



ATUC ASKAP Update

Aidan Hotan | ASKAP project scientist
April 2020

CSIRO ASTRONOMY AND SPACE SCIENCE
www.csiro.au



ASKAP observatory update

- Operations continue with contingency plans for COVID-19
 - Fast-track pilot survey observations underway
- RACS quality control leads to greater understanding of beams
 - Predictable flux correction required across FoV, primarily for outer beams
- Full steam ahead on analysis of existing pilot data
 - Data processing team working to meet requirements and upload to CASDA
- Operational support and project clashes have stretched resources
 - ASKAP-X on hold, interim operations coordination structure in place



Counting down to the launch of ASKAP 36 full survey science

csiro.au/ASKAP

09

ASKAP SURVEYS COMMENCE
Launch multi-year observing campaigns based on pilot surveys

01

FRINGES BETWEEN ALL ANTENNAS
Verify that all antennas function as an interferometer

02

SINGLE-BEAM IMAGE
Test phase stability and array calibration

03

MULTI-BEAM IMAGE
Test ASKAP's processing pipeline

04

IMAGE OF A COMPLEX FIELD
Test ASKAP on a challenging part of the sky

05

OBSERVE SCIENCE TEST FIELDS
Demonstrate performance using fields of scientific interest

06

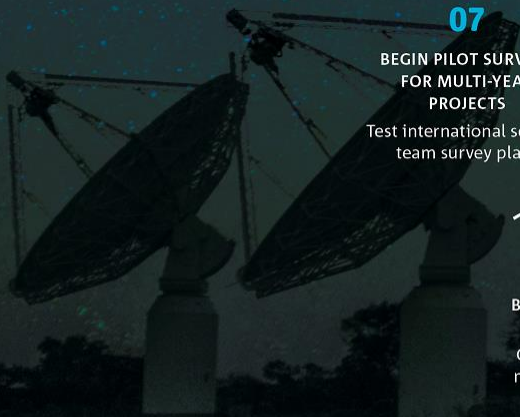
BEGIN THE RAPID ASKAP CONTINUUM SURVEY
Create an improved sky model and ASKAP's first large-scale catalogue

07

BEGIN PILOT SURVEYS FOR MULTI-YEAR PROJECTS
Test international science team survey plans

