POSSUM Workshop 2012- Day 2 Notes

Program for day 2 (see http://askap.org/possum/Meetings/SydneyPossumWorkshop2012)

Wednesday May 9th

Time	Topic	Speaker / Chair
09:00-09:30	Ionosphere Testing	Shane O'Sullivan
09:30-10:30	Source Finding	Jeroen Stil
10:30-11:00	Morning Tea	
11:00-12:30	Catalogues & value-added data products	Larry Rudnick
12:30-14:00	Lunch	
14:00-15:30	Wide-field Issues	Tony Willis
15:30-16:00	Afternoon Tea	
16:00-17:30	BETA, ASKAP-12 and Commissioning	Ettore Carretti & Cormac Purcell

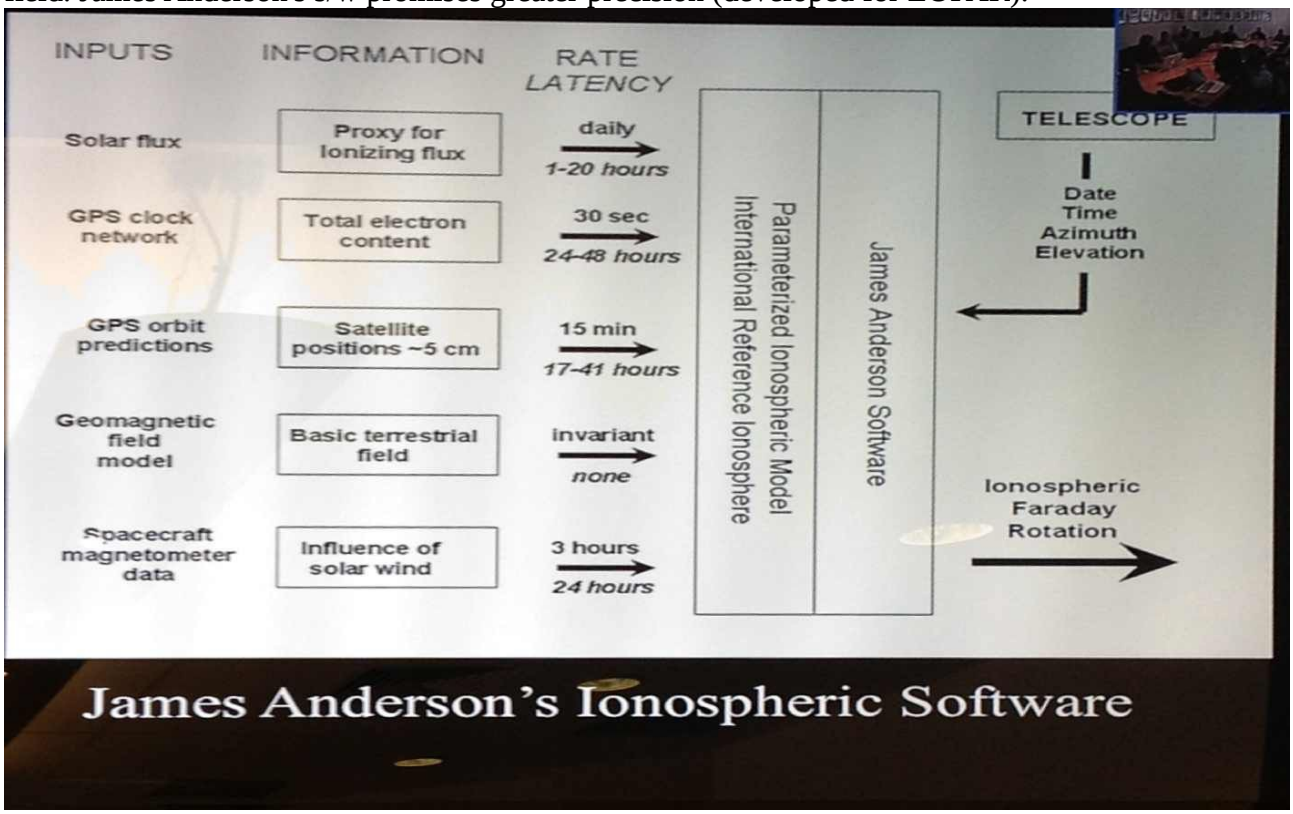
Attending:
Feain
Gaensler
O'Sullivan
Purcell
Gheissari
Rudnick
Kaczmarek
Lenc
C. Anderson
Akahori
Sun
Norris
Kothes
Stil
Taylor
McClure-Griffiths
Carretti
Seymour
Landecker (video)
Willis (video)
Robishaw (video)
Whiting

Ionospheric Testing - Shane O'Sullivan & Tom Landecker

Erickson et al. (2011) - correction of ionospheric RMs using GPS clocks

ASKAP will be observing at solar maximum

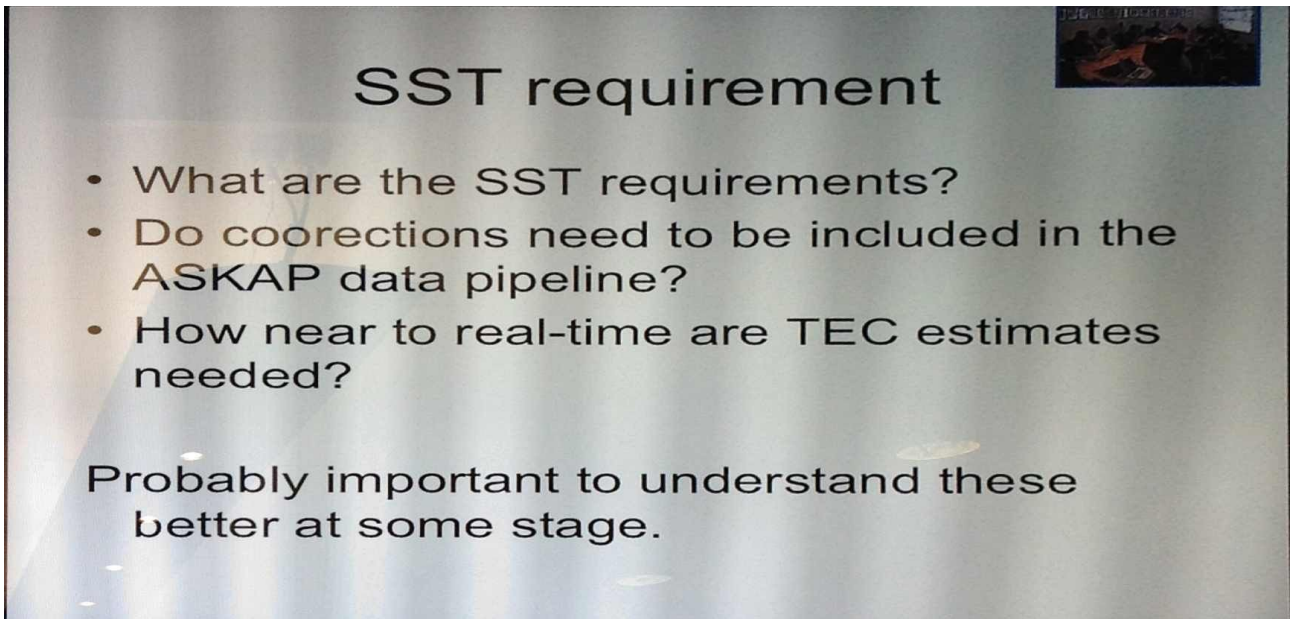
All s/w packages for correction using either International Reference Ionosphere (IRI) or Parameterised Ionospheric Model (PIM). Most s/w packages use quasi-static model of geomagnetic field. James Anderson's s/w promises greater precision (developed for LOFAR).



