GROWTH and the University of Wisconsin Milwaukee

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Leonard E. Parker
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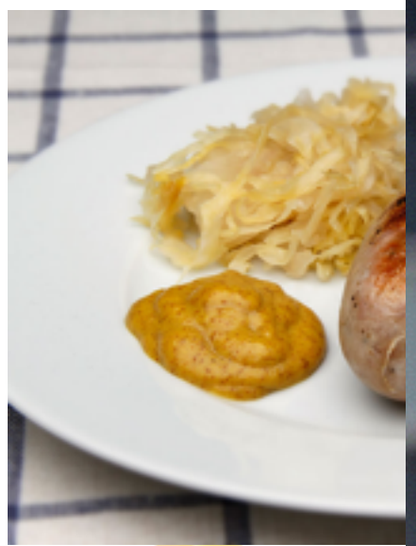
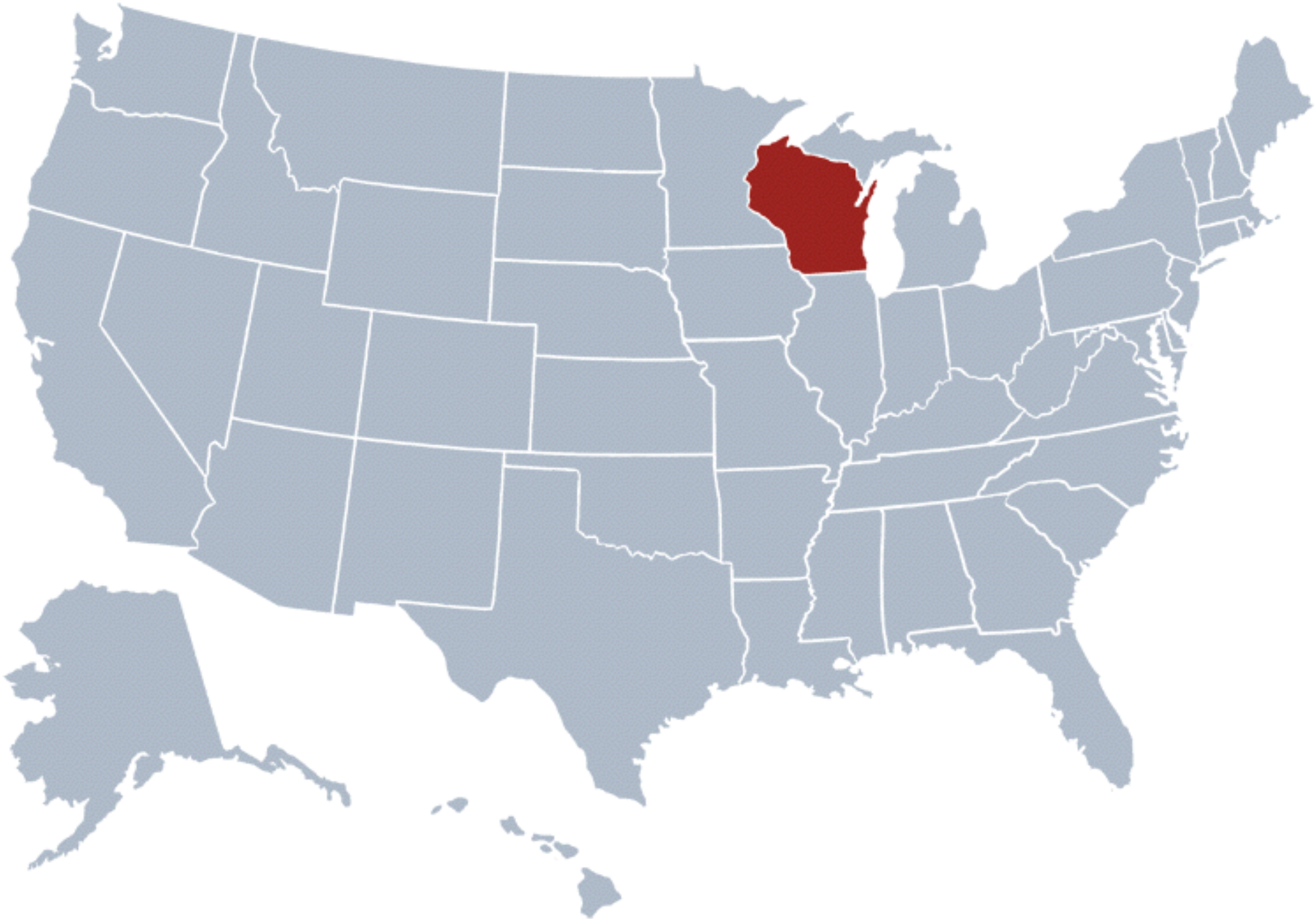
The Milwaukee Perspective



Where is Wisconsin?