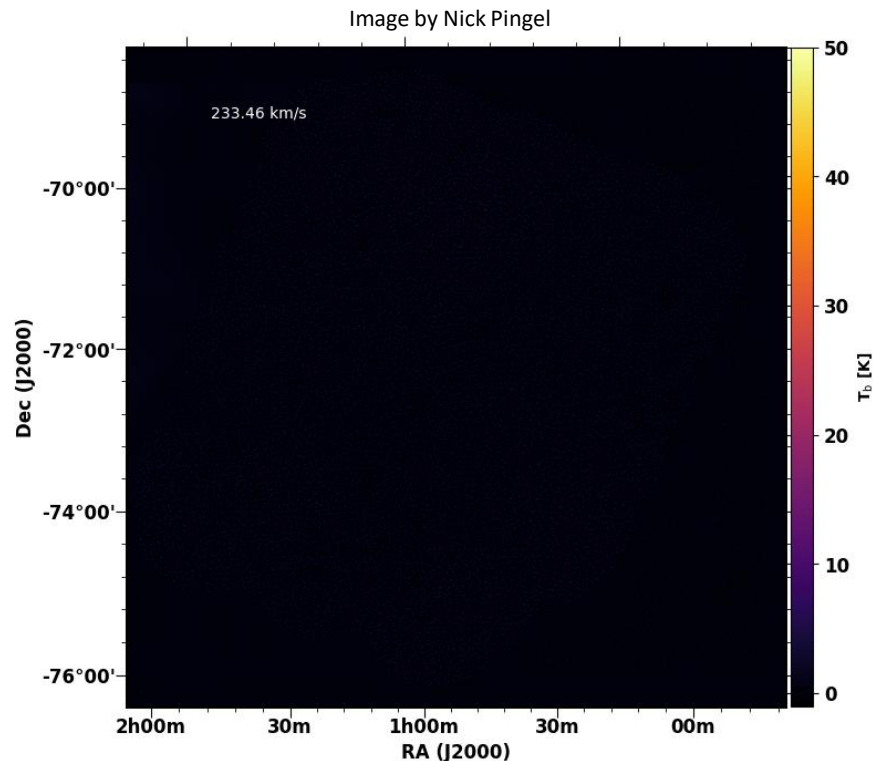
08

REVIEW PILOT SURVEY DATA
Publish and analyse pilot survey results



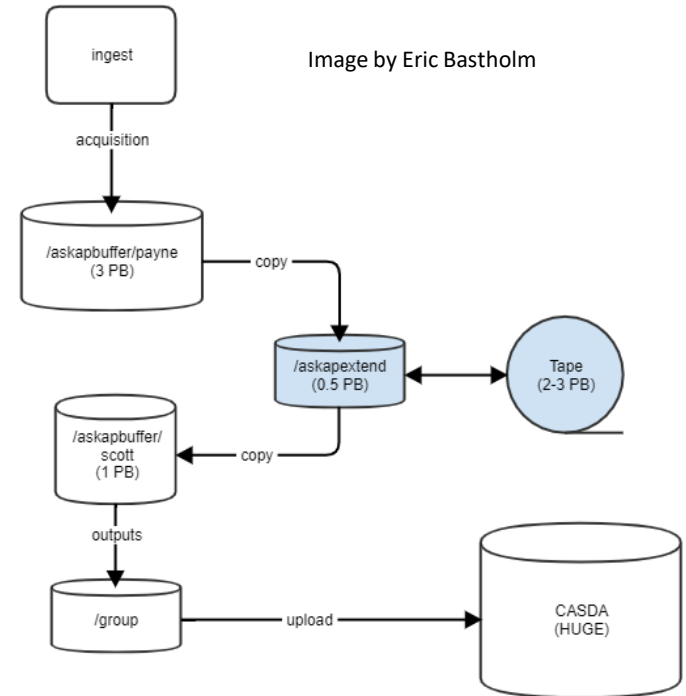
Full ASKAP + Parkes SMC cube

- Test data in 16x zoom mode
- Imaged in CASA on OzStar
 - Pipeline developed by Nick Pingel
- Operational support for joint imaging will be challenging
 - Seeking additional resources
 - Investigating alternative software
 - Pawsey hardware refresh
 - YandaSoft portability options



Fast-track pilot survey storage space

- COVID-19 increases risk of observatory closure
- Pawsey more likely to remain operational than MRO
- Need pilot data on disk even if we can't keep up with processing
- Pawsey have agreed to provide tape storage as a data buffer
- Commissioning underway now

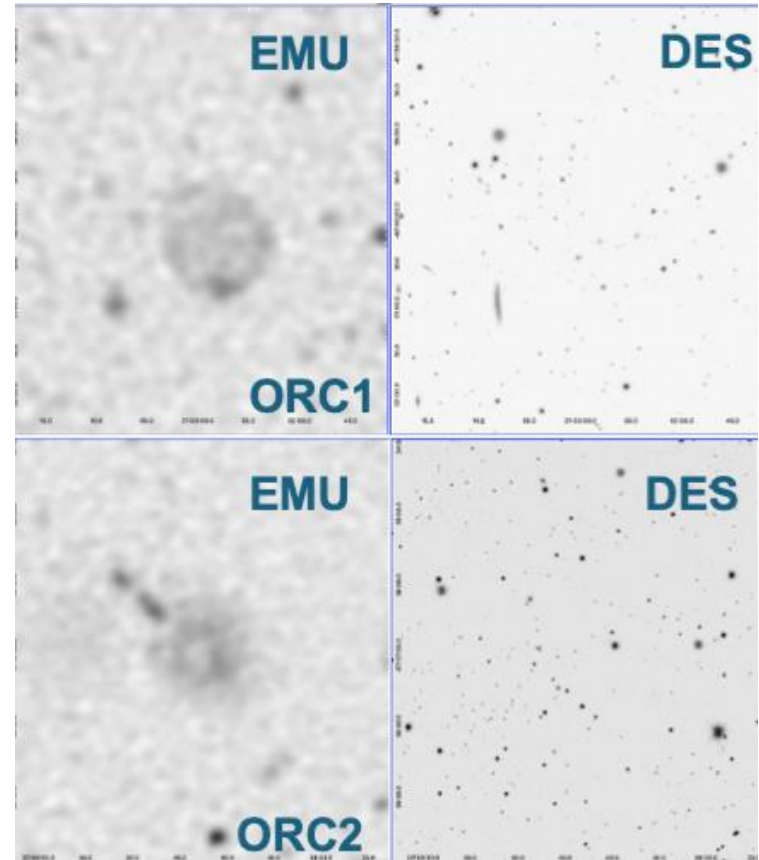


Fast-track pilot survey observing strategy

- Remaining observations require about one month of time
 - Assuming all goes smoothly, could be more given historical efficiency
- Lack of configuration agility means one survey at a time
 - LST constraints create gaps that we fill with CRAFT FRB searching
- Observing requires draining data to tape as fast as it arrives
 - Testing needed to determine whether this is possible
- Processing on /askapbuffer can interfere with data ingest
 - Halt on I/O intensive activities while observing
 - Some processing and development work can continue on /group