We can now compile Anderson's software, but there are leftover issues that Willis hopes to track down when he visits Bonn shortly.

Presentation from John Reynolds (in absentia):

Questions from John Reynolds (in absentia):

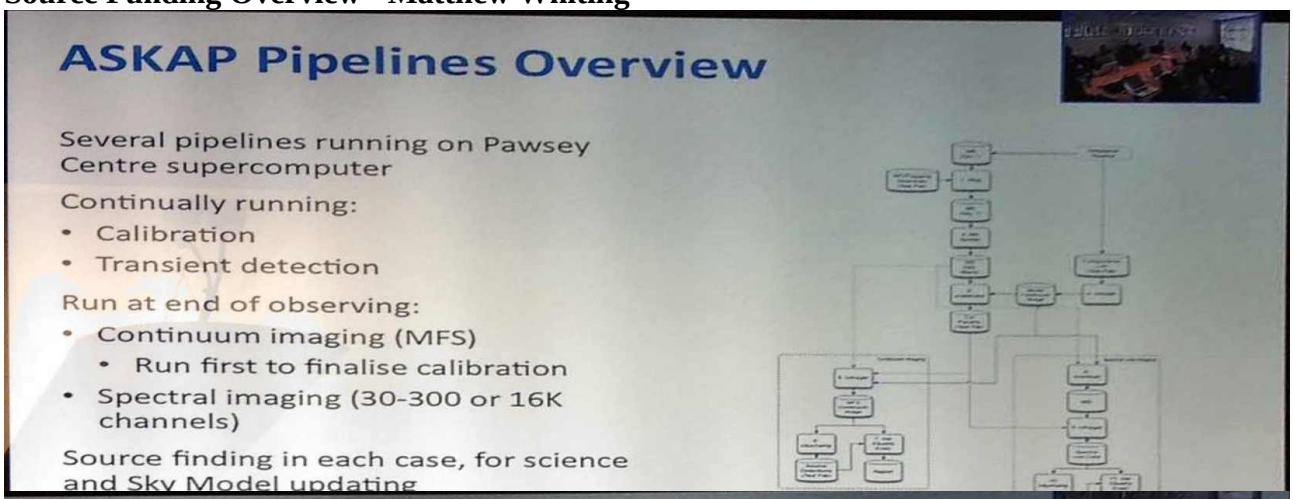


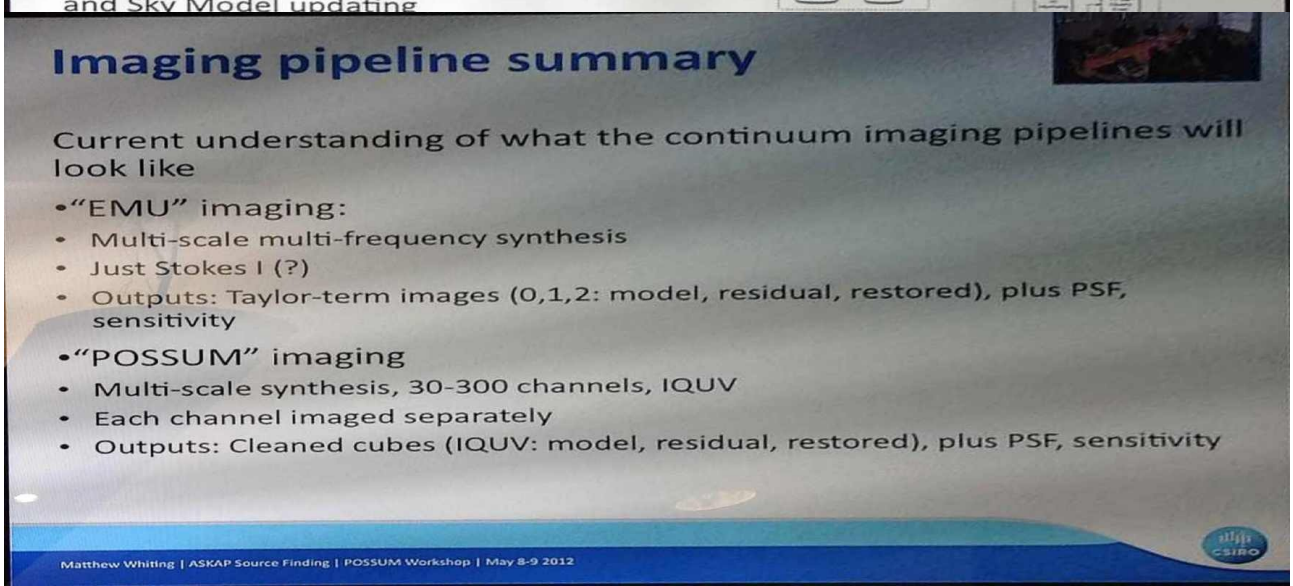
Next steps:
- get software working
- get some data to test it (GMIMS? WSRT? ATCA?)

