WSRT Pulsar Capabilities : features & prospects

WSRT Users Meeting,

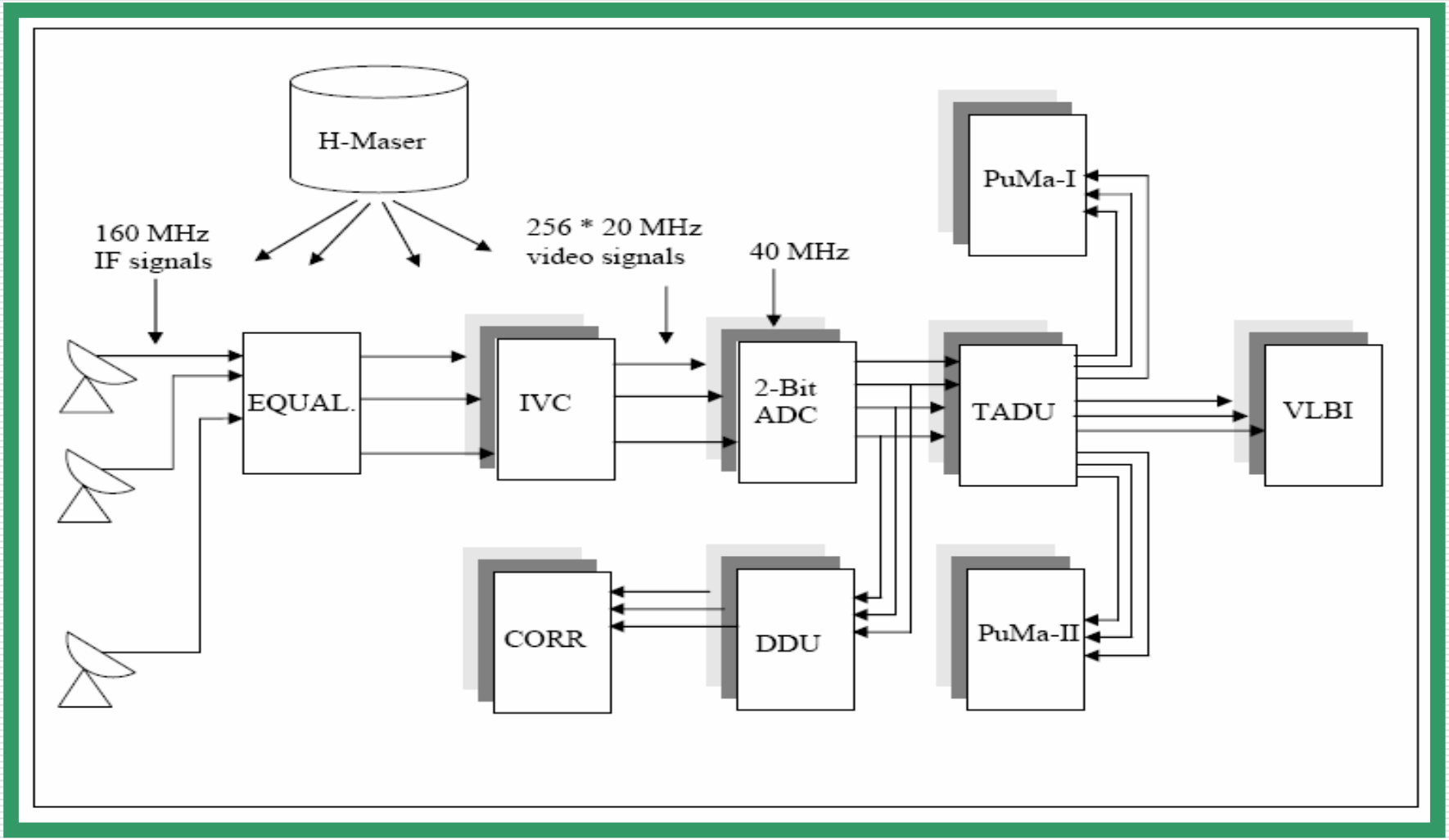
4th June 2008,

Amersfoort.

