Status of the EAO/JCMT

Paul Ho, EAO

Main Staffing Issues

- Staff at level of 24(-12); very slim since EAO take over
- Staff is evolving: retirement, reduced hours, departures
- Support for Science Projects have been carried by EAO Fellows
- Posting Staff from regions will become essential

- EAO has established own HR and now processing visas
- EAO posting: 2 instrumentalists (China, Taiwan)
- EAO directly hire: 1 Japanese instrumentalist
- EAO fellowships: 2 (+1) EAO fellows
- EAO hosts visitors: 1 PMO scientist (left)
  1 IRAM instrumentalist (left)
- Steady State: at least 2 new staff per year, none hired since 2019

Cost Saving Measures

- **Replacing senior staff with junior staff**
- **Reducing some staff to part time**
- **Replacing liquid helium system with close-cycle system (Namakanui)**
- **Reduce overhead costs by moving from RCUH and establishing EAO HR system**
- **Moved to Fully Remote Operations**
- **Replace Support Astronomers with EAO Fellows**
- **Reduce Vehicles and eliminated Mid-Level over-night stays**
- **Discontinued EAO Guest House**
- **Host Visiting Scientists and Engineers**

- **Host Visiting Instruments (Namakanui)**
- **Host Visiting Students and Postdocs**

JCMT Operational Model

- 50% Large Programs; 50% PI Proposal
- Large Programs: Open to all partners participation
- Regional PI Proposals: Not Open to all partners
- Regional PI Proposal Time: Allocated according to cash and in-kind contributions to Operating Budget
- Directly Funded PI Proposals: Directly Allocated
- Rapid Turn-Around Proposals: in addition to DDT
- TAC: one unified TAC process
- Observers: Not Needed; Observations executed by JCMT
- Queue Mode: Flexible Schedule according to Weather
- Students: Young Scientists invited to take up residency at JCMT for hands-on training
- PI Instruments: JCMT provides engineering support
- Remote Operations: Completely Remote from Hilo

