Status of the Bonn Correlator

MPIfR – BKG correlator

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Bonn correlator centre

- MK IV hardware correlator (XF)
  - 15 Mark 5s: 8 x 5A, 4 x 5B, (1 x 5B+, 2 x 5C)
  - Up to 1 Gbit/s data rate
  - 16 frequency channels
  - 32 lags (default continuum)
    up to 1024 (tested)
  - Data export:
    - To AIPS using MK4IN
    - To geodetic database (CALC/SOLVE etc.)

Bonn correlator centre

- MK IV operations
  - GMVA observations at 83 GHz
    - 13 stations
    - 512 Mbit/s
    - 10 days per year
  - MPI-based observations
    - e.g. observations above 100 GHz
  - EVN observations with special requirements
  - Geodetic VLBI (~50%)
    - Handled by partner BKG and Uni Bonn

DiFX Software Correlator
present status

- Standard DiFX implementation
  - Input from Mark 5A/B or 20 TB Raid
  - 1 Gb via Internet possible + 1 Gb from Eb
  - Cluster with 176 compute cores in 22 nodes
    - 20 Gbit Infiniband interconnect
    - 1 Gb Ethernet
- Manpower:
  - open postdoc position with geodesists
  - H. Rottmann & W. Alef: very limited time available at present for work on DiFX

DiFX plans for 2008/2009

- Realise production system similar to MK IV / VLBA
- Verify geodetic quality of correlation
  - Implement phase-cal extraction
  - File output to MK IV format ⇒ database
- Phase-out MK IV correlator
- Add >~ 4 Mark 5C
- Convert Mark 5A/B to Mark 5C

DiFX plans for 2008/2009

- Extend cluster to ~ 500 compute cores (November 2008)
  - More than ~10 stations @ 1 Gbit (1:1 in time)
- Direct rack cooling
- rebuild correlator room
- Manpower:
  - geodetic postdoc (hopefully soon)
  - H. Rottmann starting 03/09 full time on DiFX
  - J. Anderson for Lofar application

Upgrade plans for hardware

- ~16 Mark 5C
- Internet connectivity > 1 Gbit/s
  - Depending on demand
  - In 2012 10 Gbit/s ?
  - Big disk buffer: hundreds of TB
  - Asynchronous data transfer + Mark 5C mixed correlation

Geodetic correlation: needs

- massive subnetting
- typically only 1 frequency setup
  - except for cases with LO offset
- one start time, different stop times
- output 1 file per baseline/scan + station file + file root (vex excerpt) incl. Model
  $\longrightarrow$ translation program needed
- “version control” of output files

MK IV correlator VEX files

- observe vex file + clocks + eop + pcal mode
- log vex file: station -> scan name > 8pack > file name (possibly byte position)
- correlator vex file: possible correlator setups
- experiment vex file: setup parameters for each experiment (int. time, lags, polarisations)
- vex file with setups for phase-cal extraction

geodetic correlation

- scan-based
- parallel sub-net correlation
- n x integration time fits in 1 minute
- scans of 20 s +, (soon even shorter)
- operator start script with scans
- mount requests for Mark 5 modules
- status display of playbacks and correlator
- export with data selection to CALC/SOLVE via DBEDIT