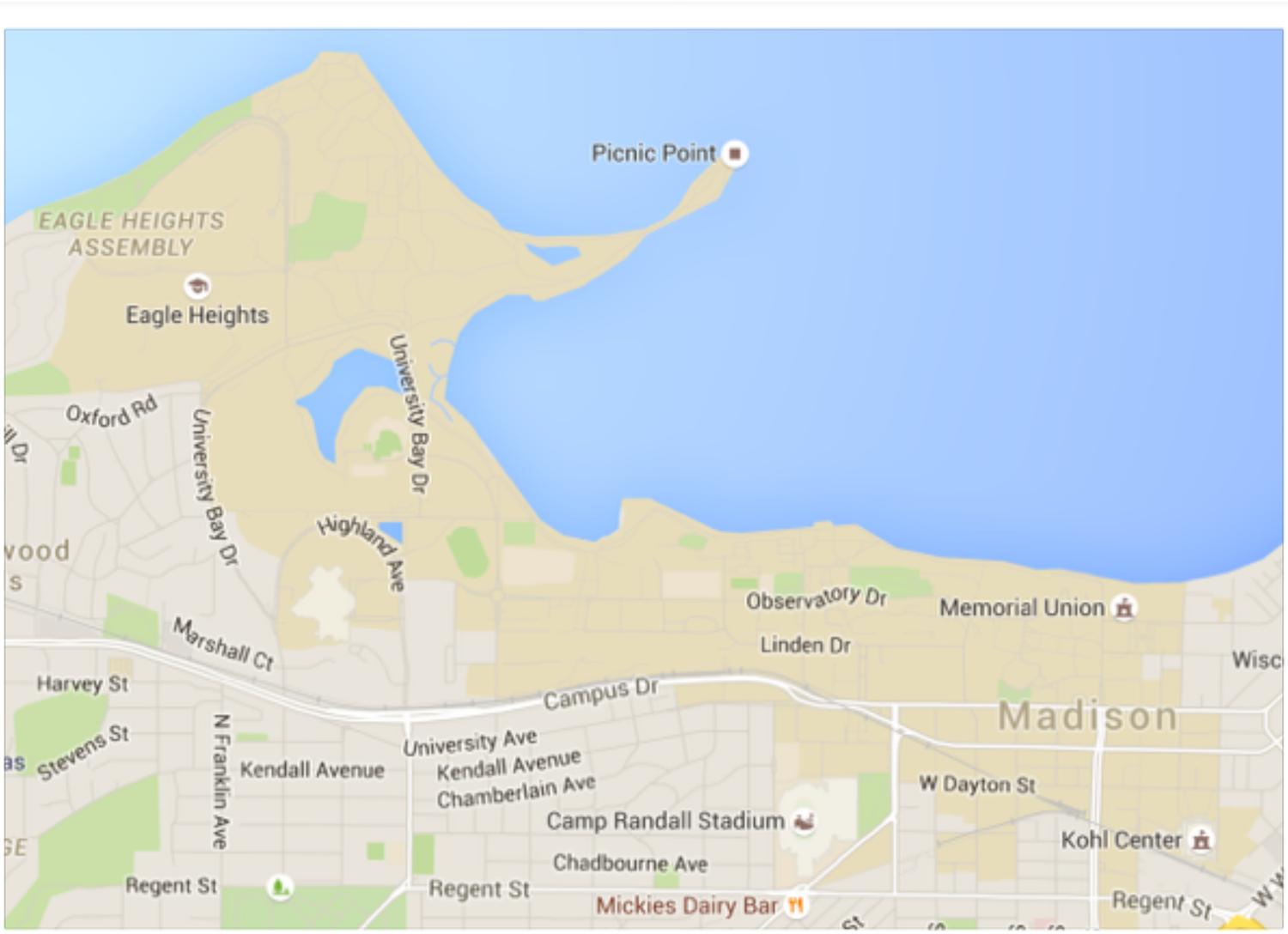
Where is Milwaukee?

So you are at the University of Wisconsin, right?

- Endowment: $2.2B
- Budget: $580M
- Undergraduates: 1001
- Graduate students: 1254
- Faculty: 300

- Endowment: $200M
- Budget: $545M
- Undergraduates: 23,031
- Graduate students: 4782
- Faculty: 1623

(all to scale)



- Endowment: $2.5B
- Budget: $2.9B
- Undergraduates: 29302
- Graduate students: 11904
- Faculty: 2200

Leonard E. Parker Center for Gravitation, Cosmology & Astrophysics

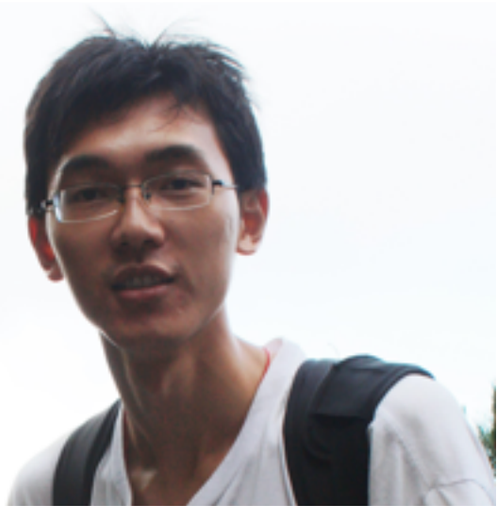
- Center within UWM Physics Dept
- 7 faculty, ~40 people total

UWM GROWTH Activities

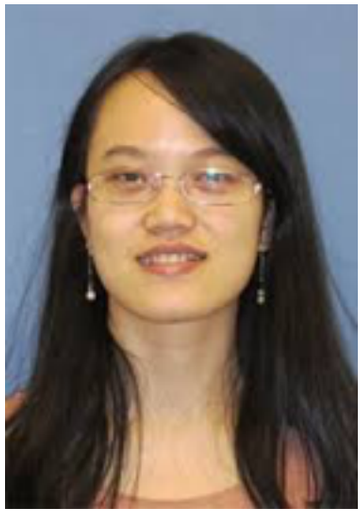
- EM: Radio time domain
- GW: LIGO
- EMGW: CLU
- Education (talks on Wed)

