

VLBI2010 and the Westford station – the path forward

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MIT Haystack Observatory

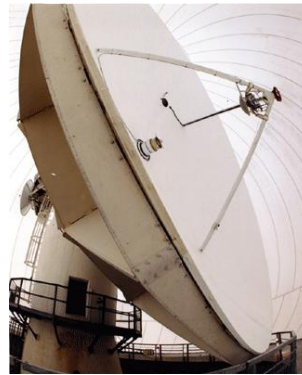


Outline

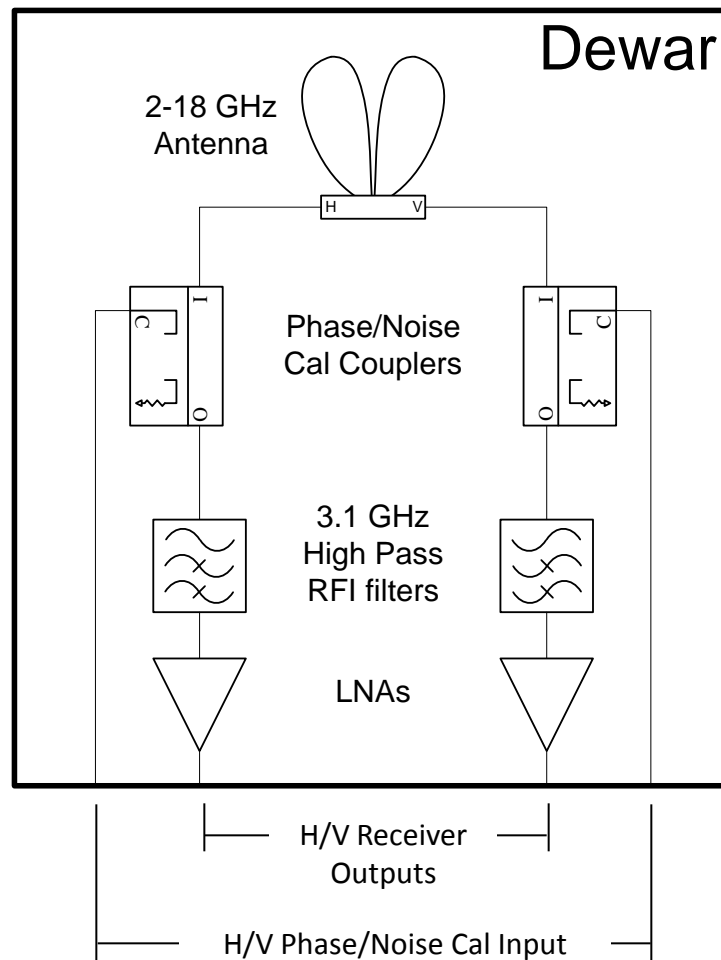
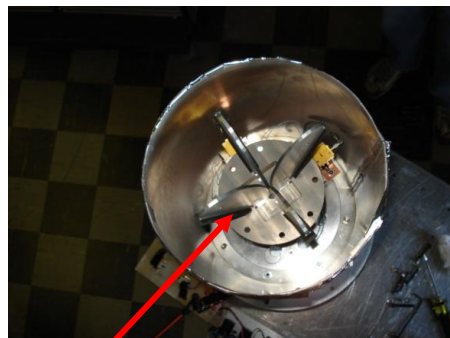
1. Dual-Role of the Westford Station within the IVS
2. Proof-of Concept System and Characteristics
3. Upgrade Issues
4. Next-Generation Westford Receiver Frontend
5. Anticipated Broadband Performance

Dual-Role of Westford Antenna

1. Operationally, scheduled in 62 sessions throughout 2012
 - Standard S/X band receiver – circular polarization
2. Transitions to broadband capability to conduct engineering tests
 - Complete removal of S/X system
 - Installation of proof-of-concept broadband receiver
 - 2-14 GHz dual-linear polarization
 - Difficult to establish seamless transition
 - Not consistent with operations model set forth by VLBI2010 specifications



