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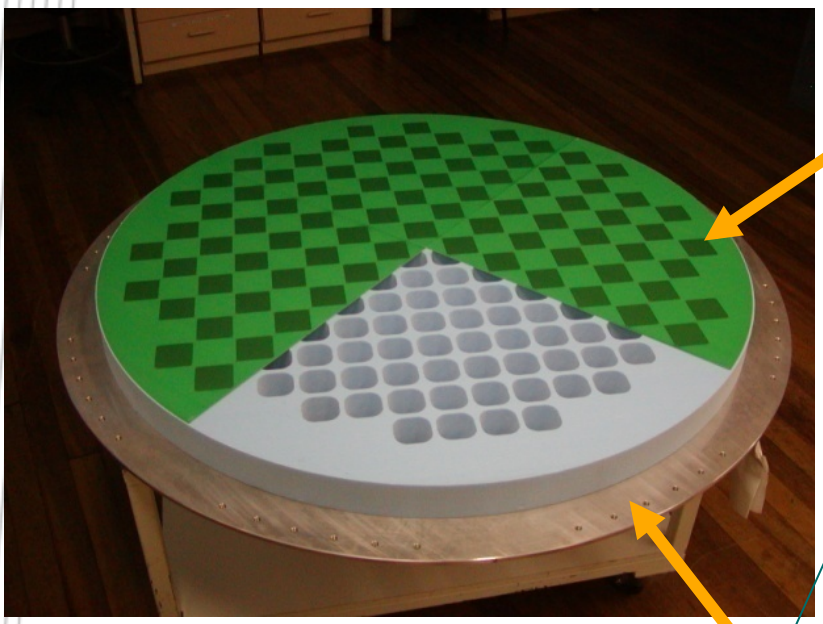
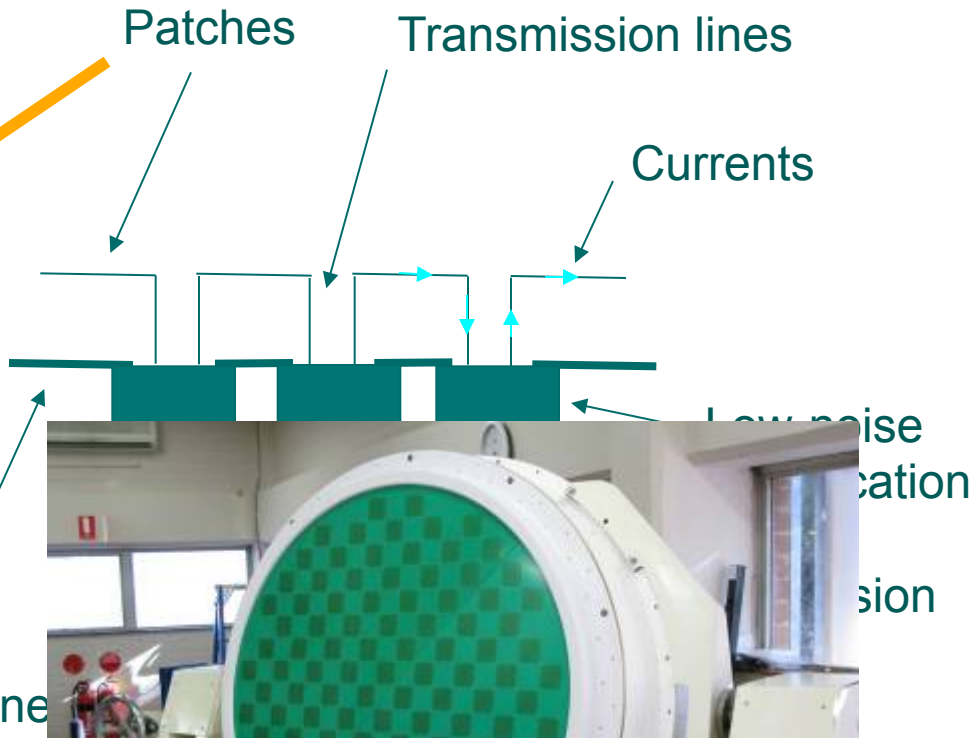
ASKAP-EMU Re-acceleration

