ngVLA Kickoff Meeting
March 31, 2020

Purpose:

- **Provide overview of ngVLA specs, status and science prospects**
- **Discuss organization and process of Science Working Groups**
- **Free discussion**

Agenda:

1. **"Introduction to ngVLA"**
   Daisuke Iono (NAOJ)
2. **"Science prospects of ngVLA"**
   Munetake Momose (Ibaraki University)
3. **QA session**
4. **Discussion**
   Plans and timeline for the ngVLA science working group, etc

ngVLA Introduction

Daisuke Iono (NAOJ)

A next-generation Very Large Array (ngVLA)

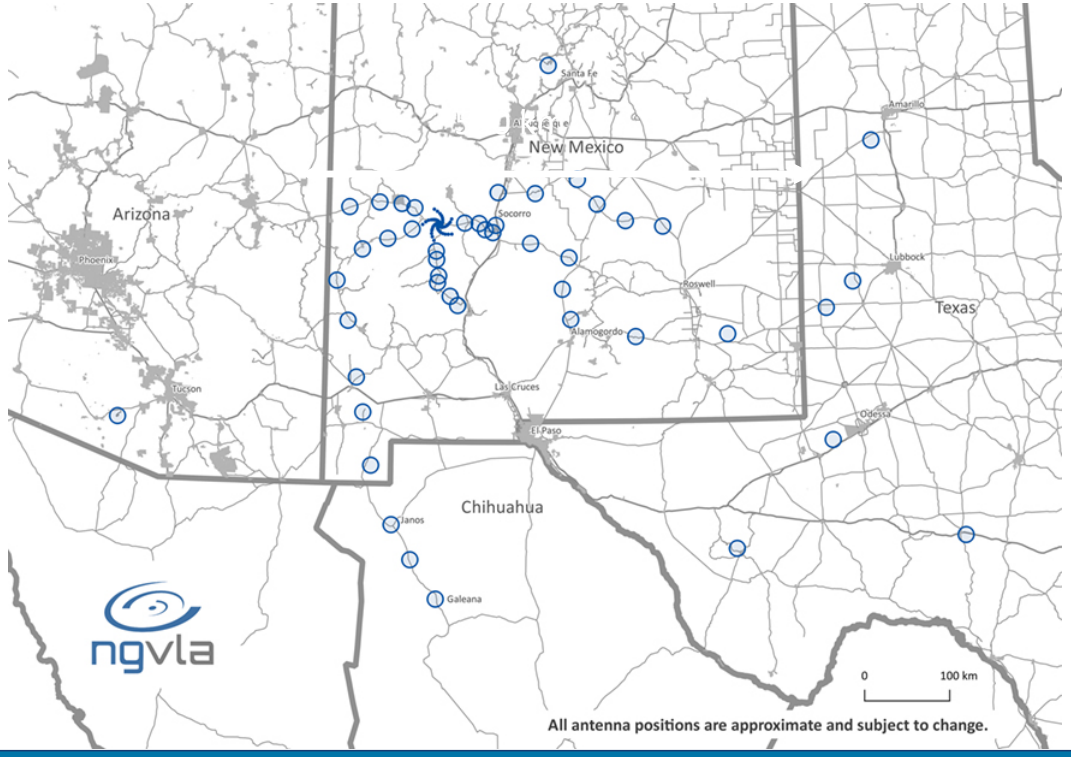
- Project led by NRAO. Significant upgrade of JVLA.
- Scientific Frontier: ***Thermal imaging at milli-arcsec resolution***
- Sensitivity/Resolution Goal: ***10x sensitivity & resolution of JVLA/ALMA***
- Frequency range: ***1.2 –116 GHz, bridging SKA and ALMA***
- Located in Southwest U.S. (NM, TX, AZ) & MX, centered on JVLA
- Guaranteed time for NRAO (+ open-sky) and partners
- Timeline:
  - 2024 – Construction Begins
  - 2028 – Early Science
  - 2034 – Full Science Operations