Outline

- WSRT overview
- WSRT Pulsar advantage
- Pulsar Machine - II
- PuMa-II - Current capabilities
- Future Prospects

Straw man WSRT

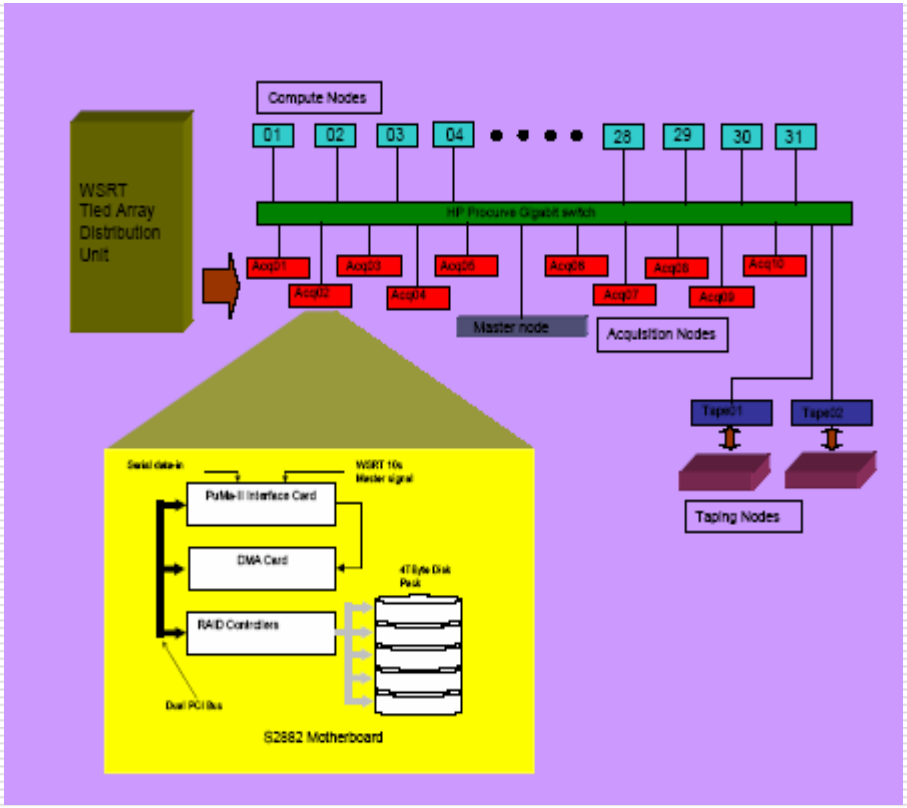


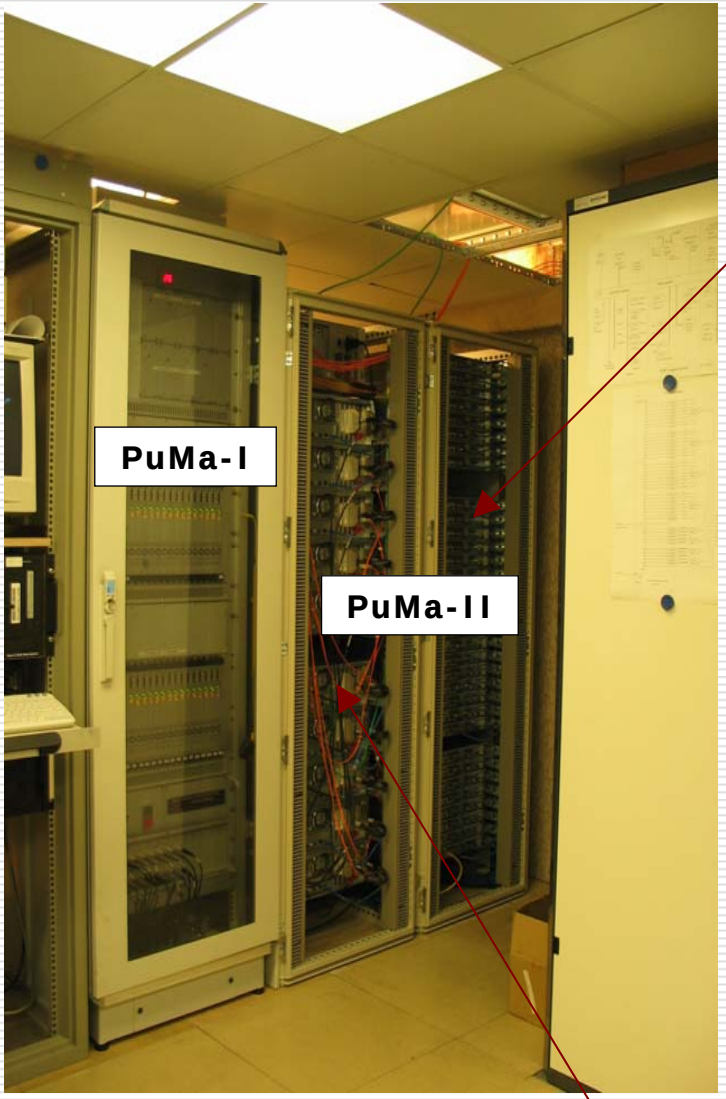
The WSRT-PuMa-II Advantage

- Sensitivity – Tied Array mode
- Multi-Frequency (new F_{sky} < 1min.)
- Multi-subarray mode
- Pulsar Machine II
  - Flexible Beowulf-like cluster
  - 8 bit system
  - Baseband recorder ~ 8x20 MHz
  - ~50ns time resolution
  - New 2-bit, 160 MHz possibility
  - Replace PuMa-I (end 2008)

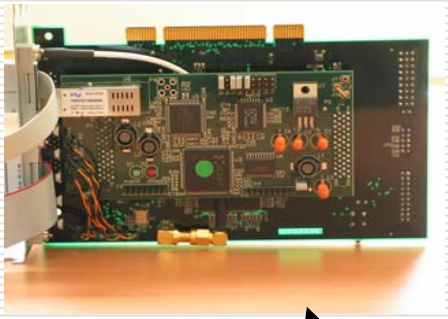
PuMa-II Overview

- 44-node cluster
  - dual 2.0 GHz CPUs
  - 10 storage nodes (27TB)
  - 31 compute node
  - 2 archival nodes (22 TB)
  - ≈500 GFlops
  - ≈70 TB storage
- 640 Mbytes/sec throughput
- Optical interface to WSRT
  - Signal quality
- Accurate time stamps
  - H-Maser

