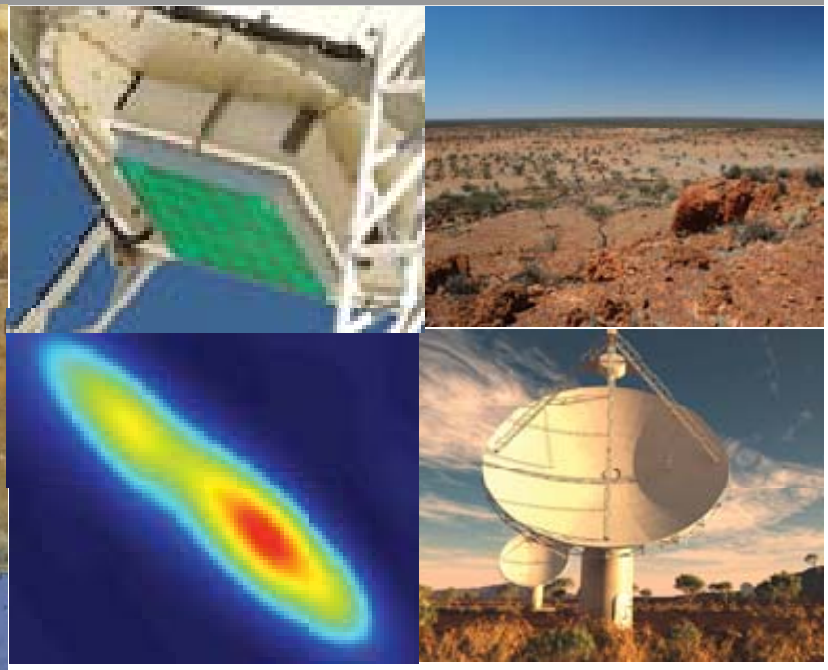
ASKAP: Setting the scene

Max Voronkov
ASKAP Computing
23rd August 2010

www.csiro.au

CSIRO

ASKAP overview



http://www.atnf.csiro.au/projects/askap/

- Located at radio-quiet site approx. 300 km inland from Geraldton
- Array of 36 12m antennas with phased array feeds (PAF)
- Initially 6 antennas: BETA (Boolardy Engineering Test Array)
- First antenna on site since last year, already used for some science (VLBI with other Australian antennas and Warkworth in New Zealand)

CSIRO

ASKAP 3-axis antenna mount

- 3-axis mount allows us to keep beam pattern fixed on the sky

ASKAP: General project news

- Antennas ahead of schedule
  - BETA antennas (1-6) to arrive to WA within a month
- Same hardware for beamformer, correlator and tide array unit
  - Digital team redesigned hardware for Virtex 6 FPGA
  - Virtex 7 could be a game changer (direct sampling + 4 boards instead of 32)
- Ten survey science projects
  - Two high priority projects (EMU,Wallaby)
  - Simulations to ensure software is ready
- PAF is the main technical risk
  - New technology, fundamentals to learn
  - Aggressive timescale
  - Economical production
  - Performance requirements
- Scaling is another risk

CSIRO

Calibration & Imaging challenges

- Strong sources contaminating the data through primary beam sidelobes
  - We have 3-axis mount which keeps sidelobes fixed
  - Beam variations due to PAF instabilities could be a problem
- Wide field calibration
  - Ionosphere is benign at frequencies about 1 GHz
  - PAF is stabilized in hardware (noise sources)
  - Software calibration is per synthetic beam
- Wide field imaging
  - Take direction-dependent effects via convolution functions
- Wide field deconvolution
  - Subtraction of the local sky model from uv-data
  - Joint processing of the full field of view
  - S/N-based cleaning (eventually MSMF algorithm)

Calibration & Imaging challenges - 2

- Mosaicing in full polarization
  - Polarisation properties of each beam will be taken care of by adding an extra dimension to convolution functions
- Mosaicing with different primary beams
  - Comes out naturally in our approach to mosaicing (we planned for this up front designing our software, but haven't tried this case yet in practice)
- Large data volumes (LDV) - pipeline processing
  - Central Processor of ASKAP will reduce data on-the-fly, astronomers are not expected to touch uv-data
- Large data volumes (LDV) - data formats
  - At this stage we use Measurement Sets. In any case, we plan to write a tool exporting the data into MS to assist with debugging (e.g. using casa)

Calibration & Imaging challenges - 3

- Large data volumes (LDV) - processing power limitations and shortcuts (e.g. algorithm and data compression) needed
  - Shortcuts to ensure single iteration over data is sufficient
  - Replaced traditional weighting schemes with post-gridding preconditioning (e.g. Wiener filter)
  - Assumed a good instantaneous uv-coverage
- Sky models: greater sophistication in specification
  - Plan to reuse LOFAR approach
  - Not much research done so far
- Solvability (cal): enough calibrators?
  - ASKAP field of view has on average 56 Jy of flux
  - With the target performance figures / 5 min solution interval, it allows to calibrate gain amplitudes with the 2% accuracy and phases with a few degrees accuracy
  - The impact on the dynamic range is not clear

Calibration & Imaging challenges - 4

- Time and frequency dependence of calibration parameters
  - Predict forward approach (no interpolation)
  - Frequency dependence: bandpass, leakages per coarse (1 MHz) channel
- Full pol imaging
  - Specify polarisation of the primary beams via convolution functions (extra dimansions)
- On-the-fly mapping (ask Gerry what this means)- Long baselines / large fields of view: dumping fast enough
  - ASKAP will deliver eventually a continuum map every 5 seconds (for transient search)

Australia Telescope National Facility
Max Voronkov
Software Scientist (ASKAP)

Phone: 02 9372 4427
Email: maxim.voronkov@csiro.au
Web: http://www.atnf.csiro.au/projects/askap/

www.csiro.au

Thank you

Contact Us
Phone: 1300 363 400 or +61 3 9545 2176
Email: enquiries@csiro.au Web: www.csiro.au

CSIRO