ASKAP 188-element Phased Array Feed

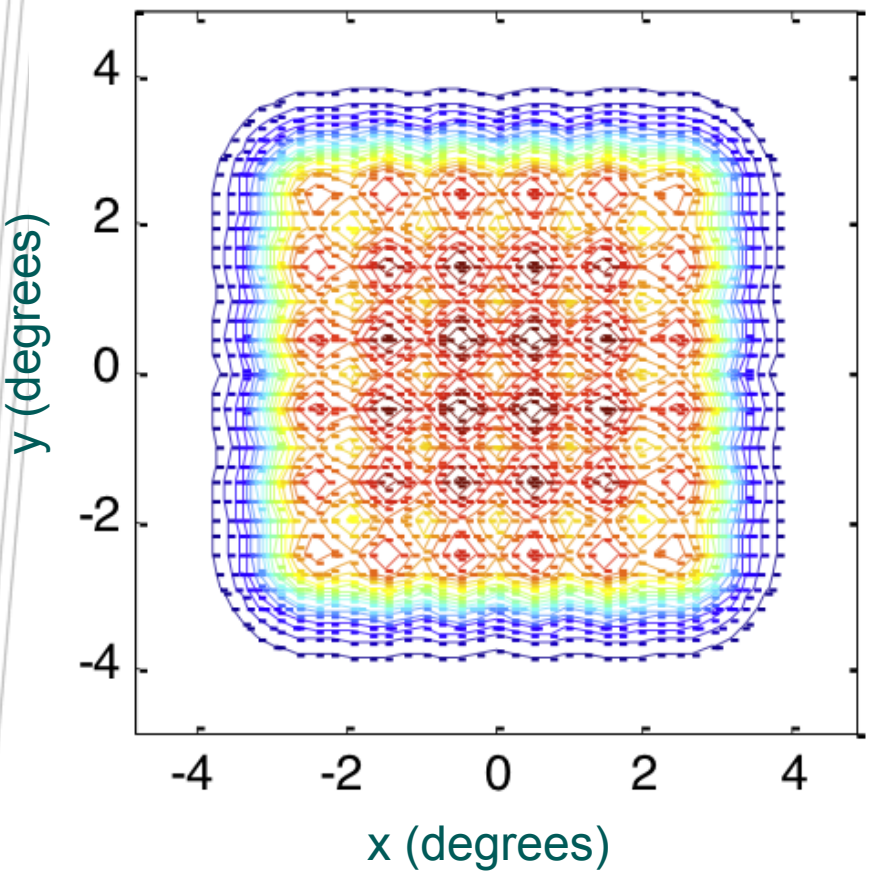




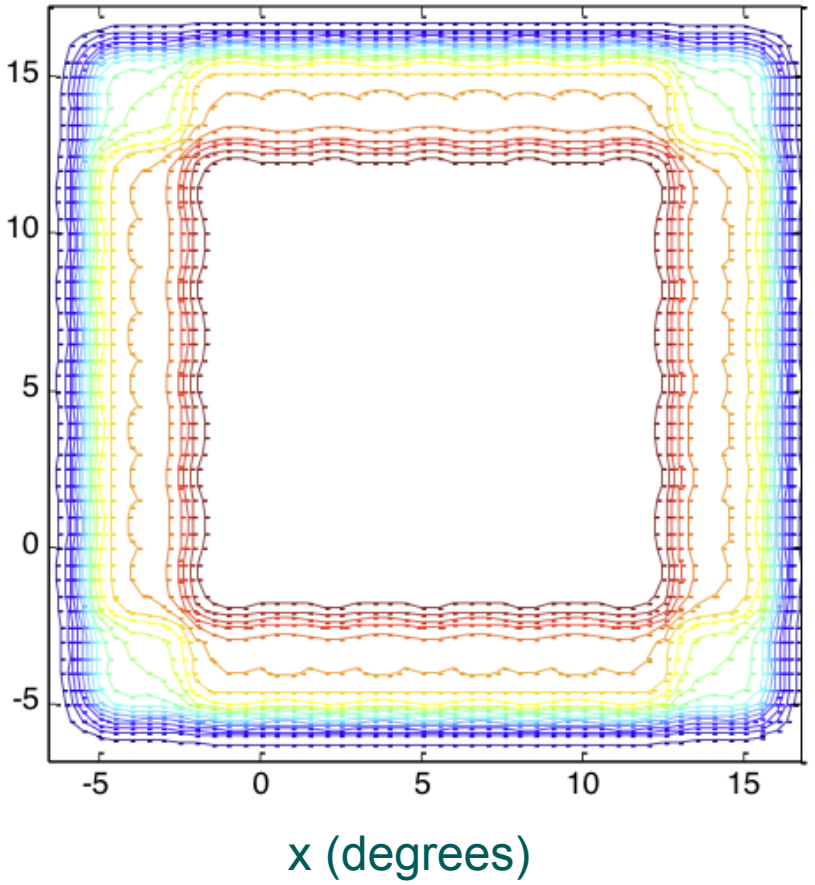
- Connected checkerboard arra
- Self-complementary screen (
- Operating range defined by
  - 1800-700MHz
- LNA - High-impedance, differential

ASKAP PAF footprint

Raw (5% contours)