Grad Students

Chaoran Zhang



Hong Qi



Patrick Brady

David Kaplan

Postdocs

Angie van Sistine

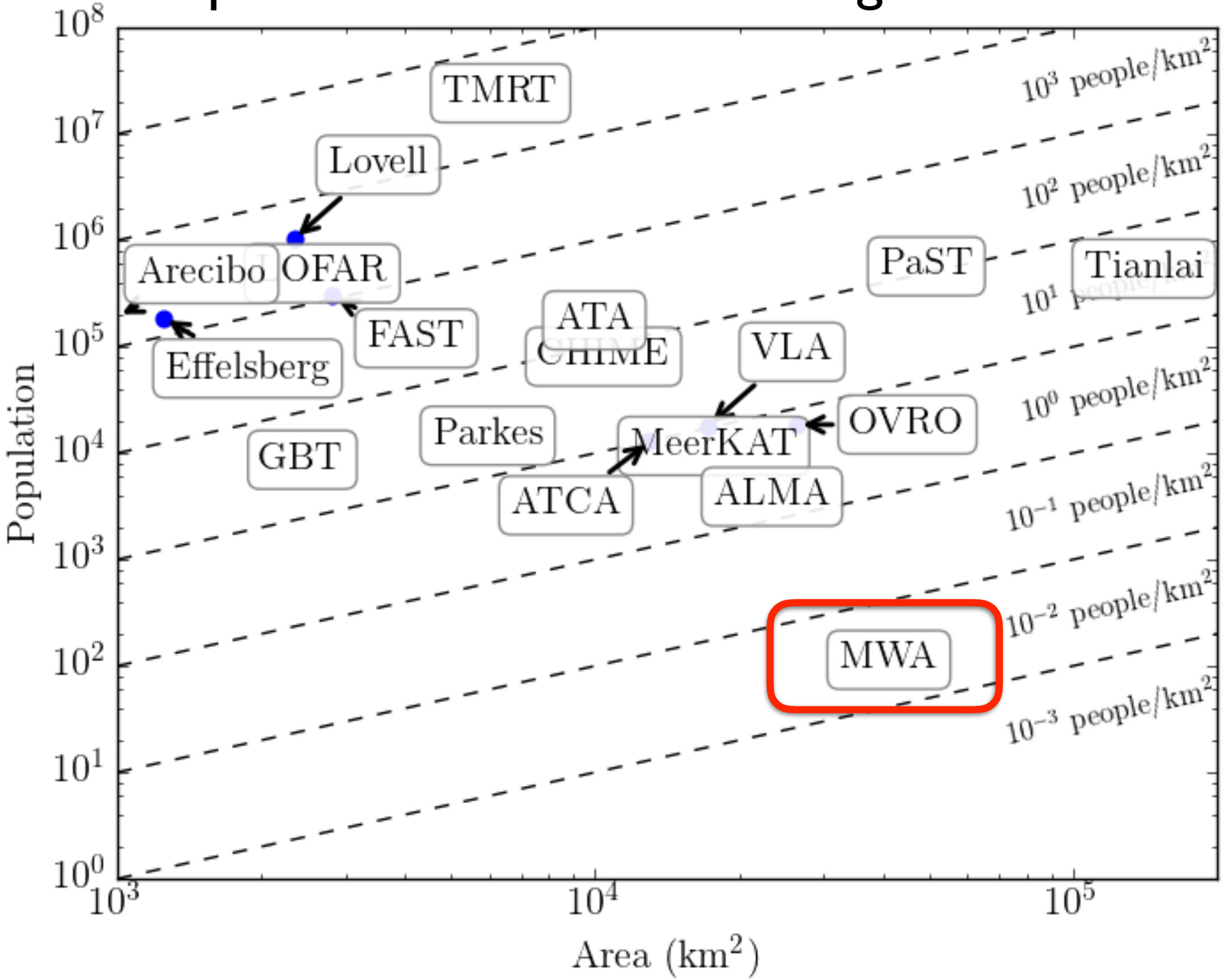
Joe Swiggum

Murchison Widefield Array

Tiles	128
Dipoles	2048
Frequency	80-300 MHz
Bandwidth	30 MHz
Resolution	>1 arcmin
Max baseline	3 km
FOV	>1000 deg^2
Sensitivity	~10 mJy

Instrument Capabilities: Tingay et al. 2013, PASA, 30, 7
Science Prospects: Bowman et al. 2013, PASA, 30, 31

