



RFI mitigation and excision

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Radio Frequency Interference

Sources: intentional (e.g. TV), accidental (power lines, etc), natural (lightning, etc)

Characteristics: narrow line vs broadband, time variable vs steady

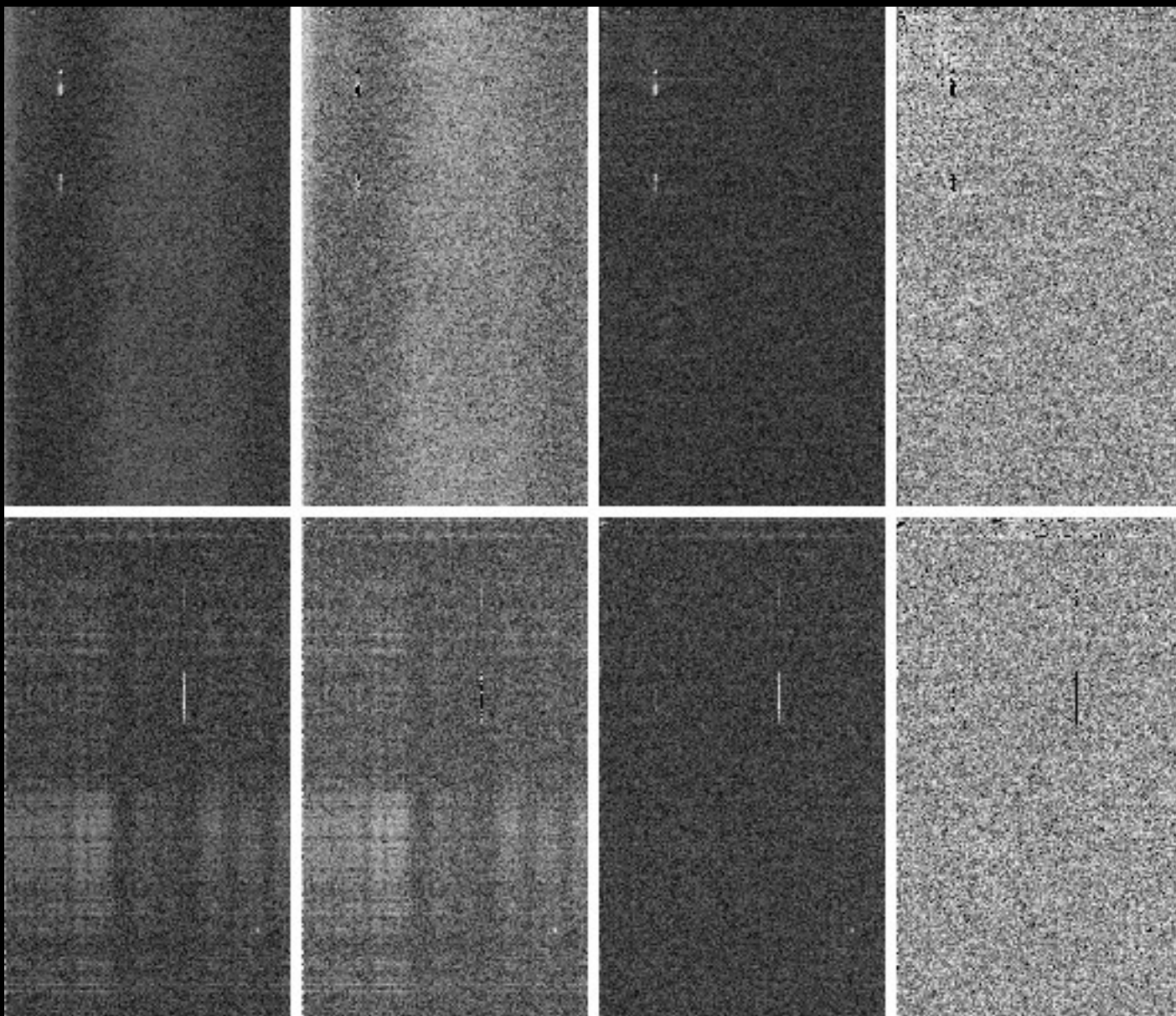
Treatments: excision, mitigation, removal

