

Sensitivity evaluation of two VLBI2010 candidate feeds

Christopher Beaudoin, Bruce Whittier MIT Haystack Observatory





Outline



- Patriot 12m Considerations
- Eleven Feed Developments
 - Construction
 - Efficiency Expectations
 - System Temperature
- Caltech Quadridge Feed Horn
 - Construction Status and Plans
 - Efficiency Expectations
 - Ambient Noise Pickup







Patriot 12m Considerations

- Dual-shaped reflector design
- Attempt to constrain Dewar/cryostat size to the specified shadow angle to minimize blockage/scattering losses
- Feed itself will satisfy constraint but required cryogenic components will not
- Shadow is actually frequency dependent







Eleven Cryostat Contruction



- Cryostat Dimensions
 - Feed Recess: 22.2 mm
 - Outer Wall Diameter: 279 mm
 - Inner Wall Diameter: 254 mm
 - Outer Wall Length: 420 mm
 - 70K Shield Thickness: 3.2mm
- Eleven Feed Diameter: 204 mm

SMA/Microwave Connections



Vacuum Window





MIT Vacuum Valve Refrigerator HAYSTACK OBSERVATORY







Eleven Front-End Contruction















Quadridge Feed Horn (QRFH)

- California Institute of Technology Design
 - Sandy Weinreb
 - Ahmed Akigray
 - Bill Imbriale
- 2-14 GHz Unbalanced Design
 - One single-ended port per polarization
- Designed for Patriot 12m Antenna Shaped Optics
 - Adaptable to other antenna optics
- Overcomes limitations of commercial quadridge designs
- Haystack working to confirm QRFH performance expectations on GV12



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A Vision for Geodetic VLBI

Construction Status and Plans

- Recently Completed Components
 - Base Plate
 - 70K Radiation Shield
 - Rough machining of outer can
- Short term work
 - Final machining of outer can
 - o-ring grooves
 - Vacuum window fasteners
 - Welding gussets for base ring
 - Weld base ring
 - Fabricate 20,70K stations
 - Assemble vacuum window
- Installation of Refrigerator
- Installation of Microwave Hardware
 - QRFH/IR Blanket
 - CRY01-12 LNAs
- Front-end Y-factor Measurements
- Installation on GV12
 - Measure Sensitivity!













Computed Aperture Efficiency





Computed Noise Temperature



Notse Temp K



Conclusion and Future Work

- Best-Case Eleven performance on the 12m
 - 60-70% Aperture Efficiency (frequency dependent)
 - 20K Noise Temperature (slight higher >4 GHz)
 - Strut/feed scattering and surface errors can influence performance (not considered here)
- QRFH has comparable best-case aperture efficiency
 - Note above on scattering and surface errors also applies here.
 - Noise temperature expectation should be calculated to make fair A/T comparison
- Haystack is working to evaluate VLBI2010 candidate feeds
 - Latest Eleven front-end not consistent with previous 20K noise performance
 - Investigation is needed possibly reconfiguration of components
 - QRFH front-end construction underway
 - Conduct Y factor measurements and compare to expectation
 - Measure 12m SEFD