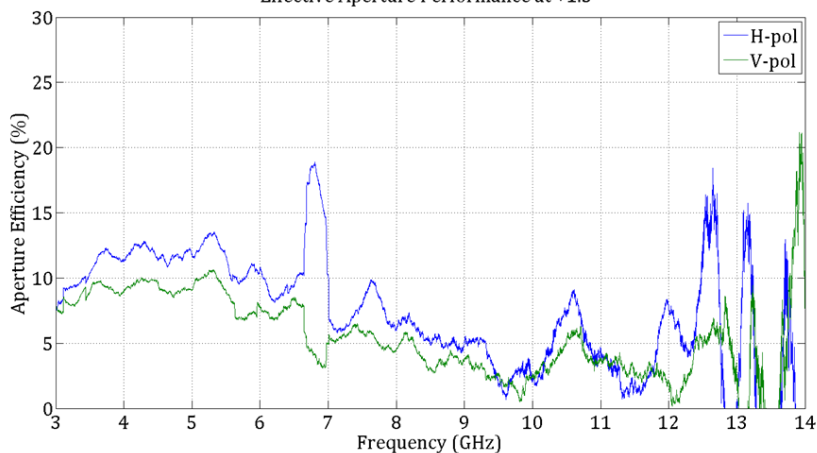
Proof-of-Concept Frontend



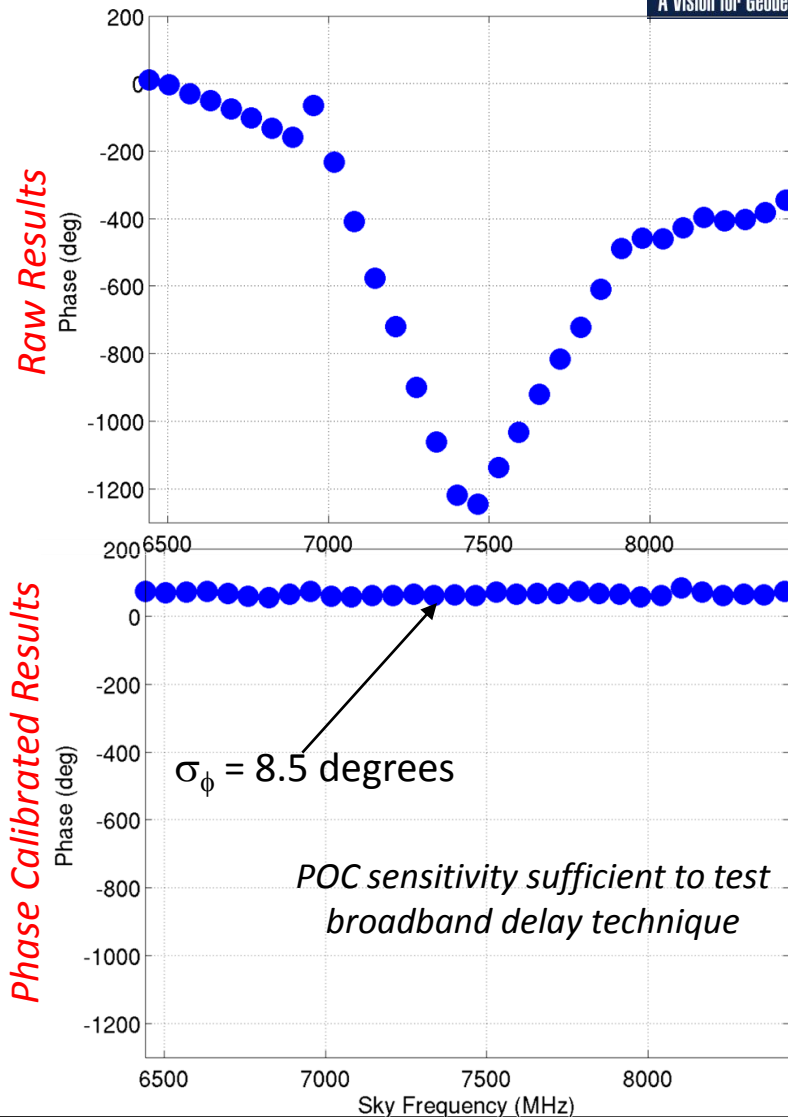
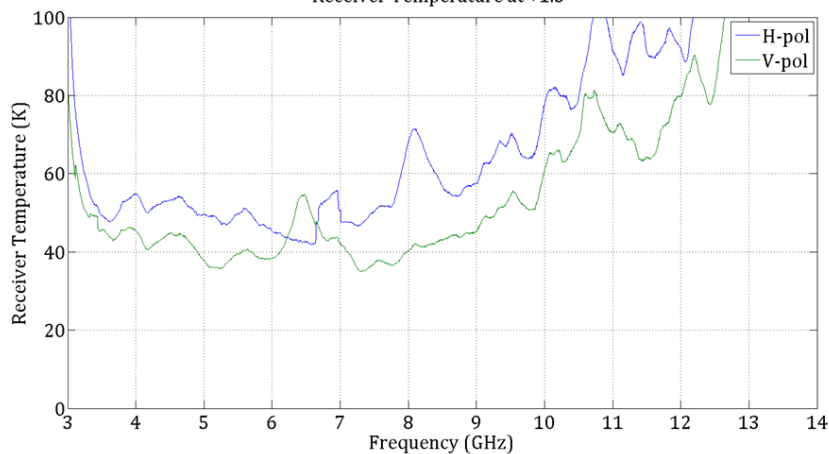
ETS-Lindgren 3164-05