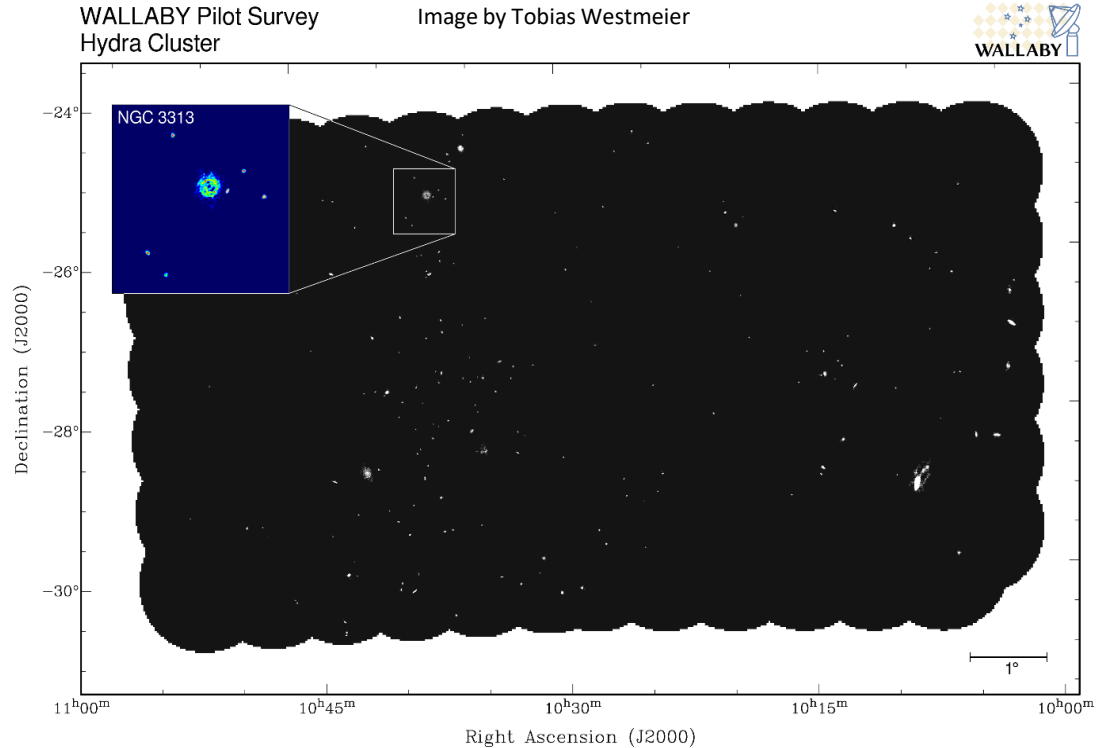
EMU pilot survey

- Discovery of Odd Radio Circles
 - No optical or IR counterparts
 - Roughly 1 arcminute in diameter
 - Not SNRs, spiral galaxies
 - Most likely not artefacts
- Leading theory is spherical shock waves from unidentified transient events



WALLABY pilot survey

- Hydra field awaiting quality control & release on CASDA
- SoFiA source detection software identifying many new galaxies in the cluster
- Extensive quality analysis report provided to CASS
- Two more fields observed