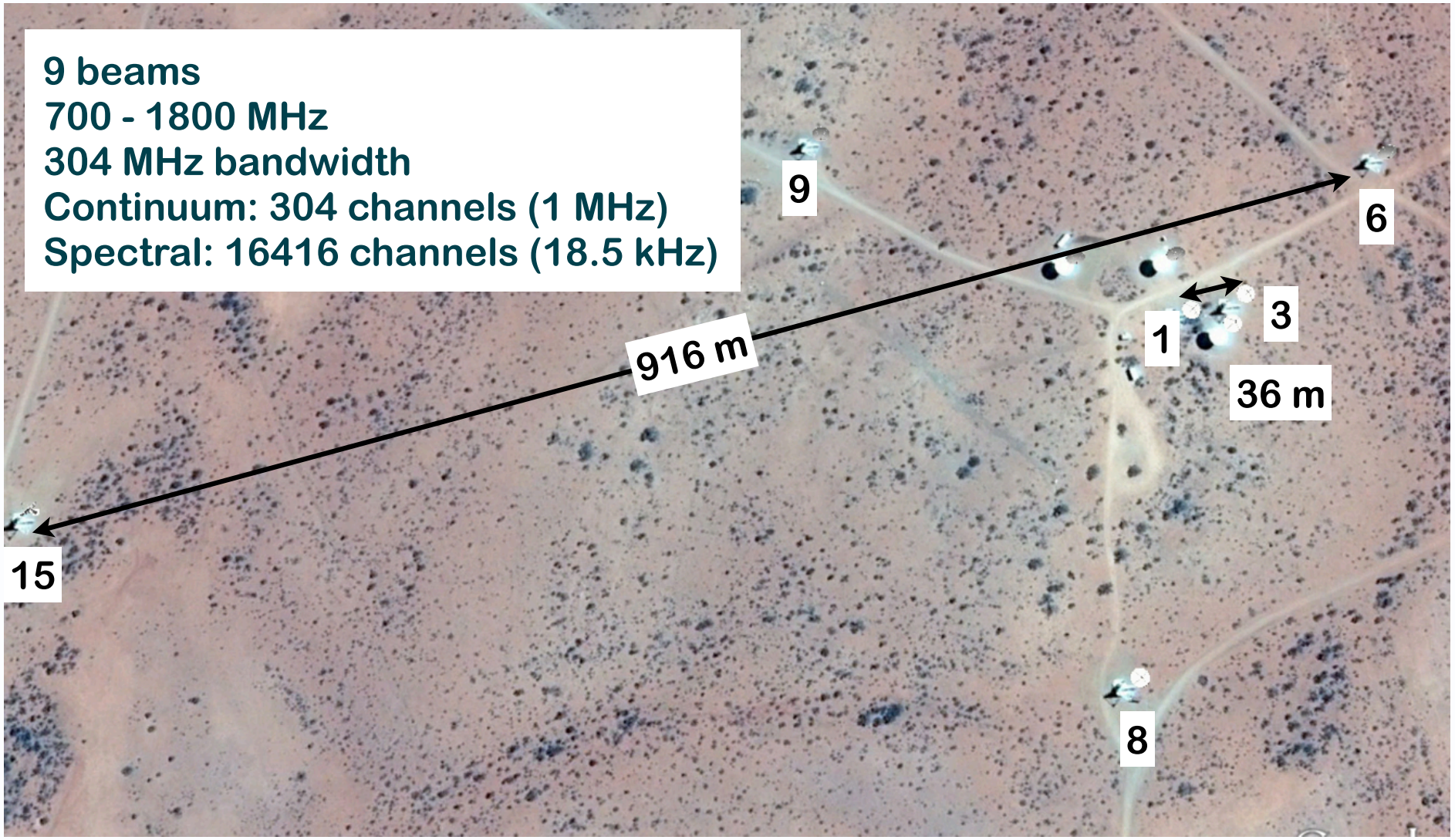
Dithered (1% contours)