Landecker: Observations from Narrabri (above 1.2 GHz, at least) are critical and now is time to make them. Need long observations of polarised calibrators

---

Source Funding Overview - Matthew Whiting





"EMU" source finding

Primary EMU data product: Stokes I Taylor-term image

Source finding done on "Taylor-0" image – flux at reference frequency

Searching algorithms still topic of research

- Spatial variation of detection threshold
- De-blending of merged/confused sources
- Component fitting to compact sources
- Extended/Diffuse source extraction likely to be a separate pipeline

Catalogue produced includes:

- Set of components, with fluxes, spectral index/curvature, local noise

Sky Model

Global Sky Model used as basis for calibration of telescope

Best prior guess as to what the sky looks like

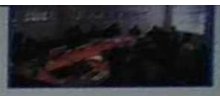
Composition of Sky Model:

- All sources down to ~1mJy
- Discrete components, as result of source finding
- Image cutouts, for complex sources

Sky model used for

- Calibration
- Starting point for cleaning
- Continuum subtraction for spectral-line imaging

POSSUM source-finding



Inputs

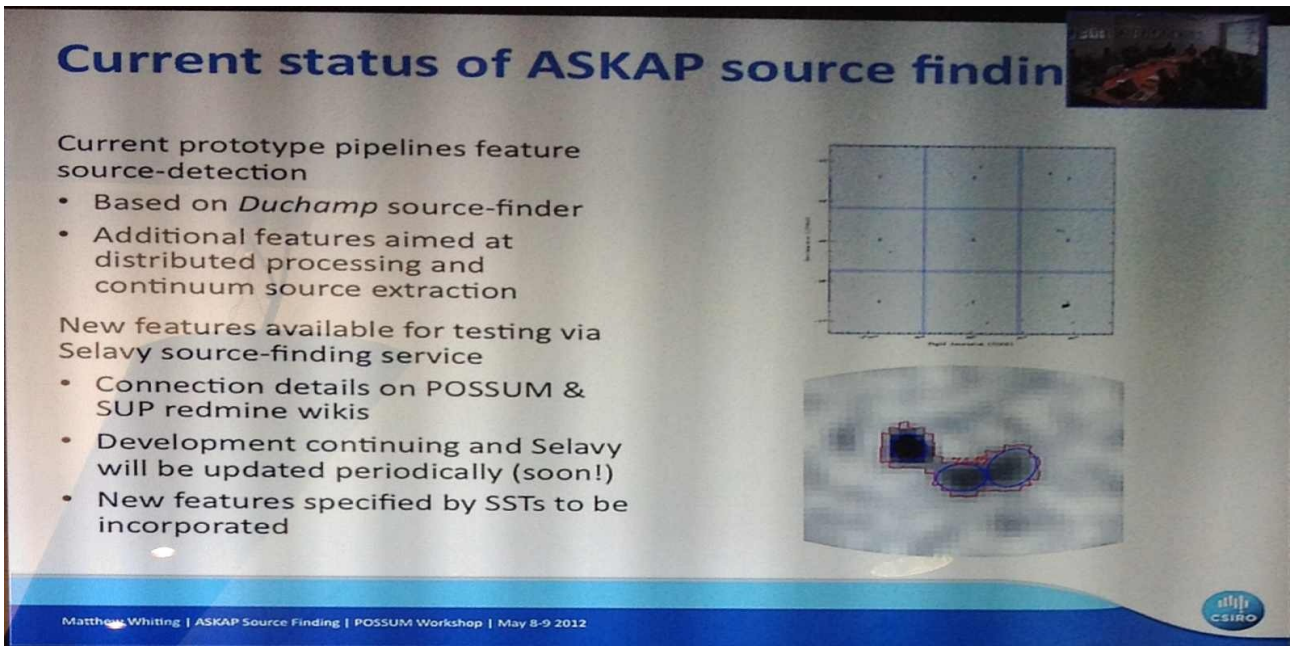
- Imaging:
  - Multi-frequency synthesis (Stokes I)
  - Coarse spectral-cube (up to 300 channels, all Stokes)
- Source catalogues:
  - "EMU" catalogue: Stokes I continuum sources
  - Sky Model: will contain polarisation information

Outputs

- Integrated spectra (Q, U, V?) of each "EMU" source location
- RM Synthesized spectra, no RM clean
- Basic polarisation measurements on dirty RM spectrum

Methods

- Have detailed specifications of algorithms for extraction of spectra and RM synthesis
- Cormac's software pipeline as starting point



BMG's thoughts on this:

* want EMU MFS output to include band-averaged V (definitely), and also probably band-averaged Q, U
- would have significant extra memory/CPU cost

* will multi-channel cubes be convolved to common angular resolution? (do we want this?) (and want same resolution as EMU MFS cubes!)
- would prefer uniform resolution across the band; but how can we get EMU's resolution (corresponding to middle of band) at our lowest frequencies.
- some of this will come to light and can be fine-tuned during BETA observations
ACTION: Report needed on best way forward here

* when/how will we decide whether cubes are 30 channels vs 300 channels?
- governed by what they can do and what we need (we would prefer 300!)

* who from the ASKAP computing group will interface with SCOM-2?
- don't know - need to chase this up

Additional technical issues from Jeroen Stil that we ran out of time to fully discuss/present:
- we don't have a prescription on how to detect sources between 5 and 10 sigma (90% of the sources that POSSUM is capable of detecting); our focus so far has only been on 10% brightest sources
- we're strongly underestimating what diffuse Galactic polarisation is going to do to our background source fluxes
- bright sources (?) could be leakage dominated

Catalogues and Value-Added Products - Larry Rudnick

Lisa Harvey-Smith has said that we're lacking a big picture of how value-added catalogue is going to come together.

PPC:

* IMPORTANT: value of lambda_0^2 for each source is not part of PPC! (but EMU will use some different mean frequency; do we need to match with EMU?)

ACTION: Add lambda_0 to list of outputs.

* If we provide an RM-synthesis cube, how can we divide by Stokes I (or by spectral index) first over the whole image? What do we divide by for the noise pixels? Larry says we should use the fitted spectrum from MFS, and divide every pixel by that spectrum (both source and noise).

* Noise map is not a map, it's a spectrum.

* Intention is that CSIRO will generate PPC using our algorithms, except for quality control that we may then have to apply

PPA (now called PVAC?):

Broadly provides:
- more RM info
- more spatial info
- sources not found in EMU
- full cubes for added exploration

Rudnick wants to remove "RM statistics for defined classes". This was something that Rudnick originally put in (see notes from Calgary meeting on 2 Jul 2011), but it's something that might be hard to compute definitively in time for the PPA.

