SKA PATHFINDER SCIENCE AND THE VERY LARGE ARRAY SKY SURVEY

Stefi Baum, University of Manitoba
Mark Lacy, NRAO
June 2, 2016

Galactic Center (Survey) Multiwavelength Image
SKA Pathfinders & Precursors

- **Pathfinder**: SKA-related technology, operations and activity
- **Precursor**: Pathfinder at one of the two SKA sites (Australia or South Africa)

**Pathfinders**
- Jansky Very Large Array
- Aperture Tile In Focus (AperTIF)
- Low Frequency Array (LOFAR)
- Pathfinder status for CHIME in progress

**Precursors**
- Murchison Widefield Array (MWA)
- Karoo Array Telescope (MeerKAT)
- Australian SKA Pathfinder (ASKAP)
Canadian Leadership in Pathfinder Science

- CHIME (UBC, McGill, UoT, DRAO)
  - BAO intensity mapping
  - Pulsar timing
  - Fast radio bursts

- MWA (UofT)
  - Consortium & board member for Phase 2
  - Leading polarimetry, cosmic web studies

- ASKAP (UofT, UBC, DRAO, RMC, …)
  - Leading POSSUM (cosmic magnetism)
  - Leading COAST (pulsar search & timing)
  - Delivering key pipelines for WALLABY (21cm)

- VLA Sky Survey (UofM, UofT, UofA)
  - Co-lead of overall survey science program
  - Co-leads of 4 of 7 survey working groups

Pressing need for Canadian data services for all of the above
CFI Innovation Fund 2017
“Unlocking the Radio Sky with Next-Generation Survey Astronomy”
UofT (lead), UofM, UofA, Queen’s, McGill, UBC, CADC, NRAO, Cornell, …
The VLA Sky Survey (VLASS)

- A 21st century version of the NVSS and FIRST
- All-sky above declination $-40^\circ$ (33,885 deg$^2$)
- Resolution: 2.5"
- Frequency: 2 to 4 GHz (excluding $\sim$15-25% affected by RFI)
- RMS: 120 $\mu$Jy/beam (per epoch); 69 $\mu$Jy/beam (co-added)
- I,Q,U polarisations
- Cadence: 3 epochs spaced by 32 months, starting Oct 2017 pending reviews.
- 5400 hours of telescope time over 7 years ($\sim$15% impact on PI science)
Scientific Motivations

- Time domain science
- Polarisation and cosmic magnetism
- Galaxy evolution and AGN
- Milky Way science
- Reference radio sky for multi-wavelength studies
Hidden explosions

- VLASS will open new parameter space for finding dusty unbeamed GRBs, supernovae, and compact object mergers
Faraday Tomography and Cosmic Magnetism

• Rotation measures and Faraday depth data for \(~10^5\) sources
  • Milky Way’s magnetic field at 10x better resolution
  • Unique probe of AGN feedback
  • Evolution of magnetic fields over cosmic time

37,543 RMs (NVSS; Taylor, Stil & Sunstrum 2009)

H II region around ζ Oph (Harvey-Smith, Madsen & BMG 2011)
Survey Strategy and Timeline

• Observing strategy
  • half of the visible sky observed every 16 months (B-array)
  • cadence for any given position is 32 months

• Milestones and Schedule
  • Pilot survey: 196 hours, 2500 deg$^2$, May - August 2016
  • PDR and CDR
  • Main survey commences Oct 2017, ends ~2023
    (final epoch is subject to a further review)
Science Survey Group

- Stefi Baum and Shami Chatterjee: Co-Chairs of SSG Executive
- Gordon Richards and Amy Kimball: Co-Chairs of Extragalactic WG
- Rachel Osten and (Joe Lazio standing in): Co-Chairs of Galactic WG
- Gregg Hallinan and Greg Sivakoff: Co-Chairs of Transients WG
- Larry Rudnick and Bryan Gaensler: Co-Chairs of Polarisation WG
- Susana Deustua and Jayanne English: Co-Chairs of Education & Public Outreach WG
- Casey Law and Kunal Mooney: Co-Chairs of Survey Implementation WG
- Eric Murphy and Erik Rosolowsky: Co-Chair of NRAO Data products, Archiving and Enhanced Data Products Working Group
- Rick White, Jim Condon, Tracy Clarke, Joe Lazio, Russ Taylor, Ashley Zauderer, Jim Cordes: Expert Community Members at Large
How to get involved

• New participants welcome to Survey Science Group (SSG)
  • Working groups work on all aspects of VLASS science and technical planning
  • Please email mlacy@nrao.edu if interested

• We will have way more data than we can cope with!
  • Community has responsibility to produce enhanced data products beyond what NRAO can deliver
  • Other help from the SSG in terms of data reduction, quality assurance, etc, is welcome