ASKAP Computing Status

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Telescope Operating System (TOS)

Responsibility for overseeing the monitoring and control of the overall ASKAP system, including

- Telescope Operating Manager (TOM)
- Monitoring Archiver (MoniCA)
- Alarm Management System
- Logging
- Operator Displays

TOS software periodically released, usually aimed at providing new features/functionality for particular milestones.

- Currently at 0.11 (released start March), with 0.12 due start June

TOS 0.12

Released in time for next SCOM MRO visit

New features will include

Control System Studio (CSS) for ASKAP

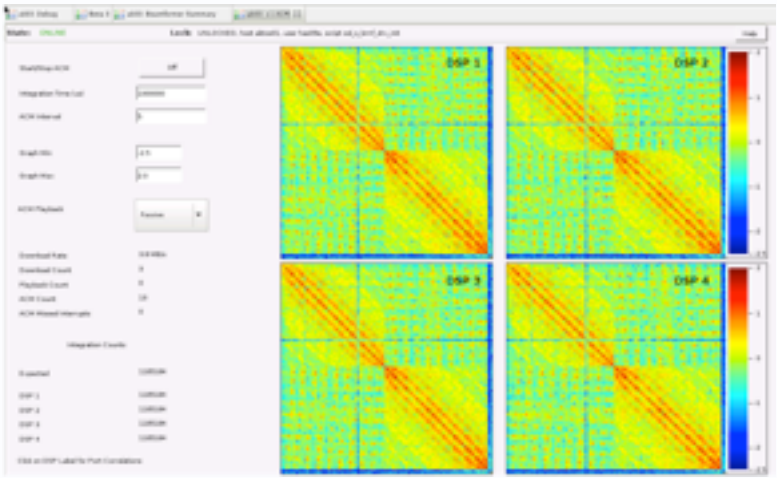
- BEAST alarm handler
- BOY GUI support
- Data Browser
- Logger

Synchronized startup of 3 digital backends

BMF data capture and software correlation (Max's correlator) via OSL of multiple beamformers

Integrate Eaton Power Supply IOC into TOS metapackage

Implement Failure Modes



Other activities

Software correlator

- Very valuable for MRO work
- Max to visit MRO in July

ADE

- ADE Backend common software framework

Science team interactions

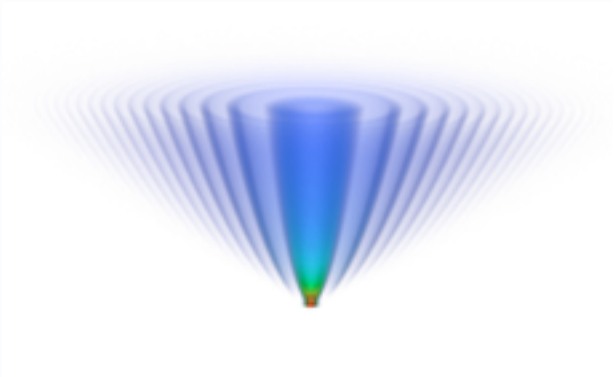
- Produced version 2 of ASKAP Science Processing document
- Have sought input from science teams on improvements to source finding code
- Provided access to our prototype for their testing
- Plan to work closely with SCOM-2 during BETA observations

