

# The Jansky VLA Sky Survey (VLASS)

## Technical Plan and Status



**Steven T. Myers** (National Radio Astronomy Observatory, Socorro, NM)

**Casey J. Law; Stefi A. Baum; Claire J. Chandler; Shami Chatterjee;**

**Mark Lacy; Eric J. Murphy**

for the VLASS Survey Team

and the Survey Science Group

Atacama Large Millimeter/submillimeter Array

Expanded Very Large Array

Robert C. Byrd Green Bank Telescope

Very Long Baseline Array



# VLASS Proposal and Technical Plan

- Website : <https://science.nrao.edu/science/surveys/vlass>
- Science Proposal and survey definition by community Survey Science Group (SSG) following AAS 223 workshop in Jan 2014
- Technical Working Group (S. Myers, C. Law co-chairs) and VLASS Director (Chandler) wrote Technical Plan
- Community Review of proposed survey held in March 2015
- Recommendation of review to go ahead with All-Sky approved by NRAO Director, pending passing design reviews and pilot survey
  - Hidden Explosions & Faraday Tomography as headline science
  - Deep field part of survey recommended to put forward as separate P.I. large project



# VCLASS SSG and Proposal Contributors

Table 8: VCLASS Proposal Contributors, Including VCLASS White Paper Authors

F. Abdalla, Jose Afonso, A. Amara, David Bacon, Julie Banfield, Tim Bastian, Richard Battye, **Stefi A. Baum**, Tony Beasley, Rainer Beck, Robert Becker, Michael Bell, Edo Berger, Rob Beswick, Sanjay Bhatnagar, Mark Birkinshaw, V. Boehm, Geoff Bower, **Niel W. Brandt**, A. Brazier, Sarah Bridle, Michael Brotherton, Alex Brown, Michael L. Brown, Shea Brown, Ian Browne, Gianfranco Brunetti, Sarah Burke Spolaor, Ettore Carretti, Caitlin Casey, Sayan Chakraborti, **Claire J. Chandler**, Shami Chatterjee, **Tracy Clarke**, Julia Comerford, **Jim Cordes**, Bill Cotton, Fronefield Crawford, Daniele Dallacasa, Constantinos Demetroullas, **Susana E. Deustua**, **Mark Dickinson**, Klaus Dolag, Sean Dougherty, Steve Drake, Alastair Edge, Torsten Ensslin, Andy Fabian, Xiaohui Fan, Jamie Farnes, Luigina Feretti, Pedro Ferreira, Dale Frail, Bryan Gaensler, Simon Garrington, Joern Geisbuesch, Simona Giacintucci, Adam Ginsburg, Gabriele Giovannini, Eilat Glikman, Federica Govoni, Keith Grainge, Meghan Gray, Dave Green, Manuel Guedel, **Nicole E. Gugliucci**, Chris Hales, **Gregg Hallinan**, Martin Hardcastle, Ian Harrison, Marijke Haverkorn, Martha Haynes, George Heald, Sue Ann Heatherly, Alan Heavens, Joe Helmboldt, C. Heymans, Ian Heywood, Julie Hlavacek-Larrondo, **Jackie Hodge**, Michael Hogan, Assaf Horesh, C.-L. Hung, Zeljko Ivezic, Neal Jackson, Matt Jarvis, B. Joachimi, Atish Kamble, David Kaplan, Namir Kassim, S. Kay, Amy Kimball, T.D. Kitching, Roland Kothes, Diederik Kruijssen, Shri Kulkarni, Mark Lacy, **Cornelia Lang**, **Casey Law**, **Joe Lazio**, J.P. Leahy, Jeff Linsky, Xin Liu, Britt Lundgren, R. Maartens, Antonio Mario Magalhaes, Minnie Mao, **Sui Ann Mao**, Maxim Markevitch, Walter Max-Moerbeck, Ian McGreer, Brian McNamara, Lance Miller, Elisabeth Mills, Kunal Mooley, Tony Mroczkowski, **Eric J. Murphy**, Matteo Murgia, Tom Muxlow, **Steve Myers**, Bob Nichol, Shane O'Sullivan, Niels Oppermann, **Rachel Osten**, Pat Palmer, P. Patel, Wendy Peters, Emil Polisensky, Ed Prather, J. Pritchard, Cormac Purcell, A. Raccanelli, Scott Ransom, Urvashi Rao, Paul Ray, A. Refregier, **Gordon Richards**, Anita Richards, C. Riseley, Tim Robishaw, Anish Roshi, Larry Rudnick, Michael Rupen, Helen Russell, Elaine Sadler, M. Santos, Anna Scaife, B.M. Schafer, Richard Schilizzi, Dominic Schnitzeler, Yue Shen, Kartik Sheth, Greg Sivakoff, Lorant Sjouwerman, Ian Smail, Oleg Smirnov, Vernesa Smolcic, Alicia Soderberg, Dmitry Sokolov, Tim Spuck, Judy Stanley, J.-L. Starck, Jeroen Stil, John Stoke, **Michael Strauss**, Meng Su, Xiaohui Sun, R. Szepietowski, A.N. Taylor, Russ Taylor, Valentina Vacca, Reinout van Weeren, Tiziana Venturi, Andrew Walsh, Wei-Hao Wang, Dave Westpfahl, Robert Wharton, **Rick White**, Stephen White, L. Whittaker, Peter Williams, Kathryn Williamson, Tony Willis, Tom Wilson, Maik Wolleben, Nicholas Wrigley, **Ashley Zauderer**, J. Zuntz