Big Questions:

- Do we want set release versions of the catalogues, or just have a rolling/evolving catalogue?
- Is there anything we'll need to derive later that will require going back to raw uv data? Yes - single-dish combination (if included); ionospheric correction; Bell et al. Faraday synthesis.
- what is the overall vision of how the PVAC gets constructed, i.e., who, when, connection w research projects, etc.
--- PVAC could have own governance structure, with management team receiving reports back from underlying teams
--- or could self-organise
--- or middle ground, with highest-priority things run through structured process, and rest self-organised
--> should be coordinated/combined with EMU?

EMU: science teams have been formed, who both develop value-added catalogue and pursue associated science. EMU doesn't put much stock in making things proprietary.

Where do students fit in, if involved in developing pipeline and catalogues? Management team needs to make decisions about what is protected for students. "RM statistics for defined classes" in PVAC list below is a good example of a student project.

Nick Seymour: tension in how long you wait to release/develop PVAC: get it out early and public, or reserve science for internal teams? Issues in quality control only come up when (i) you start

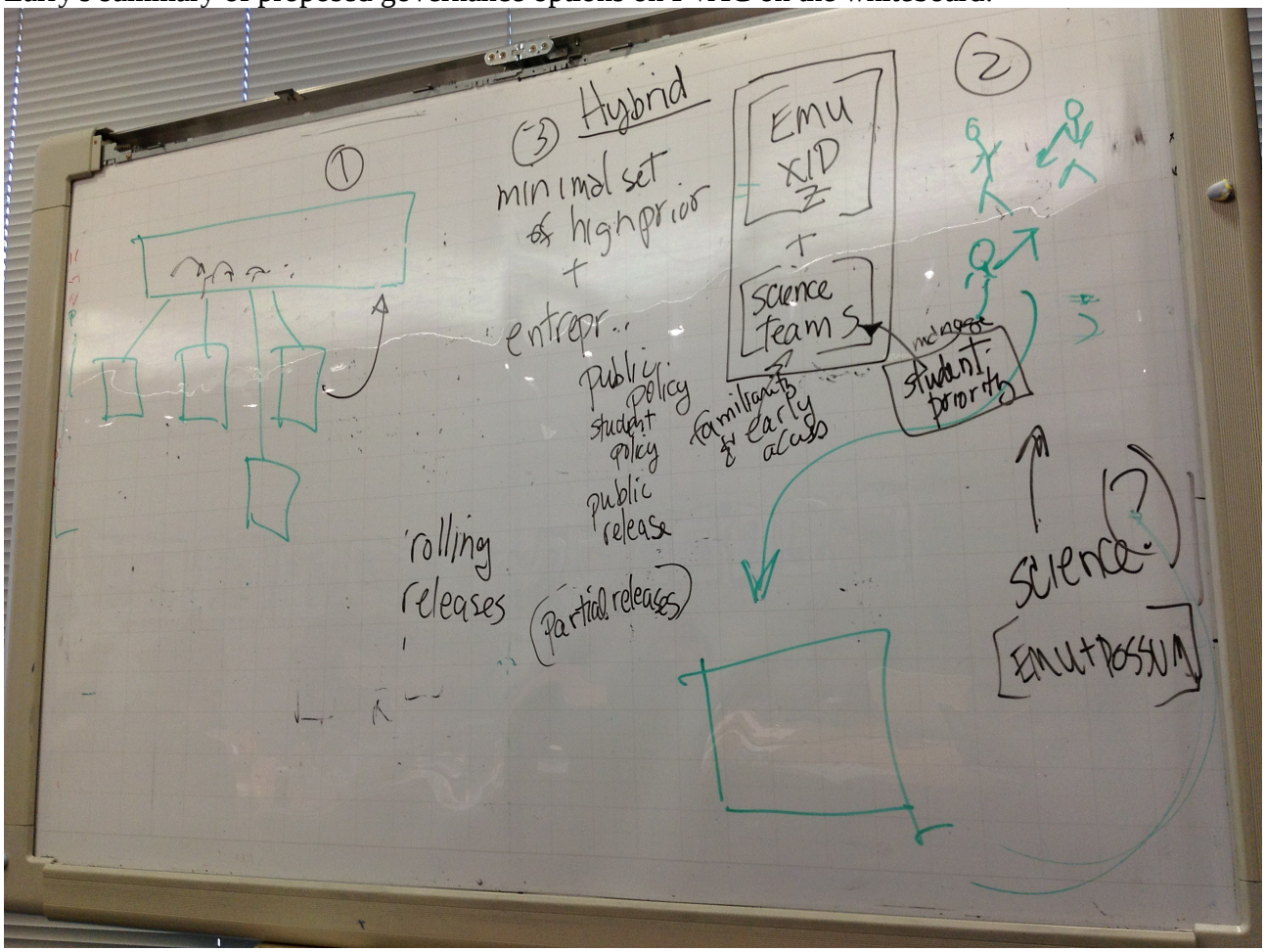
doing science, and (ii) you let other people use your data product.

Overall preference is hybrid model for developing PVAC: critical products are strongly managed ("minimal set" of high priority items), and remainder is left to "entrepreneurs". (This is similar to the EMU model.)

All coupled with public release policy, student policy, etc.

ACTION: consider how best to set up governance/management structure for PVAC

Larry's summary of proposed governance options on PVAC on the whiteboard:



Larry's slides:

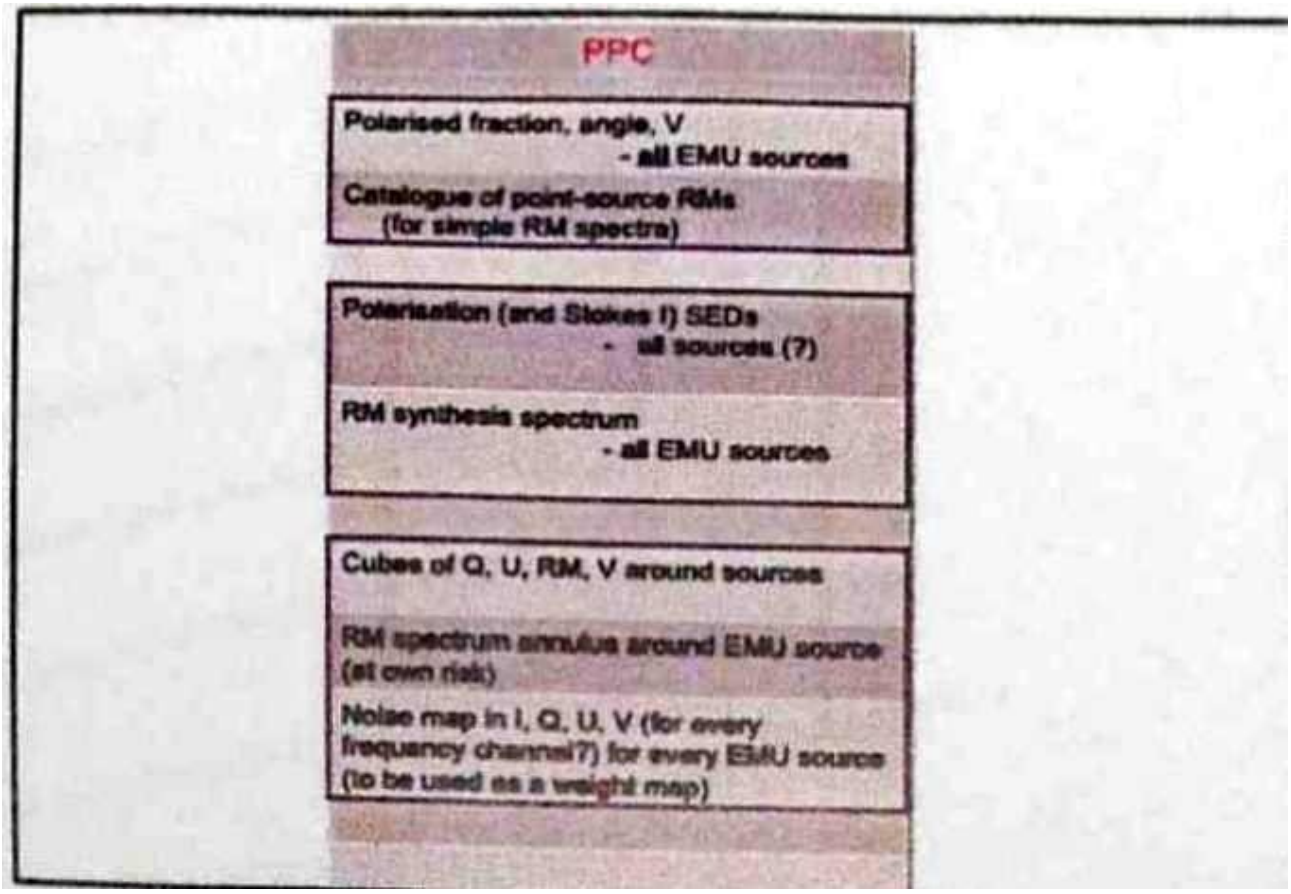
POSSUM
value added discussion

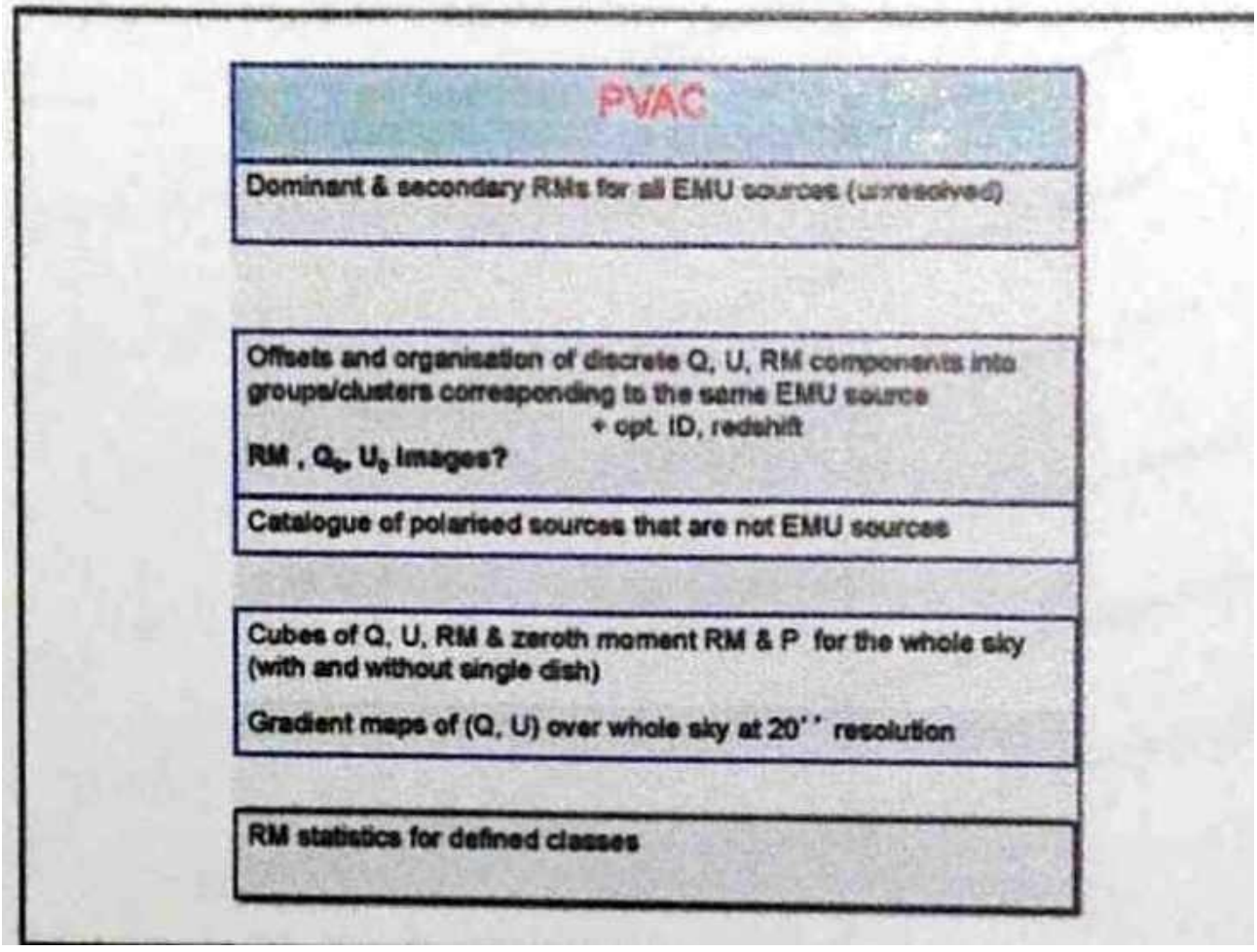
- Re-validate concept and contents of pipeline and value added catalogs
- Characterize relationship to EMU catalogs
- Establish a "big picture" view of how / when the POSSUM value added catalog will happen
- If time, connect with science goals