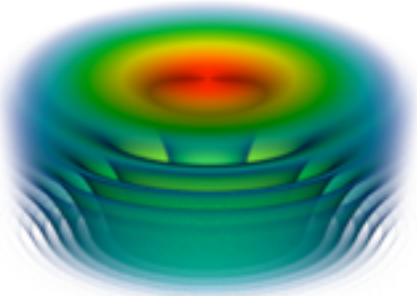
SKA work package preparations

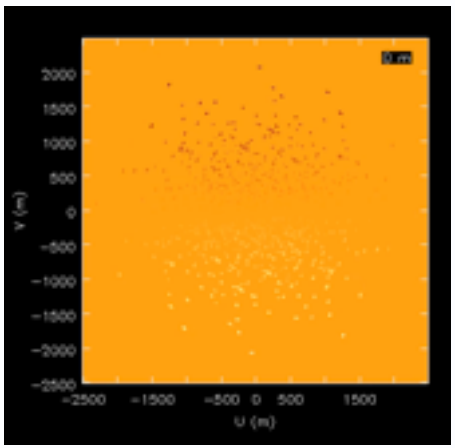
Wide field imaging

Quadratic phase term added to Fourier Transform

$$V(u,v,w) = \int \left[\frac{I(l,m) e^{j2\pi w\left(\sqrt{1-l^2-m^2}-1\right)}}{\sqrt{1-l^2-m^2}} \right] e^{j2\pi(ul+vm)} dldm$$

