

# The DiFX Software Correlator in Bonn: Latest Developments and Immediate Plans

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# About me

- PhD Student at the University of Bologna
- Working at the Institute of Radio Astronomy
- Working with Mauro Nanni and Franco Mantovani
  
- Visiting Bonn for four months
- Working with Walter Alef
- (Among other things) working on adapting the DiFX software correlator for Geodetic use

**1 Software Correlators**

**2 Verification**

**3 Development**

**4 Towards Production**

# Software Correlators

## Flexibility:-

- No hardware limits on output
- Expandable as broadband data volumes increase
- Not just a correlator but a cluster
  - Scope for pipelining and/or more complex calibration

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Flip side of flexibility:-

- Upgrading hardware/software can in principle change output
  - This is nothing new of course
- Important to have test datasets to verify after any change
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# Mark IV correlator Data Reduction

- Correlator
  - Phase cal tone extraction
  - MarkIV output (lags)
- Fourfit (fringe fitting)
- AEDIT (data inspection)
- Fourfit
- Further data inspection
- Export to Database

## Our Aim

To replace the Mark IV correlator with the DiFX software correlator

- We want to keep as close to this scheme as possible
- We need to **develop** software to fill the gaps
- We need to **verify** that the results are the same for the old and new systems
- We need to **tie together** the chosen software into a production system

# First Verification (Walter's Talk)

- Mark IV Correlator
  - fits output
- DiFX Correlator
  - fits output

## Comparison

Amplitudes and phases agree once differences in the model are taken into account

## Second Verification (Last Week)

- Mark IV Correlator
  - Phase cal tone extraction
  - MarkIV output (lags)
- Fourfit (fringe fitting)
- AEdit (data inspection)
- Fourfit
- Further Data inspection
- Export to Database
- DiFX Correlator
  - fits-idi output
- AIPS<sup>1</sup>
  - Initial fringe fit on strongest source
  - Fringe fit
  - Output to Mark III fringe files
- DBEdit

### Comparison

Won't be identical but we would expect similar results

c.f. Ohja et al. IVS newsletter 22

<sup>1</sup>following "explain ASTROMET" recipe

# Development

## High Priority

Phase Cal tone extraction

- Bachelor's Project (Frédéric Jaron)
- Parallel code will be added to DiFX

## Medium Priority

DiFX to fourfit

- Not a simple format conversion
  - Have to transform to lag space

## Lower Priority

Native K5

# Phase Cal tone extraction

## At VLBA

- Phase cal tone extraction at antennas

## On Mark IV Correlator

- Phase cal tone extraction as broadband data is read
- After clock tick extraction
- Before correlation

# Phase Cal tone extraction

## In DiFX

- Broadband data is unpacked and sent to processing nodes
- Nodes convert each sample into a 32-bit float
- Phase cal tones can be extracted at this point
  - All extracted by default
  - One for each time integration
- We will use the same vector libraries as DiFX (IPP)

# Further Testing and development

## Testing with all back-ends

- Lots of broadband formats
- Out of order channels
- Experience so far is encouraging

## Reading Directly from Mark5 units

- VLBA

## eVLBI

- ATNF

## Ensuring all observing modes are supported

- Preparing input files from SKED generated vex files

# Performance and Benchmarking

## Multiple Subnets

- Currently need to launch a separate correlation job for each subnet
- Some overhead involved with this but shouldn't be prohibitive

## Performance

- More processing power is easy
  - Just add more CPUs!
- Just as at the antenna, our bandwidth may be limited to how fast the storage is