Radio loud stars in the VAST pilot survey

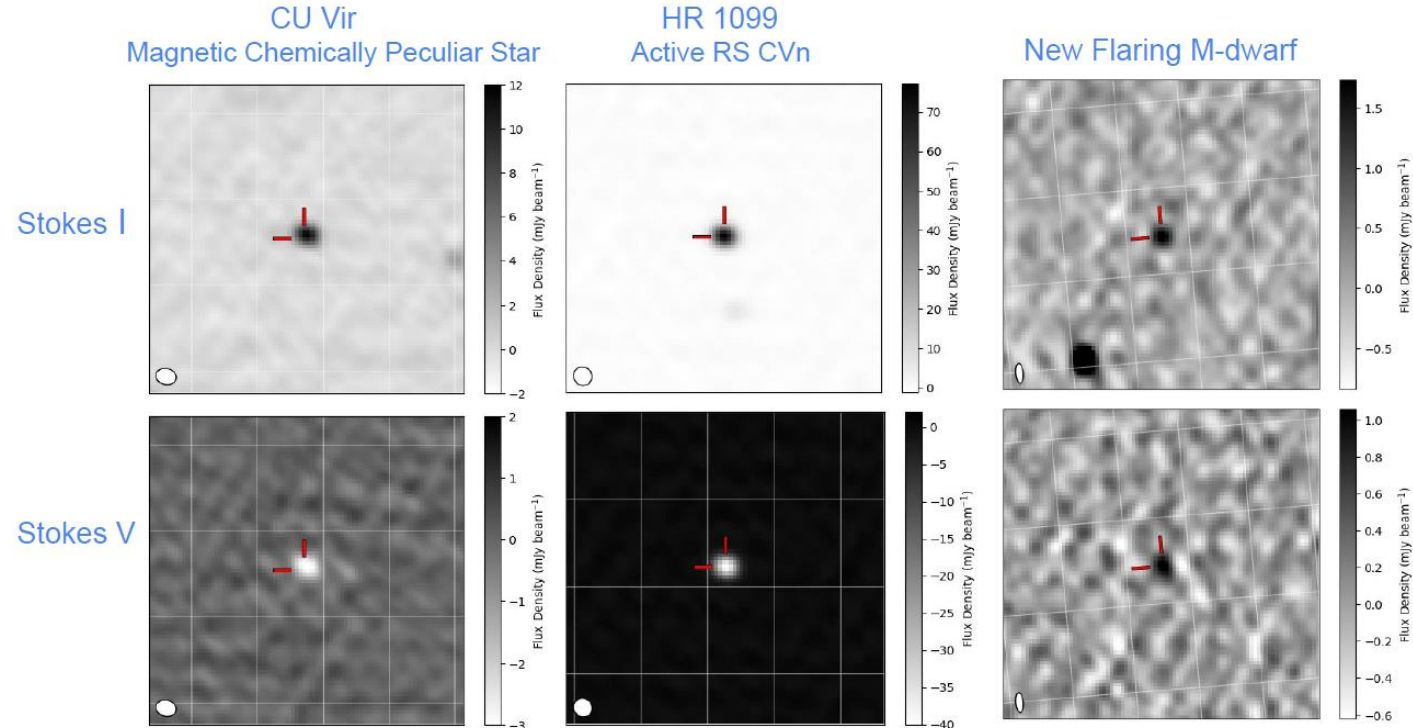


Image by Joshua Pritchard

Fast imaging pilot search on GW field (GW170814bv)

- Observed 5 times for GW follow-up pilot
 - Observations at 2, 9, 33, 86, 233 days after event
 - Several auxiliary science possibilities
- 15-minute imaging (no clean) after model subtraction
 - Identified 6 'fast' variable sources
 - Likely associated with interstellar scintillation

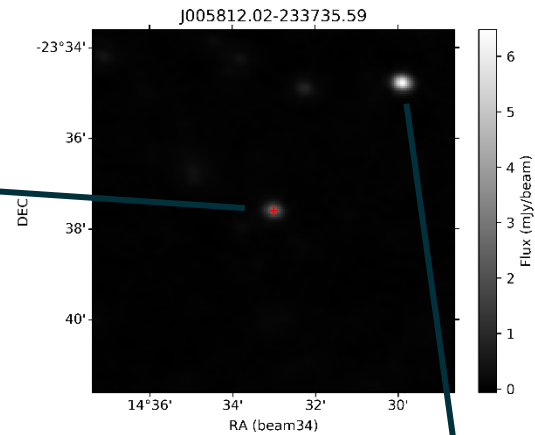
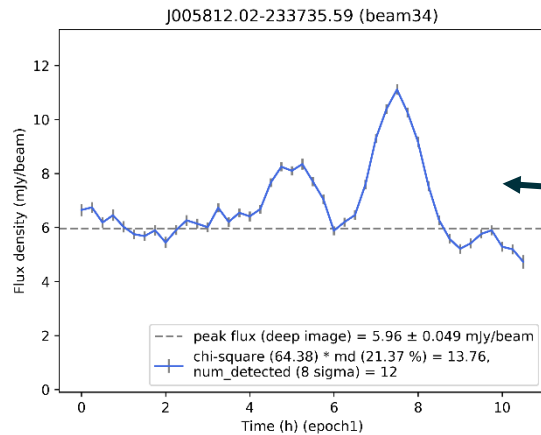
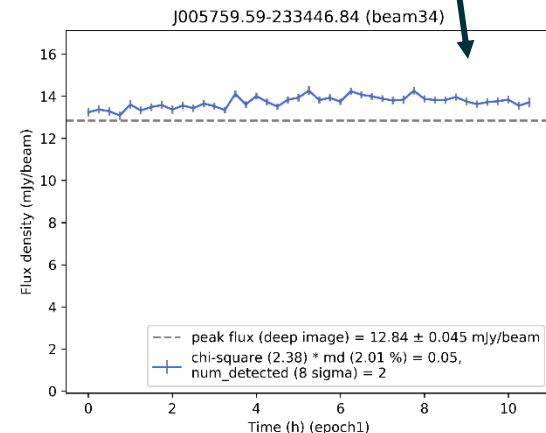
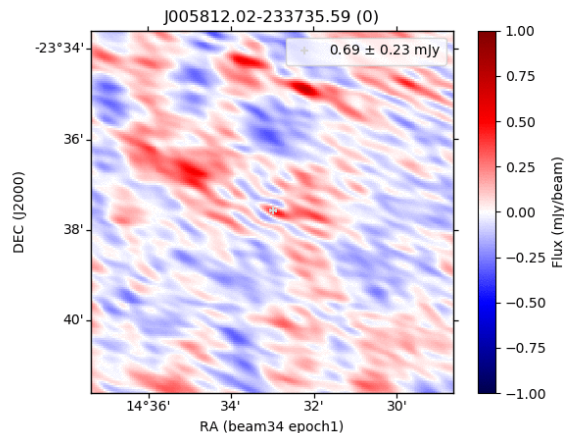