Characteristics

- Almost all RFI sources are 100% polarized
- single mode source (non-thermal): must appear 100% polarized
- enters telescope through far primary beam side lobe
- usually at fixed position on earth, never rotates at sidereal rate: always distinguishable/localizable on interferometer

Excision: automated flagging

- Set flux threshold usually at some multiple of flux in field of view, remove all data points above threshold
- set threshold as a polarization fraction: since sky is usually not strongly polarized, gets 100x lower in flux density.
- does not work for high duty cycle broadband time variable sources.



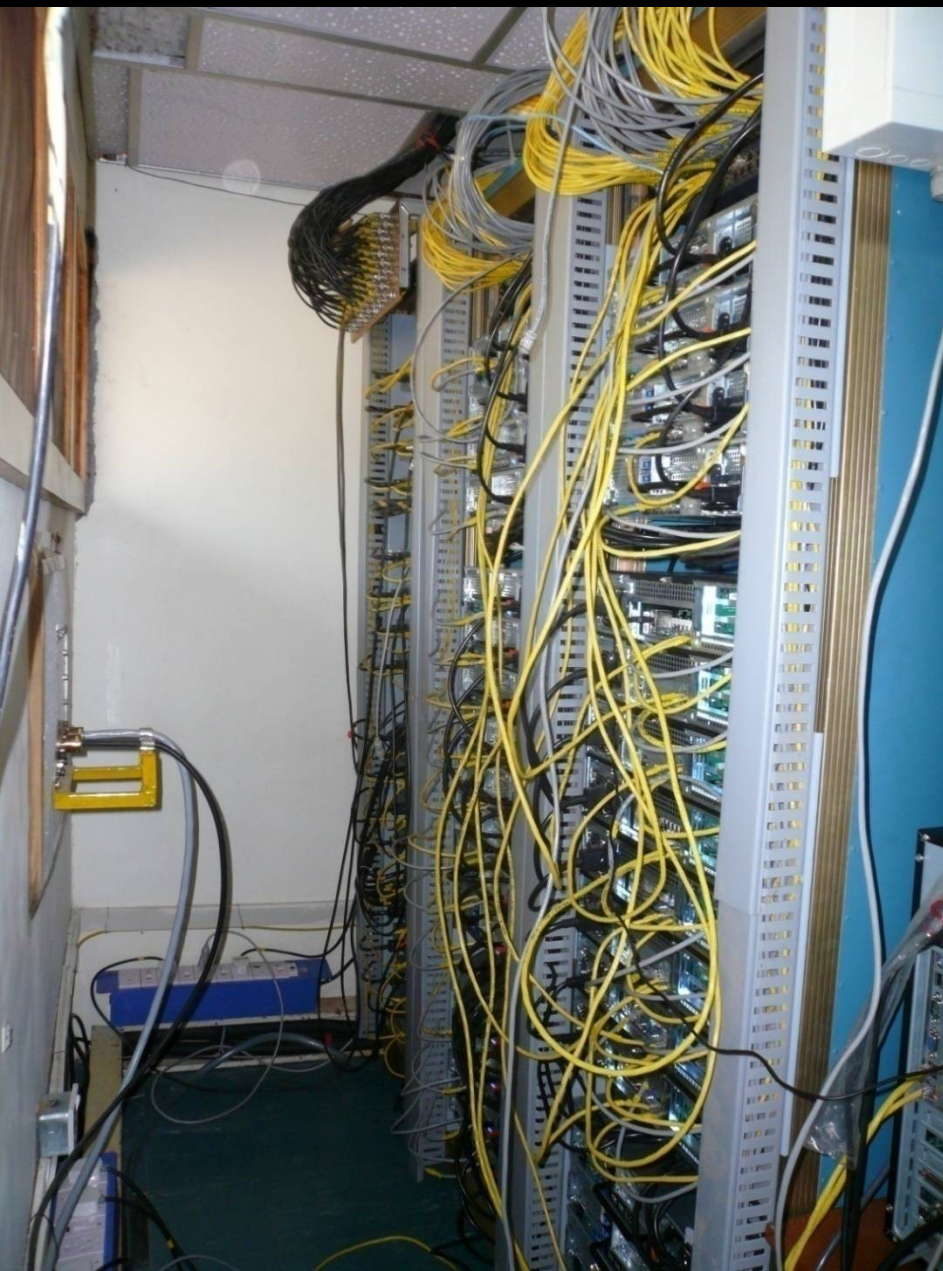
RFI mitigation at GMRT&GBT

- Interferometric localization of RFI and physical removal.
- Phase closure solution and cancellation.
- Use of software backends.
- Uses SVD-PCA based strategy: model visibilities as $V_{ij}(t) = g_i g_j^T(t)$
- Analogous to peeling – can fill in missing measurements.
- Needs 2 reference antenna for GBT, or cross polar information for GMRT.