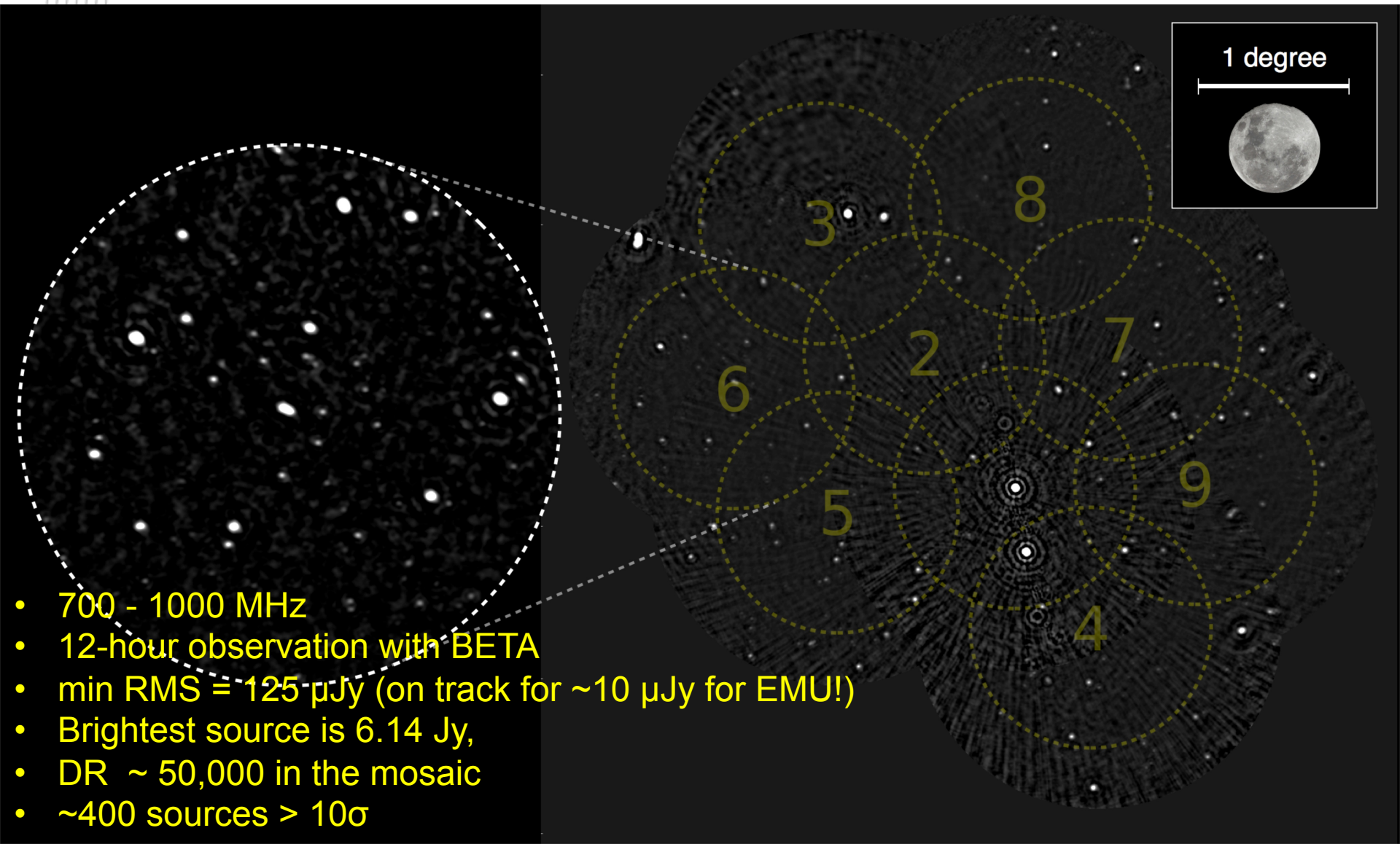
Current status

- 6-PAF-antenna BETA array currently operating with 9 beams
- Undergoing commissioning and debugging while final MkII (ADE) PAFs are being built
- Expect to have first MkII PAF at MRO in ~ July 2014
- Expect to have 8 MkII PAFS installed by ~Feb 2015
- Currently doing BETA science