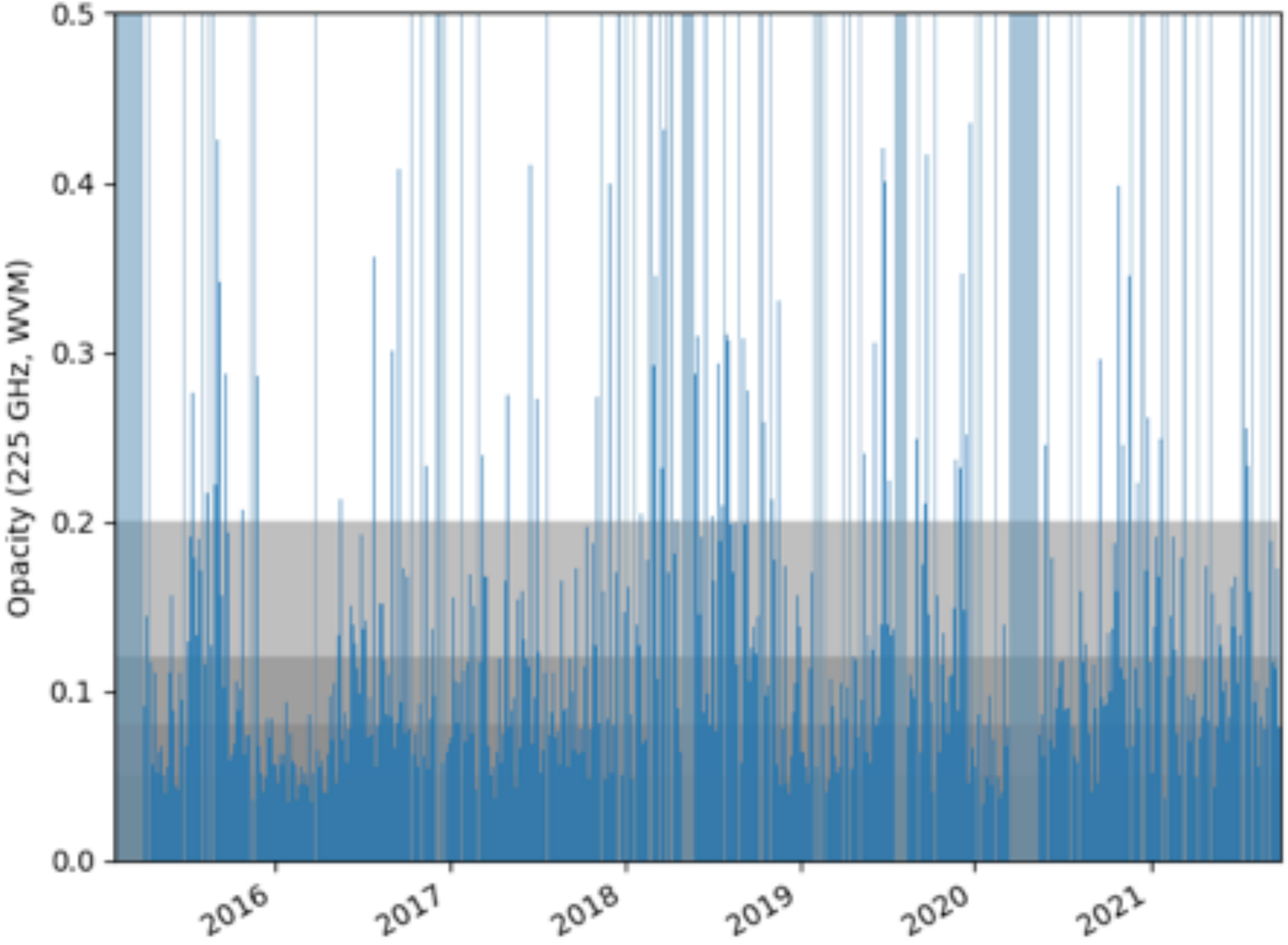
Current EAO Status

- Operations remain Effective — for the moment
- NAOJ and NAOC/CAMS budgets are greatly reduced
- NARIT is a new partner of EAO
- EAO expanding VLBI program, and supporting GLT
- EA Community interest and pressure to use facility remains high; oversubscription rate ~3-4

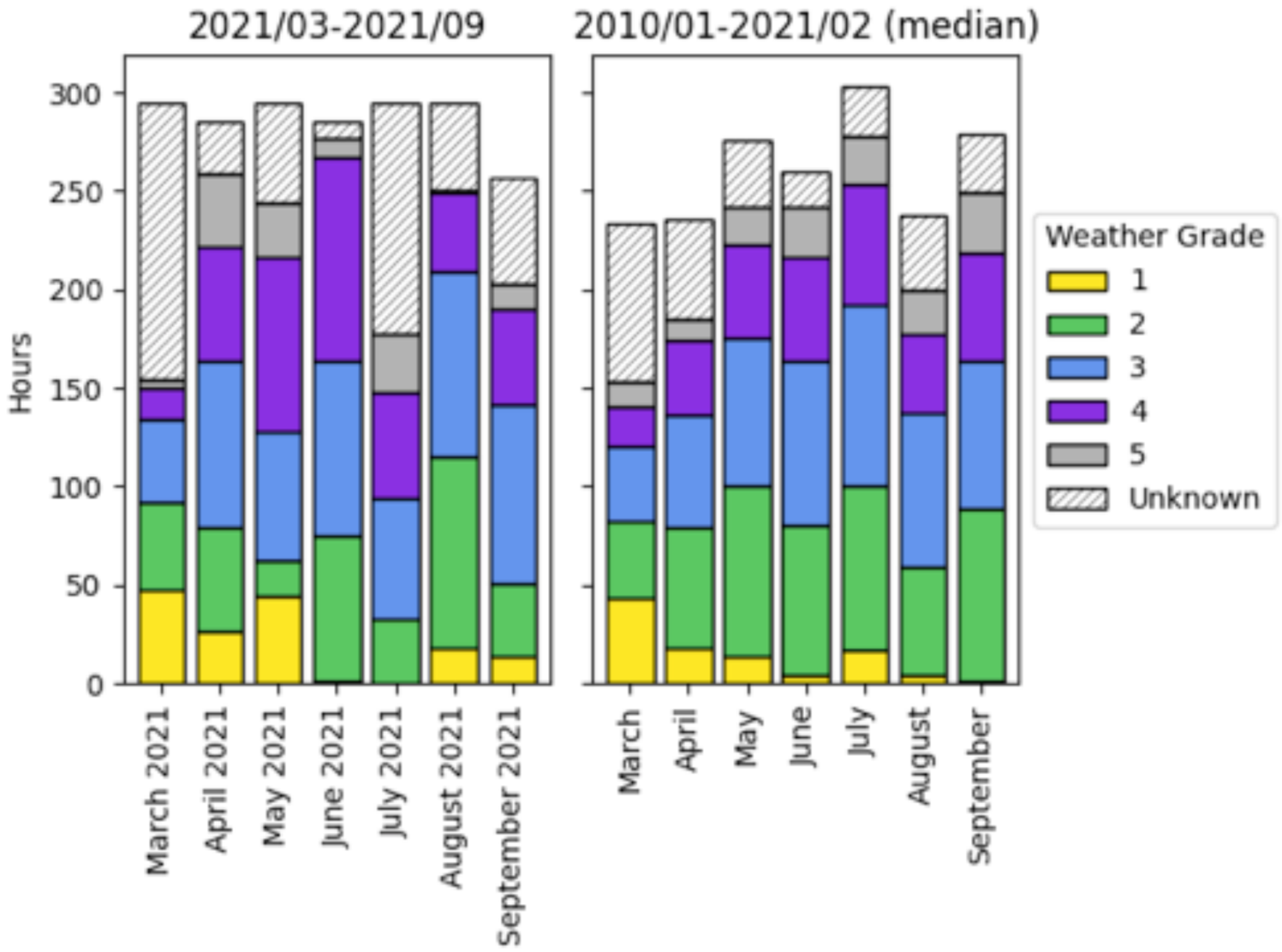
- EA Community scientific productivity is good
- Science stays at the Frontier with Large Programs
- What is the path forward to Stabilize Funding?