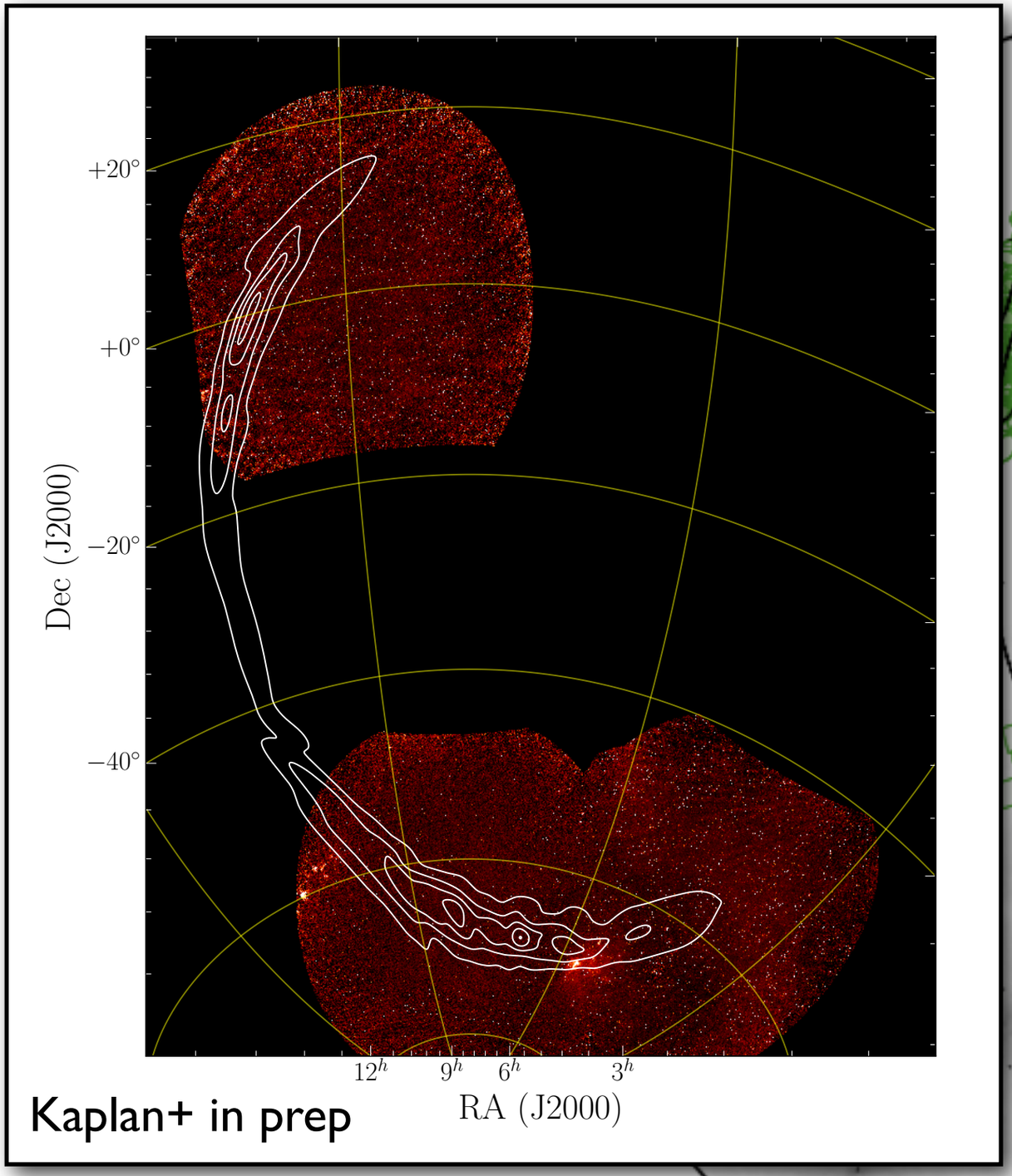
Based on published "sub-national" region



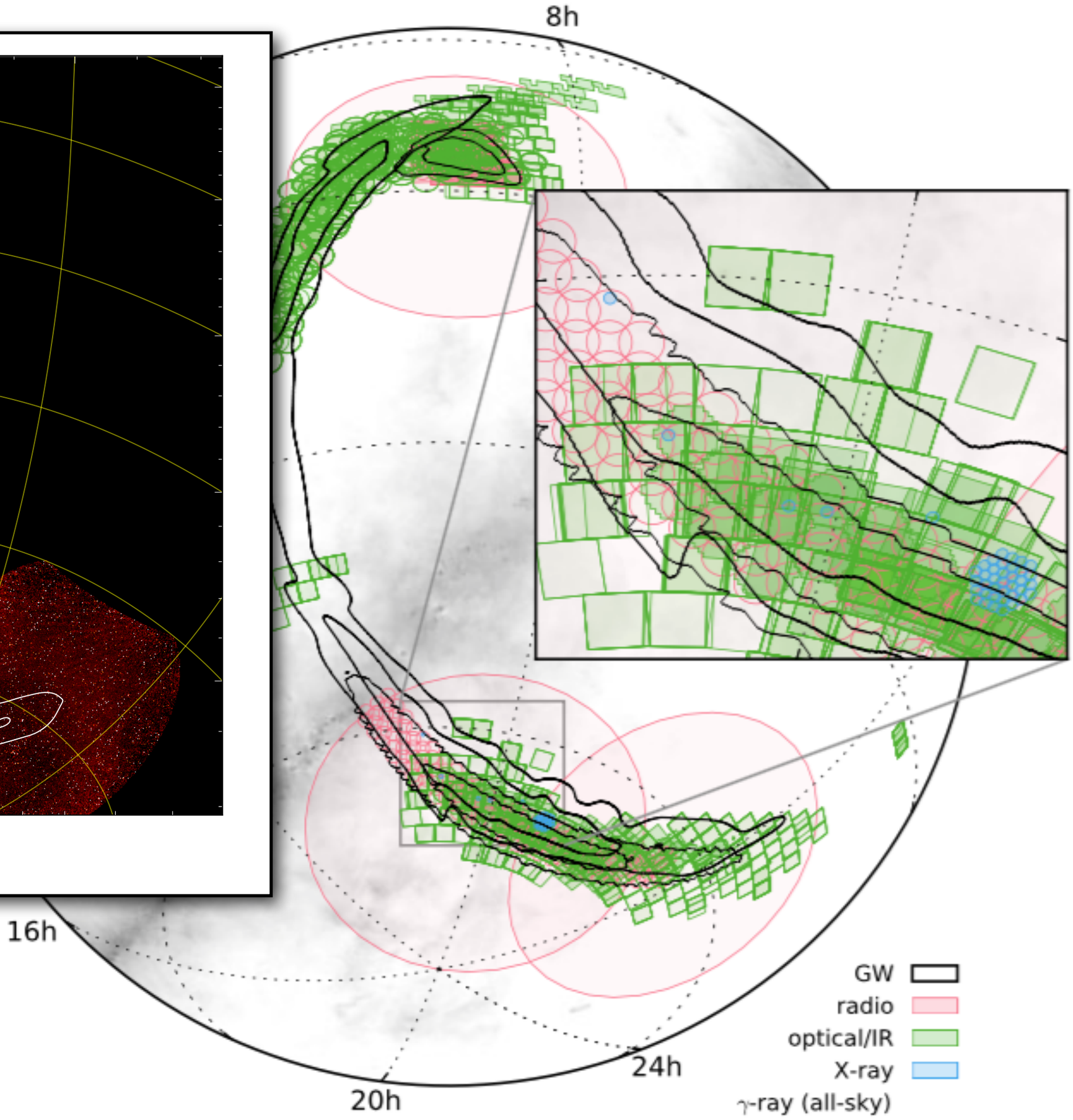
MWA Time-Domain

- Blind searches
- GW/neutrino followup
- Other triggered followup (respond in <16s)
- Flare stars & exoplanets
- Pulsars
- AGN variability
- Scintillation (ionosphere, interplanetary, interstellar)
- X-ray binaries