Image by Yuanming Wang



POSSUM pilot survey

- Stokes I image from pilot field SBID 10168, and RM distribution
 - RM catalogue clipped to keep only reliable sources
 - 16 RMs per square degree, factor of 10 improvement

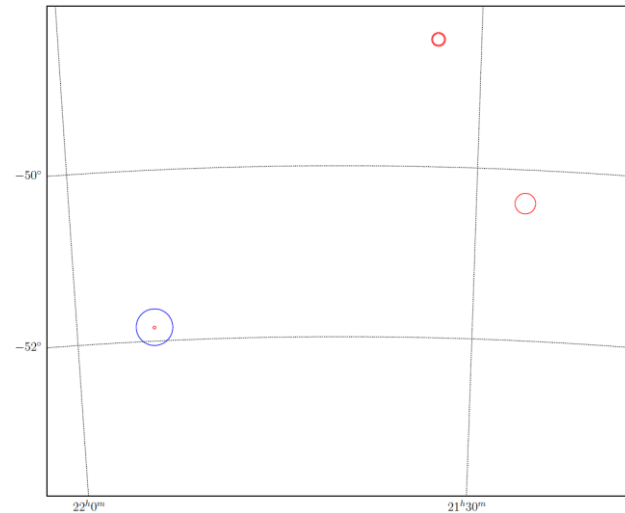
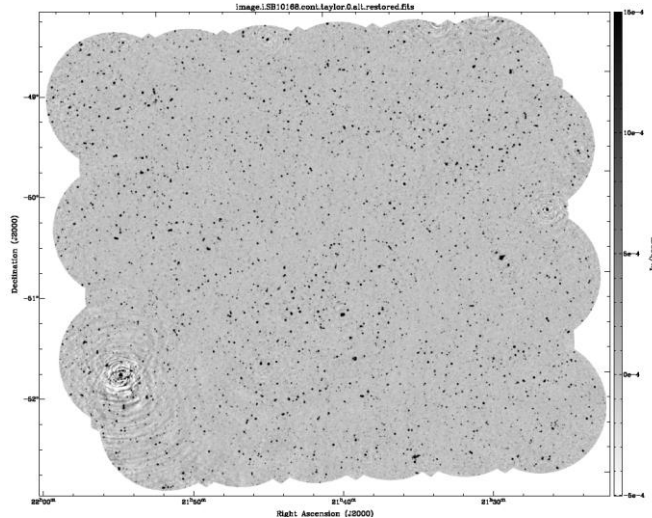


Image by Cameron Van Eck

Pilot survey review and consolidation

- Work is needed to make ASKAP survey-ready
 - Pilots have produced good data, but highlighted operational issues
 - Some planned improvements need array time for testing and development
 - Consolidation required once current observations finish
- We seek feedback from pilot survey data analysis
 - Collect and prioritise improvements needed for full surveys
- Priority shifts back to engineering before the next pilot surveys
 - Still possible to conduct time-critical observations and tests

Rapid ASKAP Continuum Survey status report

- Last ATUC reported good progress and imminent data release
 - Quality control has since found issues that have delayed release
 - We are learning a lot about ASKAP as part of this process!
- Astrometry checks pass with precision and accuracy $< 1''$
- Photometry revealed some issues we need to solve
 - Flux densities systematically high by 5-10%
 - Source spectra steeper than expected

RACS source flux investigation

- ASKAP mosaics assume circular gaussian beams, FWHM from holography
- New holography measurements were made of the RACS footprint
- These confirm significant but systematic departure from circularity in outer beams
 - Can be corrected in the image plane until position-dependent beam models are made