Operations under Coronavirus Pandemic

- Staff had been working from home, except when necessary
- Remote operations from 2 Remote Operations Center Offices
- Regular and Extended Observations are separated
- On-Site Maintenance reduced to 2-3 days a week
- No access to Mid-Level facilities except to pick up lunch
- Portable Toilet in place at site instead of using cesspool
- Electronic registration of entries into buildings
- Wearing Masks while in office and at site
- No interactions with outside groups, except Subaru access to building
- Deep clean and contact tracing for all possible cases of illnesses
- Office just now opened again as Covid-19 Omnicron Variant peaked

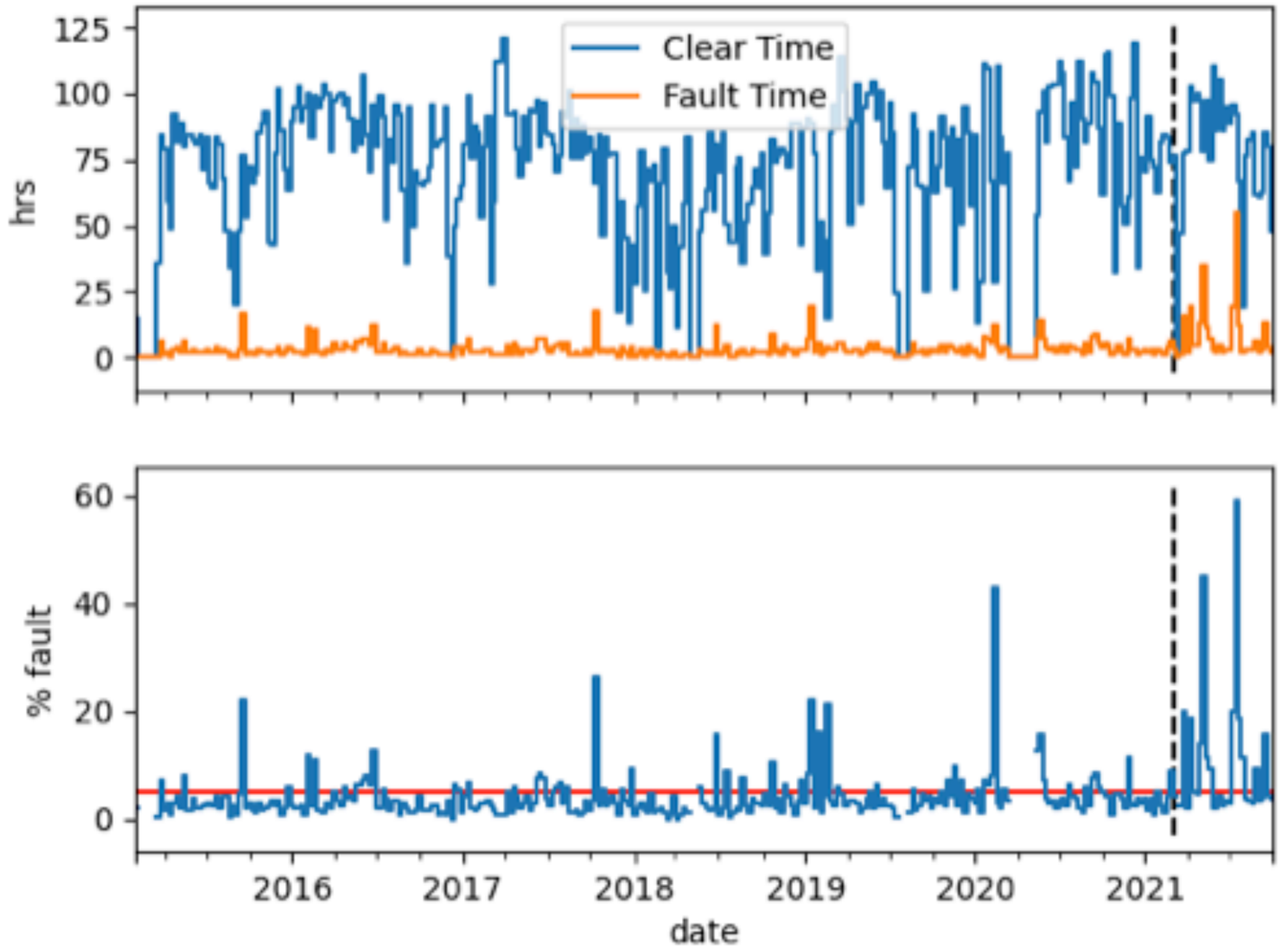


Weather has been typical in this past year on Mauna Kea, a little worse than historical mean.



Atmospheric conditions broken down by weather Grade: reporting period (left) vs historical numbers (right)

Historical Fault Rate



EAO Era (>2015) Performance had been Excellent (time lost ~ 50 hrs)

***This semester*: time lost ~160 hrs: power failure, secondary mirror**

Proposal Pressure remains High

Table 3: Semester 21B time approved and oversubscription statistics by region

Region	*# Proposals*	*Time request*	*Time available*	*Oversub factor*
CA (inst)	4	15.6 (101.7)	5.8	2.7
CA (nat)	2	11.2 (16.3)	4.2	2.7
CN	30	517.7 (517.7)	31	16.7*
JP	6	94.1 (114.1)	31	3.0
KR	3	106.0 (106.0)	80.6	1.3
TW	11	274.9 (280.0)	72.8	3.8
UK+Ireland	8	203.7 (215.3)	53.1	3.8
Totals	**66**	**1223.2 (1351.1)**	**278.4 (352.4)**	**4.4 (4.3)**