MK IV Output files

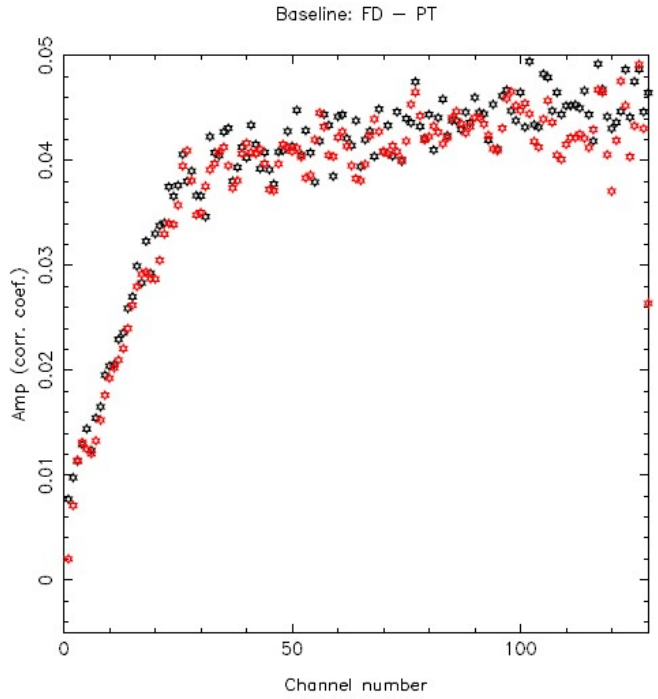
- Each scan creates a subdirectory with scan name
- Each correlation of scan creates root file with version as file extension (date encoded to base 26)
- each station has file with state counts and phase-cal
- each baseline has file with raw data
- each run of fringe fitter creates file for baseline and sub-frequency (S/X LL RR ...)

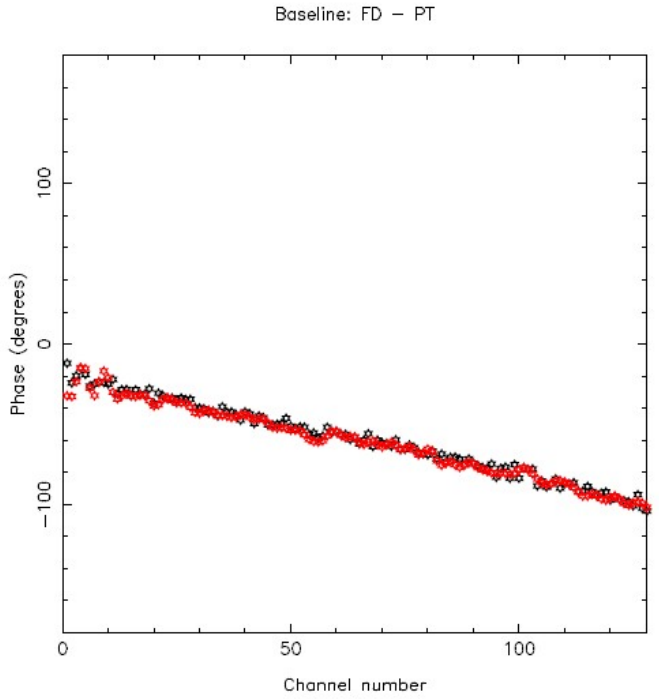
geodetic verification: step 1

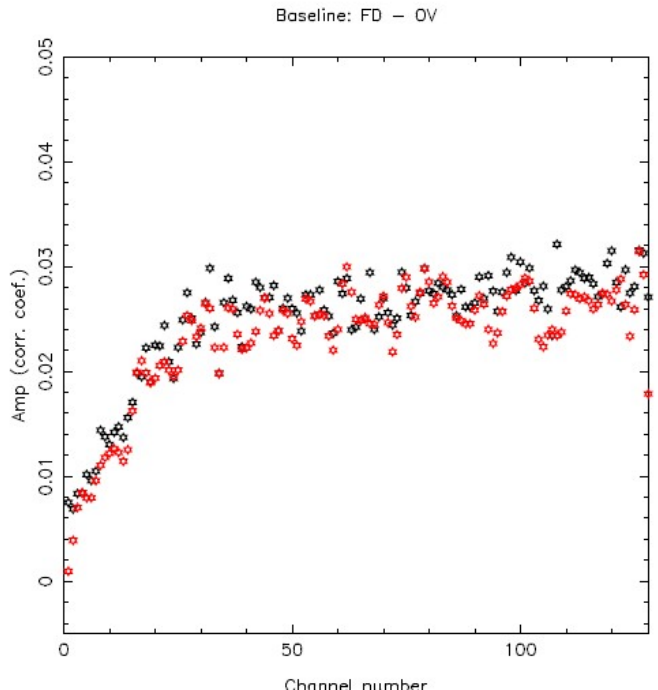
- 30 s of data of 4 stations, 1 lower sideband
- The data was exported to AIPS
- comparison was done in MIRIAD
- The total phase as a function of frequency (delay) and the total phase over time were calculated
- The differences between the results of DiFX and the MK IV correlator were calculated