André Offringa, Natasha Hurley-Walker, & MWA Commissioning Team



Kaplan+ in prep



Abbot+ '16

MWA Upgrade

- Pulsars + EoR
- Merge into SKA

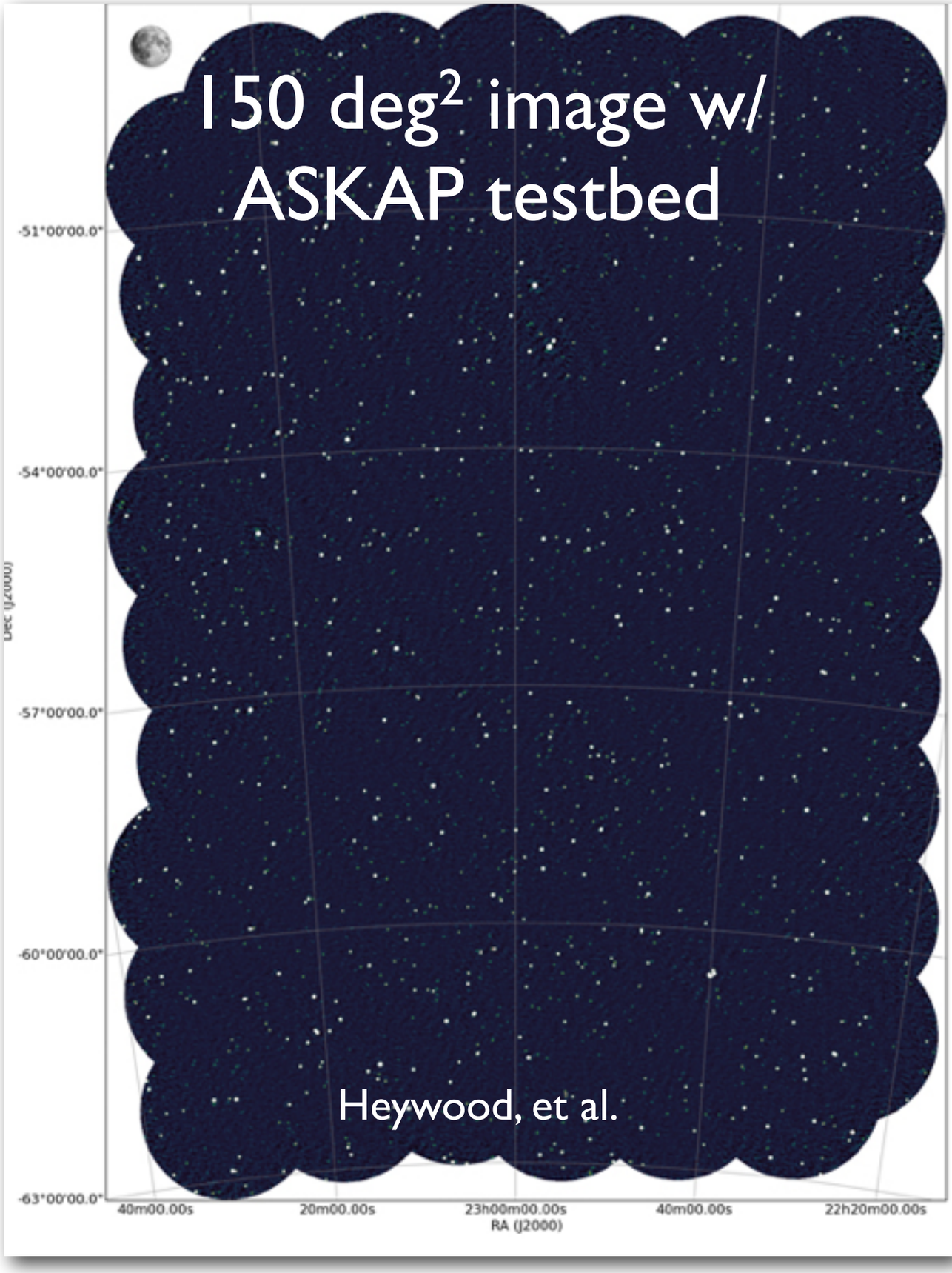
Photo: Gregory Rowbotham (ICRAR)

ASKAP

- ASKAP = Australian Square Kilometer Array Pathfinder
- SKA Survey telescope prototype:
  - 36 * 12m antenna
  - 700 MHz - 1.8 GHz
  - Each has phased-array feed (PAF):
    - ~36 beams/antenna
    - 30 deg^2 FOV

ASKAP/VAST

- VAST=Variables & Slow Transients Key Project
  - Mix of sky coverage, cadence, & depth
  - Murphy et al. 2013, PASA, 30, 6
- Early science: 2016B
  - 12 antennas, 300 MHz, 36 beams, T_{sys}~60 K (MkII)
  - Mostly commensal for transients
  - + Dedicated followup of LIGO transients (O2+…)
- Full VAST could see ~10 NS-NS merger events with ~arcsec localization (Hotokezaka+ in prep)
  - background rate is << optical, because sky is so boring, but care still needed (e.g., Williams & Berger '16; Vedanthan+ '16)
- Trade sky coverage vs. depth w/ VLASS:
  - Are there enough transients to justify rapid cadence?