RFI localization

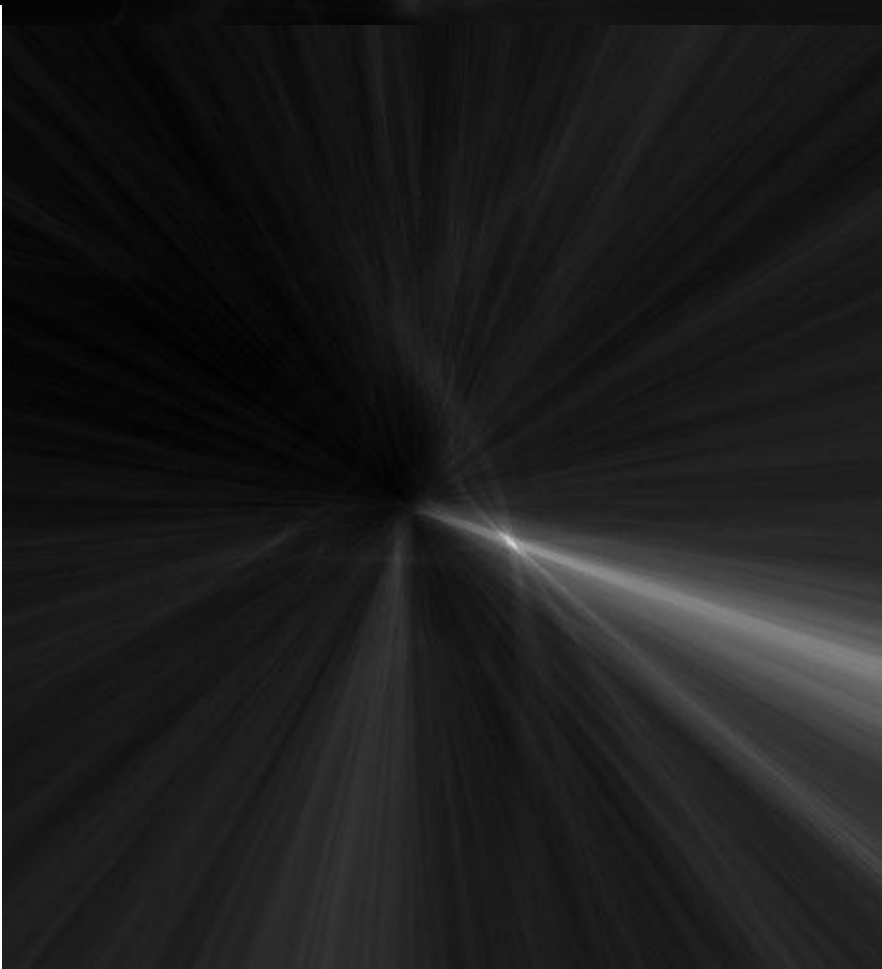
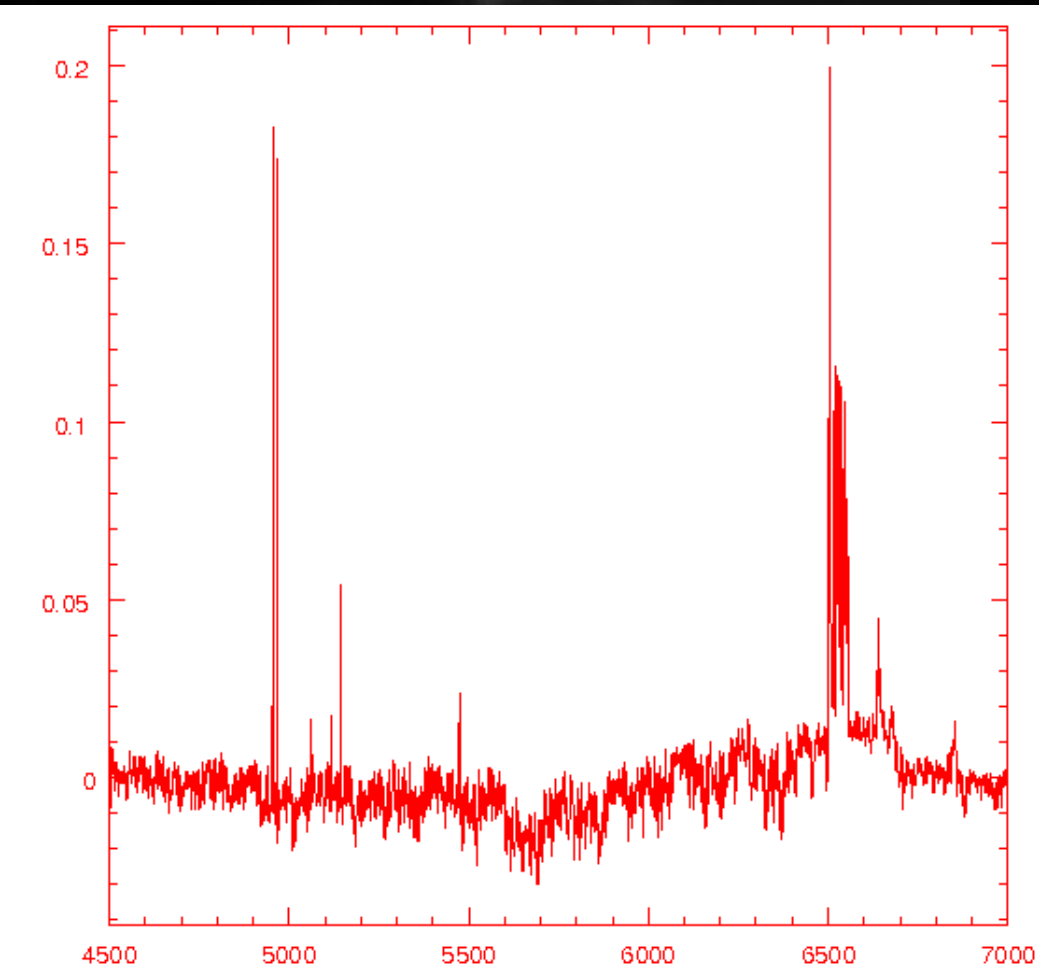
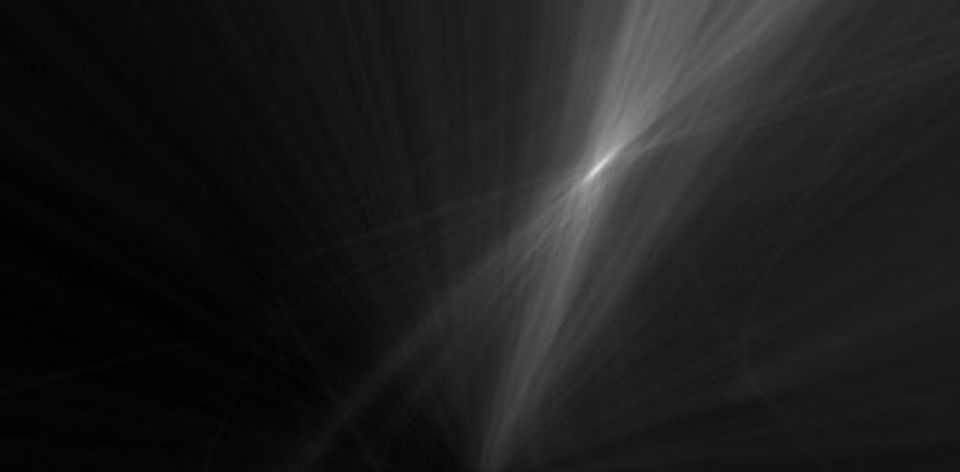
- Interferometer intrinsically measures positions
- Requires different imaging and calibration strategies in the near field
- GSB and EoR project developed identification strategies.
- Guppi and RFI reference antennae at GBT (Fisher, Ford)
- Collaboration w/Nityananda, Gupta.