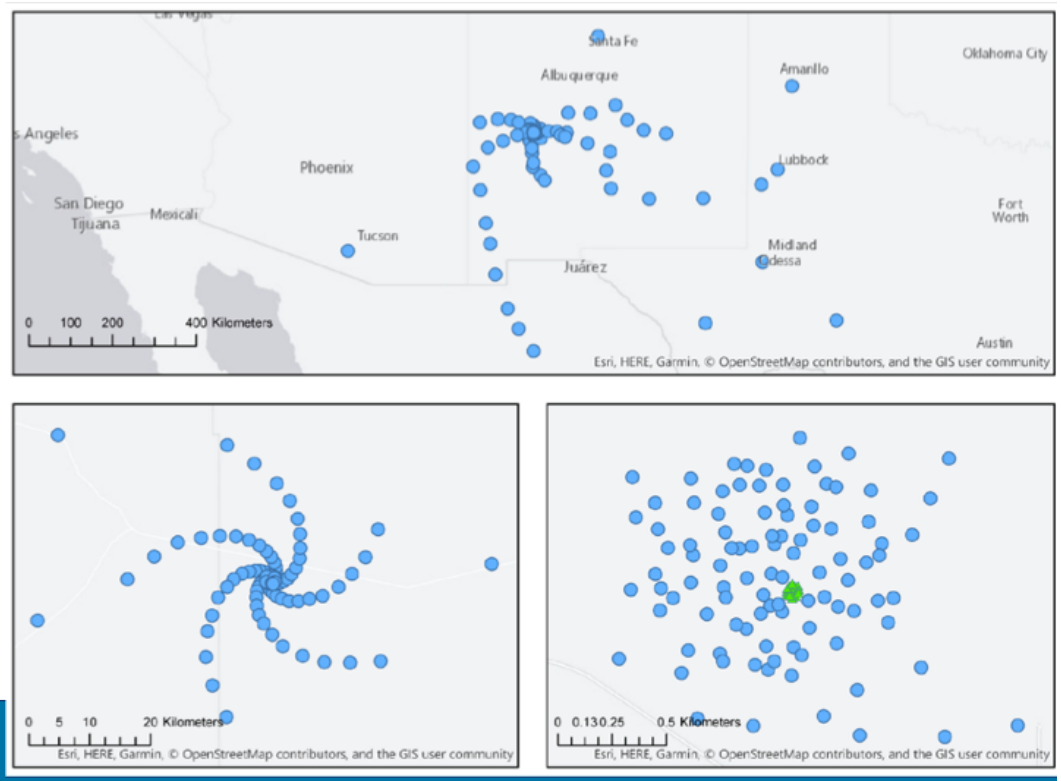
Components

- Main Array
  - 214 x 18m offset Gregorian Antennas
  - Up to 1000 km baselines
  - Fixed antenna locations near VLA site
- Short Baseline Array
  - 19 x 6m antennas
  - Use 4 x 18m in TP mode to fill in (u, v) hole.
- Long Baseline Array
  - 30 x 18m antennas located across continent for baselines up to ~9000km.

Main Array Concept

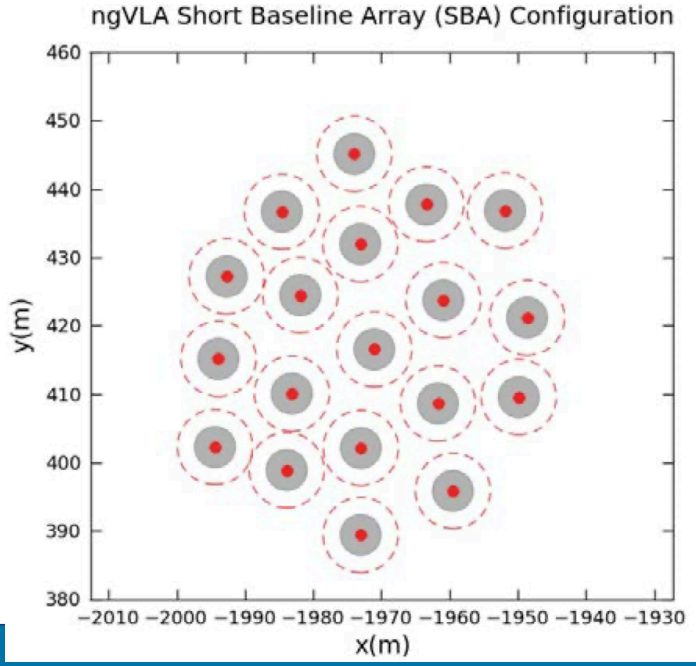
Radius	Collecting Area Fraction
0 km < R < 1.3 km	44%
1.3 km < R < 36 km	35%
36 km < R < 1000 km	21%