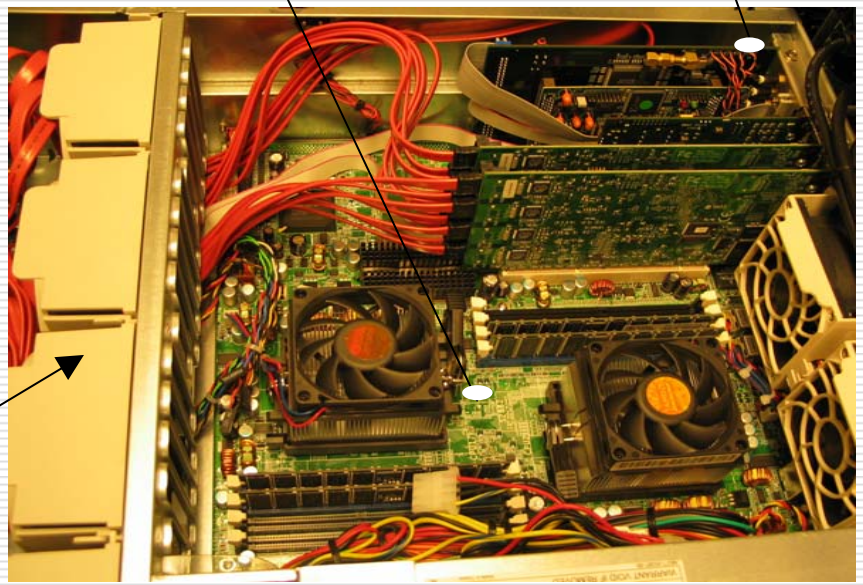




Compute nodes



Dual 2.0 GHz Opetrons
4TB RAID'ed Disks
2GB RAM
Dual PCI Bus
210 MB DMA card



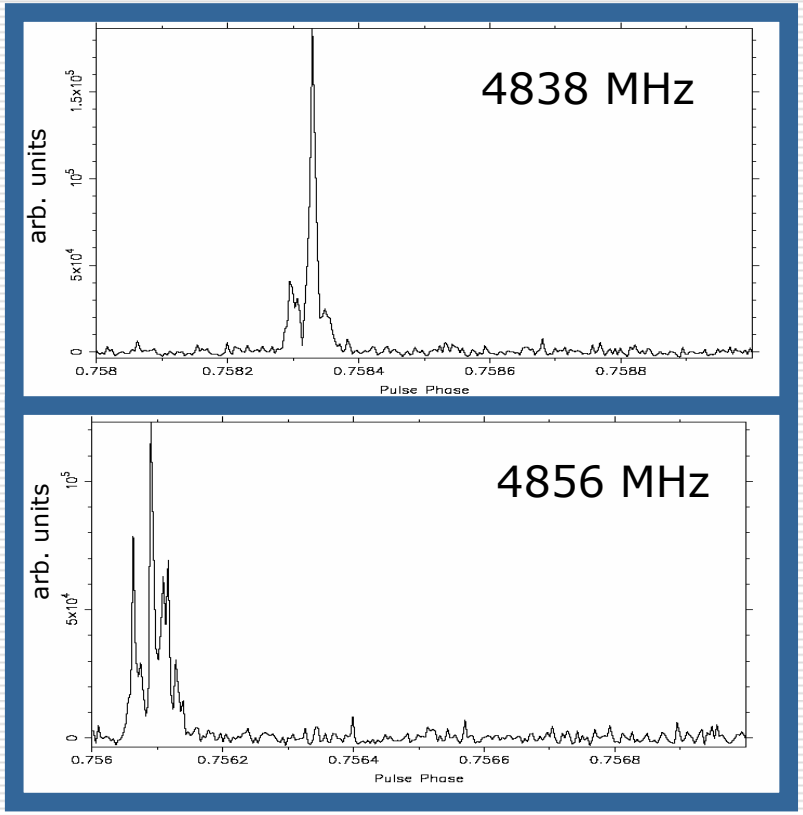
Storage nodes

PuMa-II : Current capabilities

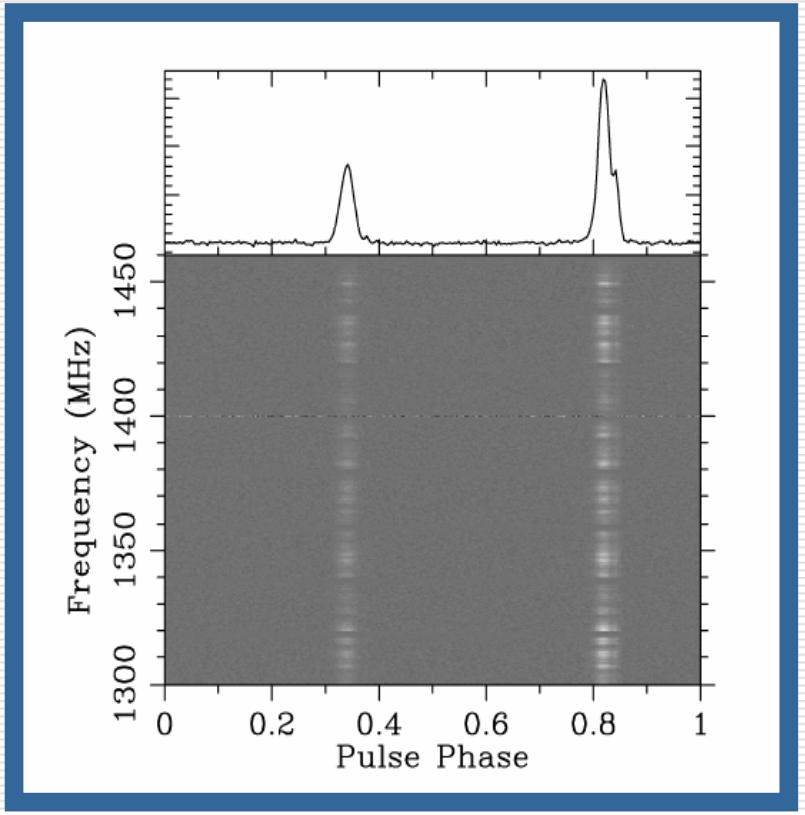
- Distributed data recording
  - C-based acq. s/w: 8 storage nodes – 8x20 MHz
  - 12-hour recording
- Distributed signal processing
  - Near realtime data reduction
  - Sun Grid Engine (SGE) queue system
  - DSP for pulsars (dspsr)
    - Coherent dedispersion, fold, GP search
  - PSRCHIVE + TEMPO
    - View, clean RFI, flux/poln. Calibration, timing