Note: Members of the SSG are listed in **bold**.



# VLASS: Post-Review Survey Definition

- Captures a set of snapshots of the radio sky unique in time & “space”
- Enables : focused radio, multi- $\lambda$ , statistical, time domain studies
- S-Band (2 – 4 GHz), B/BnA configurations
  - Wide Bandwidth – spectral index, improved synthesized PSF
  - Full Polarization – Improved RM Synthesis Imaging
  - All-sky visible to VLA ( $\delta > -40^\circ \sim 34\text{Kdeg}^2$ ) – including Galactic plane and bulge
  - Synoptic – 3 epochs,  $120\mu\text{Jy}/\text{beam}$  per epoch, 32 month cadence
    - OTFM scanning at  $\sim 3'/\text{s}$  (or  $\sim 6'/\text{s}$ )
  - High Angular Resolution (2.5")
    - locate hosts **and location within hosts**
- $\sim 5400$  hr investment over  $\sim 7\text{yr}$ 
  - $\sim 15\%$  impact on PI time

Tier	Density (deg <sup>-2</sup> )	Total Detections
<b>All-Sky</b>	<b>290</b>	<b>9,700,000</b>

10x FIRST yield,  $\sim 5\text{x}$  NVSS

Tier	Area (deg <sup>2</sup> )	Resolution (", robust)	Rms ( $\mu\text{Jy}/\text{bm}$ )	Time (hr)	Epochs
All-Sky	33,885 ( $\delta > -40^\circ$ )	2.5	69	5436	3

# VLASS Basic Data Products (BDP)

- Deliverables by NRAO (with SSG collaboration where possible):

Product	Timescale	Notes
Raw Data	immediate	no proprietary period
Calibrated Data	1 week	same, served from archive
Quick-Look Images	48 hrs.	continuum only, simple QA
Quick-Look Catalog	w/QLI	only basic image object finding
Single-Epoch Images	6 mos. (12 mos. pol)	better quality assurance
Single-Epoch Catalog	w/SEI	more object parameters
Cumulative Images	12 mos. (16 mos. pol)	produced after each epoch after first, increased depth
Cumulative Catalog	w/CI	more detailed

- Also, Enhanced Data Products (EDP):
  - added value by community groups, e.g. RM synthesis maps, transient catalogs and alerts. Announcement of call soon...