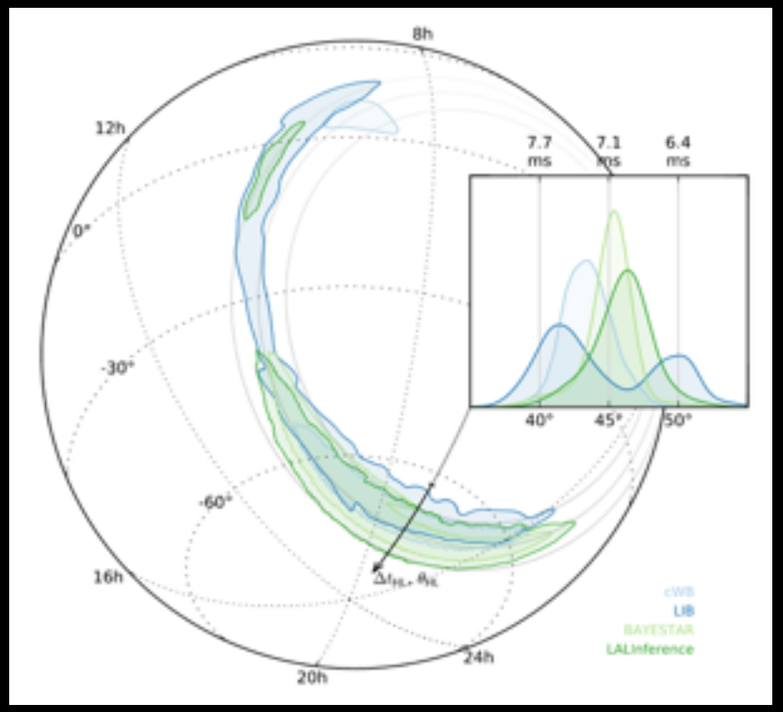
UWM LIGO Group

EMGW: CLU
(Census of the Local Universe)

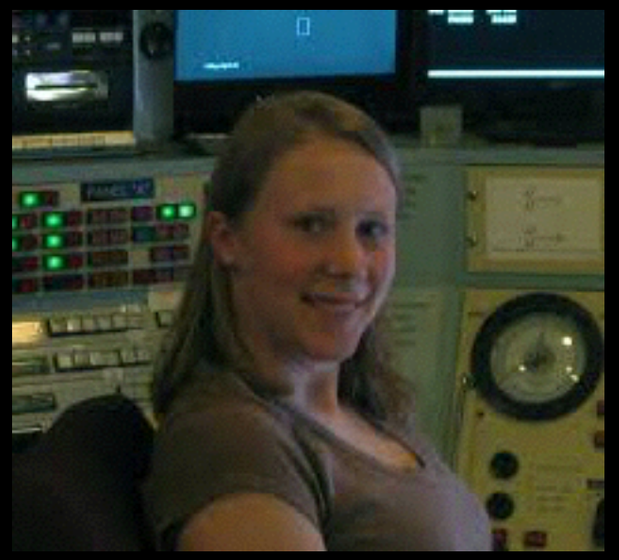
Goal: A complete galaxy catalog out to **200 Mpc** (along with Kasliwal, Cook, …)

Scientific projects include:

- Source catalog for electromagnetic follow-up of gravitational wave events
- Measurement of the local Hubble constant
- Challenges: calibration, classification, completeness, …



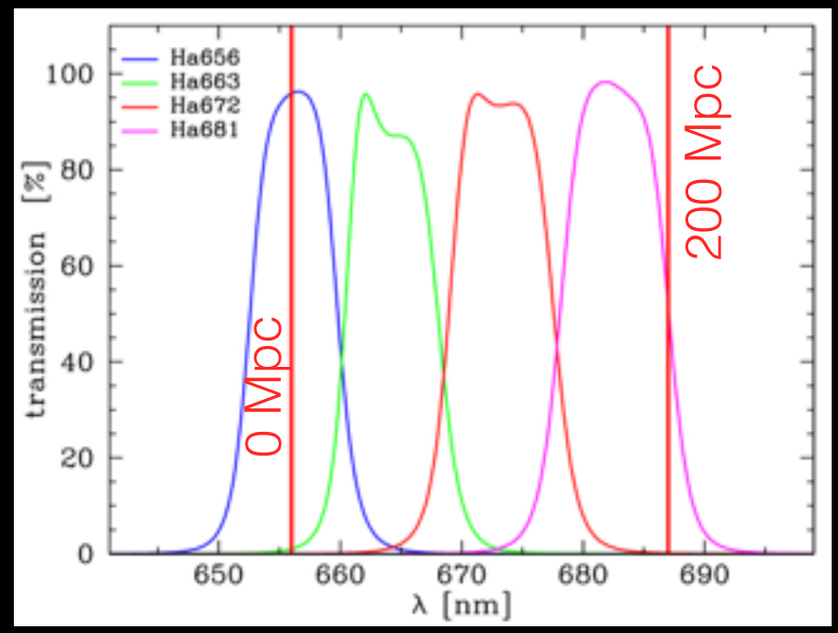
Abbot+2016 (Localization and EM Follow-up)



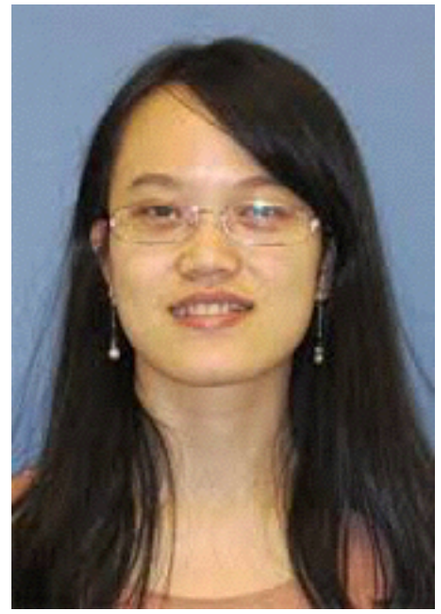
UWM Postdoc Angie van Sistine

iPTF Hα Survey: Scientific Goals

- Catalog galaxies out to 200 Mpc
  - Major contributor to CLU
  - Assisting transient surveys (e.g., ZTF LSST, VLASS, …)
- Compare star formation rate (SFR) indicators
  - Hα vs UV, IR, …
  - Better constraints in low SFR regime
- SFR Density at z=0
- And many more…
    - 15,000 sq. deg
    - 4 narrowband filters
      - Out to z~0.048 (~200 Mpc)
    - Observations complete by end of 2016

