THE VERY LARGE ARRAY SKY SURVEY

Mark Lacy, NRAO

Survey parameters

- "All-sky" (above declination -40 deg; 33885 deg^2)
- Resolution: 2.5"
- Frequency: 3GHz (2-4GHz less ~15-25% RFI affected regions)
- Cadence: 3 epochs separated by 32 months, starting Oct 2017 pending reviews.
- RMS per epoch: 120μJy; co-added RMS: 69μJy
- I,Q,U polarization.
- 5400hr of telescope time over 7 years (~15% impact on PI science).
- ~10^7 sources.

Motivation

- Provides a reference radio sky at high angular resolution for multi-wavelength studies.
- Enables focused radio astronomy studies
  - Time domain: the transient and variable radio sky.
  - Polarization: rotation measures of individual sources, Faraday tomography of the Milky Way.

Organization

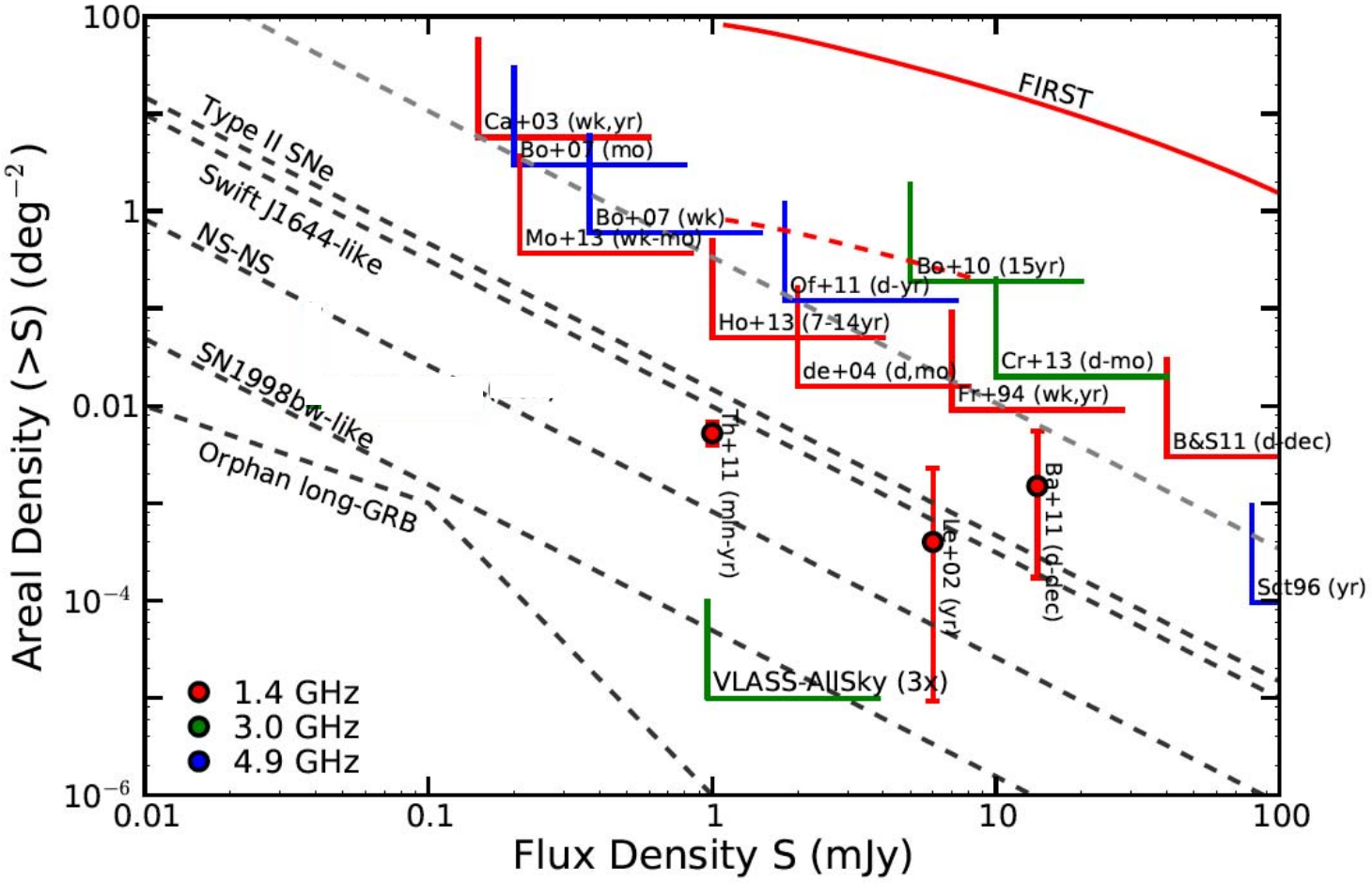
- Community-led Science Survey Group defined the survey.
- NRAO VLASS Project Office:
  - Claire Chandler, Survey Director
  - Steve Myers, Technical Lead
  - Mark Lacy, Project Scientist
  - Science support from Amy Kimball and Frank Schnitzel
- SSG provides science guidance:
  - Stefi Baum and Shami Chatterjee co-chair [Eric Murphy until 2016]
  - Working groups:
    - Extragalactic: Gordon Richards & Amy Kimball
    - Galactic: Rachel Osten and [Joe Lazio]
    - Transients: Greg Hallinan & Greg Sivakoff
    - Polarization: Larry Rudnick & Bryan Gaensler
    - EPO: Susana Deustua & Jayanne English
    - Implementation: Casey Law & Kunal Mooney
    - Data products and Archiving: Eric Murphy & Eric Rosolowsky
    - At large members: Rick White, Jim Condon, Tracy Clarke, Joe Lazio, Russ Taylor, Ashley Zauderer,Jim Cordes

