RFI Monitoring and Mitigation

Ryan Lynch







RFI Environment at GBO

- Despite Quiet Zone protections, interference from satellite and mobile ground-based sources is increasing
- Frequencies historically free of RFI will see increasing use from 5G, satellite internet, car radar, etc.



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Credit: Ericsson (https://www.ericsson.com/en/networks/trending/hot-topics/5g-spectrum-strategies-to-maximize-all-bands)



Current Mitigation Strategies

- Quiet zones and on-site mitigation efforts
 - National Radio Quiet Zone coordination and enforcement
 - Applies to permanent, fixed, licensed transmitters in a 13,000 sqmile ara
 - West Virginia Radio Quiet Zone coordination and enforcement
 - Applies to interference-causing equipment in a 10-mile radius
 - On-site policies against intentional emissions and suppression of unintentional emissions
- GBT RFI scans
 - Bandpass plots available online
 - https://science.nrao.edu/facilities/gbt/interference-protection/ipg/rfi-sca ns
- Offline flagging and excision of affected data
 - Manual or automated statistical identification
 - Typically results in loss of a full integration







Possible New Strategies

- Dedicated RFI monitoring station
 - DRAO has developed an antenna + backend that makes use of machine learning to identify RFI
 - This would be an independent source of information about strong RFI
 - DRAO system is frequency swept up to 2 GHz
 - GBO system could use DRAO backend but expand coverage to 40 GHz
 - Potential to expand to even higher frequencies in a second phase
 - 24/7 monitoring
 - User accessible data products



Cyclic Time of Day Axis Reveals Diurnal Trends in RFI



NAC-CHAC

Credit: Stephen Harrison (DRAO)





Possible New Strategies

- Active identification and excision in GBT data
 - NSF-funded project is underway to explore techniques for identifying RFI in digitized baseband voltage samples
 - All techniques will undergod rigorous astronomical verification
 - Excision would occur before accumulation and averaging
 - Has potential to excise less data, but in a non-recoverable way
 - Alternatively, both mitigated and unmitigated copies could be saved at the expense of larger data volumes
 - User-selected options
 - Currently in R&D stage; if successful, additional backend computing resources will be required



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Potential Discussion Questions

- What modes of operation would be most useful for an RFI monitoring station?
 - E.g. continuously sweep over all frequencies or focus on those being observed
- What RFI monitoring station data products would be most useful?
- Are existing methods for RFI identification and flagging/excision adequate?
 - GBTIDL allows integrations and individual channels to be flagged and ignored in later processing
 - Automatic identification and flagging is not included in the default GBTIDL release
 - Several routines are available in pulsar data reduction packages
- Would you accept excised data in lieu of "raw" data?







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