Westford PoC Sensitivity

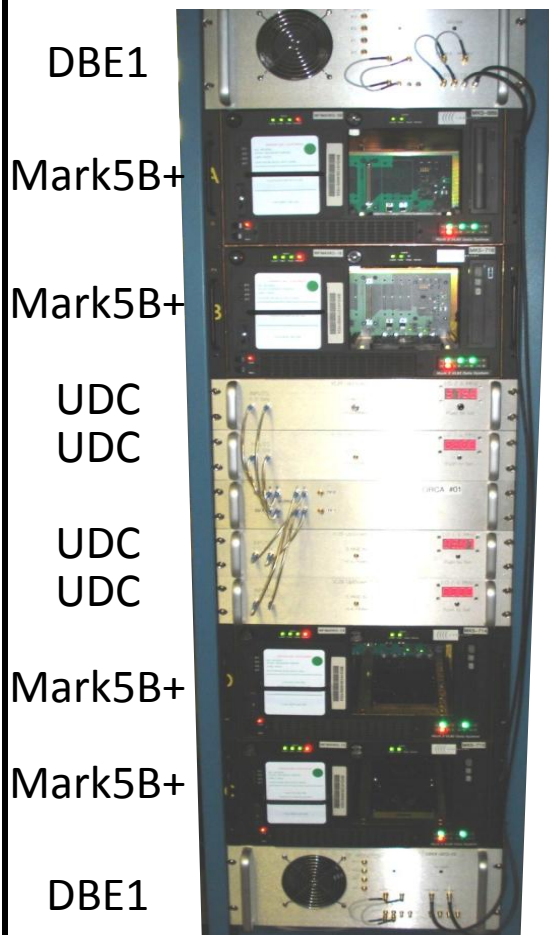
Effective Aperture Performance at +1.5"



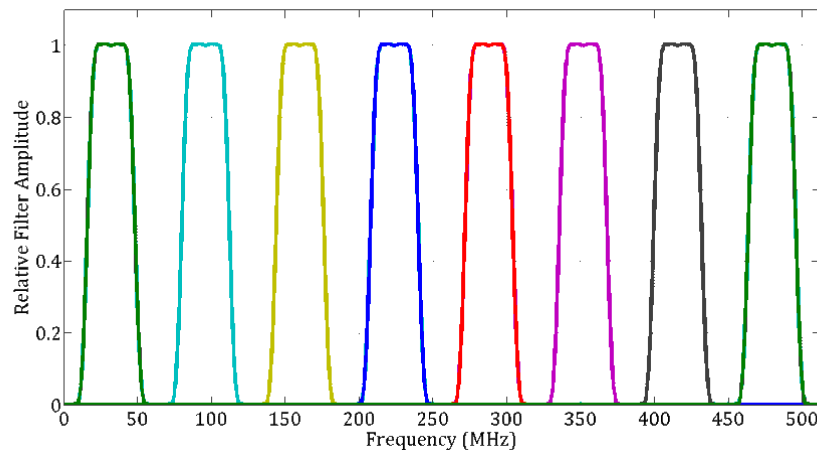
Receiver Temperature at +1.5"



Proof-of-Concept System



1. Frequency downconversion via UpDown Converter (UDC)
2. 8 Gbps onto 4 Mark5B+s
3. Frequency channelization DBE1
 - First-generation Haystack/NRAO digital backend developed for astronomy
 - Not operations-ready instrument
 - Implements 32 MHz polyphase filter bank (PFB)