Technical challenges

- Survey will be taken in “On the fly” interferometry mode
  - Telescope is scanned at a constant rate in RA, data are taken at 0.45s intervals (~10 samples across a primary beam).
  - Length of scan is ~10deg, after which another row is started.
  - Mapping rate is ~24deg^2/hr.
- Scheduling blocks need to be fairly short to accommodate PI science needs (probably ~4hr). Each block takes ~80deg^2 of data.
- Survey will take 500TB of raw data.
- Full resolution spectral/stokes cubes would be 64PB - only on demand.
- Will make ~200TB of images (~40TB continuum plus compressed cubes).

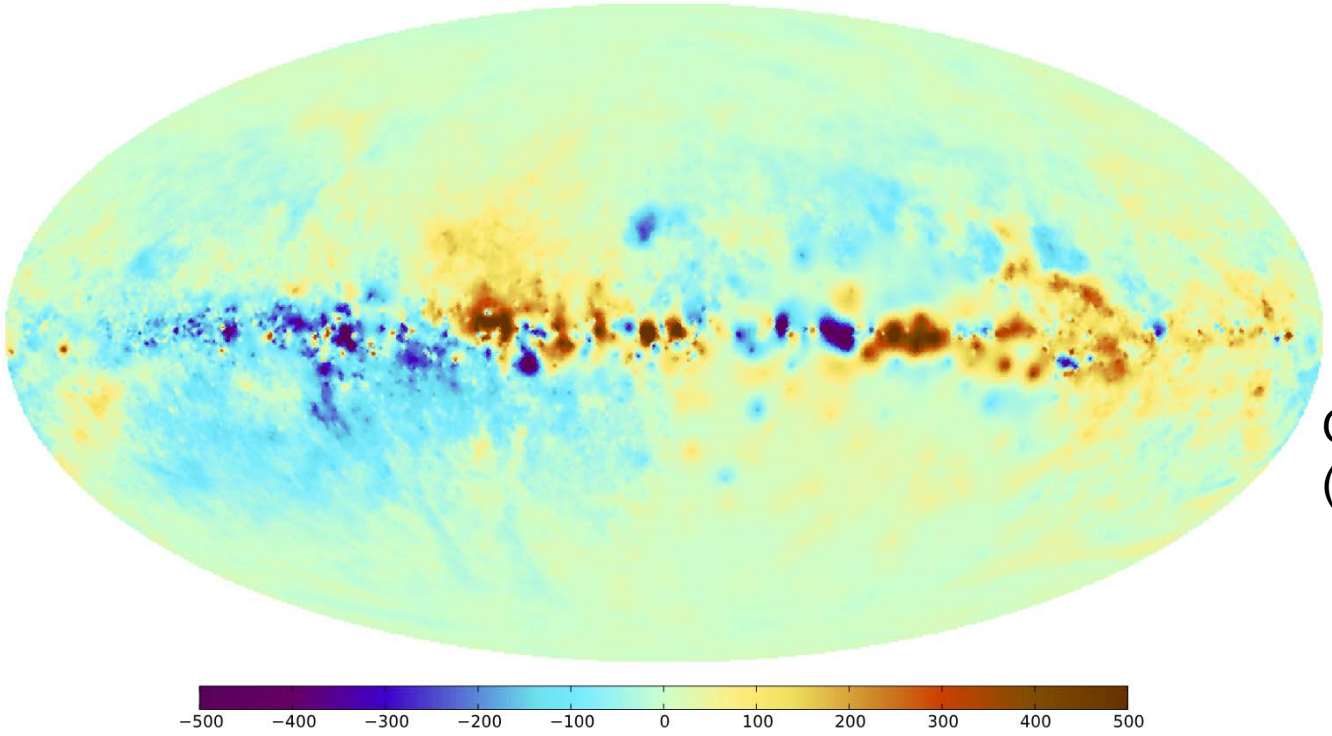
Hidden explosions

VLASS will open new parameter space for finding dusty/unbeamed GRBs, SNe, compact object mergers



Faraday tomography

- Faraday rotation map of Milky Way will increase in resolution by a factor of ~10.
- The properties of the magneto-ionic medium in AGNs and galaxies: wide bandwidth (2-4GHz less some RFI affected regions) will allow rotation measure estimates for ~10^5 sources.
- Essential for studies of AGN feedback in the “Faraday thick” regime.
- High angular resolution helps resolve Faraday screens.



Oppermann et al. 2012 (NVSS)

VLA SKY SURVEY

AGN and galaxy evolution

- New generations of wide area optical/IR surveys (PanSTARRs, DES, LSST) will benefit from a high resolution radio survey for cross-identifications.
- In conjunction with WISE, photo-zs from these surveys, will be able to determine accurate demographics of radio-loud/intermediate population, important for constraining AGN feedback theories.
- VLASS will provide a baseline for follow-up of AGN flares and candidate black hole merger events from gravitational wave detectors.