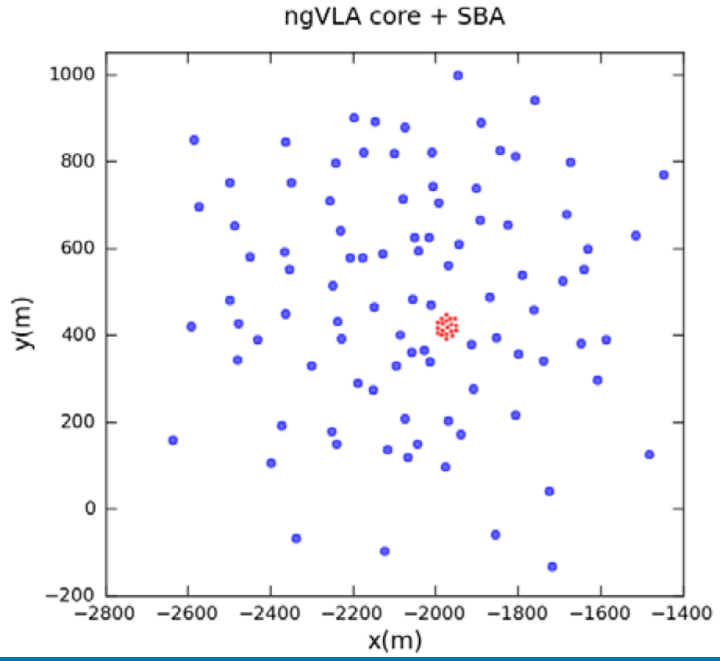




Short Baseline Array Concept

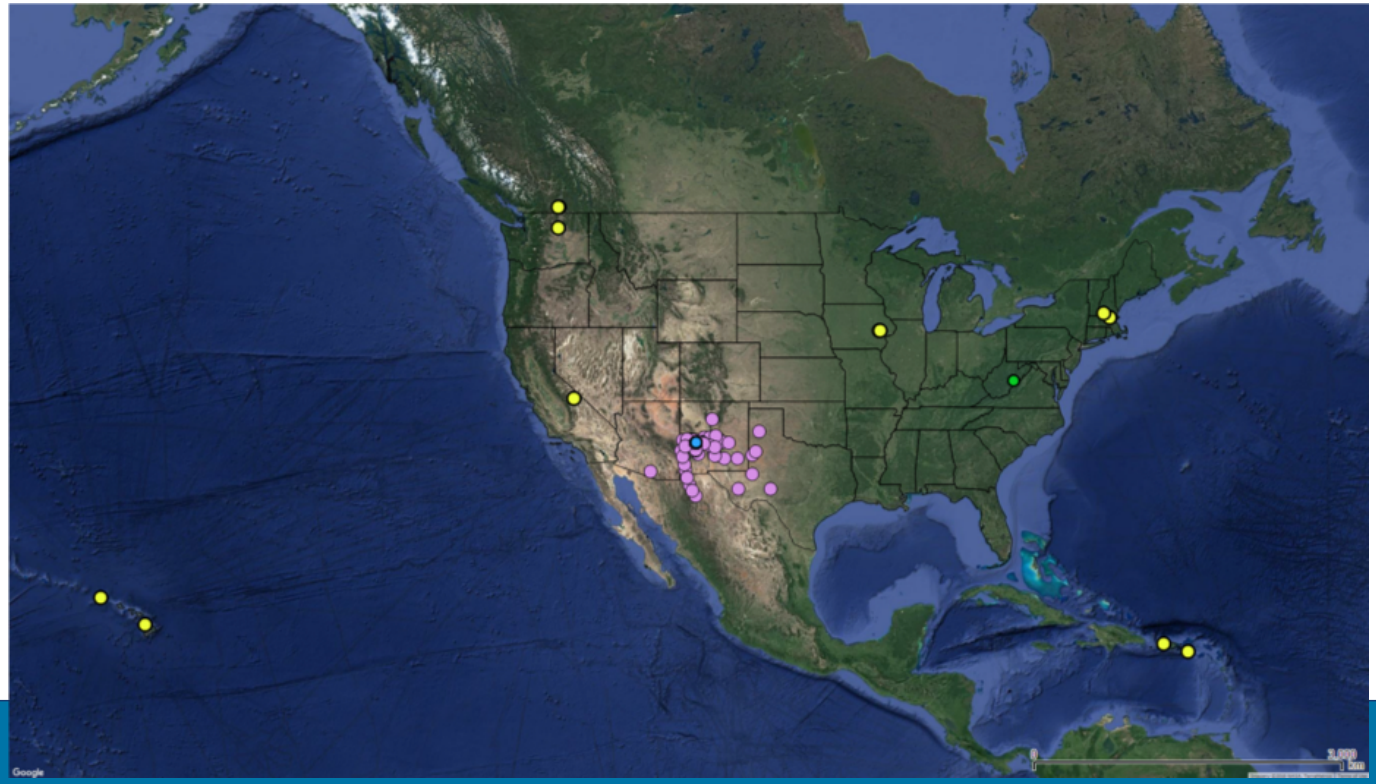
- Array of 19 x 6m antennas, and total power array of 4m x 18m
- All antennas located within < 100m