BETA the telescope

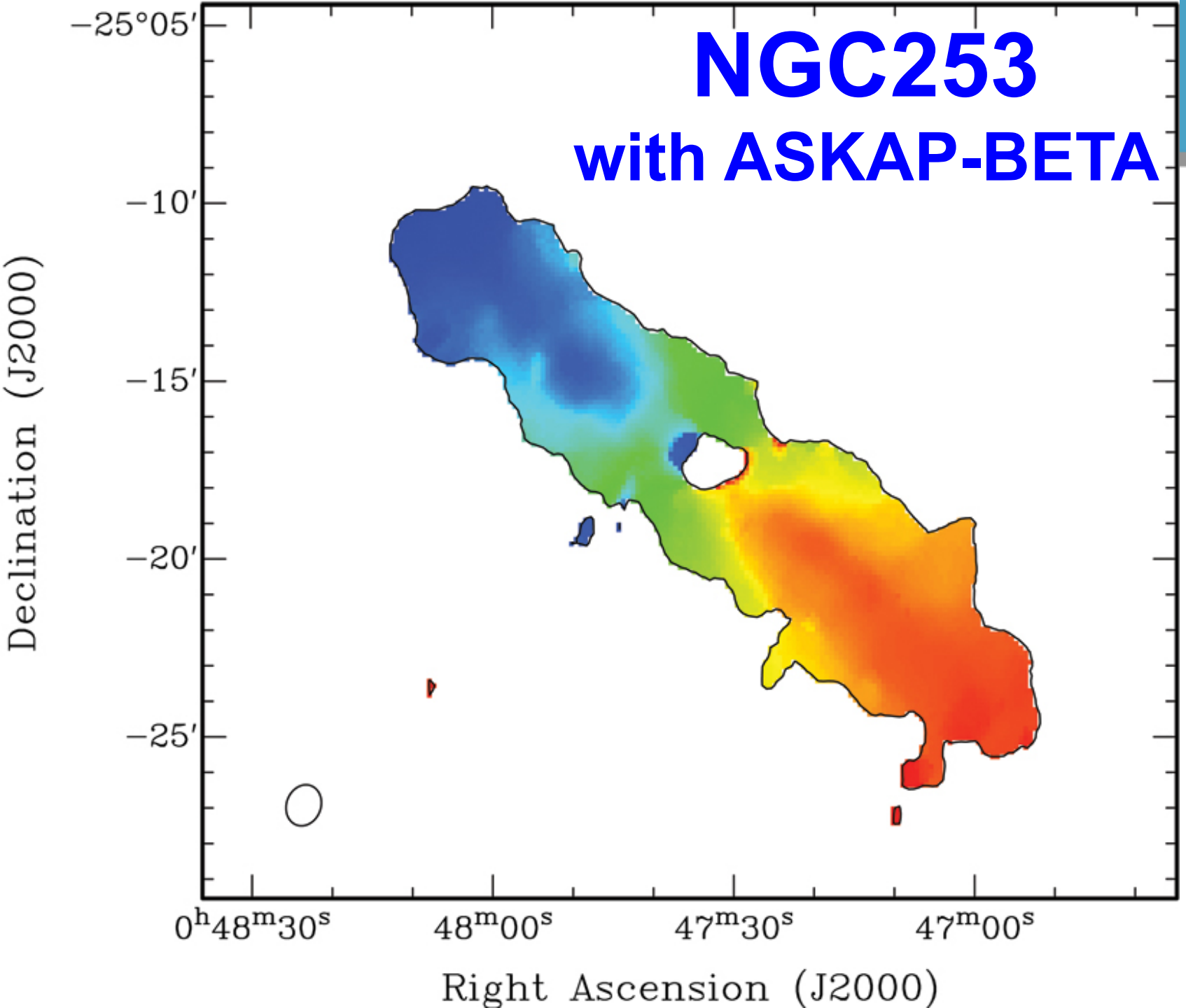


6-antenna BETA image with 9 PAF beams



- 700 - 1000 MHz
- 12-hour observation with BETA
- min RMS = 125 μJy (on track for ~10 μJy for EMU!)
- Brightest source is 6.14 Jy,
- DR ~ 50,000 in the mosaic
- ~400 sources > 10σ

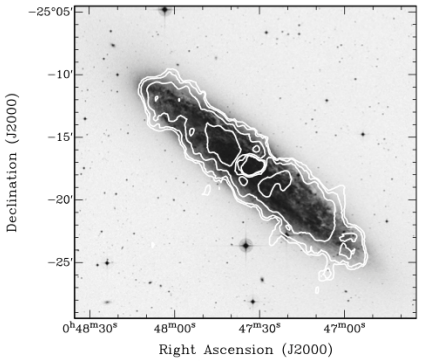
NGC253
with ASKAP-BETA

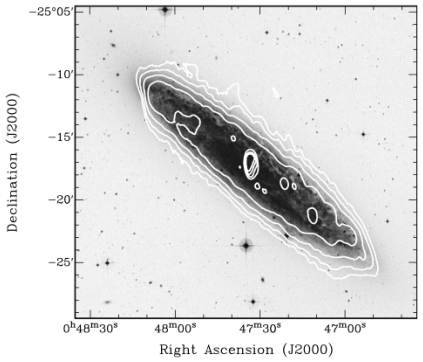


NGC 253

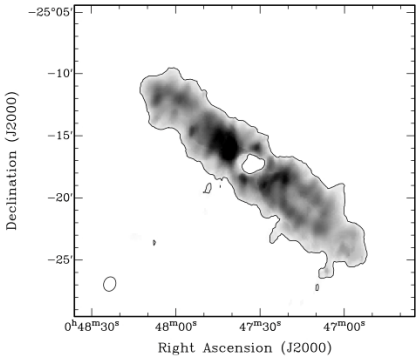
ASKAP (BETA) - 11h

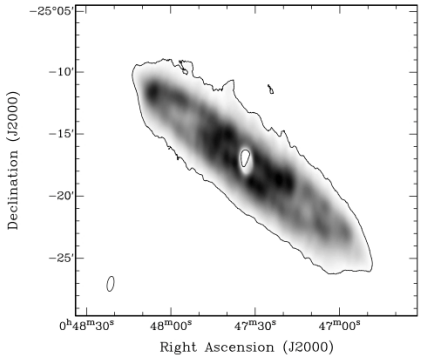
ATCA (LVHIS)