PuMa-II: Example 1

PSR B0531+21 – giant pulses



PSR B1937+21

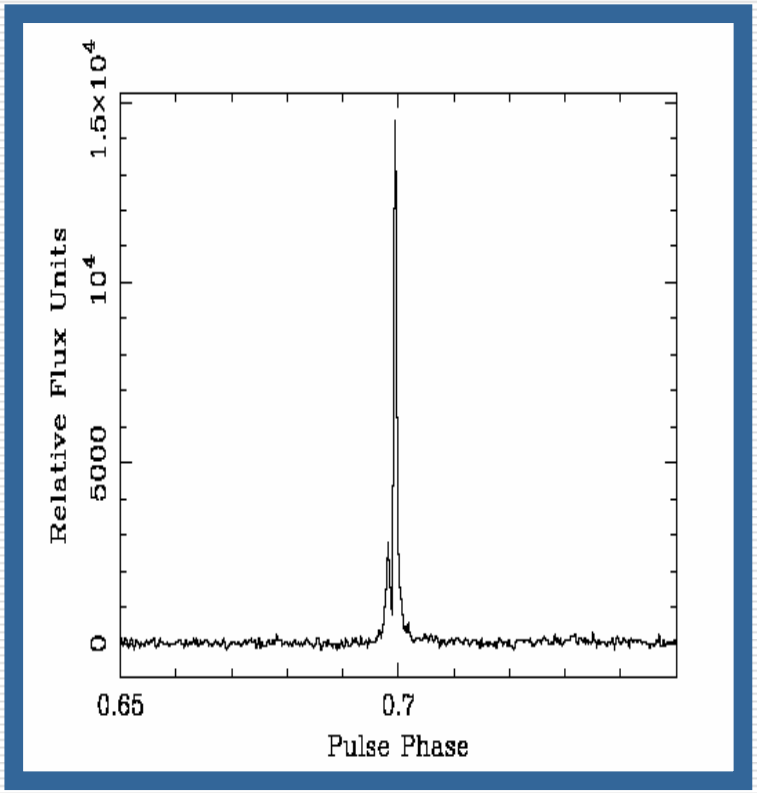


t_{res}=100 ns

PuMa-II TOA ~ 60ns

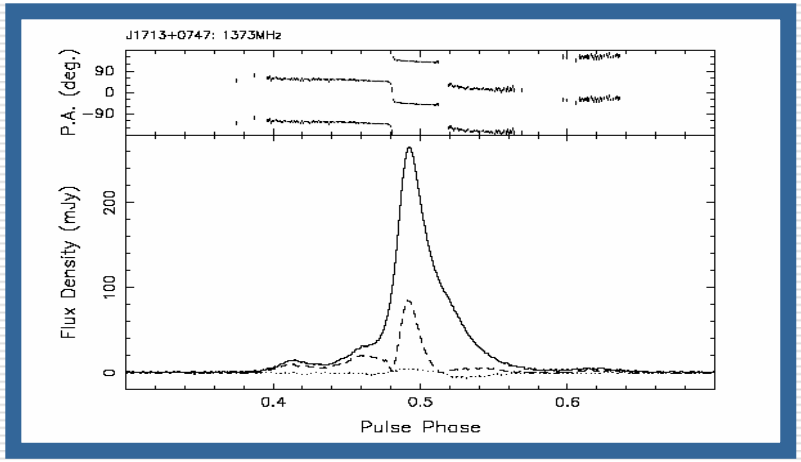
PuMa-II: Example 2

PSR B1133+16 – GPs?