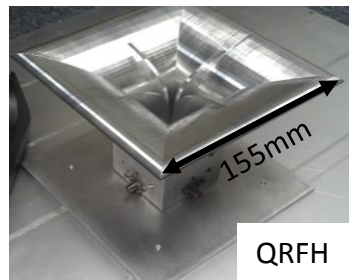
Upgrade Issues

- Sensitivity
- Polarization
- Frequency Channel Compatibility

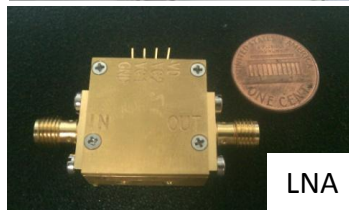
Westford VLBI2010 Frontend



Westford 18m



QRFH



LNA

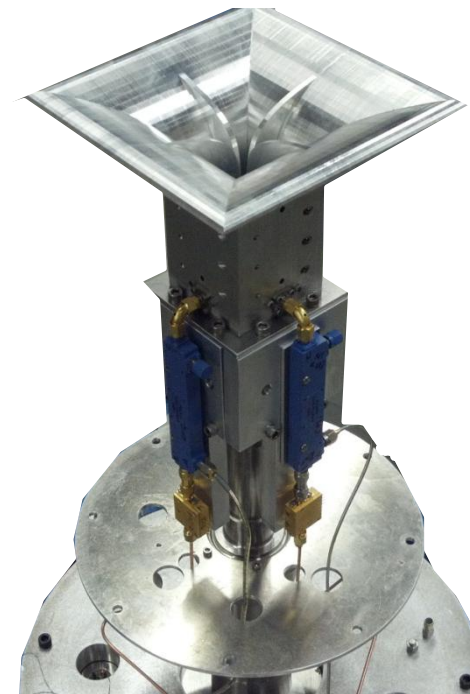
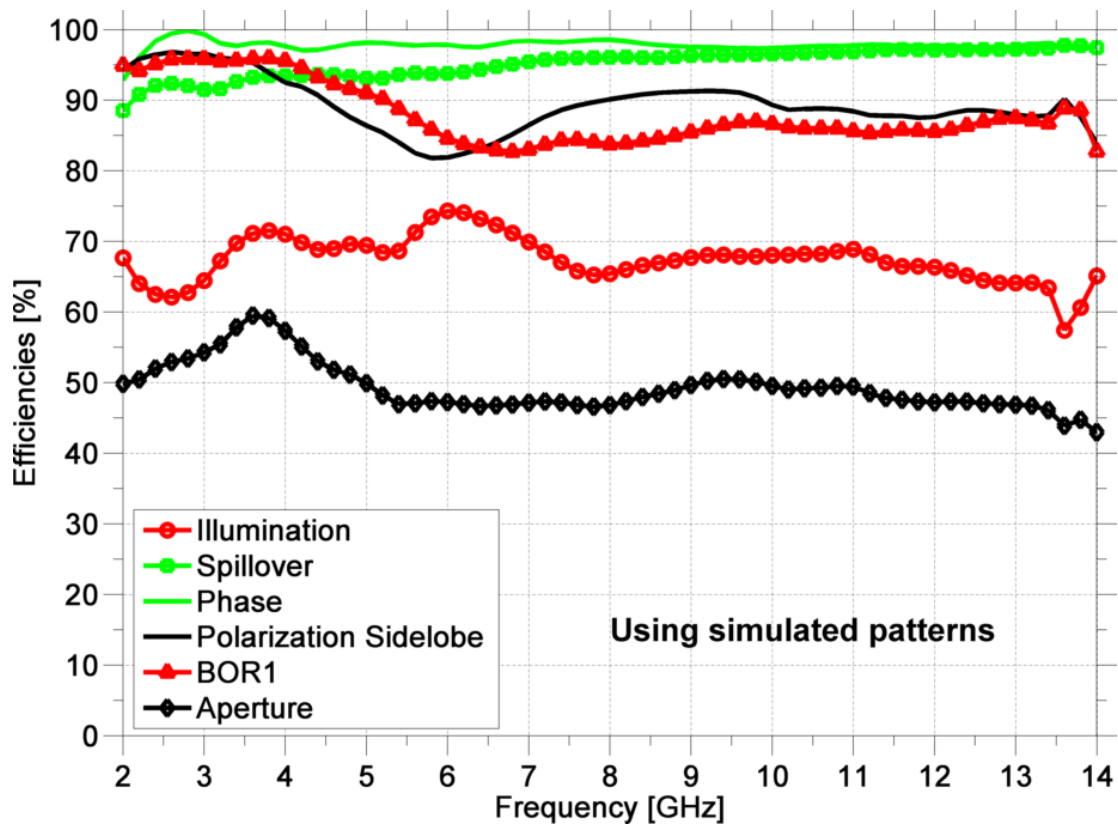
- Standard Prime Focus
 - Optical half-angle width: 80°

- Major frontend components comprising 2-14 GHz receiver:
 - New Quadruple-Ridged Flared Horn (QRFH) design
 - Optimized for Westford and cuts off at 2.2 GHz
 - CRY01-12 low noise amplifier

- Frontend diagnostics currently underway at Haystack

- Calibration signal injection via stripline coupler

Westford Broadband Performance



S/X band sensitivity 1000 Jy assuming 50 K system temperature

Summary

- Westford has been operating double-duty for past 4 years
- Goal is to conduct operations/engineering without major disruption
- Proof-of-concept system performance was limited but sufficient for testing the broadband delay technique
- Until recently, upgrading Westford to broadband capability while maintaining S/X compatibility was not possible
 - Poor sensitivity
 - Different Polarization Bases
 - Frequency Channel Incompatibility
- New Westford receiver frontend currently under development
- Expecting 1000 Jy SEFDs in S/X bands assuming 50K system temperature