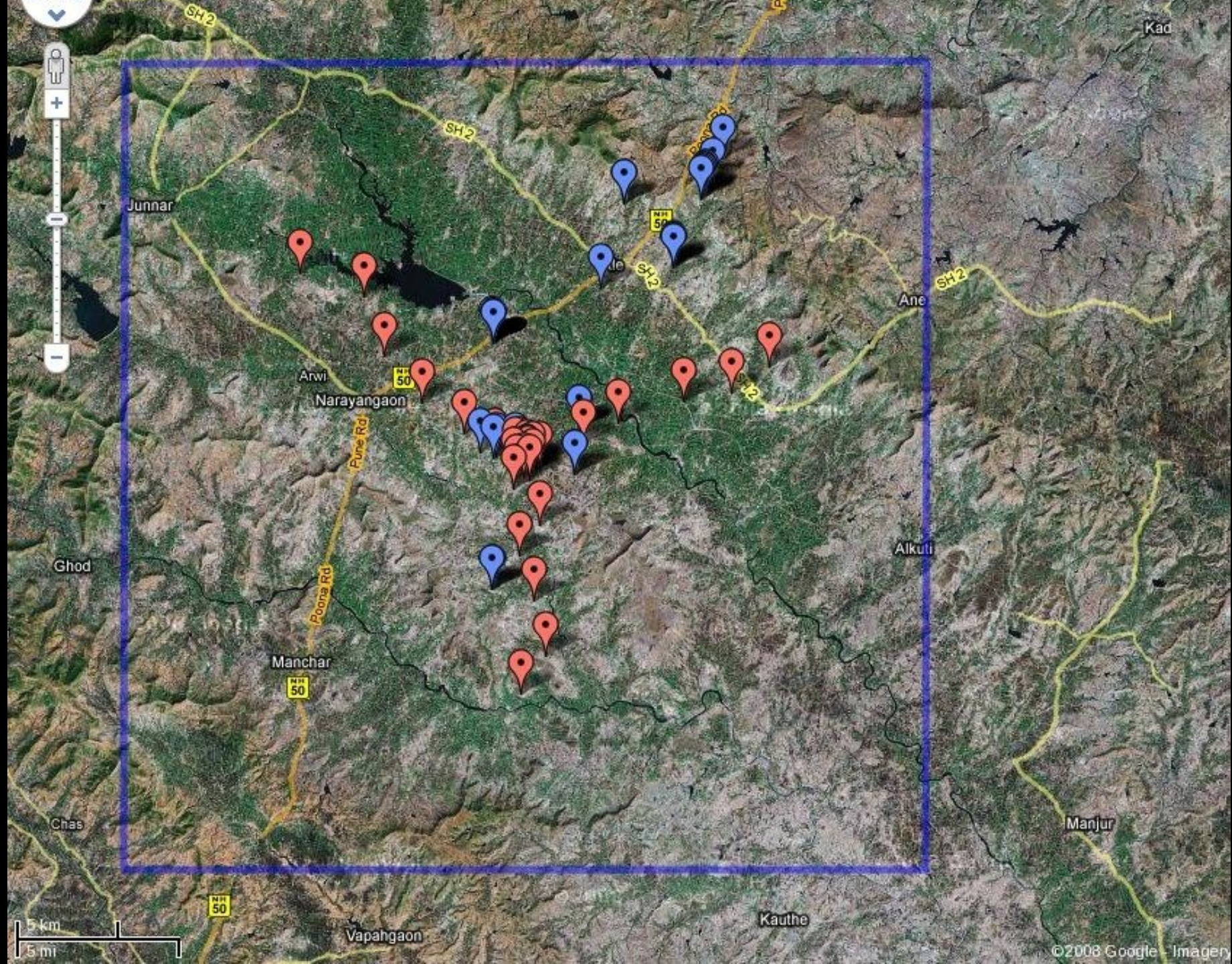
new GMRT software correlator:
imaging the full sky+horizon