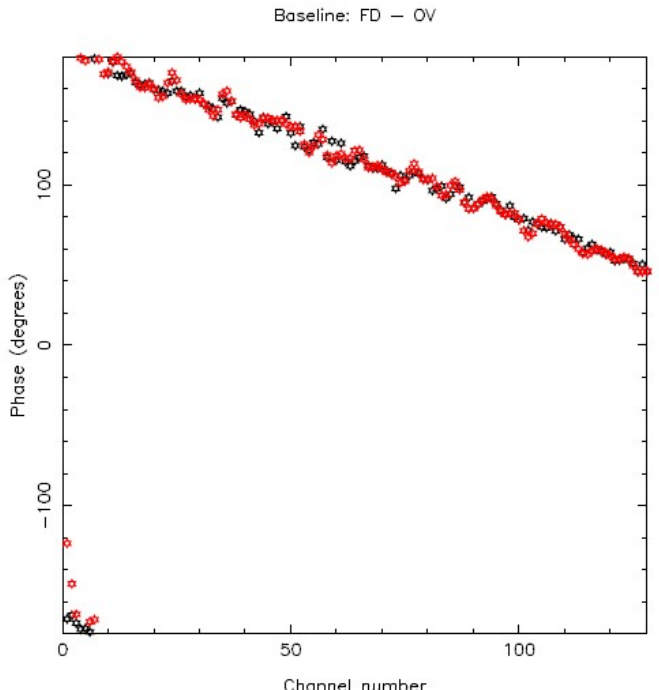
geodetic verification

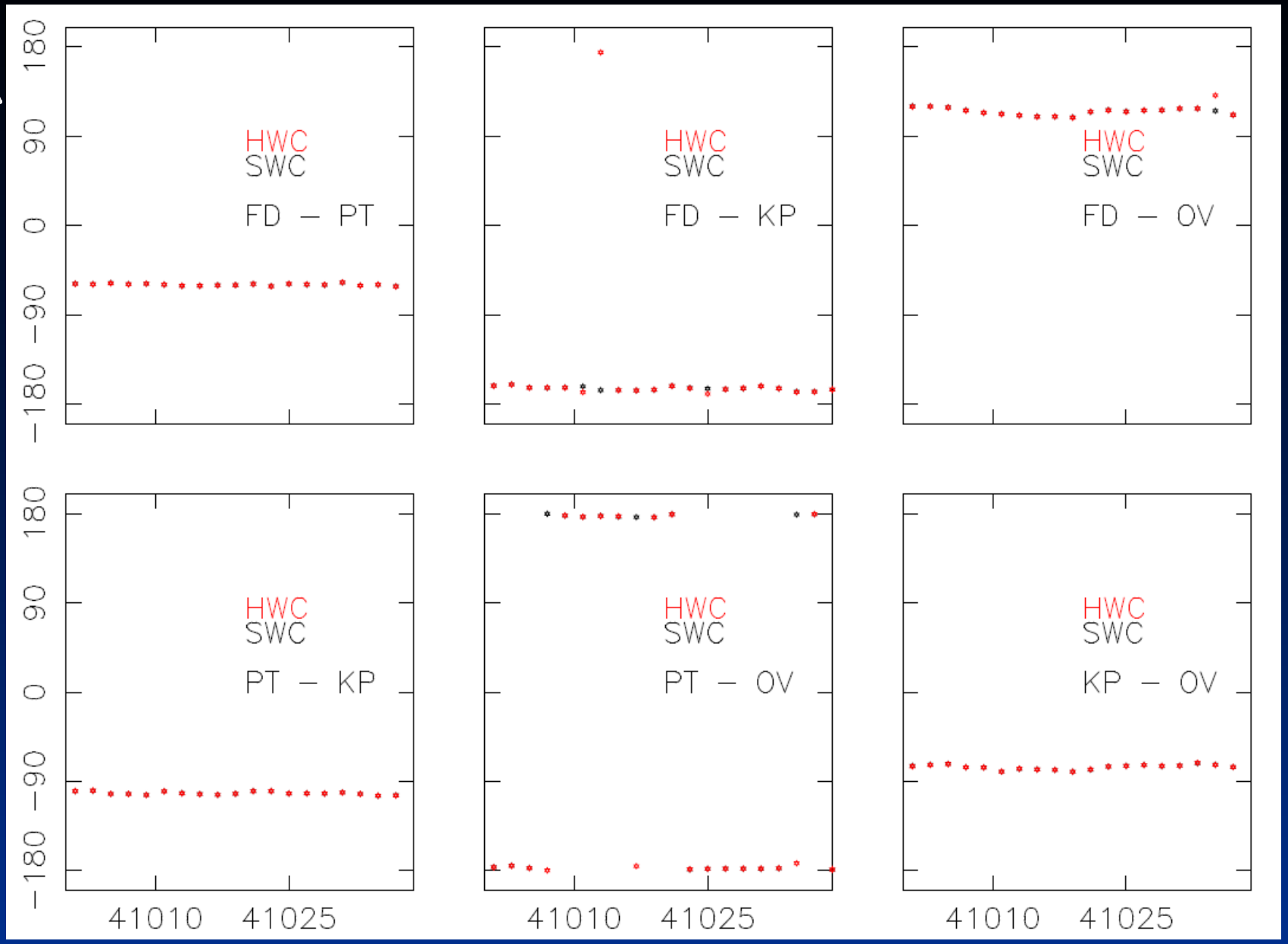
- **Results:**
- the mean phase difference is well within 1σ of zero, and the
- r^2 values indicate that far less than 1% of the variation in the data can be explained by linear regression.
- Thus, no significant differences exist between the phase outputs as a function of time, between the MK IV and DiFX correlators.


Baseline: FD – PT
Amp (corr. coef.)
0
0.01
0.02
0.03
0.04
0.05
0
50
100
Channel number


Baseline: FD – PT
Phase (degrees)
−100
0
100
0
50
100
Channel number


Baseline: FD – OV
Amp (corr. coef.)
0
0.01
0.02
0.03
0.04
0.05
0
50
100
Channel number


Baseline: FD – OV
Phase (degrees)
−100
0
100
0
50
100
Channel number


HWC
SWC
FD – PT
HWC
SWC
FD – KP
HWC
SWC
FD – OV
HWC
SWC
PT – KP
HWC
SWC
PT – OV
HWC
SWC
KP – OV
180
90
0
−90
−180
41010
41025

Next step of comparison

- 1 h 3 station INT3 (Wettzell, Ny Ålesund, Tsukuba)

Problems encountered so far:

- "Illegal VLBA format" of translated Ts data.
- Non-standard track assignments of Ts
- Mark IV formatted Mark 5 data starting on integer second before scan starts.
- manual phase-cals.

Next step of comparison

- DiFX data export and fringe fitting via AIPS to data-base.
- Problems with importing to AIPS encountered due to “unusual” (=geodetic) frequency setup. Under investigation.
- Bonn and Leipzig analysis centres will perform CALC/SOLVE comparison.
- Results so far: looks good on first inspection

full geodetic verification

- phase-cal
- 24 h full geodetic run ~ 8 stations
- documentation of algorithm

Later:

- output to MK IV format