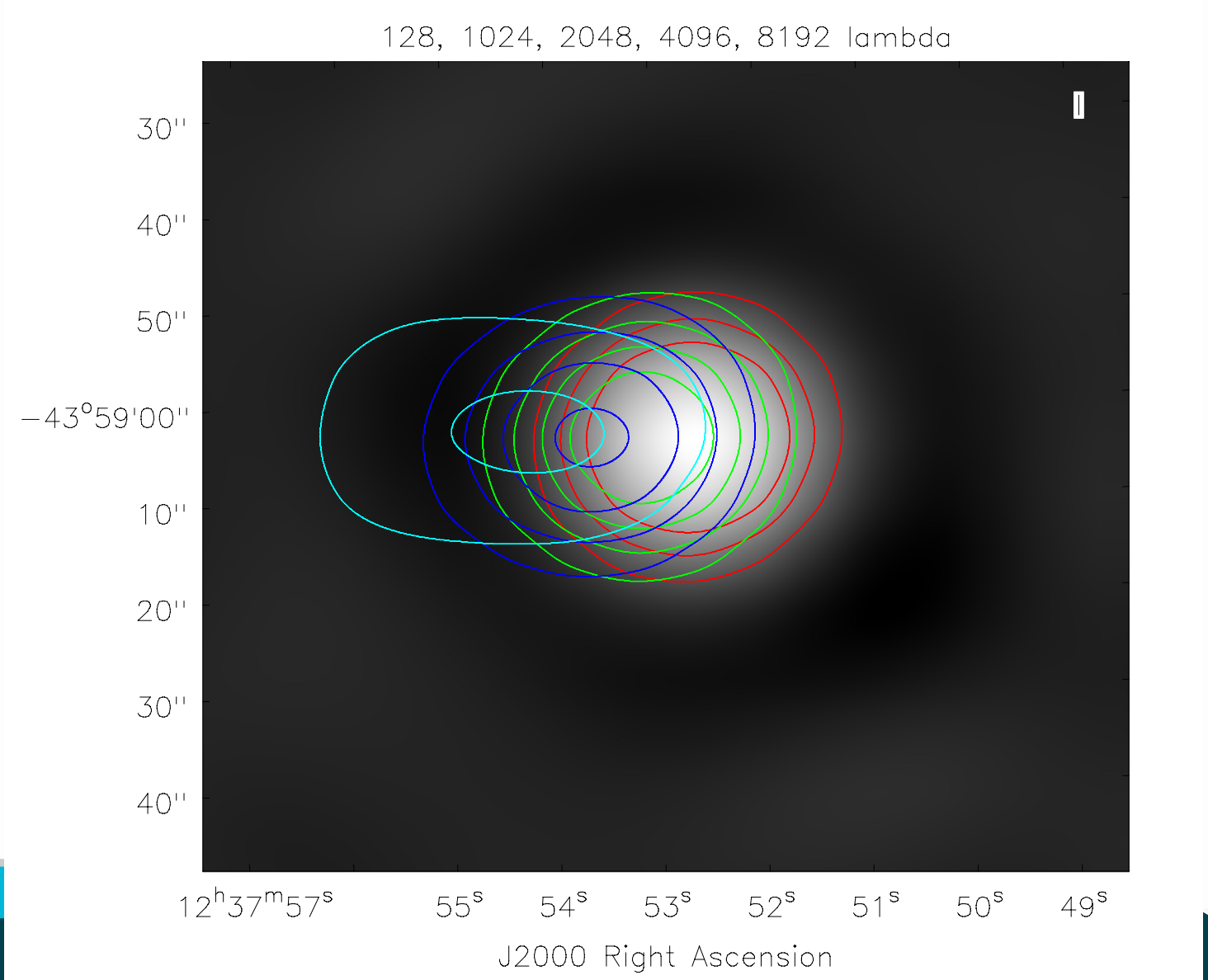




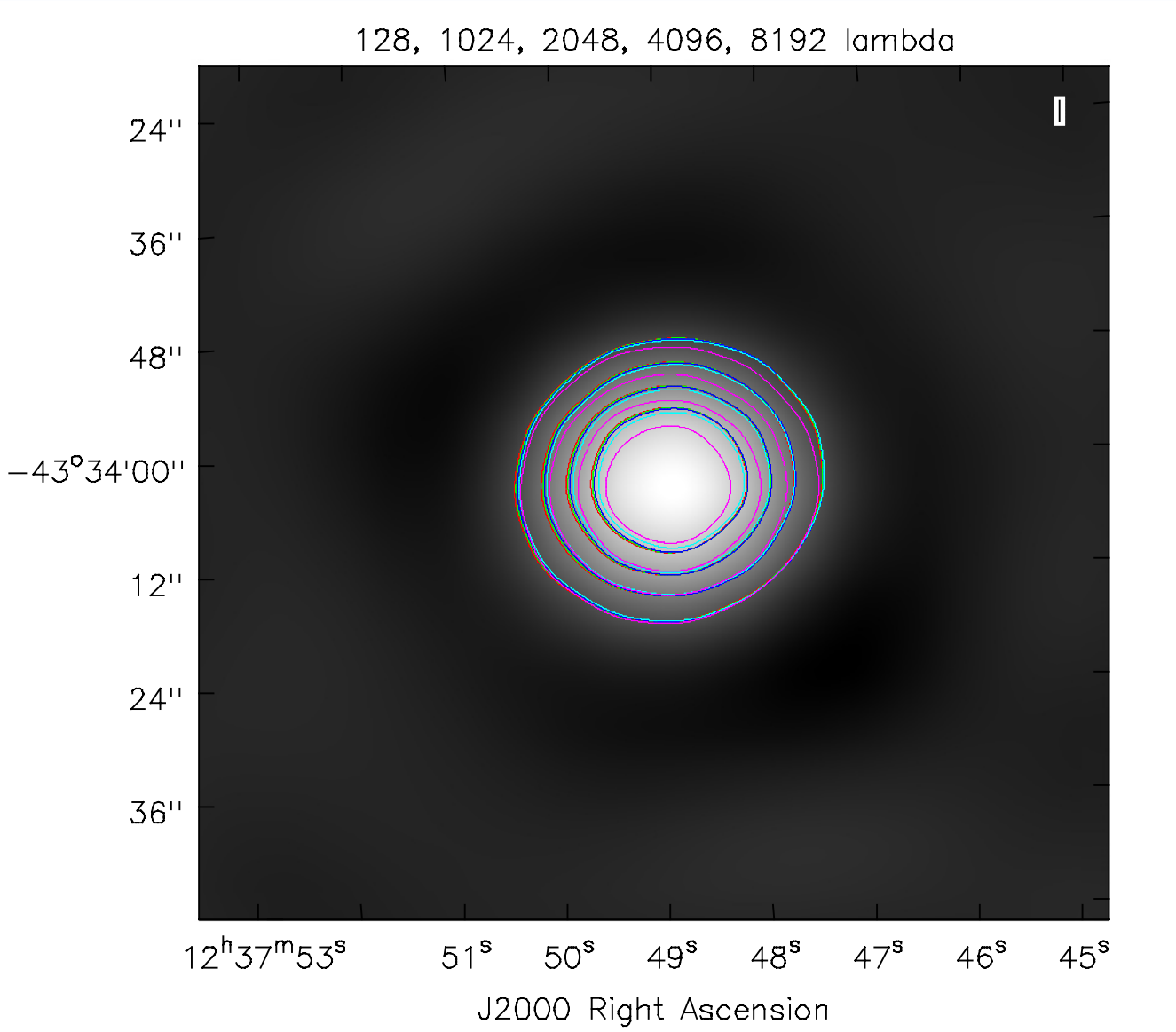