Data Acquisition

- RFI locations are produced as a by-product of EoR observations, or by specific calibrated observations with feeds pointed to the control building.
- Requires operation of software correlator to obtain sufficient lags: avoid bandwidth smearing for horizon-to-horizon imaging.





Multi-wavelength follow-up
ultrasound, VHF, UV

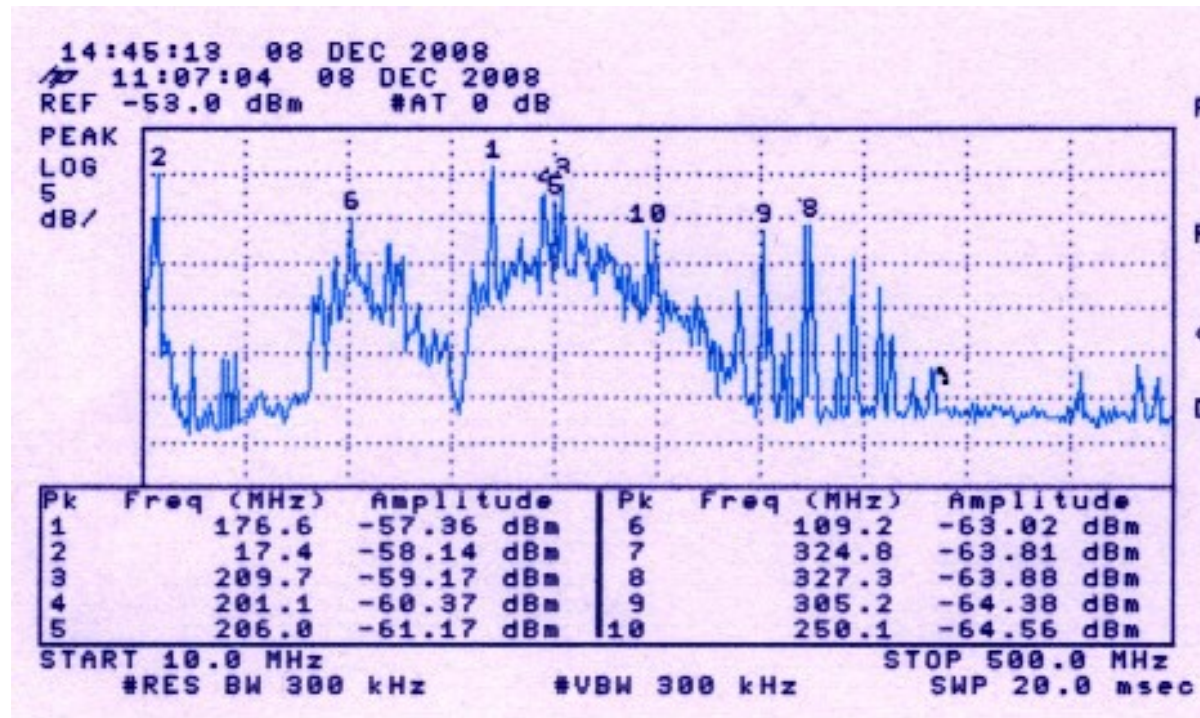
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Spectral identification

- Taken by P. Raybole with spectrum analyzer and power generator.