Holography

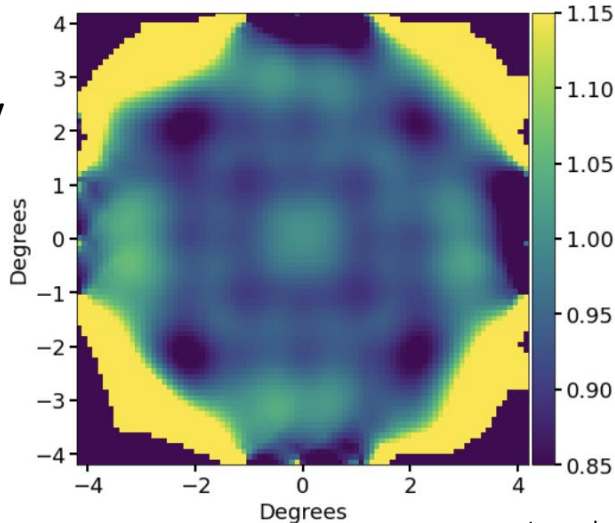
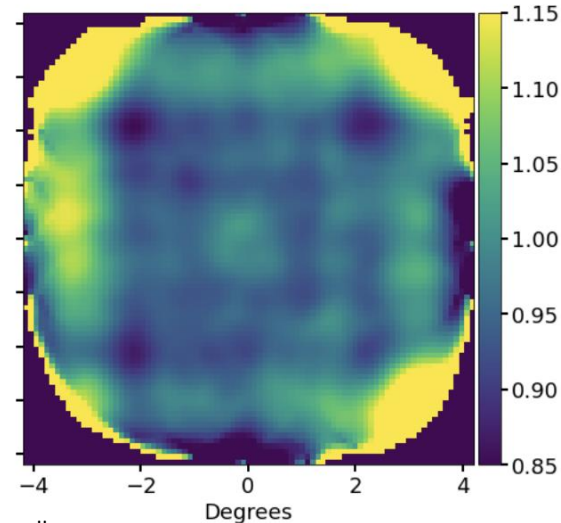


Image by David McConnell

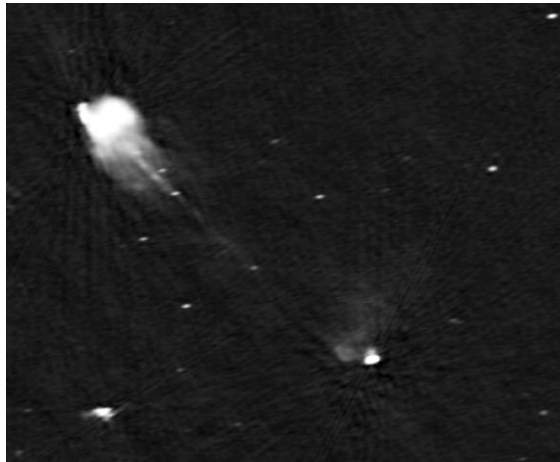
SUMSS
comparison



RACS data quality and PSF variability

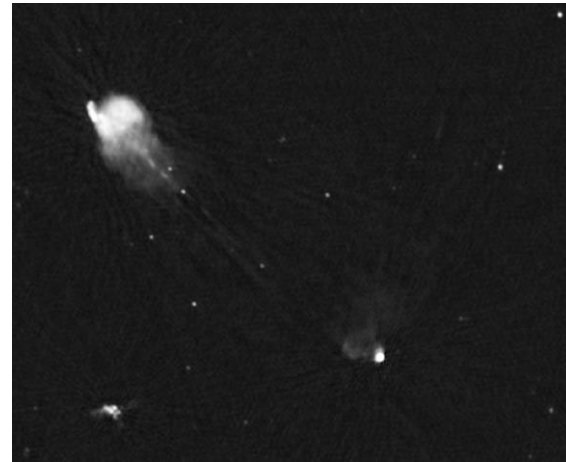
- PSF variability is present, both within and between tiles
 - Caused by early observations being taken away from the meridian, and some differential flagging
- Methods developed to characterise PSF changes over each tile
 - A selection of badly affected fields have been re-observed
- These recent data show great improvement in telescope performance since early last year

0321-45



May 2019

Image by David McConnell



March 2020

SWAG-X: ASKAP eFEDS project

- MoU between AAL and the eROSITA-DE collaboration
 - ASKAP is observing the GAMA-09 field, alongside eROSITA performance verification
 - Continuum test at 888 MHz covering the full area complete (release pending)
 - One 888 MHz spectral epoch observed and awaiting processing (behind pilots)
- Widespread interest in GAMA-09 from ASKAP SSTs
 - Obtain a wide range of data products as an observatory project
- Provide a public resource for multi-wavelength comparison