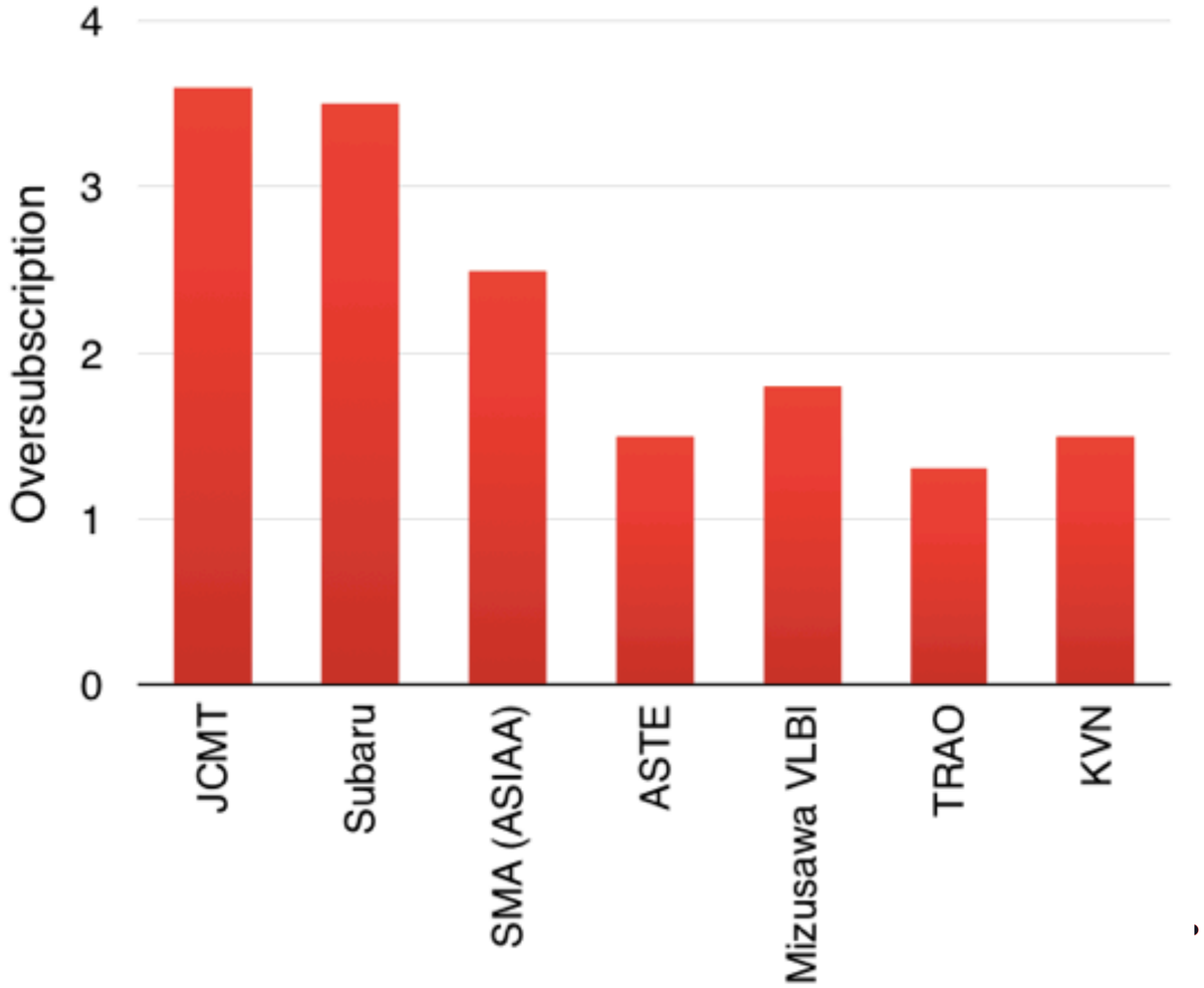
Table 5: Semester 22A PI proposal distribution by region

Region	# Proposals	Time requested	Time available	Oversubscription
CN	11	303.3 (339.7)	36.2	8.4
JP	4	76.7 (109.0)	36.2	2.1
KR	6	139.9 (169.4)	36.2	3.9
TW	8	293.5 (294.5)	76.1	3.9
UK+Ire	10	201.9 (213.1)	62.3	3.2
EAO/VN	5			
Total	**44**	**1028.5 (1139)**	**283.4 (358.7)**	**4.1 (3.1)**