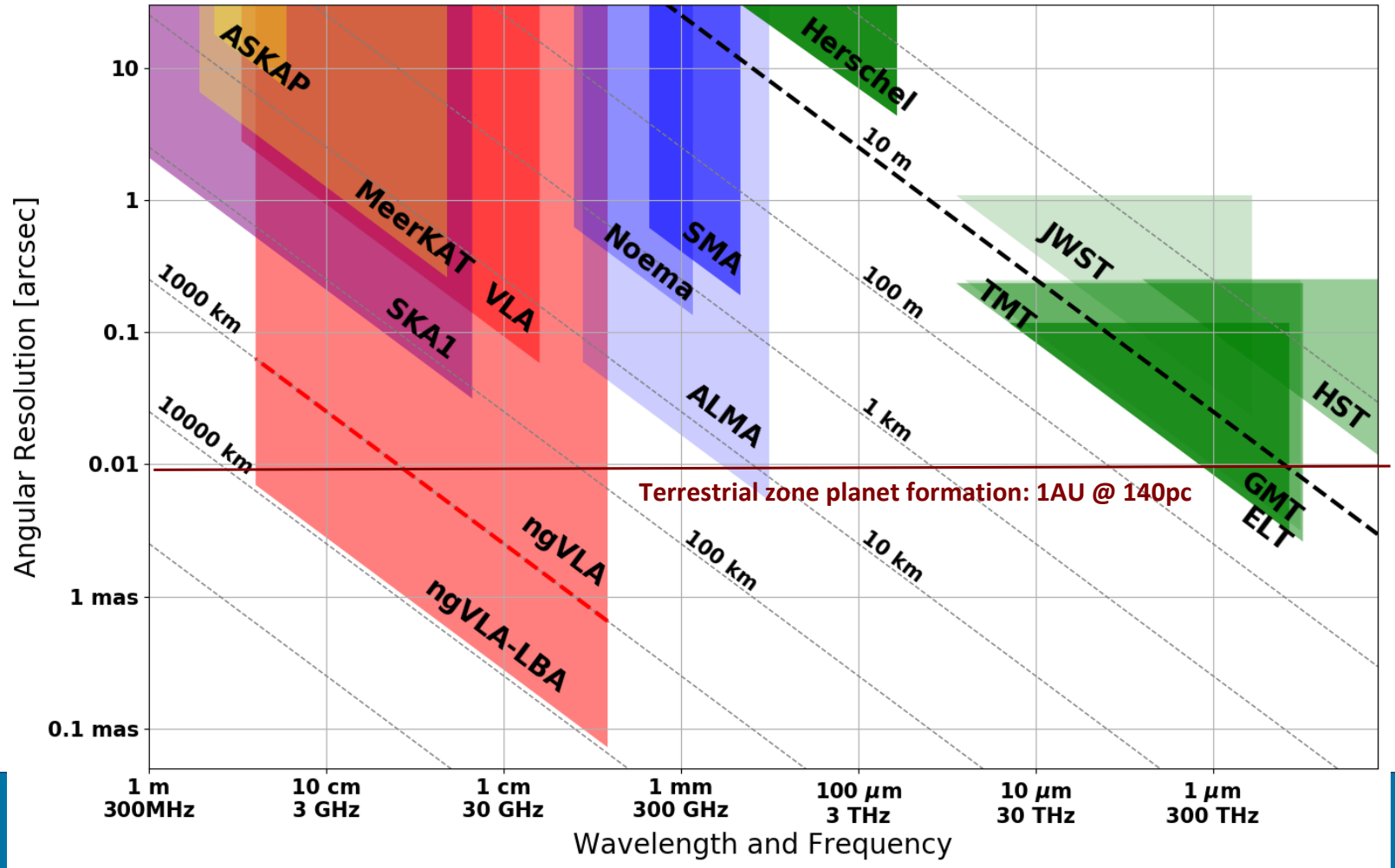


Long Baseline Array Concept

- Array of 30 x 18m antennas at 10 sites used as VLBI mode



Angular Resolution



ngVLA Bands

- **Max Freq Resolution:** 400 Hz (0.1 km/s at 1.2GHz)
- **Max instantaneous BW:** 20 GHz per pol

Band #	f_L GHz	f_M GHz	f_H GHz	f_H: f_L	BW GHz
1	1.2	2.35	3.5	2.91	2.3
2	3.5	7.90	12.3	3.51	8.8
3	12.3	16.4	20.5	1.67	8.2
4	20.5	27.3	34.0	1.66	13.5
5	30.5	40.5	50.5	1.66	20.0
6	70.0	93.0	116	1.66	46.0

1 hour integration

0.01“ beam

	B1 (2.4 GHz)	B4 (27 GHz)	B6 (93 GHz)
Continuum [uJy/B]	0.41	0.27	0.97
Continuum [K]	870	45	1.4
Line 10km/s [uJy/B]	70	33	78
Line 10km/s [K]	1.5e5	555	109

1“ beam

	B1 (2.4 GHz)	B4 (27 GHz)	B6 (93 GHz)
Continuum [uJy/B]	0.52	0.39	2.2
Continuum [K]	0.1	0.7e-3	0.3e-3
Line 10km/s [uJy/B]	89	48	180
Line 10km/s [K]	19	0.08	0.03