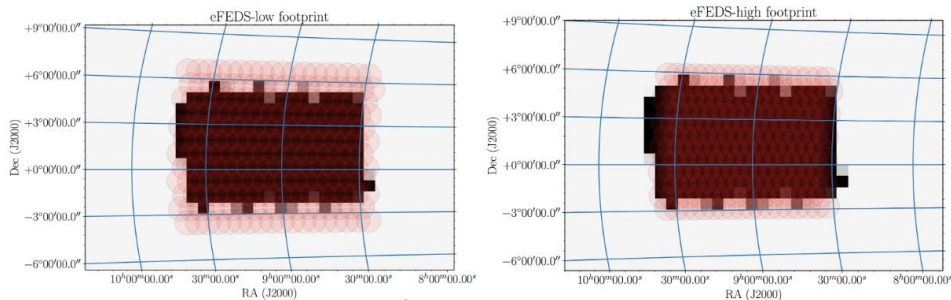
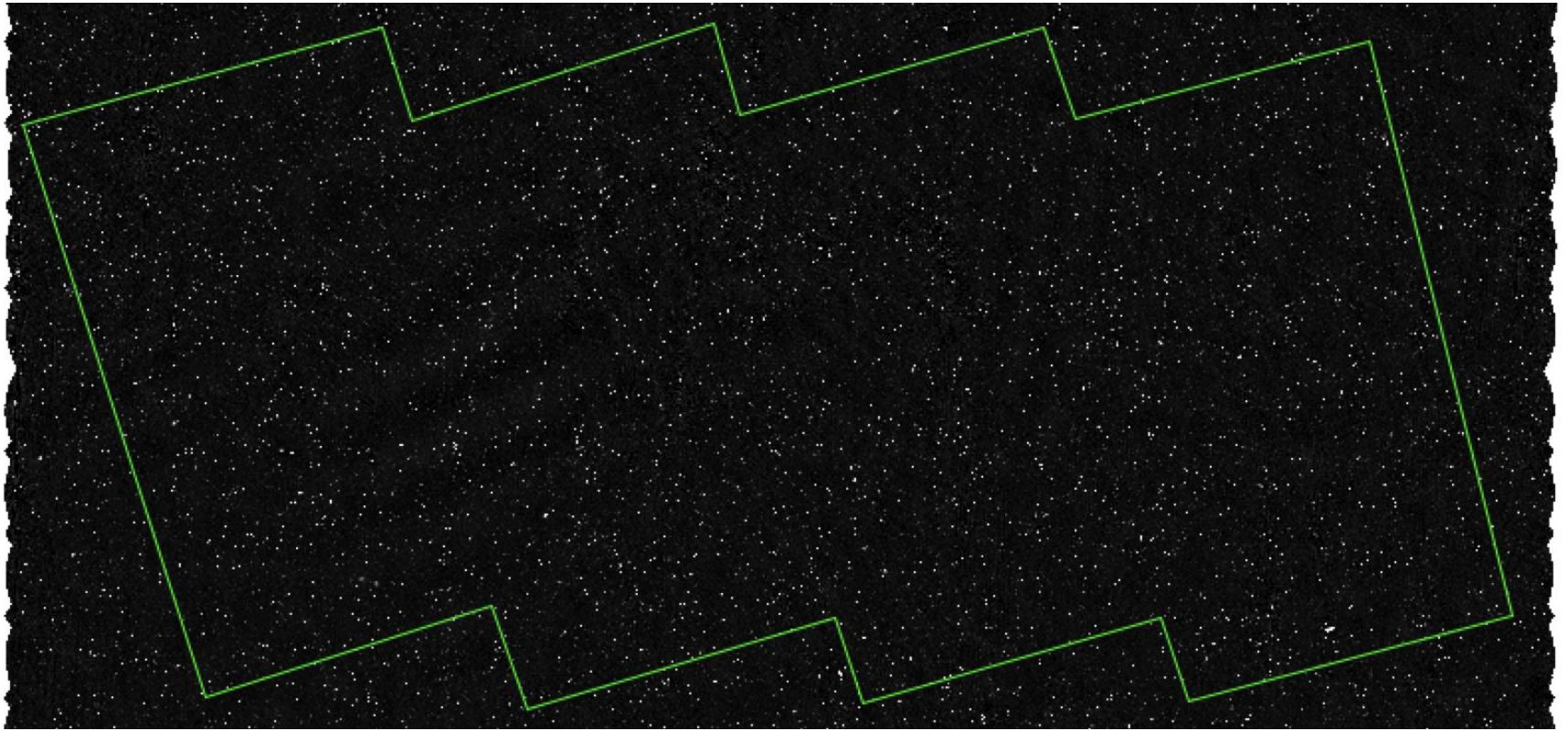