- Convolution in data space
- Multiplication in image space
- Slices in data space

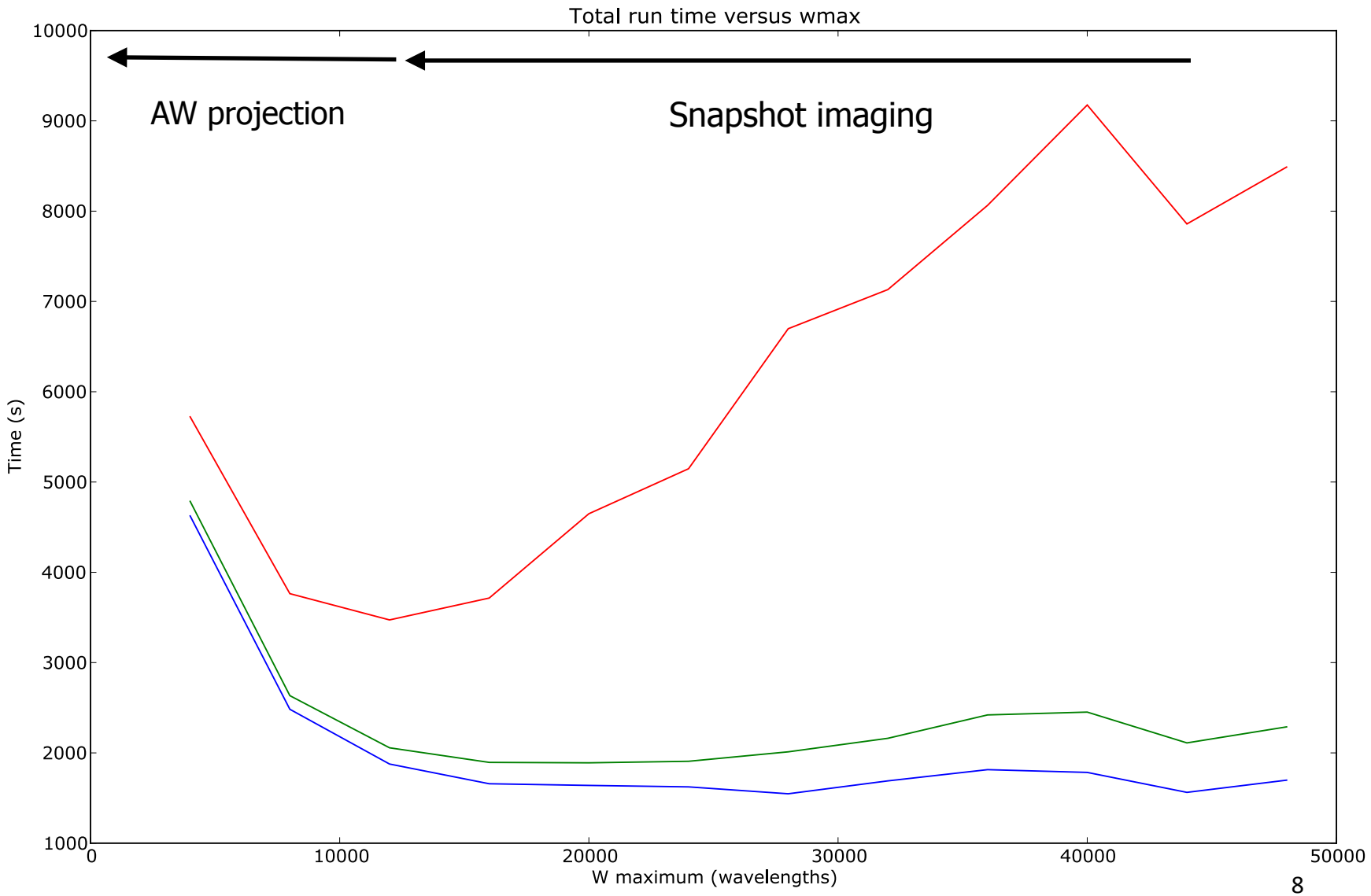
Position and width errors in snapshot imaging