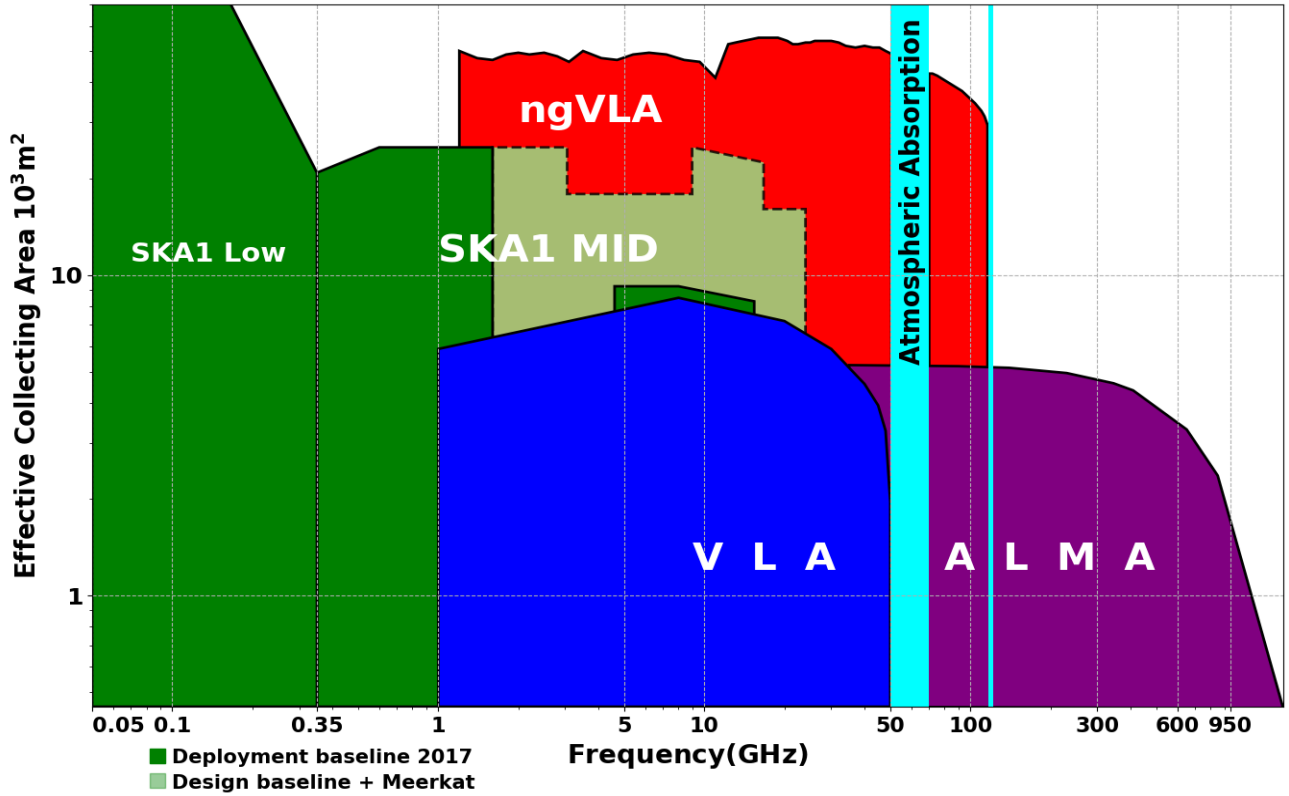
Operations Concept (key points)

- Peer review: scientific merit and technical feasibility
- Pipeline will automatically generate Science Ready Data Products for most standard projects (~80%)
- Continuous Operations (no reconfiguration): Subarrays used for maintenance and commissioning activities
- PIs awarded time (not sensitivity): Different from ALMA
- Dynamically scheduled

Bridging SKA & ALMA Scientifically

Complementary suite from cm to submm arrays for the mid-21st century

- **< 0.3cm:** ALMA 2030 superb for chemistry, dust, fine structure lines
- **0.3 to 3cm:** ngVLA superb for terrestrial planet formation, dense gas history, baryon cycling
- **> 3cm:** SKA superb for pulsars, reionization, HI + continuum surveys



Concept Development in the US

- 2015-2020: Science Meetings led by NRAO
- Sep 2016: Science Advisory Council (SAC) formed
- Nov 2016: Launched ngVLA Community Studies Program
  - 38 studies over 2 rounds, financially supported by NRAO
  - Community-led Science Use Cases: 80 Submitted
- Feb 2017: Technical Advisory Council (TAC) formed
- Key Science Goal (KSG) development by Science Working Groups (SWGs)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ngVLA Key Science Goals
(ngVLA memo #19)
1. Unveiling the Formation of Solar System Analogues on Terrestrial Scales
2. Probing the Initial Conditions for Planetary Systems and Life with Astrochemistry
3. Charting the Assembly, Structure, and Evolution of Galaxies Over Cosmic Time
4. Using Pulsars in the Galactic Center as Fundamental Tests of Gravity
5. Understanding the Formation and Evolution of Stellar and Supermassive BH's in the Era of Multi-Messenger Astronomy
Details in next talk by M. Momose
ngvla.nrao.edu

ngVLA
Science Advisory Council

- Interface between the Community & NRAO -- Est. Sept 2016
- Recent/Current Activities:
  - Lead SWGs: science use cases → telescope requirements
  - SOC for science meeting in June 2017/2018/2019
  - Lead Science case development → 'Science Book' & Astro2020 White Papers
  - Document Review: e.g., Sci Reqs, Ops Con, Ref Observing Program, etc.
  - Help with preparation of Astro2020 APC white papers