Over-Subscription Rate

2020B: 3.7
2021A: 2.8
2021B: 4.4
2022A: 4.1

JCMT proposal pressure drops in 2021A due to funding uncertainties in China



Proposal Pressure has Stabilized again in 2021B

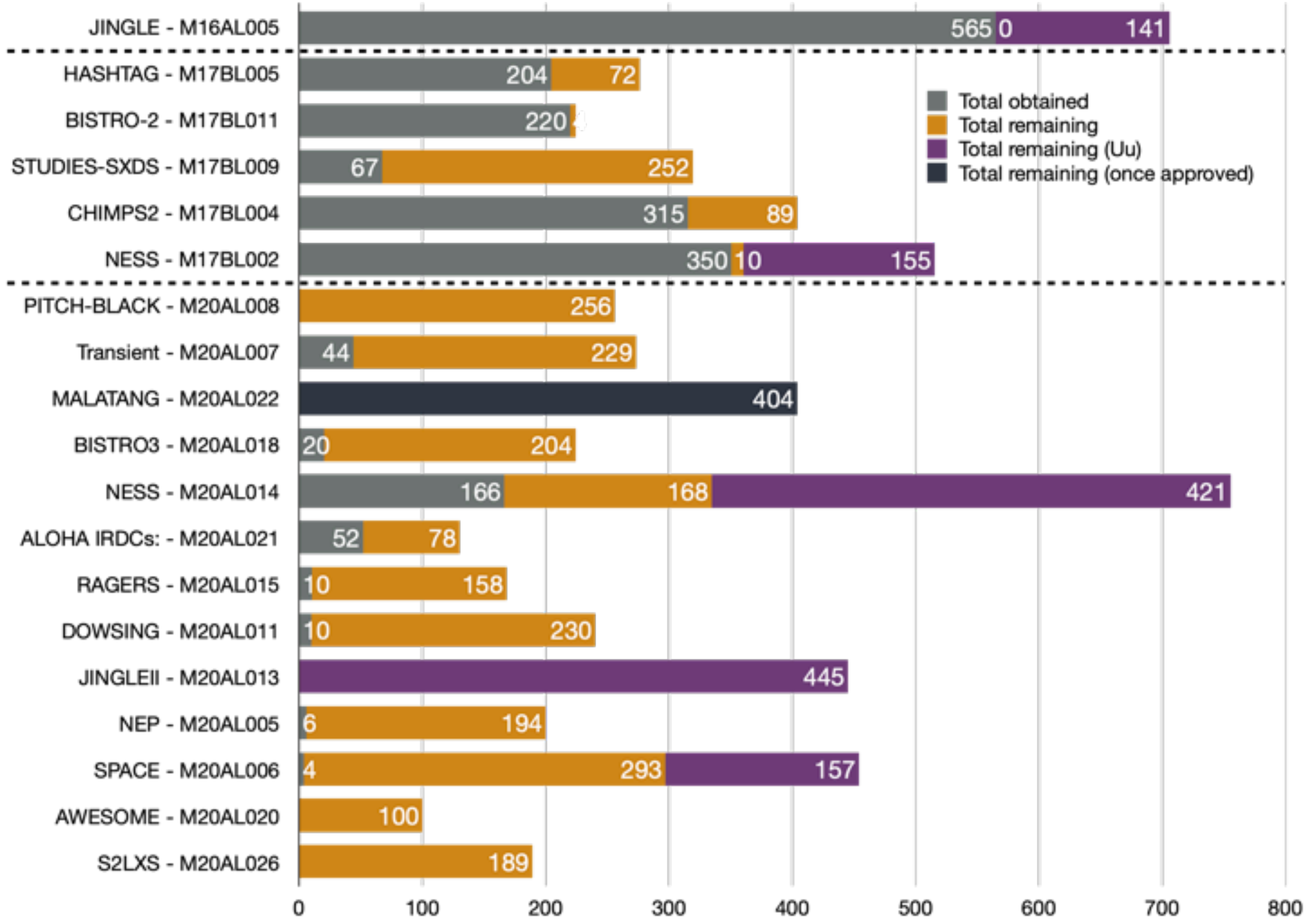
Large Program Queue and Call

The Status of Current Programs: 11.2020

Completed: S2COSMOS, SCOPE, MALATANG, BISTRO, TRANSIENT, STUDIES
Retired: eS2COSMOS 17B moved to 20A: S2XLS, JINGLE2, NEP

17B

20A



Large Programs Publications: https://ui.adsabs.harvard.edu/public-libraries/gd1aj27oTHWBRaYWmeX-YA **60 papers**

