Progress towards VLBI2010: First fringes

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VLBI2010

- Goals
  - Small delay uncertainty per observation (4 ps)
  - Sample full sky in short time to minimize atmosphere error
  - Minimum cost

- Possible solutions
  - Small, high slew rate antennas ➔ 12 m antennas
  - Phase delay via multiple bands and very high data rates
VLBI2010 system

- Data acquisition
  - Four frequency bands 2 GHz to ~15 GHz
  - Record rates of 16 – 32 Gb/s

- System components
  - Broadband dual linear pol’n feed (cooled)
  - 2 – 14 GHz MMIC LNAs (cooled)
  - Up-down converters for RF to ADC
  - Digital back ends
  - Mark5B+s
GGGAO
X1 test
with fiber
and coax
2007/11/16

signal generator
(8592 MHz)
(shows up at 512 MHz)

10 MHz

short coax

from inside UDC
IFA or IFB
+29dB
0.5 – 2.5 GHz
(no NZ filter)

optical fiber
G = -6 dB
NF = 17 dB

fiber path

coax path

coax to waveguide
transition as polarized feed
for test signal

500 MHz
12 GHz

-95 dBm
(50K)

V H

T_sys 50k 50K

LNA G 37 37

-58 dBm

-6 dB

-6 dB

approx
+5 dB
for both
channels

-6 dB

-6 dB

-44 dBm

-45 dBm

Gain 32 db 33 db
f(Luff) = 7.645 GHz for 8080 MHz LO

approx
-12 dBm

-44 dBm

-45 dBm

10 MHz

5 MHz

Mk4 rack

Input level (dBm): -10 to -15 dBm

DBE1

IF0

IF1

1 pps
serial
internet

1 pps from 'dotmon'
to counter

Mk5B+

Up-Down Converter
2^2 NZ 512-1024 MHz
Gain: 60 - (0 to 30) dB
(set LO frequency)

approx
+5 dB

for both
channels

-44 dBm

-45 dBm

Spectrum Analyzer
or oscilloscope with
5 MHz maser reference

GGAO
X1 test
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First VLBI test

- X-band only
  - 512 MHz bandwidth
  - Sixteen 32 MHz channels in each polarization from each iBOB
  - Select odd channels from each polarization and route to one VSI-H connector
  - Data record rate 2 Gb/s

- MV-3 5m antenna
  - VLBI2010 configuration
  - Cooled feed/LNAs; UDC; DBE1; Mark5B+
  - Optical fiber Dewar to UDC for one channel; coax for other channel

- Westford
  - CDP X-band feed (circular pol’n) and LO
  - DBE1 and Mark5B+
  - Right circular polarization split and fed to both iBOBs
Results

- **MV-3 sensitivity**
  - System temperatures 35K and 45K
  - Efficiency only approximately 8% (half of normal X-band efficiency)

- **Actual useful bandwidth**
  - Westford feed/filter cutoff suppressed top channel
  - So seven usable channels each polarization

- **Observation**
  - 3C279 correlated flux density ~10 Jy
  - 125 seconds of data
  - Expected SNR’s for the two polarizations: 111 124
  - Observed 127 117
Mk4 Fringe Plot

3C279.teqzyr, 323-1500, EG
WESTFORD - GGA07108, fgroup X, pol LL

Fringe quality 9
SNR 127.2
PFD 0.0e+00
Intg.time 124.844
Amp 6.812
Phase 119.4
Sbdelay (us) 0.093362
Mbdelay (us) 0.000123
Fr. rate (Hz) 0.004563
Ref freq (MHz) 8640.0000
AP (sec) 1.000
Exp. BBAND2
Exper # 3203
Yrday 2007-323
Start 150059.00
Stop 150304.00
FRT 150130.00
Fourfit date: 2007:323:211546
Position (J2000) 12h56m11.1665s
-54°7'21.524"

~3 nsec FWHM

32 MHz

Amp. and Phase vs. time for each freq., 25 segs, 5 APs / seg (5.00 sec / seg.), time ticks 5 sec

January 12, 2006
IVS Analysis workshop 2006

Average
Plans for BBDev

- **X-band**
  - Install fiber for both channels
  - Look at differential phase between channels over several hours

- **Multiband**
  - Build Dewar for Westford with Lindgren feed and LNAs
  - Complete 4 UDCs and 2 dual board DBE1s for each site

- **Observation**
  - Compare with four bands at same frequency
  - Investigate ability to extract phase delay from four bands
  - Look at results of geodetic-style sessions
Plans for VLBI2010

- NASA
  - BBDev (just described) in progress
  - Request for Information about to go out for 12m antennas
  - Funds appear to be available for 12m prototype
  - Support efforts to develop better broadband feed (~2 – 14 GHz)

- Other efforts
  - New Zealand: 12m to be delivered 2008 for geodesy and SKA
  - Australia: RfT for 3 12m antennas is out
  - Germany: RfT for 2 12m antennas is out

- Analysis
  - Simulation effort underway to determine antenna parameters and limiting error sources