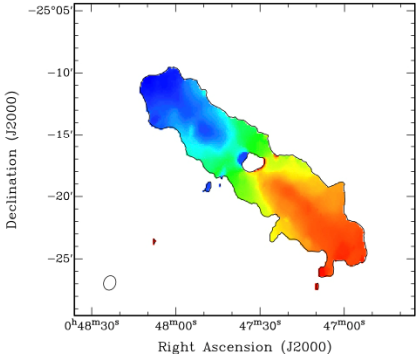


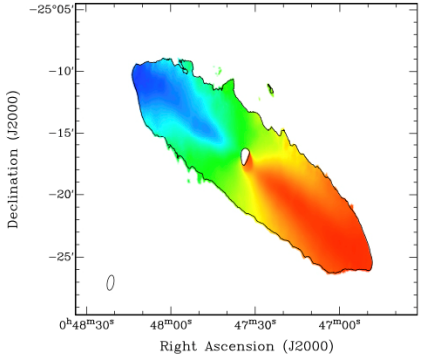
HI contours overlaid on optical



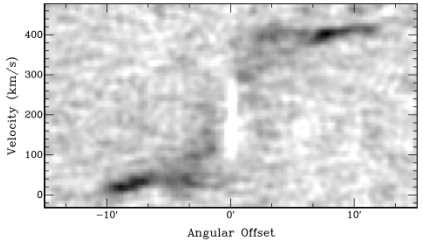


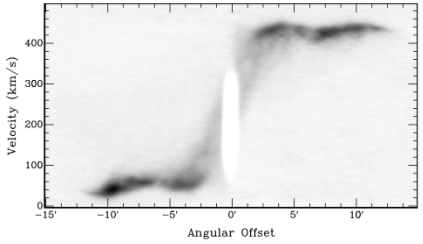
HI image





HI velocity field





HI position-velocity diagram along the major disc axis

ASKAP early science, mid 2015
(see EMU memo 30)

- **12 antennas equipped with ADE PAFs, 2.4km max baseline**
- **Do early science while array is progressively upgraded with additional PAFs**
- **E.g. engineering in daytime, astronomy at night**
- **No "time allocation"**
- **Instead a unified ACES observing/commissioning team focussing on EMU/WALLABY science, but also bringing in other survey project science as appropriate (e.g. HI absorption, transients)**

SENSITIVITY (AT 1.4 GHz)

- Thermal rms ~ 30 uJy in 12h, over a FOV of 30 sq deg.
- Beamsize ~ 25 arcsec
- Confusion noise ~ 25 uJy
- So image noise ~ 40 uJy
- So could do a hemisphere in 3 months to rms ~ 60 uJy

ASKAP continuum early science
(see EMU memo 30)

Early Science focus: wideband over smaller area

- Focus on a smaller area (e.g. 1000 sq deg)
- Image from 700-1400 MHz
- Obtain a catalogue of ~1 million sources (nearly doubles no of know radio sources)
- Get accurate spectral index and Rotation Measures
- New science: first time anybody has produced a sensitive catalogue of accurate RMs and spectral indices
- Adds value to EMU, not superseded

ASKAP continuum early science
(see EMU memo 30)

Questions

- What part(s) of the sky?
- What is optimum processing strategy when observing over an octave?
- Three processing pipelines:
  - All band – optimises dynamic range because of mfs
  - Top of band – optimises resolution
  - Bottom of band – optimises intrinsic sensitivity (but increases confusion noise)

ASKAP Science

38 proposals submitted to ASKAP

2 selected as being highest priority

- EMU all-sky continuum (PI Norris)
- WALLABY all-sky HI (PI Koribalski & Staveley-Smith)

8 others at a slightly lower priority

- COAST pulsars etc
- CRAFT fast variability
- DINGO deep HI
- FLASH HI absorption
- GASKAP Galactic
- POSSUM polarisation
- VAST slow variability
- VLBI

- Deep radio image of 75% of the sky (to declination +30°)
- Frequency range: 1100-1400 MHz
- 40 x deeper than NVSS
  - 10 μJy rms across the sky
- 5 x better resolution than NVSS (10 arcsec)
- Better sensitivity to extended structures than NVSS
- Will detect and image ~70 million galaxies at 20cm
- All data to be processed in pipeline
- Images, catalogues, cross-IDs, to be placed in public domain
- Survey starts 2016(?)
- Total integration time: ~1.5 years ?

Science Goals

1) Evolution of SF from z=2 to the present day,

- using a wavelength unbiased by dust or molecular e

2) Evolution of massive black holes

- how come they arrived so early? How do bi erge?
- what is their relationship to star-formatio

3) Explore the large-scale struct cosmological parameters of the Universe

- E.g, Independent tests of d models

4) Explore an unchart of observational parameter space

- almost certainl w classes of object.

5) Explore C & Diffuse low-surface-brightness radio objects

6) C an Atlas of the Galactic Plane

te a legacy for surveys at all wavelengths (Herschel, JWST, ALMA, etc)

How did galaxies form and evolve?

