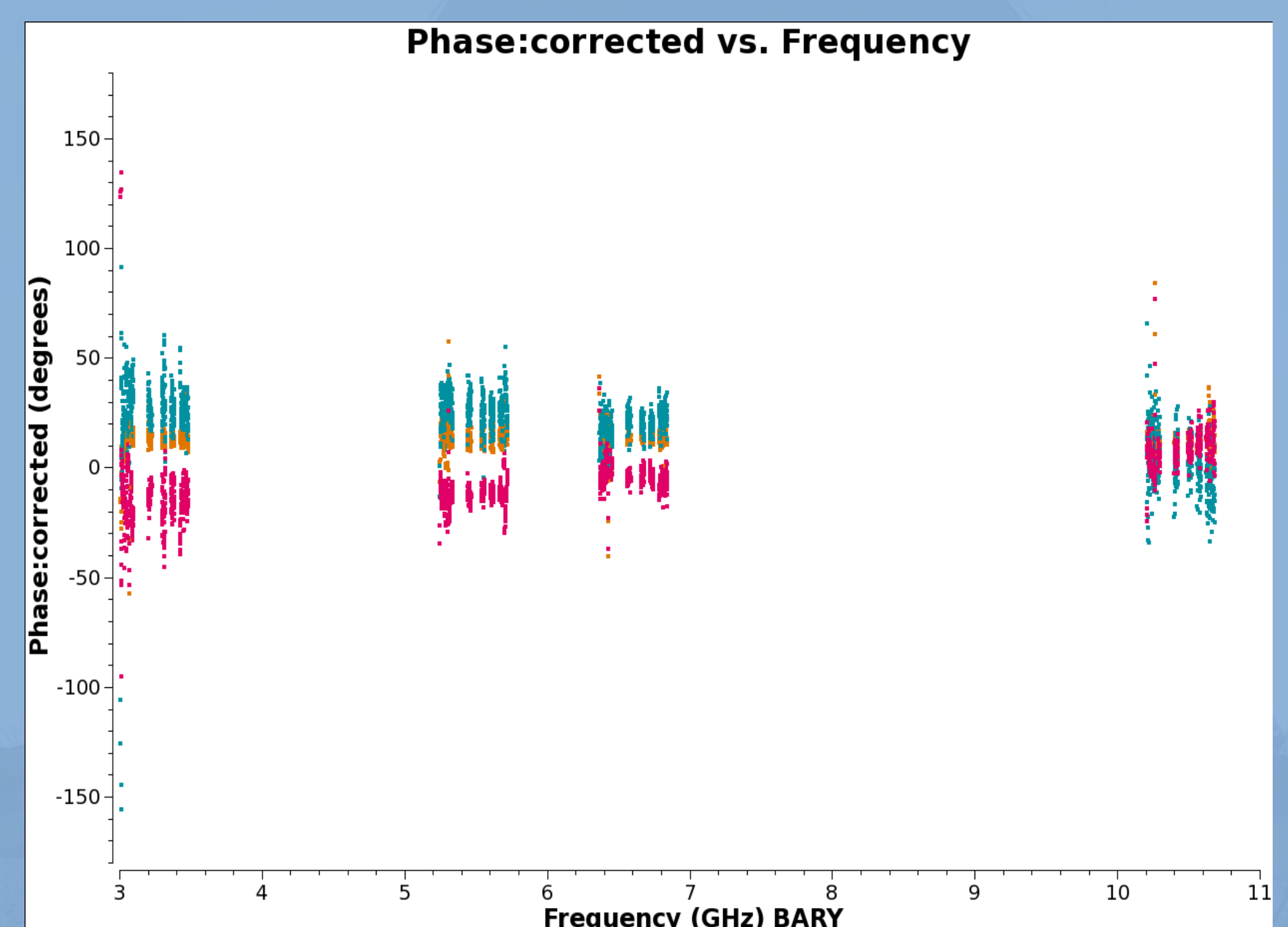
EU-VGOS data

3–11 GHz (wide band with gaps)