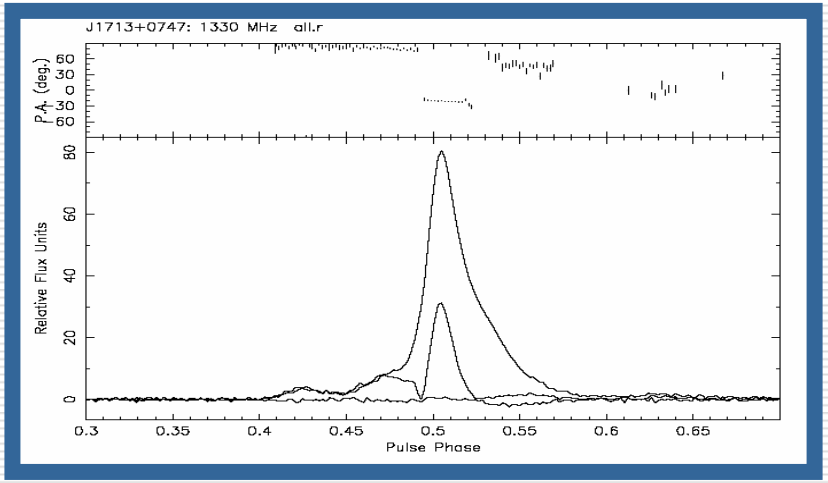


T_{res}=256μs, peak flux ~ 2000Jy

PSR J1713+0747
Polarization.