Position and width in w projection/snapshot imaging



Optimum transition point in hybrid



Why do we need hybrid wide field algorithms?

Trade off space is large

- Scientific performance
- CPU
- Wall clock time
- Memory
- Memory bandwidth

No single wide field algorithm will suffice

Need very flexible hybrids

- AW Projection
- W Stacking
- Snapshot imaging
- Faceting

Autotuning

Changes in imaging during scaling work

AWProject (2007) Convolution

- W projection + A projection (for primary beam)
- Too much CPU
- Too much memory for convolution function

AProjectWStack (2008) Convolution/Multiplication

- Apply W term in image space
- Much less CPU
- Too much memory for w stack

AWProject + trimmed convolution function (2009) Convolution

- Only apply and keep non-zero part of convolution function
- Still too much memory for convolution function

AWProject + trimmed convolution function + multiple snapshot planes (2011)

- Fit and remove w=au+bv plane every 30 - 60 min
- Small memory for convolution function

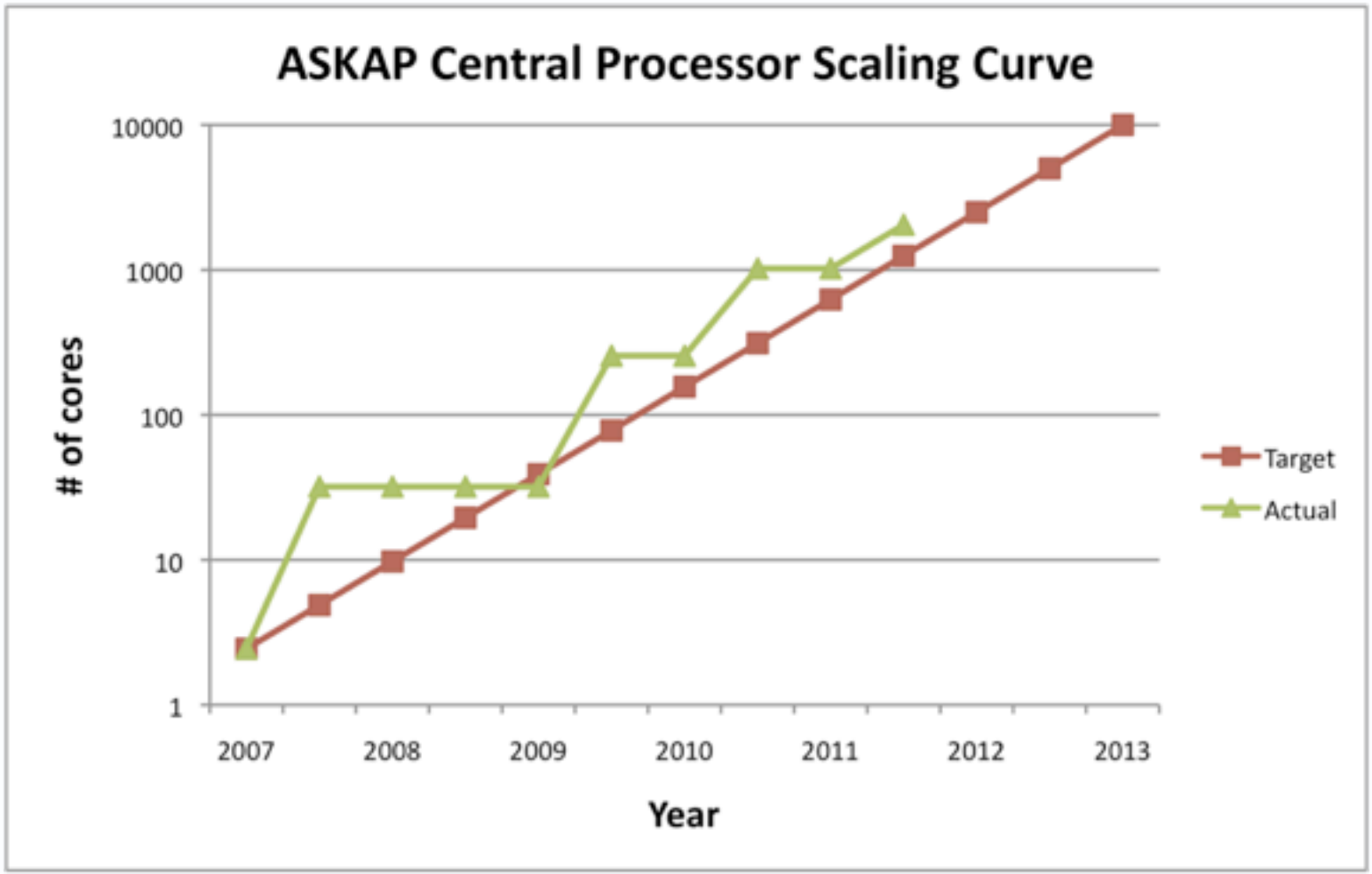
Convolution + slices

Serialise normal equations piece-by-piece for MPI (2011)

- Cuts down short bump in memory use

No current algorithm will scale as-is to full-field longer baselines (ASKAP 6km)