# ALL-SKY images (tentative plan)

- 33885 deg<sup>2</sup> at 0.6" pixel size → 1.2Tpix (4.8TB) per plane
- QL images
  - 2 continuum images ( $I + \sigma$ ) = 2.4Tpix (9.6TB)
- SE images (3 epochs)
  - 3 x 4 continuum images ( $I\alpha + \sigma$ ) = 14.4Tpix (57.6TB)
  - 3 x 5 (IQU+ $\sigma$ ) coarse cubes (14 planes, 128MHz) = 252Tpix (1008TB)
    - very large! considering compress/cutout/drop options
  - 3 x 5 full cubes (180 planes, 10MHz) = 3.24Ppix (13PB) = NO WAY!
- CF images (best combined images after each new epoch)
  - 6 continuum images ( $I\alpha\beta + \sigma$ ) = 7.2Tpix (28.8TB)
  - 5 coarse cubes (14 planes) = 84Tpix (336TB) – compress 10:1 to 33.6TB
  - 5 fine cubes (180 planes) = 1.1Ppix (4.32PB) – compress 40:1 to 108TB
- Full spectral resolution (> 100 PB) – Process on Demand (PoD), no storage
  - pursuing development of this as new workflow model

Fast Transient Search  
Correlator dump  
time 0.45s (or 0.25s)  
100Mpix x 1024ch x  
4 pol / 0.45s ~  
1Tpix/s  
(LSST ~ 1.6Gpix/s)

VLA NGAS storage  
plan 5.7PB in 2020



# Status & Plans

- Establishment of the VLASS Survey Team underway
- Preparing for Preliminary Design Review (PDR)
  - current schedule for PDR in May 2016
- Carrying out Test & Development Program
  - test observations ongoing & available (TSKY0001)
    - B/A 16deg<sup>2</sup> M31, Taurus, Orion; A/D 144deg<sup>2</sup> Stripe-82
  - benchmarking for processing needs
- Planning for VLASS Pilot Project
  - goal for 150+ hours in 16A B-configuration
  - scientifically viable observations, 3000+ deg<sup>2</sup>
  - community SSG will define the pilot survey



# Opportunities

- Participate in the VLASS Pilot Project!
  - students, post-docs can embed in small team
- Calling for Community interest in Enhanced Data Products & Services (EDPS)
  - transient alerts, polarization, catalogs & IDs, archives, ...
  - community-led MSIP, international partners
- Do your science with VLASS data and data products!
  - data public when observed, can propose to NSF
  - participate in advising and conducting the survey
    - mechanism TBD, if interested contact: [vlass@nrao.edu](mailto:vlass@nrao.edu)
- Developing VLASS EPO plan
  - partnerships welcome!





# VLASS Milestones

Notional schedule (as of Nov 2015)

Date	Activity
2015 March 4–6	External Community Review (Socorro)
2015 March – 2016 Jan	Set up Project Office & Team, draft workplan, allocate resources
2015 March – 2016 Oct	Test & Development Program carried out
2016 May (TBD)	VLASS Preliminary Design Review (PDR), pilot go/no-go
2016 May 27	Start of 2016A B-config (VLASS pilot observations)
2016 Sep 5	End of 2016A B-config (includes 1 week extension for pilot)
2016 Oct (TBD)	VLASS Critical Design Review (CDR), final go/no-go
2016 Oct – 2017 Sep	Demonstration of Basic and Enhanced Data Products from pilot
2017 Sep	VLASS epoch 1 observing begins (B-config)
2018 March	Delivery of Epoch 1 BDP (6 months: Stokes I only)
2018 Sep	Delivery of Epoch 1 BDP (12 months: Pol.)
2020 Jan	VLASS epoch 2 observing begins (B-config)



The National Radio Astronomy Observatory is a facility of the National Science Foundation operated under cooperative agreement by Associated Universities, Inc.

[www.nrao.edu](http://www.nrao.edu) • [science.nrao.edu](http://science.nrao.edu)