Image by Vanessa Moss

SWAG-X: ASKAP eFEDS project

Image by Vanessa Moss
eROSITA footprint in green

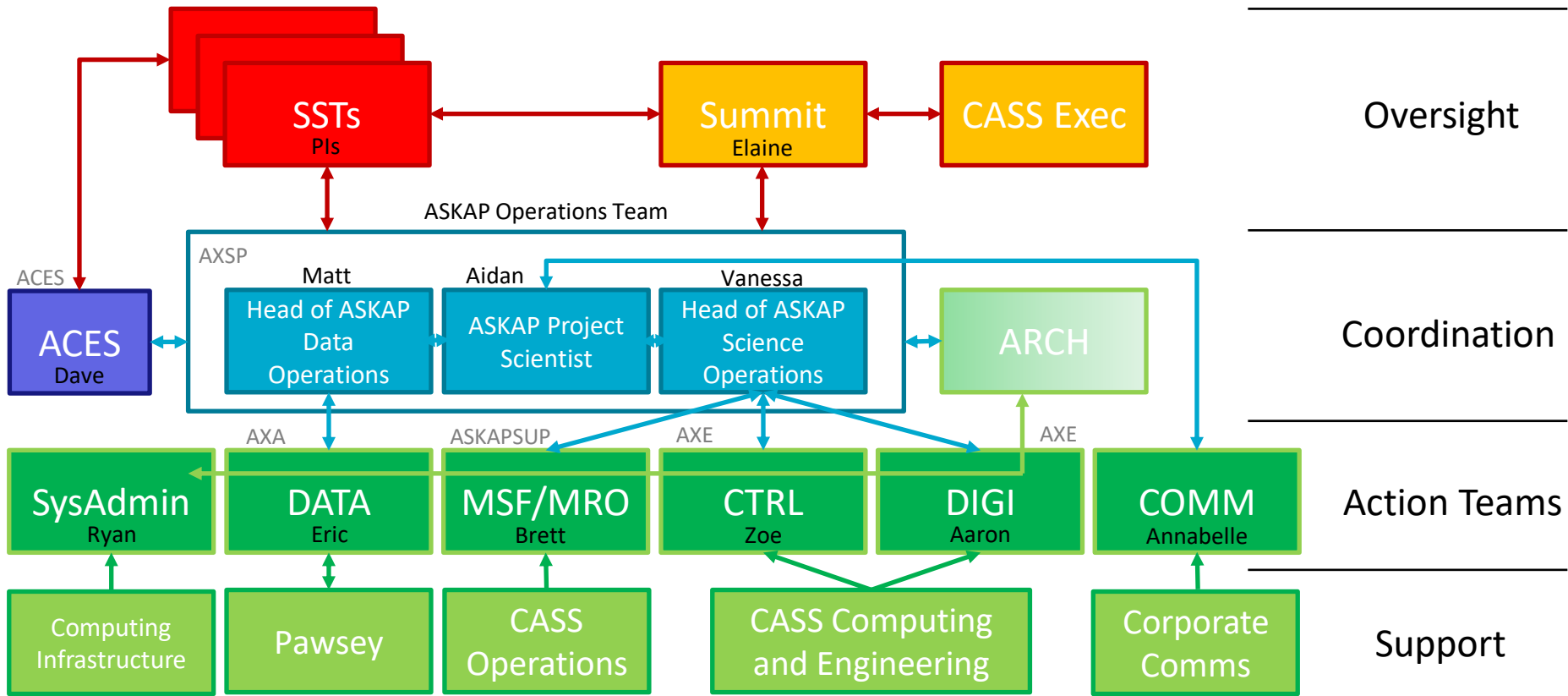


Suspension of ASKAP-X

- ASKAP is a new instrument and fully operated by CASS
 - Routine operations frequently cross into engineering domains
 - No operations structure existed to coordinate activities
- The ASKAP-X project was created to implement fixes and features
 - Operational support was always out of scope, but taking most of people's time
- With the need to complete pilots, we have suspended ASKAP-X
 - Focus on operational support during this difficult time
 - Develop a viable operations model for surveys in future
 - Manage “funded” features like CRAFT coherent search mode as projects

Creating a workable operations model

- We need an operations structure crossing the observatory site, science, development, engineering and computing domains
 - All highly distributed and often de-centralised teams
- ASKAP-X SAFE procedures weren't always working in our situation
 - Overheads too high when teams are fractional
 - Skills isolated to individuals, making team focus difficult to achieve
- Need to keep the cross-team coordination we developed
 - Team representatives, structured test time, release planning, etc.



The path to beginning full surveys

- Priority is currently on finishing the existing pilot survey plans
- The first pilot surveys have been very instructive
 - We are planning a second round that will focus on commensality
- Pilot survey experience will inform a Combined Survey Strategy
 - This should optimise the science/time ratio for the full survey projects
 - Must clearly identify resource requirements for each survey

ASKAP survey project review

- The combined survey strategy will be the observatory's recommended approach to maximise efficiency
 - It will be developed in consultation with the science teams
- An external review of the strategy will be arranged
- As a fall-back, the review panel will rank updated science cases
 - This can be used as a tie-breaker when survey strategies conflict

Conclusions

- Pilot surveys are progressing and producing exciting results
- RACS is teaching us a lot about the telescope
 - It should still be the world's benchmark survey at 1 GHz
- Operating ASKAP requires new ways of thinking for CASS
 - We are navigating this and iterating on an optimal operations model
- Science teams encouraged to discuss commensality opportunities