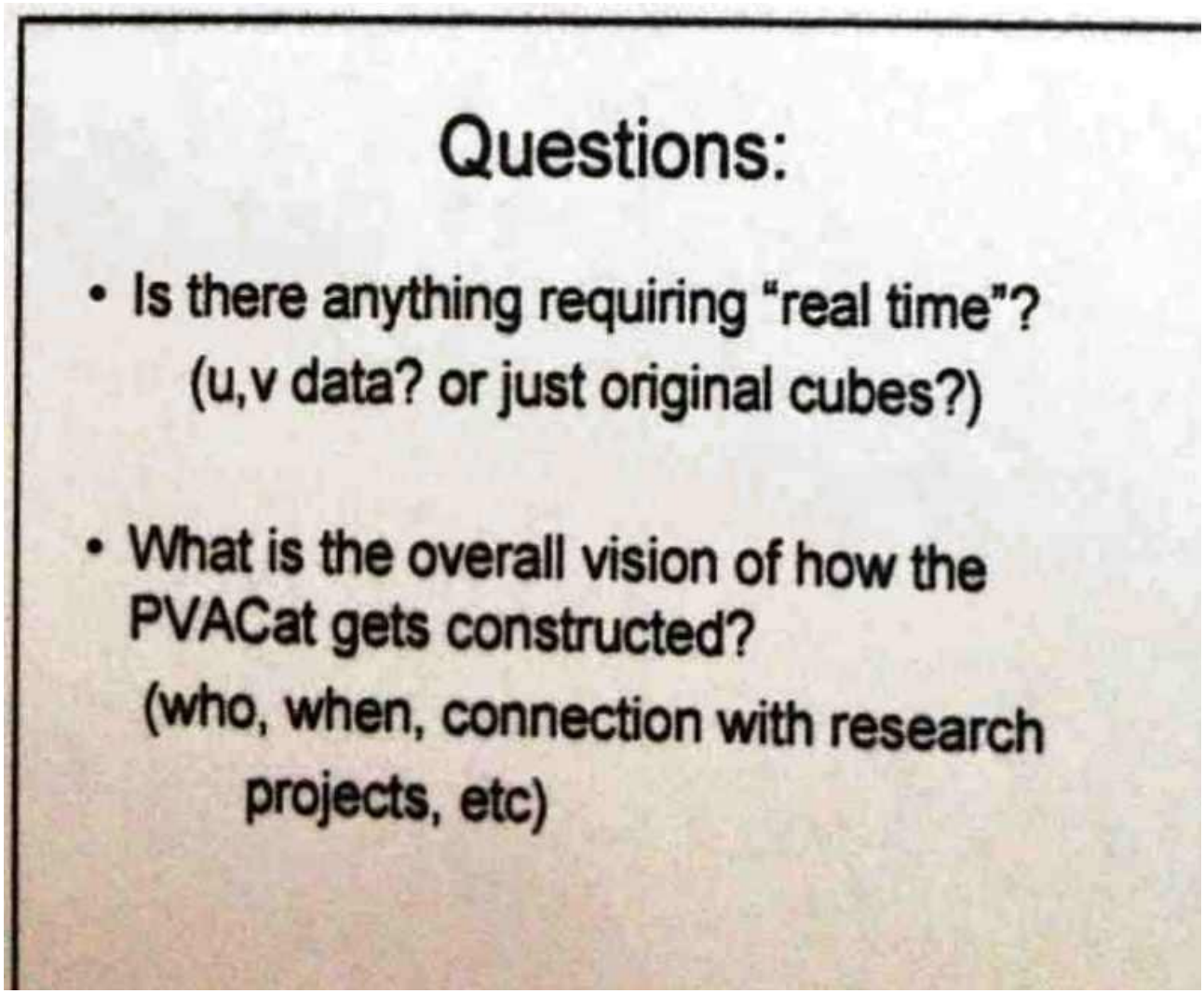
EMU products

EMU Source Catalog	EVACat (EMU value added catalog)
Name, position (all with errors) Size, Peak flux, Integrated flux Spectral index & curvature Beam size Time of observation Local rms Postage stamp links to images	Cross-ID (and components → source) Redshift +? number of pixels > some threshold flux-weighted moments (e.g. SE/major), maximum/minimum extent/orientation, total flux estimates

PPC	PVACat
• Automated, based on EMU • Fixed product *(perhaps 1 iteration)* • Early, easy, fast public access • Acceptable to ASKAP/CSIRO **ART:: "PPC should be the best we can do in real time on the EMU objects" (nothing more and nothing less)**	Evolving Everything we've put blood and sweat into, and which can't be done in real time.


PPC
Polarised fraction, angle, V
- all EMU sources
Catalogue of point-source RMs
(for simple RM spectra)
Polarisation (and Stokes I) SEDs
- all sources (?)
RM synthesis spectrum
- all EMU sources
Cubes of Q, U, RM, V around sources
RM spectrum annulus around EMU source
(at own risk)
Noise map in I, Q, U, V (for every
frequency channel?) for every EMU source
(to be used as a weight map)


PVAC
Dominant & secondary RMs for all EMU sources (unresolved)
Offsets and organisation of discrete Q, U, RM components into
groups/clusters corresponding to the same EMU source
+ opt. ID, redshift
RM , Q_0, U_0 images?
Catalogue of polarised sources that are not EMU sources
Cubes of Q, U, RM & zeroth moment RM & P for the whole sky
(with and without single dish)
Gradient maps of (Q, U) over whole sky at 20'' resolution
RM statistics for defined classes



Wide-Field Issues - Tony Willis

* Instrumental polarisation will be visible in individual spectral channels

* We have a procedure to deal with this that we use at DRAO ST
- DRAO leakage shows strong frequency dependence; had to measure this empirically

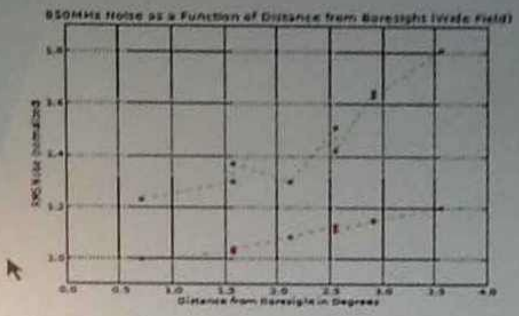
* Proposed ASKAP procedure:

6) ASKAP Procedure

- Need to map out voltage pattern for each of the 188 receptor elements in the PAF
- Need to Nyquist sample at resolution of beam at highest frequency
- Need to map out to at least first sidelobe level as sidelobe levels are high and sources will be seen in them.
- Need to do this exercise for each telescope with a PAF (almost certainly will be small, but noticeable, differences)
- need to map at all frequencies? Not sure here - had to be done at DRAO.
- Use strong unpolarized source

NRC CNRC HERZBERG INSTITUTE of ASTROPHYSICS

4) Noise will Increase Toward Outer Beam Positions



- 850 MHz Noise as a Function of Distance from Boresight
  - ☐ Upper curve - Gaussian Fitting
  - ☐ Lower curve - Conjugate Weighting. (Note: All results are normalized to conjugate weighting at boresight)
  - ☐ Outer phased array beams have a considerably higher noise than inner beams, no matter what weighting function used.