Executive Committee

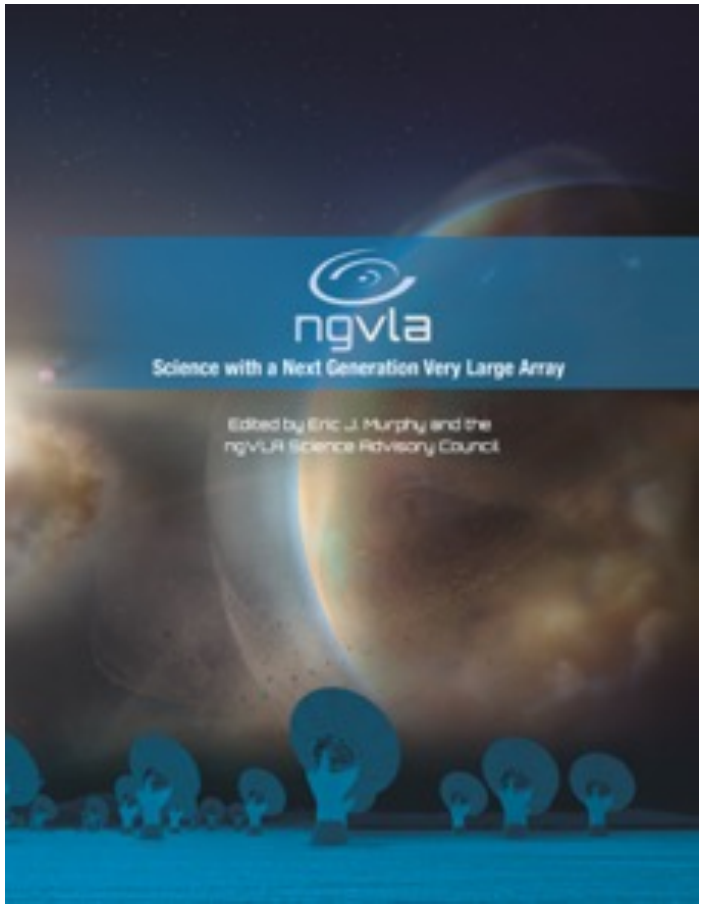
Alberto Bolatto (Maryland: **co-Chair**)
Andrea Isella (Rice: **co-Chair**)
Brenda Matthews (NRC–Vic: **SWG1 Chair**)
Danny Dale (Wyoming: **SWG2 Chair**)

Dominik Riechers (Cornell: **SWG3 Chair**)
Joseph Lazio (JPL: **SWG4 Chair**)
Shri Kulkarni (Caltech)
James Di Francesco (NRC–Vic)

International Participation

Science Book

- Science Book published by ASP!
  - 88 peer-reviewed contributions received
  - 286 unique authors (comp: LSST Science Book had 245)
- Volume is culmination of:
  - Numerous science/technical meetings, beginning with Jan 2015 AAS
  - Community-led Science Use Cases:
    - 80+ submitted for 'Reqs to Specs' process (ngVLA memo # 18)
  - Community Studies Program:
    - 38 studies over two rounds, financially supported by NRAO.



International Collaboration and Status in Japan

- NRAO seeking ~25% contribution from international partners
- NAOJ ngVLA study group (from April 2019)
  - Group lead: Daisuke Iono (NAOJ)
  - Project scientist: Munetake Momose (Ibaraki University)
- Contribution to international ngVLA advisory council
  - ngVLA Science Advisory Council member:
    Nami Sakai (Riken), Kotaro Kohno (U Tokyo), Daisuke Iono (NAOJ)
  - ngVLA Technical Advisory Council member:
    Alvaro Gonzalez (NAOJ), Tetsuo Hasegawa (NAOJ)

Status in Japan

- Submitted application to Master Plan 2020, and listed as ”学術大型研究計画”
- Preparation for Master Plan 2023 (and subsequent roadmap)
  - LoI in Summer 2021(need solid support by the community)
  - Submit application in early 2022
  - Notification of results in early 2023
- Science working group (SWG)
  - Output -> ngVLA-J memo series and project book

Details in the discussion session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Next Generation Very Large Array