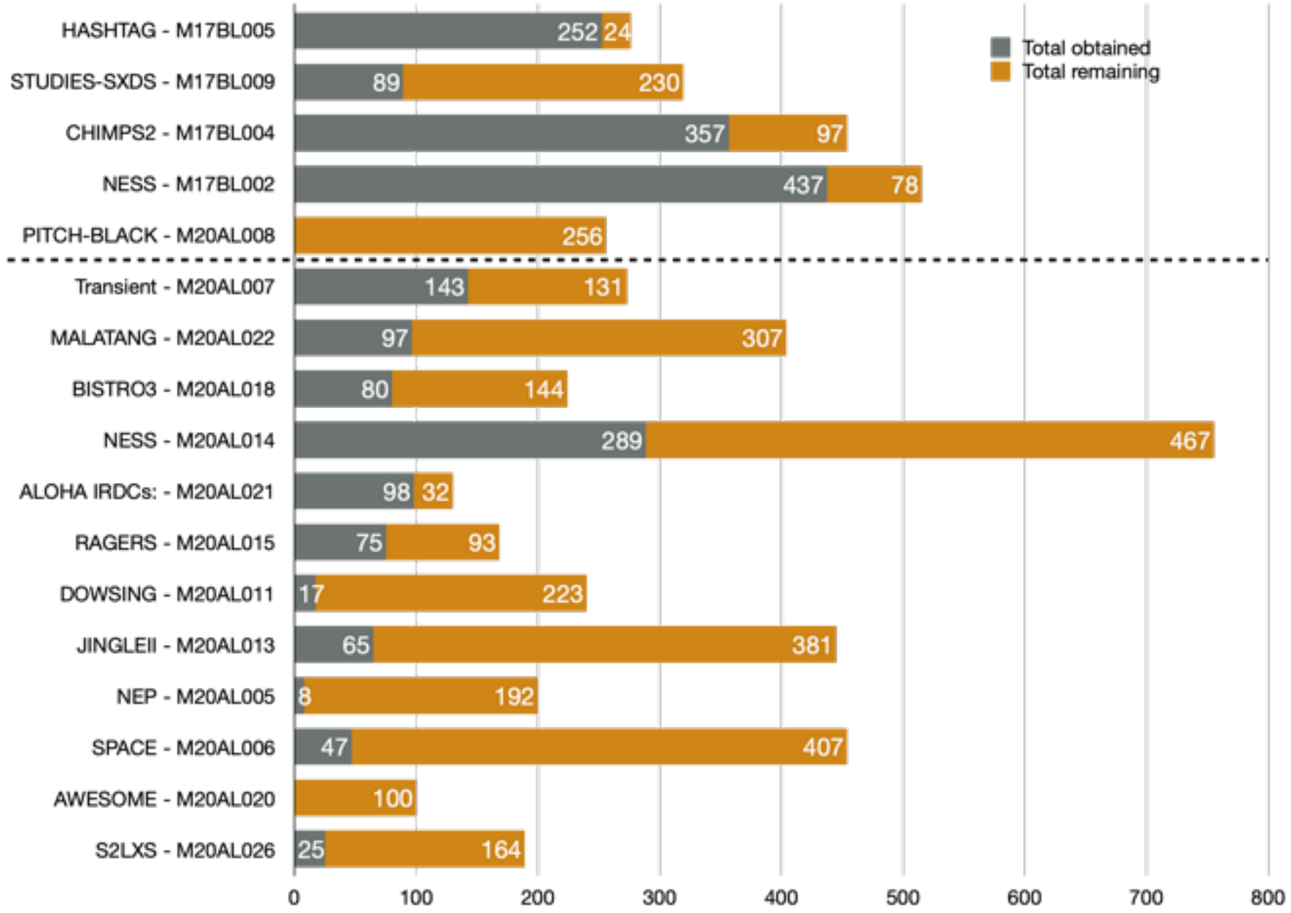
Large Program Queue and Call

The Status of Current Programs: 11.2021

Completed: JINGLE, BISTRO2

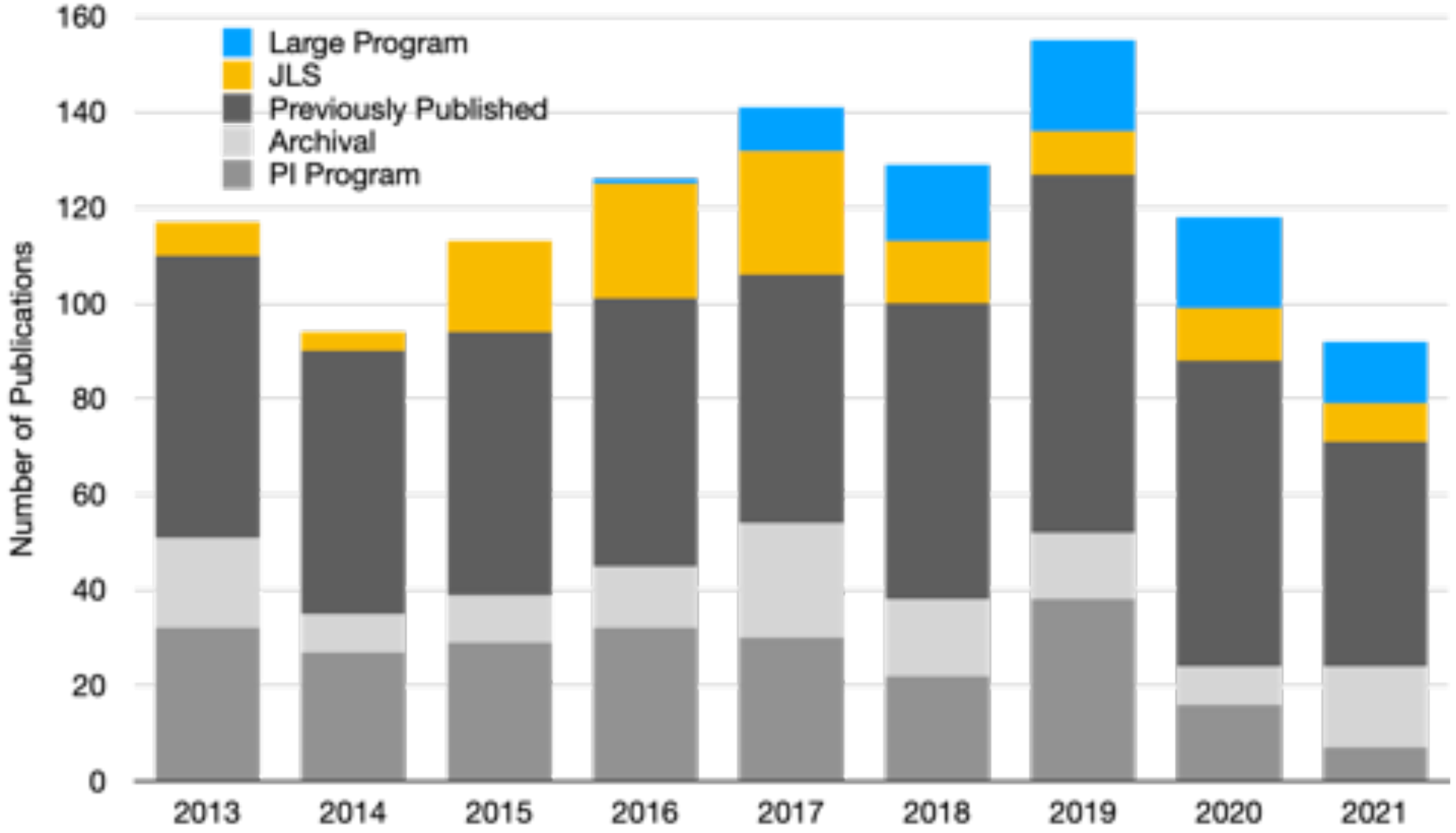
17B

20A



Large Programs Publications: https://ui.adsabs.harvard.edu/public-libraries/gd1aj27oTHWBRaYWmeX-YA **79 papers**

Large Program Publications Accelerating



2016 : 1

2017: 10

2018: 17