Before dispersive fringe fit:



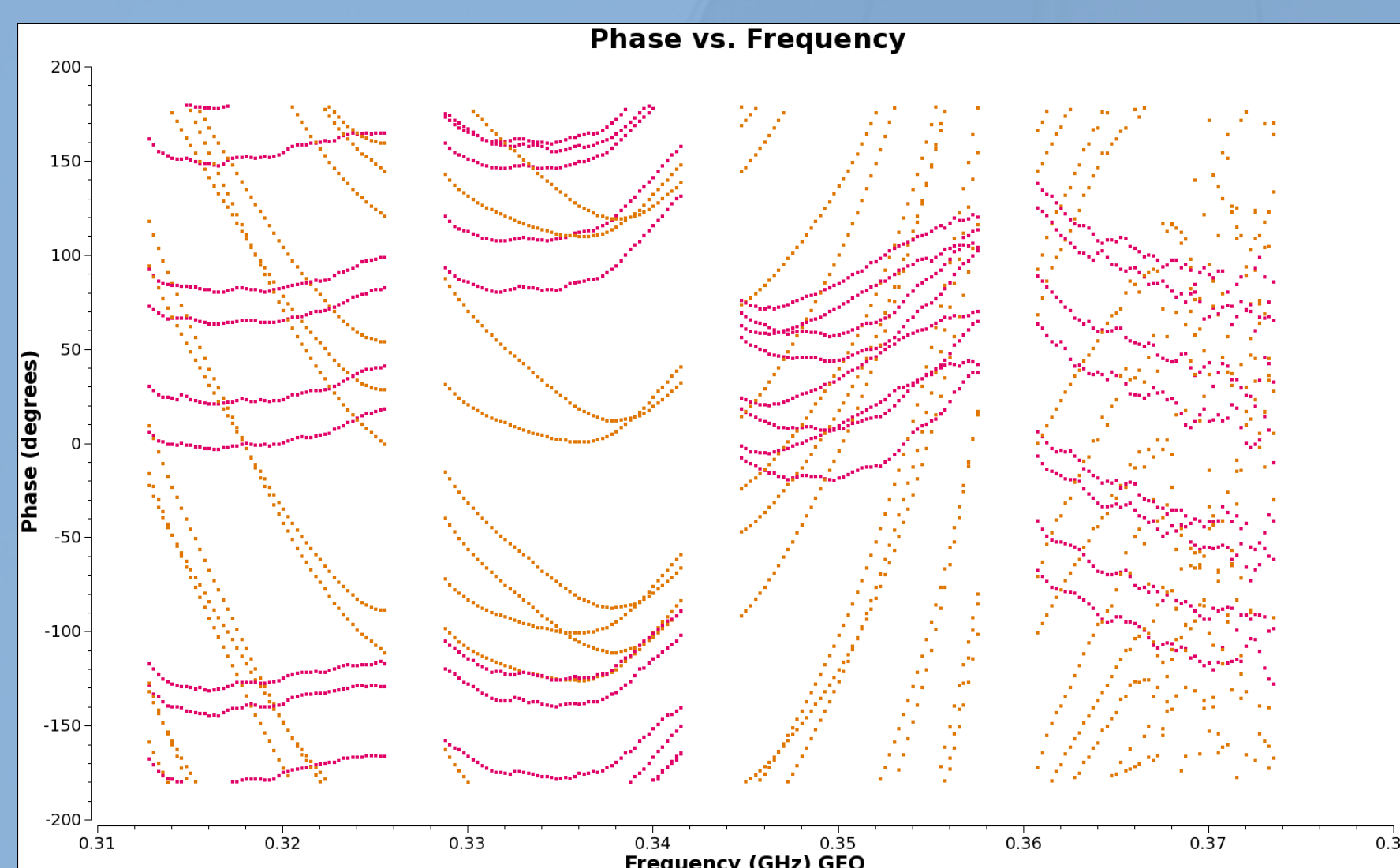
After dispersive fringe fit:



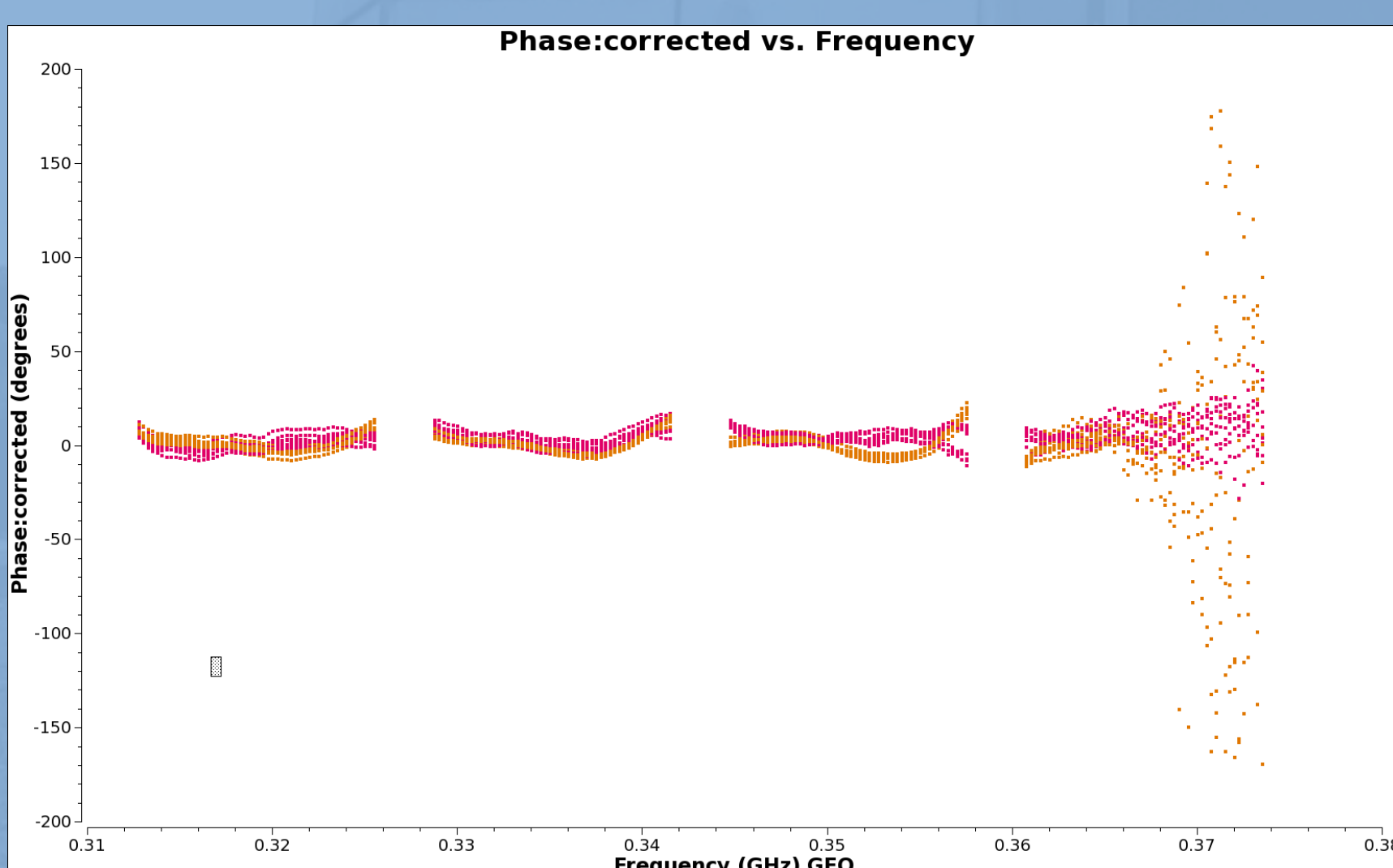
P Band data

300 MHz (low frequency for dish VLBI)

Before dispersive fringe fit:



After dispersive fringe fit:



(Constant phase across frequency band is good!)