ASKAP imaging scaling curve



Multi-scale Multi-frequency Synthesis

MFS necessary to correct for source changes over ASKAP bandwidth

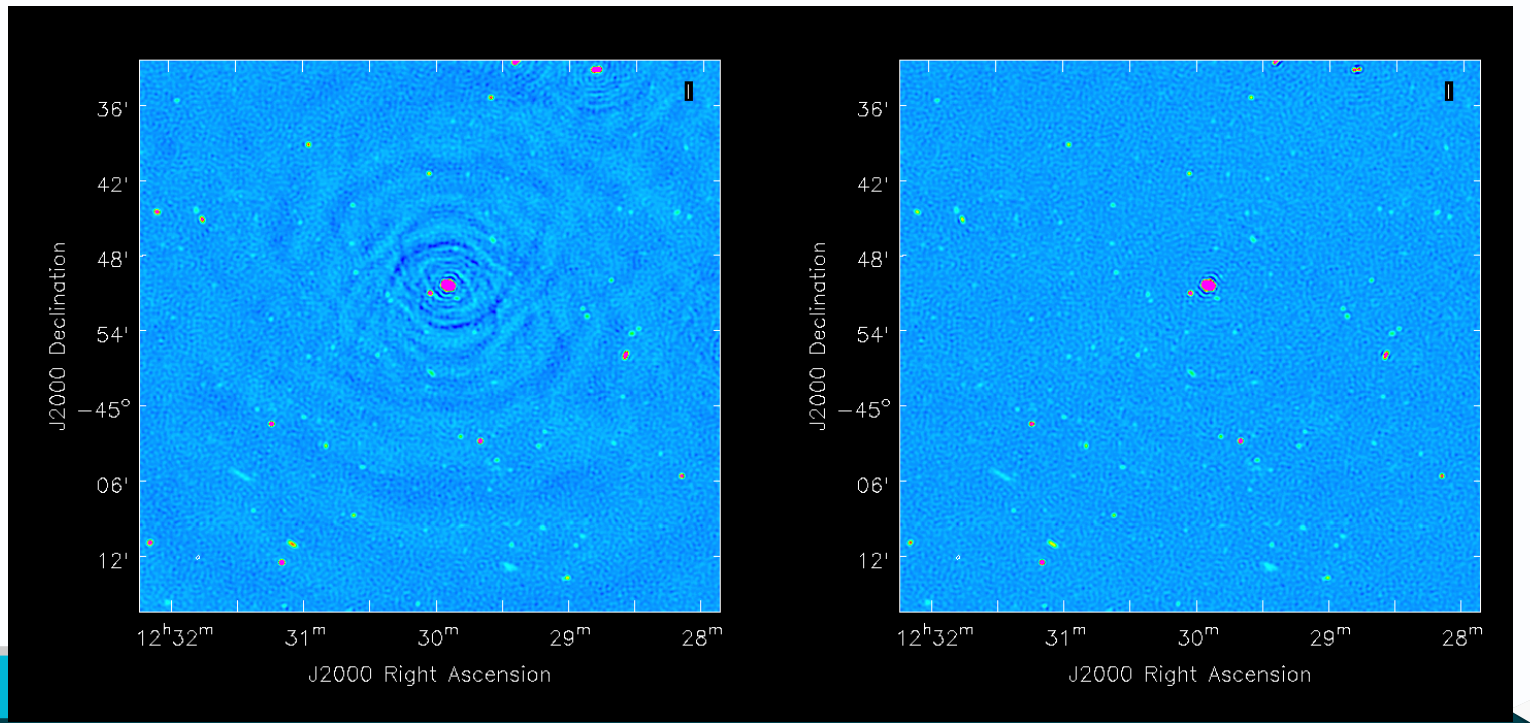
MFClean in MIRIAD

Multi-scale multi-frequency synthesis algorithm

- Urvashi Rau PhD (CASS/NMT/NRAO)
- Rau and Cornwell, A&A

Parallel version in ASKAPSoft, currently memory hungry

Also testing Compressive Sampling algorithm



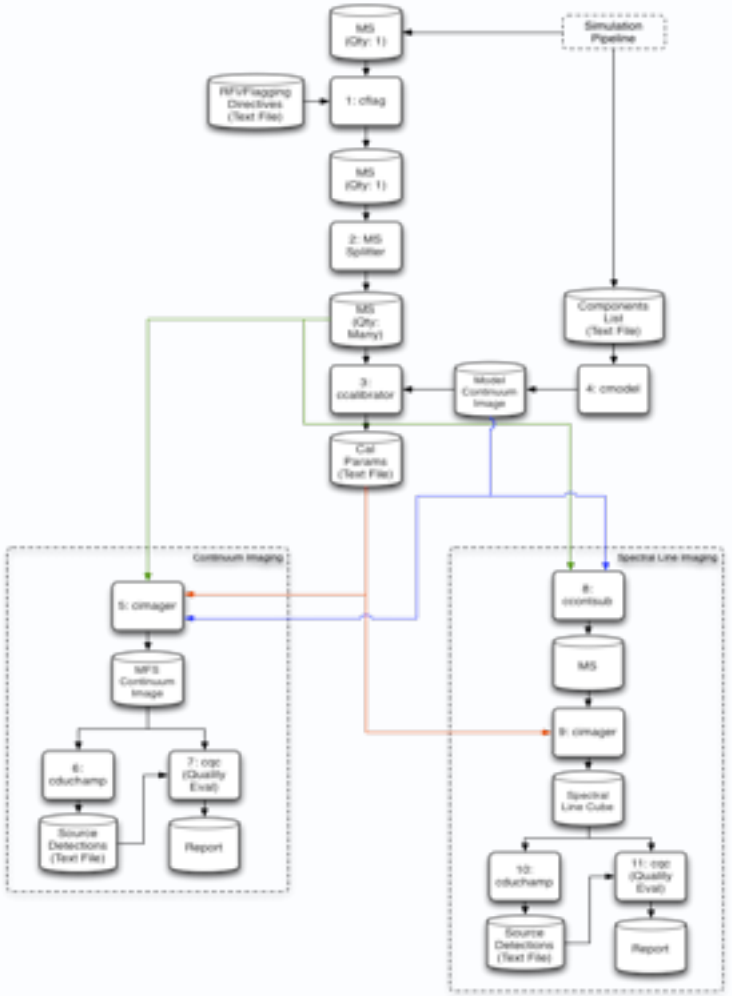
Science Processing Data Challenges

Imaging data challenge

- Develop simulated processing pipeline on Pawsey 1A supercomputer
  - Create complete pipeline
  - Use as regression test
  - Drive improvements in software to be ready for BETA
- Visibilities simulated from model of sky & telescope
- Then treated as we would real observations

Ingest data challenge

- Simulation of the ingest pipeline running on Pawsey 1A supercomputer
  - Control ingest process via TOS
  - Move visibilities & metadata from MRO to Pawsey 1A

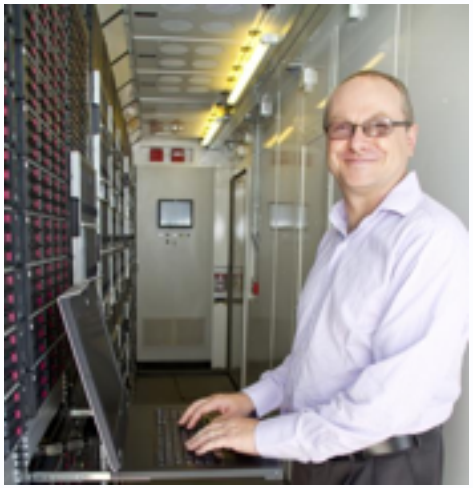


Pawsey High Performance Computing Centre for SKA Science, Perth

A$80M, funded by Australian Federal government

8800 core machine now in operation

- HP cluster in a box at Murdoch University: EPIC
- ~ 120 on Top 500
- ASKAP used EPIC as early adopters
- Now regular use - 8 Mhour mid 2012



Petascale system by 2013

- 25% for radio astronomy

Network link

From start of April, have access to 1Gb link from Perth to MRO

Replaces the ADSL connection, and allows computers to live on the CSIRO WA address space

Numerous benefits

- Allows faster access to MRO computers, via VNC sessions
- Ability to better support operations at MRO from Marsfield
- Phones and network access at MRO!

Future work

- Connection to Pawsey Centre
- Await conclusion of negotiations on full bandwidth link

Summary of imaging capabilities

Highly parallel code

- Necessary for 10TB/hour throughput
- ASKAP requires ~ 10000 cores

AWProjection + snapshot imaging

- Wide field imaging with low memory costs
- AProjection allows frequency dependent polarised primary beams

Post-gridding preconditioning

- To avoid multiple passes through the data for visibility weighting

Multi-Frequency Multi-Scale deconvolution algorithm

- For wide-band (300MHz) imaging

SNR-based CLEAN

- To avoid cleaning low sensitivity regions

Summary

ASKAP computing capabilities coming along well

Within a factor of a few for calibration and imaging

New problems always popup: cube merge I/O limited

Still lots of work to do

~~Instability in imaging program now a worry~~

Data Challenge now being deployed onto Pawsey *epic* system

Thank you

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