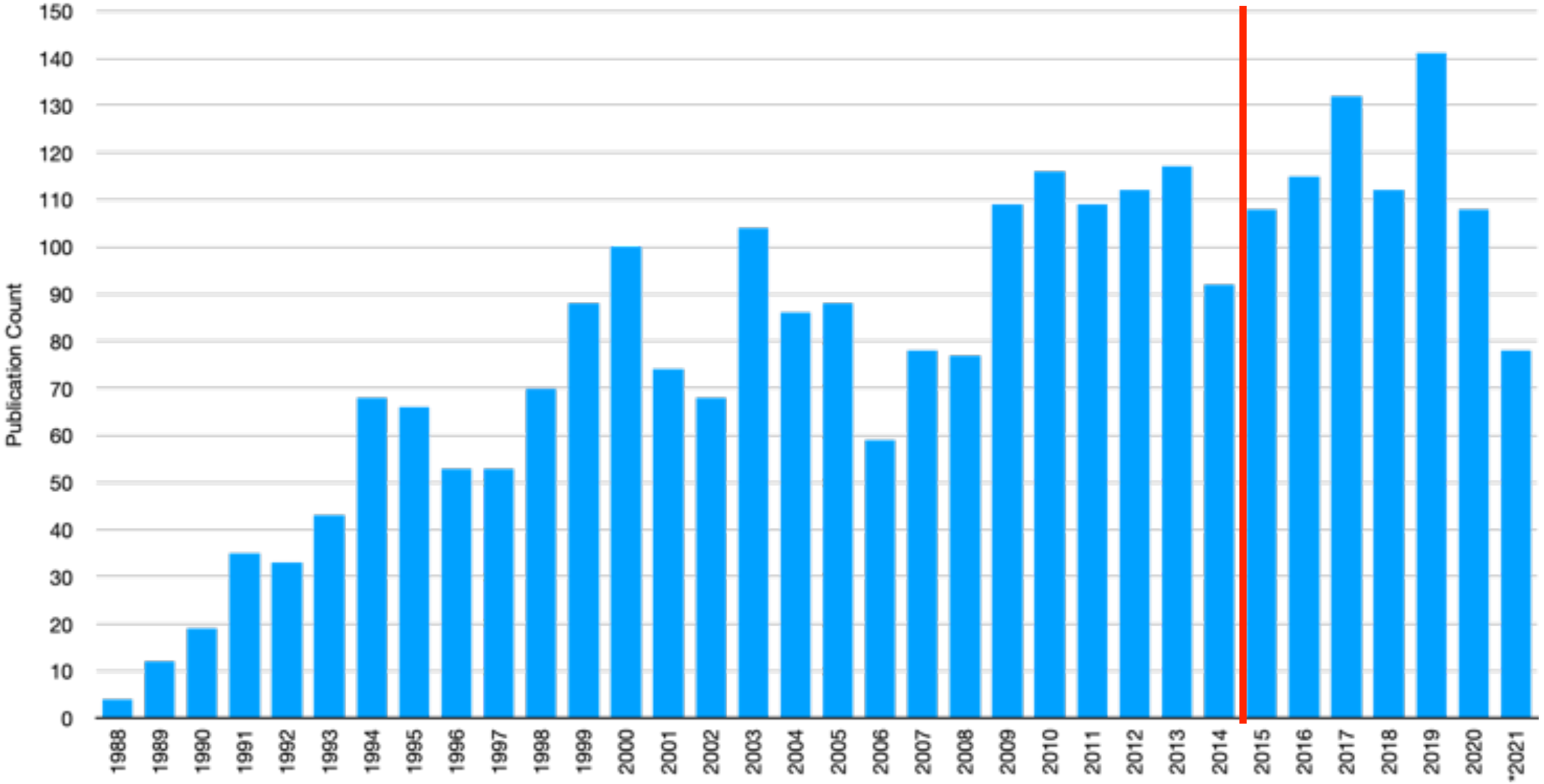
2019: 17

2020: 20

2021: 14

JAC era Large Programs (the JCMT Legacy Surveys, JLS) and the EAO era Large Programs (LAP)

Publication Statistics



Instrumentation

GLT DUPLICATE RECEIVER: NAMAKANUI

Namakanui commissioning is completed for 230GHz, and 345GHz

All three wavelength inserts are installed (345 GHz, 230GHz, 86GHz)