NRC CNRC HERZBERG INSTITUTE of ASTROPHYSICS

Ettore Carretti: what would be the impact on the survey if the noise increases by 30% as a result of gaussian fitting (see slide below): x-axis is distance from boresight in degrees and y-axis is RMS noise in normalised units. Axis label is "850 MHz noise as a function of distance from boresight [Wide Field]

For EVLA, Sanjay Bhatnagar has taken known primary beam shape, fourier transformed this into uv plane, and then convolved data with this - provides direct image with (first order) correction for primary beam attenuation already included. This is for a single-pixel feed. For ASKAP, would need

a different convolution function for every feed - would be messy.

For BETA, need to test time and frequency stability of polarisation performance. Need to test various different correction algorithms.

BETA, ASKAP-12 and Commissioning - Ettore Carretti & Cormac Purcell

Stages:
* Science-commissioning will commence this year
* BETA
* ASKAP-12

Presentation from Gaensler:

* Seymour:
- worth doing a deep field, especially at higher frequencies where angular resolution is better
- if you want 700-1100 MHz, you'll get this for free from FLASH survey with full ASKAP anyway

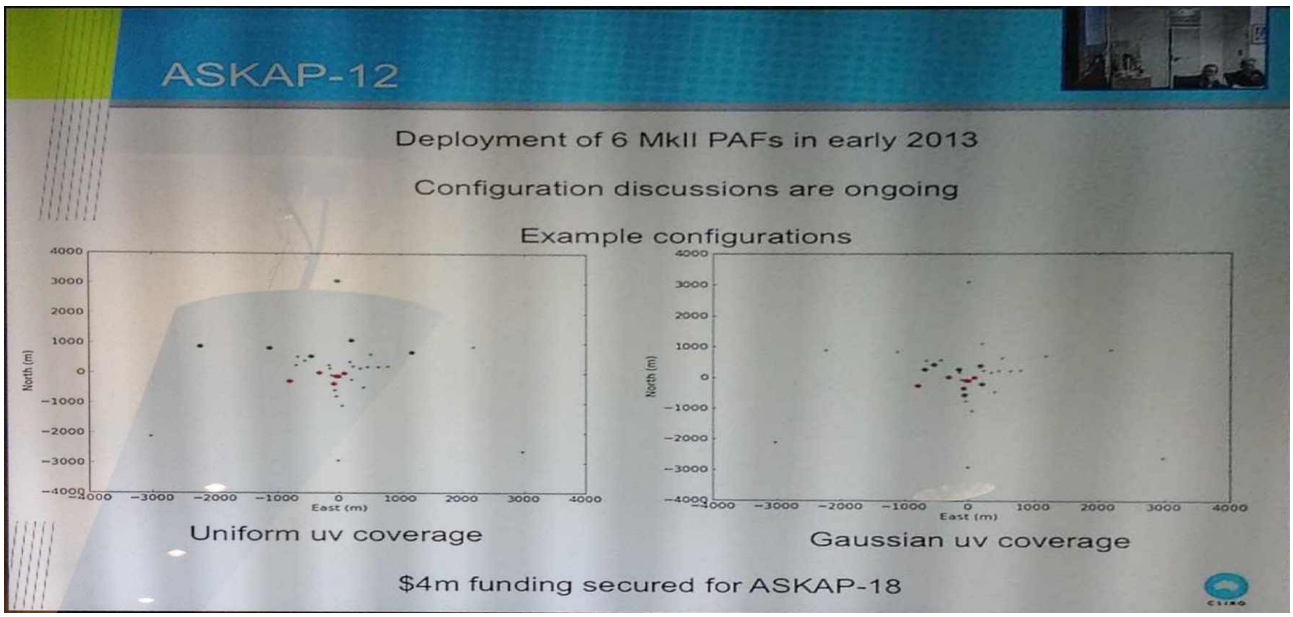
* Rudnick:
- 700 MHz polarimetry is a critical bridge between LOFAR/MWA and VLA/ASKAP. Need this info over lots of sources to understand complexity, Faraday depth, depolarisation: 700-1000 MHz would be best (although note that T_sys goes up by factor of two between 800 MHz and 700 MHz)
- predicted source counts on slide 3 may be too good by factor of two

* Norris
- don't want to push to 700-1000 MHz for EMU, as confusion will get worse; want 800-1100 MHz (or may even not use bottom half of the band)

Tim Shinwell:

- BETA is probably no longer being considered by SSPs as a science instrument

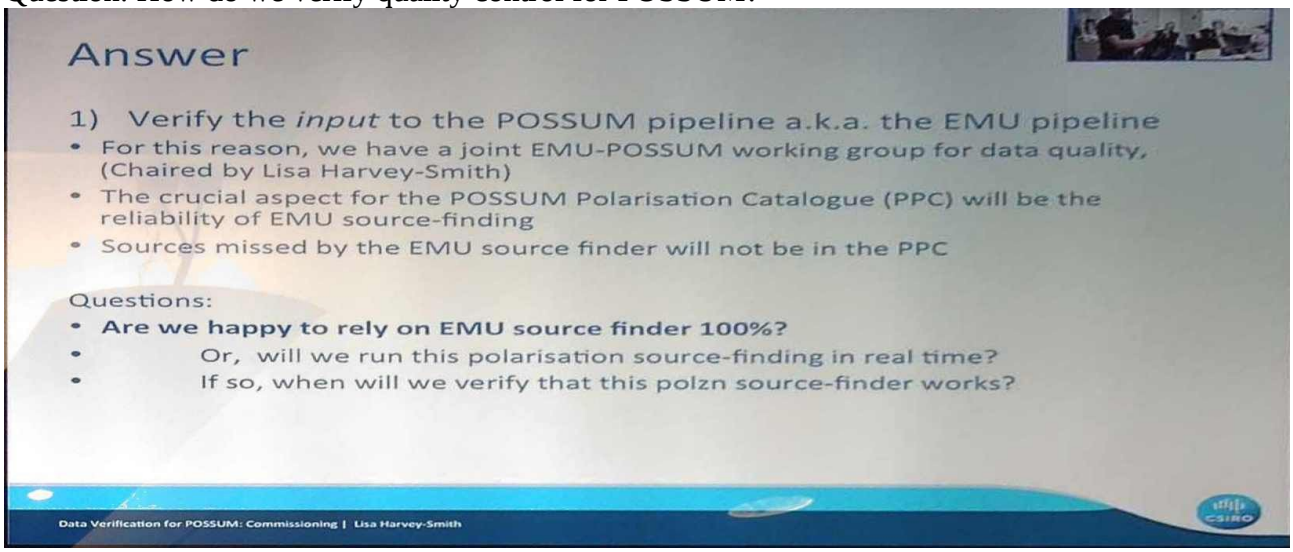
- ASKAP-12: array configuration still being developed; meeting w EMU & WALLABY on Friday to discuss this further; WG4b meeting next week.