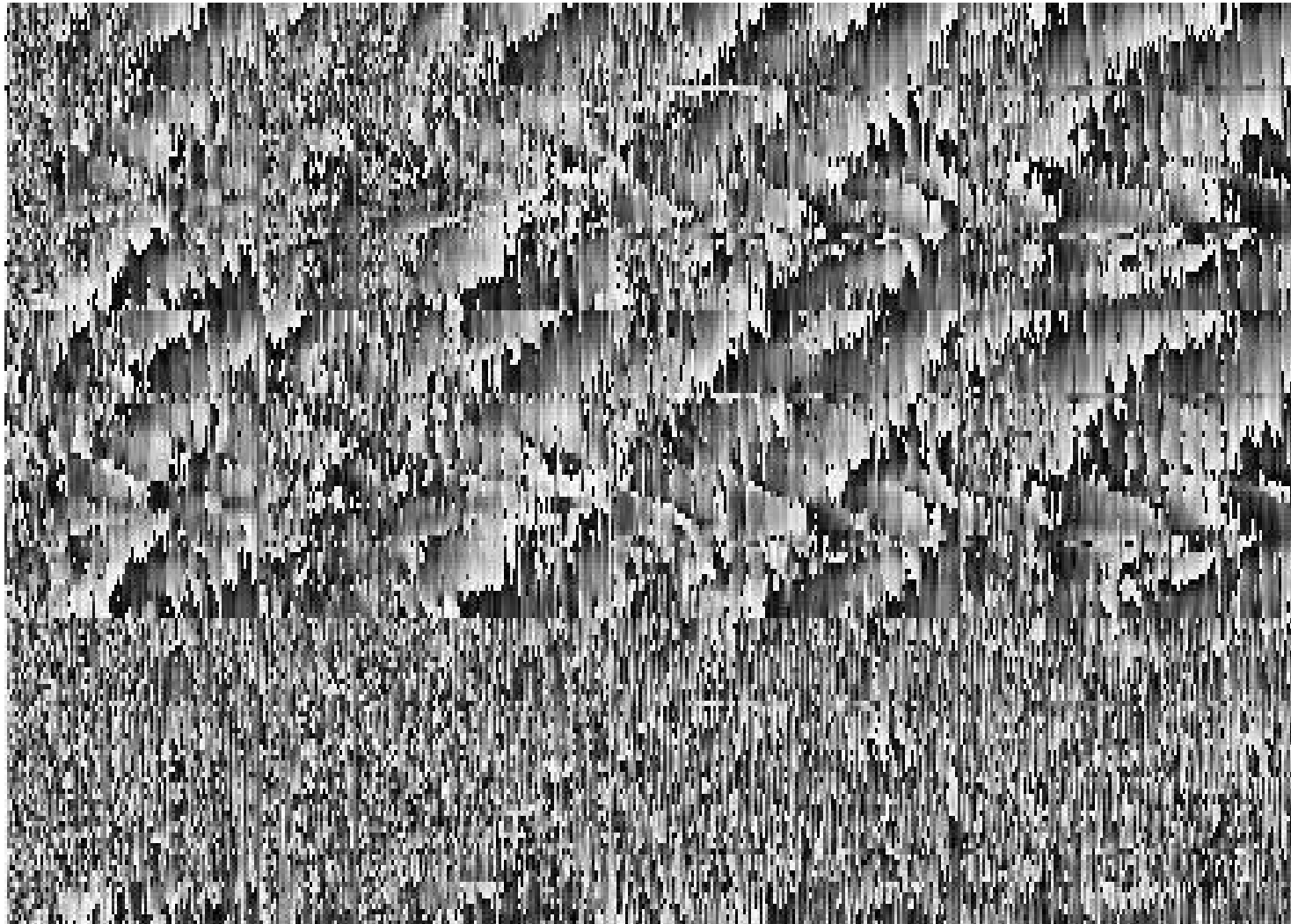












Raw data

Model

Clean
data

Summary

- RFI: excision, mitigation, removal.
- Single mode sources: rank 1 reduction of visibilities
- Interferometric RFI localization successful at GMRT, conclusive identification of sources.
- RFI noise cancellation in astronomical data now part of GMRT EoR pipeline, and work in progress to implement at GBT (w/R. Fisher, J. Ford).