

# DiFX At NRAO

Walter Brisken

National Radio Astronomy Observatory

2011 Dec 5



## VLBA correlator hardware

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- \* 15 Mark5 units
- \* 10 dual quad-core CPUs
- \* 10 dual hex-core CPUs
- \* Master node w/ RAID
- \* 1 Gbps CAT-5 network
- \* 40 Gbps Mellanox Infiniband network
  - o Two 36-port switches bonded w/ 2x 40 Gbps interconnect
- \* Off-cluster data archive using NGAS
- \* Transient processor box (via Curtin)

## VLBA operations

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- \* Implemented by a set of NRAO-specific scripts
- \* Using DiFX-2.0.1 as default or trunk on request
- \* Analysts/operators perform entire observe-correlate cycle
  - o Almost all projects now performed without expert DiFX help!
- \* Astronomy data ends in web-accessible archive
- \* Media pool: about 400 Mark5 modules
- \* Turn-around time:  $\sim$  2 weeks from observe to archive

## Supported features

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- \* *Allowed based on local verification and operations support*
- \* All modes ever supported by VLBA hardware correlator
- \* Fast dumps (10 ms and up)
- \* High resolution (4 Hz and up)
- \* Massive-multi-phase-center correlations
- \* FITS-IDI output format (only)
- \* Extraction of pulse cal and switched power (on request)
- \* Pulsar gating and binning
- \* Multiple passes
- \* Power-of-two FFTs
- \* Near field (as close as  $\sim 10^9$  m)
- \* Media: Mark5 modules
- \* Data formats: VLBA, MarkIV & Mark5B

## VLBA Resident Shared Risk Observing

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- \* Modeled after EVLA RSRO program
- \* Mechanism to allow outside users to implement features they want
- \* Not restricted to DiFX developments
- \* 2+ month visit to Socorro required
- \* Visitors will get some guaranteed observing time and first access to new modes
  - o But at risk of getting nothing at all!
- \* Successful RSRO projects will yield lasting benefit to the VLBI/DiFX community

## User control of DiFX

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- \* Correlation driven by `.vex`
- \* Basic correlator parameters ( $\Delta t$ ,  $\Delta \nu$ ) given in `.key` file
- \* Advanced features require interaction with analysts
- \* (Expert) user supplied `.v2d` files are welcome

## Recent/ongoing issues

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- \* vex2difx and mpifxcorr disagreed on value for guardNS
- \* “bufferindex $\geq$ bufferbytes”: result of VLBA header miscalculation; fixed
- \* Rogue “su” processes taking 100% CPU time
- \* SMART error detected on processing unit drive  $\rightarrow$  /tmp read only  $\rightarrow$  MPI fail
- \* Mark5 hang on playback “DMA timeout error” (fixed in SDK 9.2?)
- \* StreamStor bug: XLRRead() fails unless “primed” with a read at byte position 0; fixed???

## Recent developments

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- \* `mk5daemon` has VSI-S interface
- \* Support for DiFX-based switched power extraction
- \* Support for RDBE-based switched power extraction
- \* Improvement in Mark5 tools
- \* Code quality improvements (as time permits)
- \* Improved messages to operations



## Next year development plan

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- \* Development centered largely on VLBA hardware upgrades
- \* 2 Gbps / RDBE upgrade
  - o Interface to the new monitor and control database
  - o “ $P_{\text{dif}}$ ”-based amplitude calibration
  - o vex2 support (pending finalization of the standard)
- \* Support for phased EVLA (low priority until 2 Gbps is functional)
  - o VDIF decoding (heterogeneous thread geometry)
  - o Calibration data transfer
  - o Support for VDIF module directory entries (w/ Haystack?)
  - o Some automated band-matching may be required
  - o Support for X-cube recorders
- \* Verify operation of non-power-of-2 FFTs and offer to users
- \* Support for delay model expansion (see my upcoming talk)
- \* Primary beam correction

## Longer term development goals

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- \* Separate out some bits into libraries for better modularity
  - o `mk5daemon` and utilities (share w/ `mpifxcorr`)
  - o `vex2difx` vex handing code (share w/ VLBA upgrade)
  - o `difx2mark4` and Fourfit?
- \* Create new low level library of useful routines
  - o E.g., time/date handing functions, string manipulation
- \* `mk5daemon-mpifxcorr` shared memory → dual bank usage
- \* “Restart” mode to continue interrupted processing
- \* Support for Mark4 output
- \* On-the-fly application of calibration
  - o E.g., apply bandpasses *before* fringe rotation
- \* Improved “sniffer” replacement
  - o Possible synergy with Fourfit?