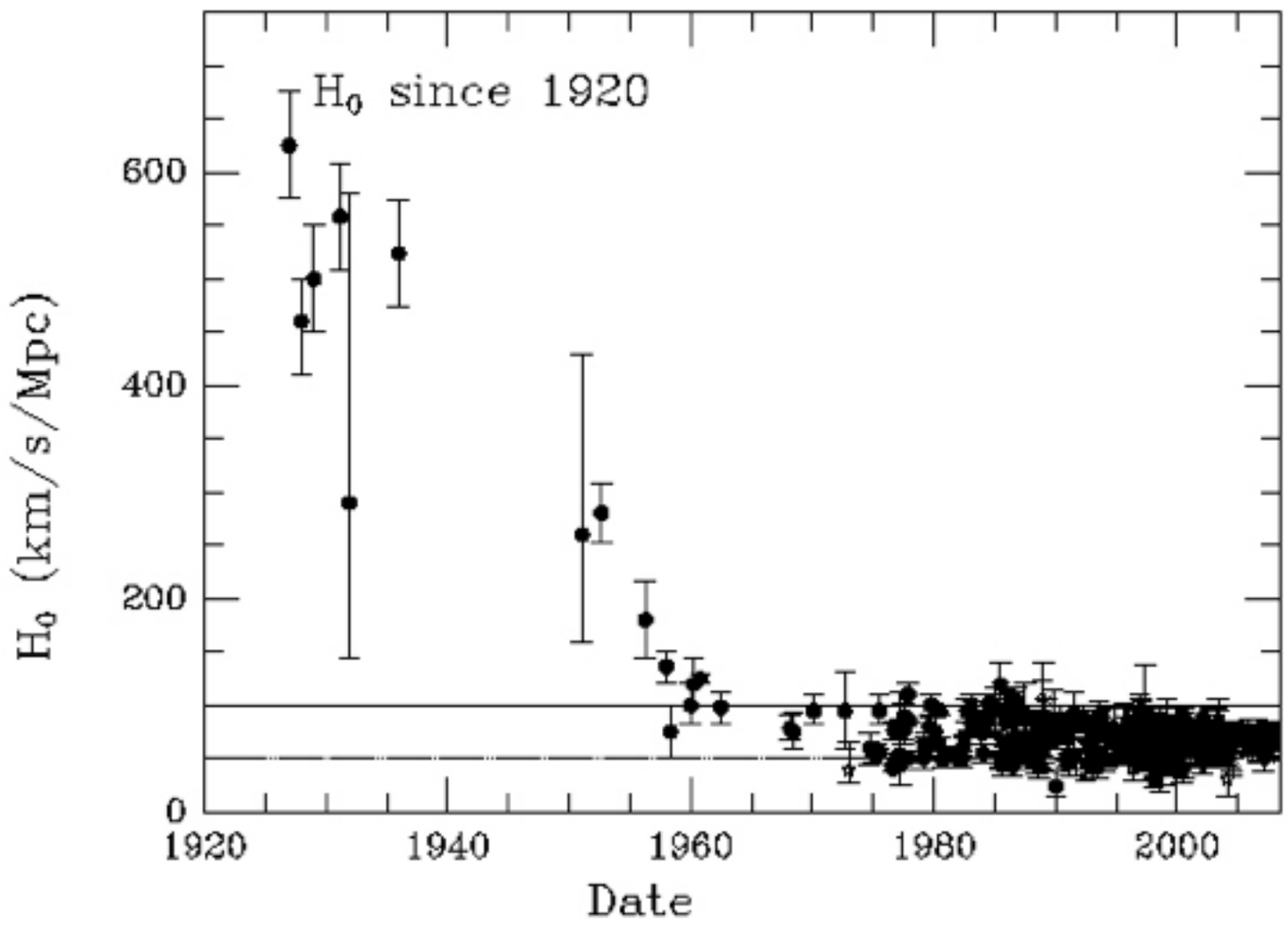


Measuring Hubble constant with GW and Galaxy Catalog



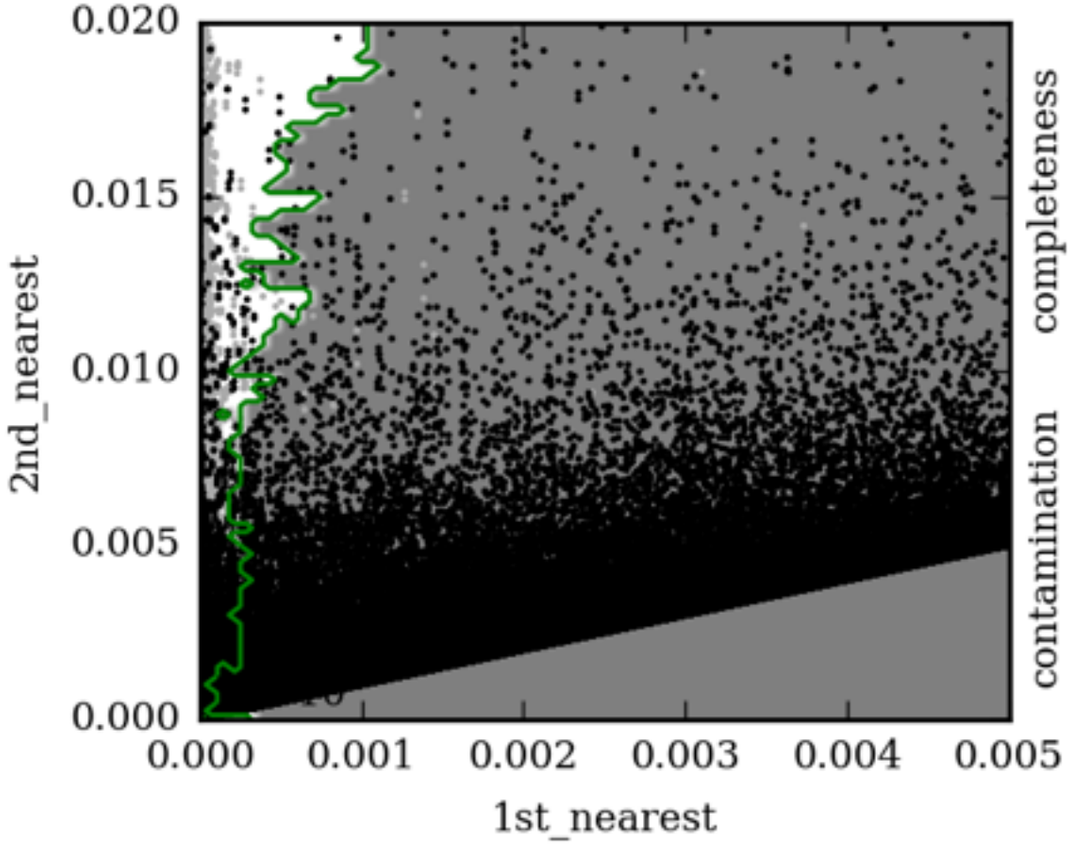
Grad student Hong Qi

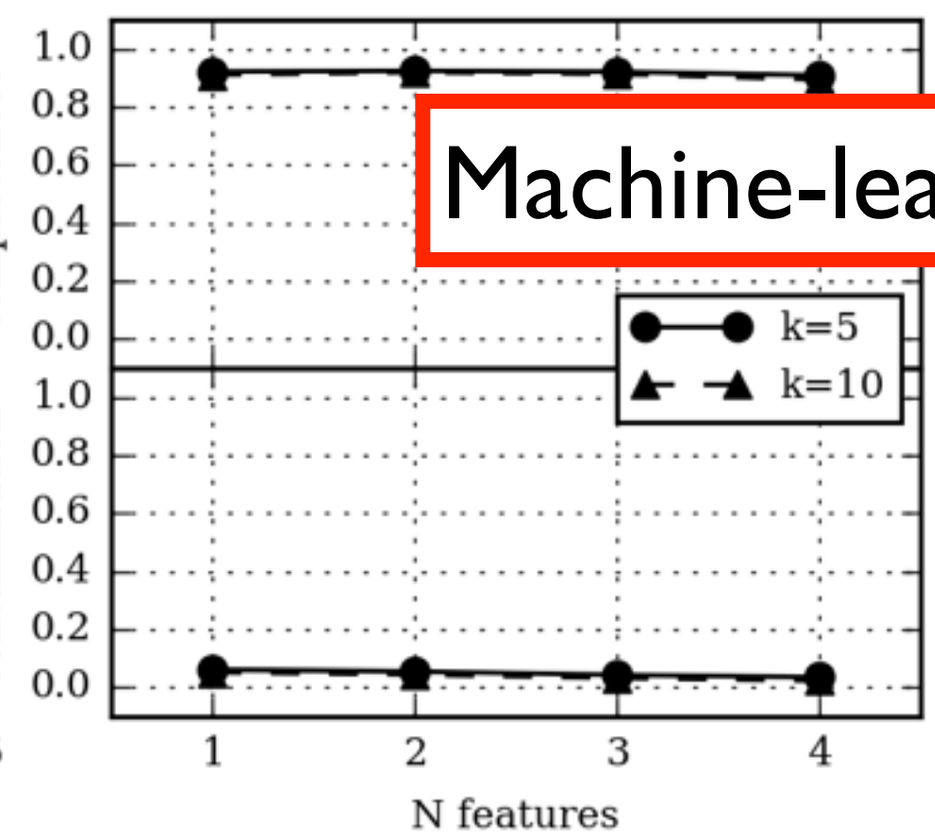
- Statistical measurement of H_0 using properties of galaxies within GW error region
- Need robust, complete, well-characterized catalog of galaxies: CLU



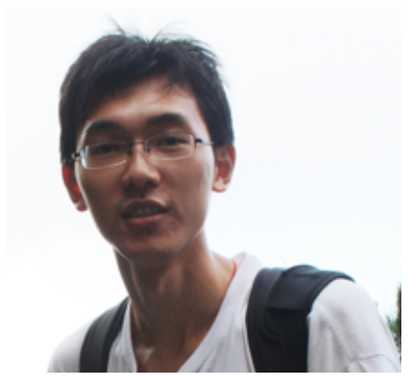
Uniqueness & Completeness of CLU

	Total Entries	Queriable by Name in NED	Unique Galaxies	Pure Unique Entries	Duplicate Entries
CLU 2015	399,833	364,918	239,957	118,447	246,471
CLU 2016	422,046	365,497	240,498	118,953	246,544





Machine-learning tests



Grad students Hong Qi and Chaoran Zhang

Black points are unique entires, gray points are duplicate entries.
Green line is the decision boundary, entries in the shaded area are determined to be unique.

UWM Challenges

- Physics Dept: teach about Astronomy
  - Techniques
  - Lingo
  - Sociology
- Solution: GROWTH/PTF/ZTF summer schools and internships
- Benefits: teach astronomers about physics methodology