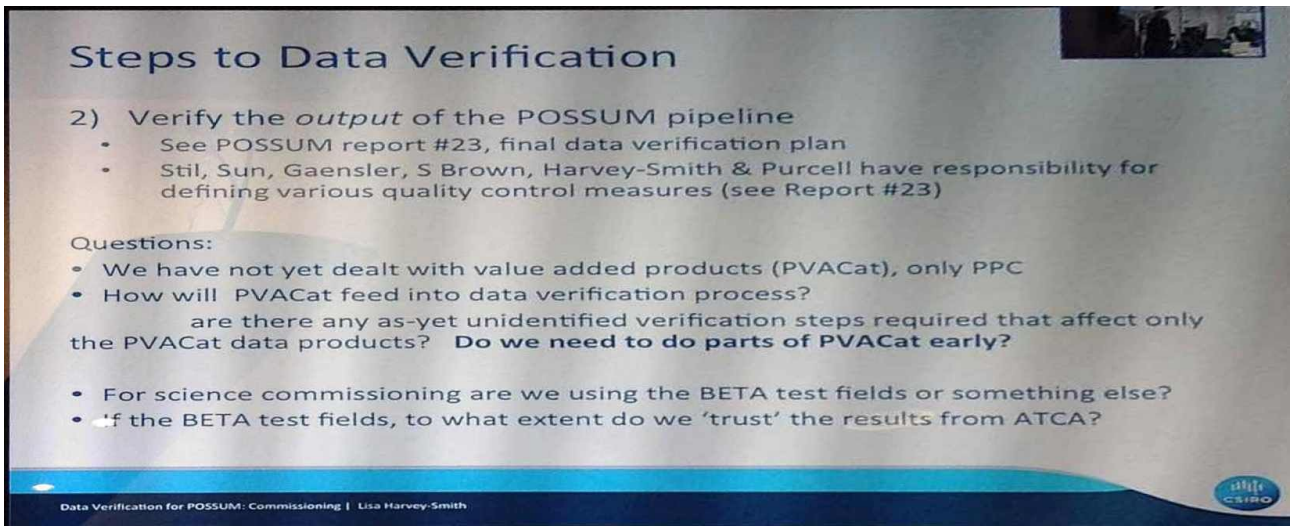


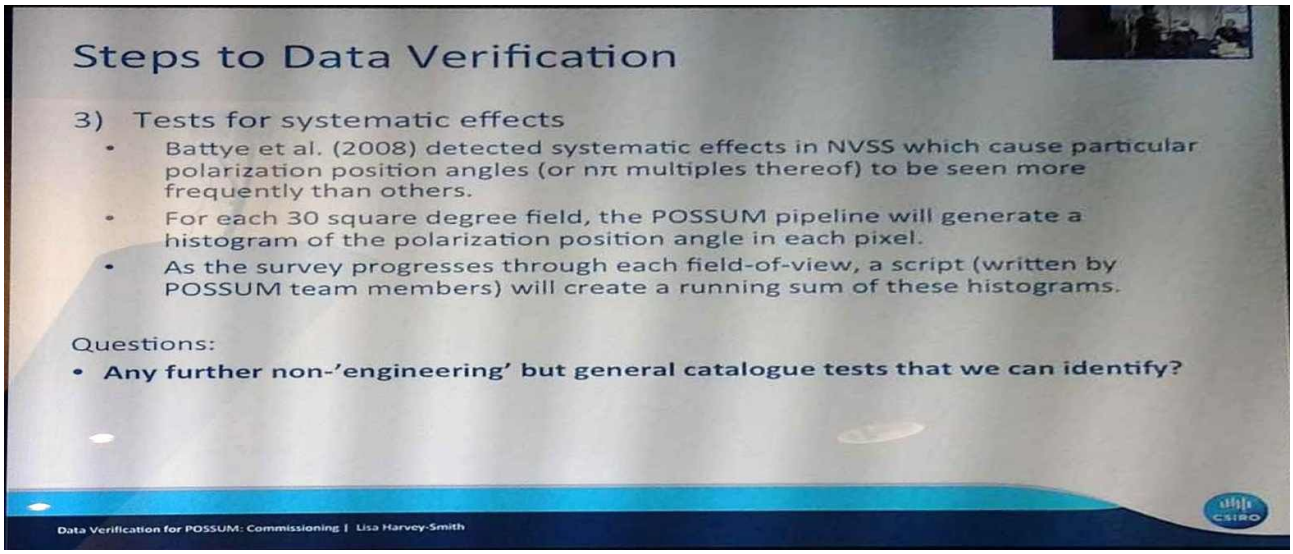
- SCOM2 includes postdocs, such as Tom Franzen (EMU) and Ivy Wong (WALLABY)

* Larry Rudnick (for Lisa Harvey-Smith) - Quality Control

Question: How do we verify quality control for POSSUM?







Some clear gaps in existing quality control have been identified. E.g. will we actually look at multi-channel images and identify bad images? POSSUM Report #23 starts to cover this, e.g. it says images will be checked as per EMU Memo #14. But they won't look at individual 1-MHz channel maps. POSSUM Reports #43 & #51 touch on this but don't properly develop this.

ACTION: We need more quality control steps, involving checking images, not just PPC values. Need to think about folding in quality control associated with PVAC (PPA) products, as above.