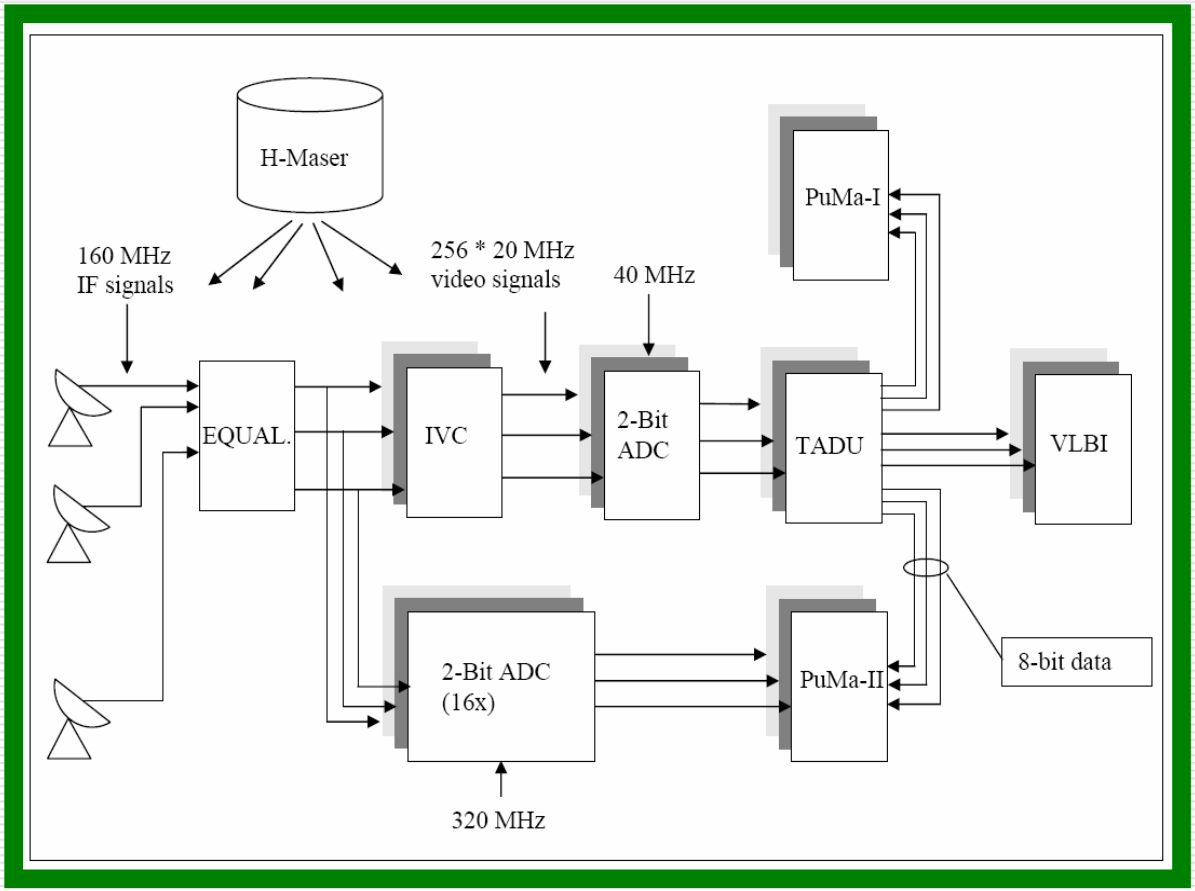
Ord et. al, MNRAS,2004



~ 10% more linearly poln. flux

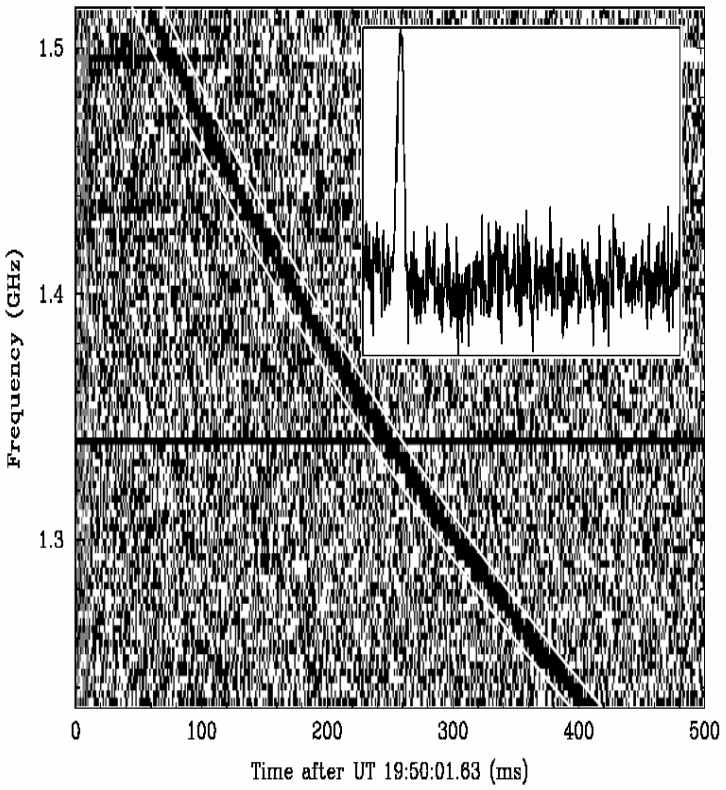
PuMa-II: Future prospects

- 2 Bit Mode
  - ~3ns
  - 320 MHz clock
  - Reuse software
- Incoh. Addition
  - S/N ~ √14
- Transient monitor
  - Large FoV
- Software Corr.
- APERTIF signal processing test bed



2Bit Mode : Science

- Eg. ~5ms "Lorimer burst"
  - 30Jy, 1.5 Gpc (DM=375)
  - Probe Intergalactic medium
- Piggy-back monitor mode
  - Better use of telescope
- Reduce location uncertainty
  - Software correlator
- LOFAR trigger
  - eg: DM=500@1400MHz → 40 min. delay @ 40 MHz



Lorimer et. al, arXiv:0709.4301 (2007)