Galactic Science – peering through our dusty galaxy

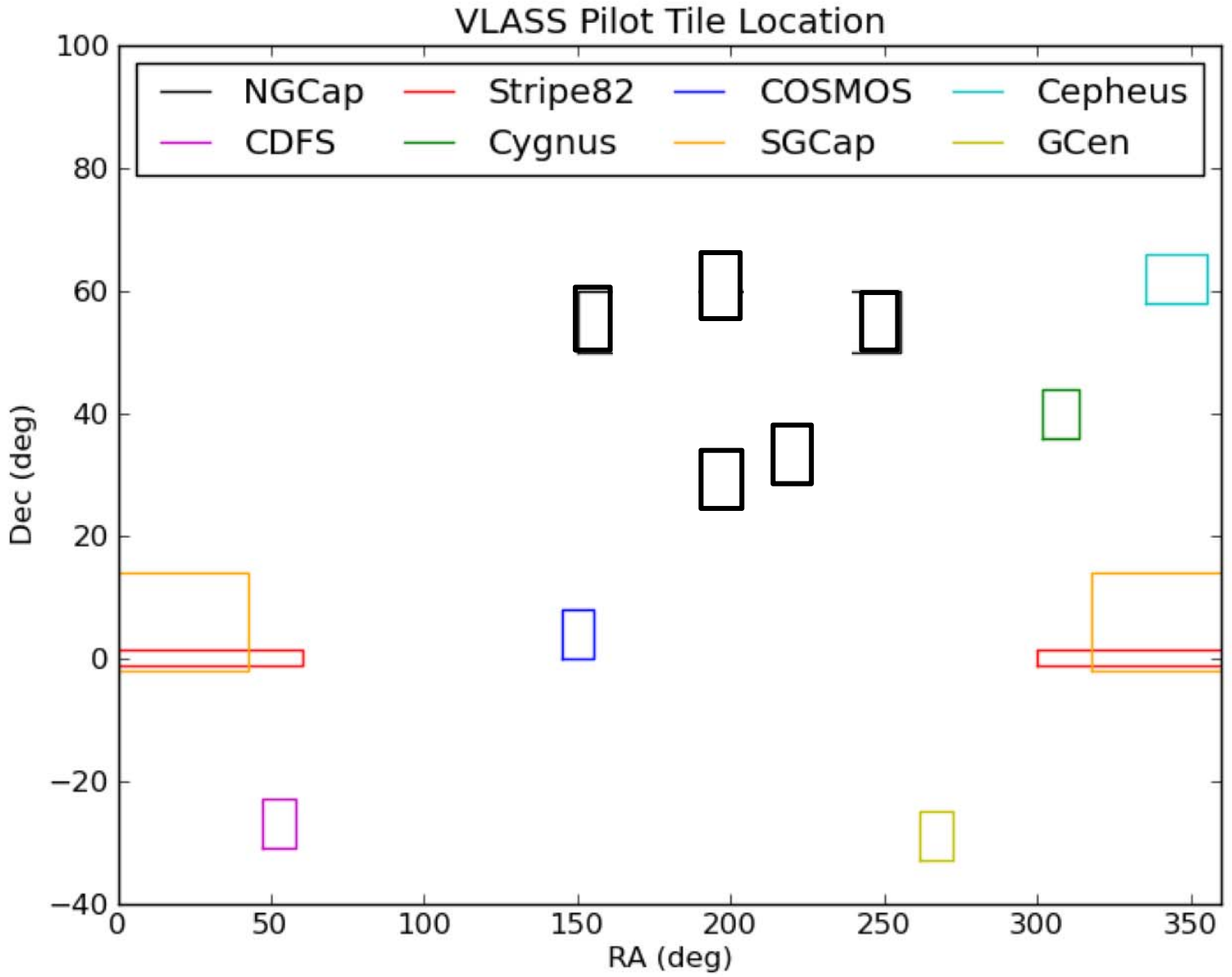
- Extreme pulsars – identify candidate double neutron stars, millisecond pulsars for follow-up
  - Potential for finding exotic systems e.g. pulsar-BH binary with which to refine tests of GR.
- Cool stars with active coronae
  - Cross-correlate variable objects in VLASS with LSST and vice-versa.
- Planetary nebulae
  - Refine evolutionary models
- HII regions
  - Improve census of massive star formation and galactic structure models.

Education and Outreach

- EPO activities have been built into the survey from the start.
- Will use social media to explain the survey and report on its progress. #VLASS
- “Picture of the week”
- Citizen Science.
- Science stories and blogs.
- Educational activities (in partnership with NRAO and other institutions).
- Science community email updates.

Pilot survey

- Pilot survey this summer (June-August).
- 196hr of time, dedicated to exercising the survey execution and data reduction process.
- Will map ~2500 deg^2 in fields scattered through the sky.
  - Special emphasis on fields that have pre-existing 2-4GHz data (COSMOS, Stripe 82) that can be used to validate the completeness and reliability of the survey.
  - Galactic fields in Cygnus, Cepheus and the Galactic Center.
  - Additional extragalactic fields: CDFS, NGC (ELAIS-N1, Bootes, Coma/H-ATLAS-N, HDF, Lockman), SDSS SGC.
  - COSMOS, Cygnus and Stripe82 will be observed in 3 epochs.
- Raw data public immediately, image products through the VLA archive once made and validated.
- Now is a good time to get involved!



VLA SKY SURVEY

Main survey

- Current schedule anticipates taking one half of the sky in one epoch every 16 months when the B-configuration comes round. So the cadence for any given position on the sky is 32 months.
- Assuming the PDR and CDR go well (and there are no problems with the pilot survey data), the main survey will start with the B-array in Oct 2017 and complete about six years later (final epoch is subject to a further review).

How to get involved

- We welcome new participants to the Survey Science Group (SSG).
  - Please email mlacy@nrao.edu if interested.
  - See also next month's NRAO eNews.
- We will have way more data than we can cope with!
  - We would like to work with the community to produce enhanced data products that NRAO does not have the resources to produce.
    - Examples: Faraday synthesis cubes, enhanced catalogs (including cross-Ids) etc
  - Other help from the SSG in terms of data reduction/QA etc is welcome.