Challenge: difficult to get redshifts, or even optical/IR photometry

Survey Name	Area (deg^2)	Wavelength Bands	Limiting Mag. or flux[a]	EMU Detected (%)	Survey Matched (%)	Data Relea Date
WISE[1]	40000	3.4, 4.6, 12, 22 μm	80 μJy	23	100	2012
Pan-Starrs[2]	30000	g, r, i, z, y	$r < 24.0$	54	50	2020
Wallaby[3,b]	30000	20 cm (HI)	1.6 mJy[c]	1	100	2013
LSST[4]	20000	u, g, r, i, z, y	$r < 27.5$	96	67	2020
Skymapper[5]	20000	u, v, g, r, i, z	$r < 22.6$	31	66	2015
VHS[6]	20000	Y, J, H, K	K< 20.5	49	66	2012
SDSS[7]	12000	u, g, r, i, z	$r < 22.2$	28	22	DR8
DES[8]	5000	g, r, i, z, y	$r < 25$	71	17	2017
VST-ATLAS[9]	4500	u, g, r, i, z	$r < 22.3$	30	15	2012?
Viking[10]	1500	Y, J, H, K	K< 21.5	68	5	2012
Pan-Starrs Deep[2]	1200	$0.5 - 0.8$, g, r, i, z, y	$g < 27.0$	57	4	2020

EMU Re-acceleration

Challenge

- **All ASKAP survey projects have slowed because of delays in commissioning ASKAP – now back on track**
- **Some WG were not very effective**
- **We weren't effectively tapping into the 220 EMU members**
- **Have looked at structures of other large collaborations**

Rest of this presentation is work in progress

- your ideas and suggestions needed!

Result

- **WGs will be largely replaced by "tasks"**
  - May still need some WG
- **Introduce incentive to active participation:**
- **"Key members" (better name?) require commitment but get more rewards**

Three categories of EMU Papers

1) The survey definition paper (EMU paper 1).

2) EMU key papers

- describe some aspect of the survey or its data,
- or present a key science result addressing an EMU science goal
- Titles of key papers start with “Evolutionary Map of the Universe x:” where x is a roman numeral

3) Other EMU papers, which have a title starting with “Evolutionary Map of the Universe” but don’t have a roman numeral

We will make a call for proposals for papers:

- ASKAP early science (deadline 3 months)
- EMU key papers (deadline 1 year from now)
- EMU survey science (no deadline, but first come, first served)

Three types of EMU member

- **Key members** *drive* and take responsibility for the project/task that they've taken responsibility for, and commit to ~20% FTE through to project completion (negotiable)
- **Core members** have at some point made a significant contribution to EMU (e.g. chaired a WG)
- **Other members** have contributed in other ways
- Can anyone think of a better name? ☺

Benefits of core/key members

- No EMU member will be on an EMU paper unless they contribute to it

- **Ordinary members**
  - Are kept informed of EMU and can get involved in particular projects & papers

- **Core members**
  - have the right to be on any EMU paper provided they contribute significantly
  - will be included as a co-author on the EMU survey definition paper

- **Key members**
  - have all the benefits of core members, plus:
  - will be invited to be first author on an EMU key paper, or to nominate someone (e.g. their grad student or postdoc) to do so.
  - will be asked to identify which key paper they would like to lead
  - will be asked for input on key decisions

Examples of EMU key papers

- **Survey definition paper. Describes the survey, design decisions, area of sky, uniformity, etc**
  - Co-authors: every core member and key member, plus anybody else contributing.
- **Source extraction, incl. noise properties, artefacts, and maybe a component count plot.**
- **Self-ID and cross-ID, incl source count plot**
- **Photo-z**
- **Extended source extraction**
- **Diffuse emission**
- **AGN/SF split**
- **Cosmic evolution of SF**
- **Cosmic evolution of AGN, including radio luminosity function**
- **Cosmic variance, source counts, P(D) analysis, Clusters – in collaboration with eRosita (then spin off several non-key papers)**
- **Large-scale structure**

Examples of EMU tasks

Some of these appropriate to an individual, some to a WG

- **Infrastructure**
  - Coordinate and edit a twice-yearly EMU newsletter
  - Project manager
- **Technical**
  - Set up and run the data quality/validation process
  - See what special imaging is needed for the Galactic Plane
  - Develop source extraction for complex and extended sources
  - Design and run the cross-ID algorithms
- **Collaborations**
  - E.g. Run the interface between EMU & eRosita, SkyMapper, WISE etc.
- **Science**
  - Next slide…

Examples of EMU science tasks

Some of these appropriate to an individual, some to a WG

- **Prepare for science papers (outline of paper, identify first author, etc) for three phases:**
  1. ASKAP early science
  2. EMU early science (after ~1000 sq deg)
  3. EMU final science (after survey completion)
- **Presumably (?) one WG for each science area, as before,**
  - recognise that WG chair can't be first author on every paper!
- **Start by focusing on early science.**
- **Identify one task for each paper**
  - first author is the task leader
- **Should be generating papers NOW using other surveys**

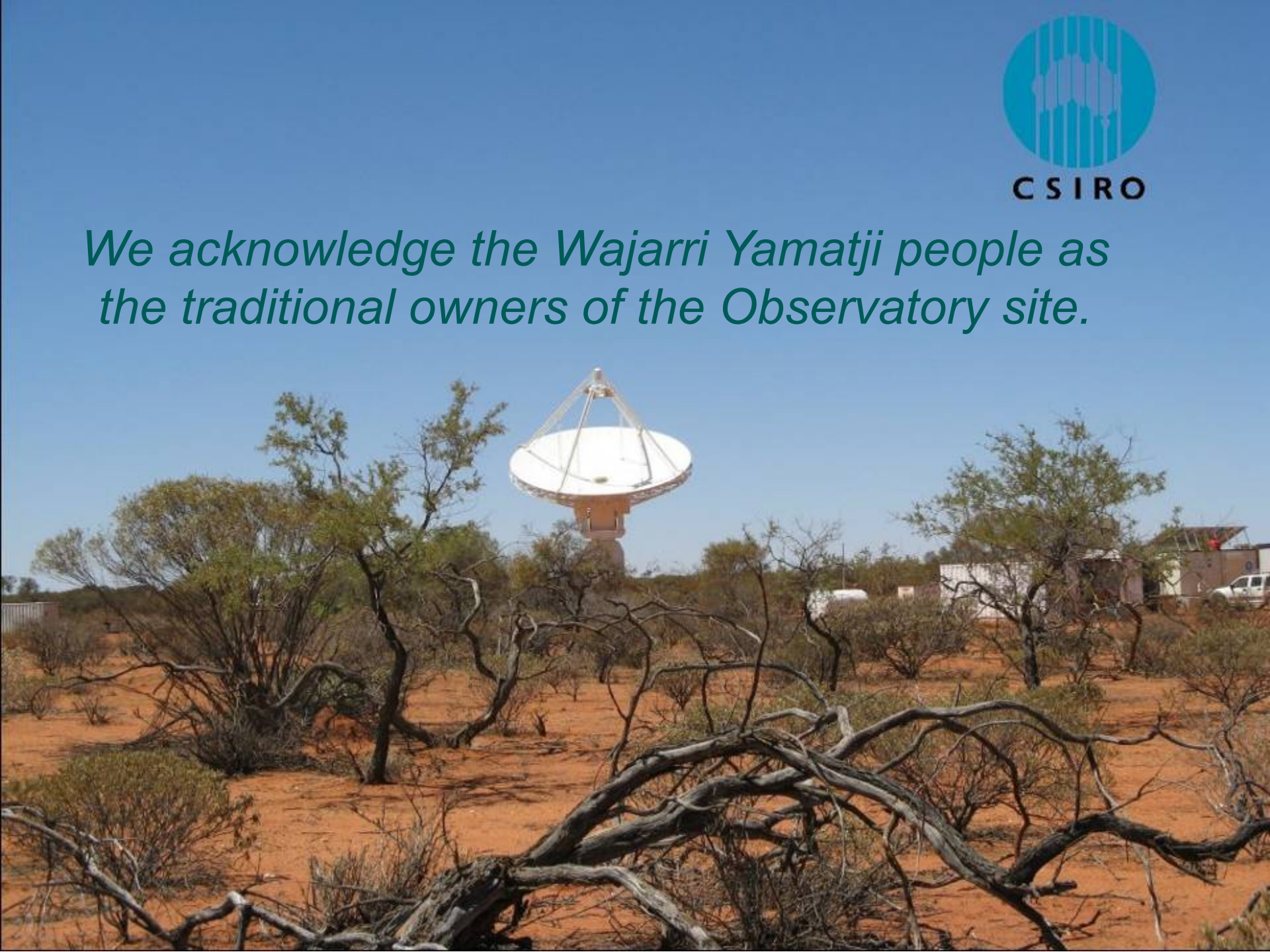
Discussion

- **Will this work?**
- **Enough incentives – what else?**
- **Suggestions for tasks**
- **Suggestions for science papers**
- **How can we generate papers now?**
  - NB: 11 EMU journal papers so far!

- **Any volunteers for**
  - Project manager
  - newsletter editor
  - Web manager

Postdoc alert: several postdoc positions to be advertised in October AAS job register

Conference alert:
Sydney, December 2013:
Astroinformatics 2013: Knowledge from data
www.tinyurl.com/astroinfo



We acknowledge the Wajarri Yamatji people as the traditional owners of the Observatory site.