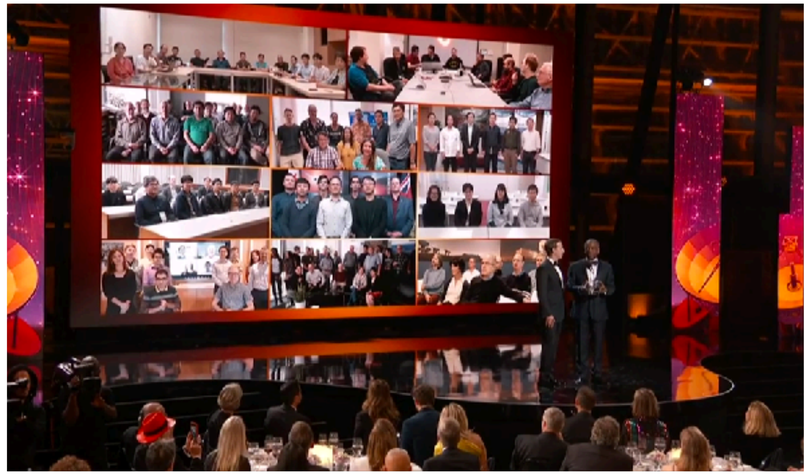
Quadruple the sensitivity of previous instrument

Instrument is being used regularly.

Impact: JCMT Recognition

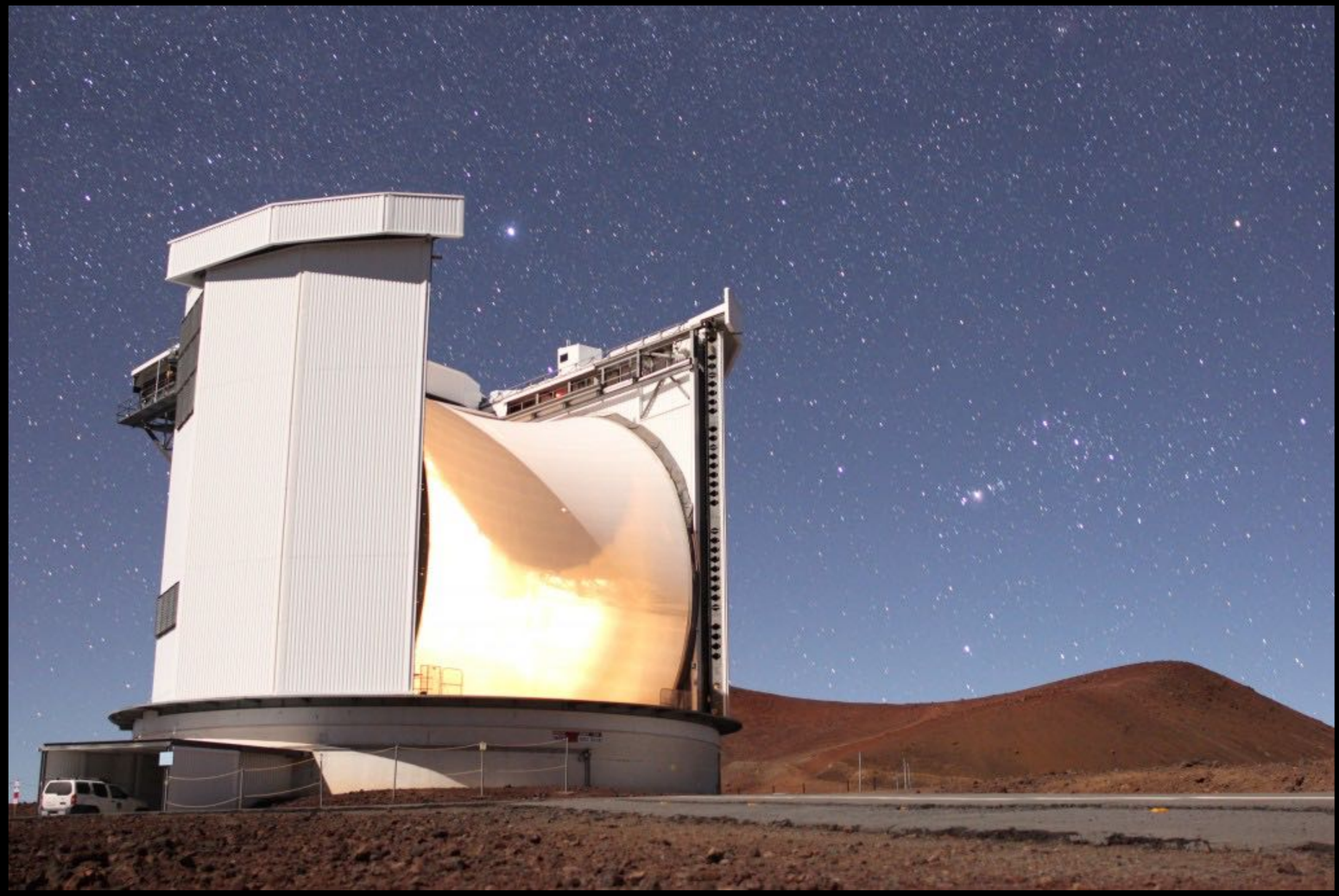
EHT Collaboration wins
the 2020 Breakthrough Prize,
Einstein Medal, Rossi Prize

Award recognizes JCMT staff and EAO VLBI scientists.



JCMT Science Highlights

April 2021 - October 2021

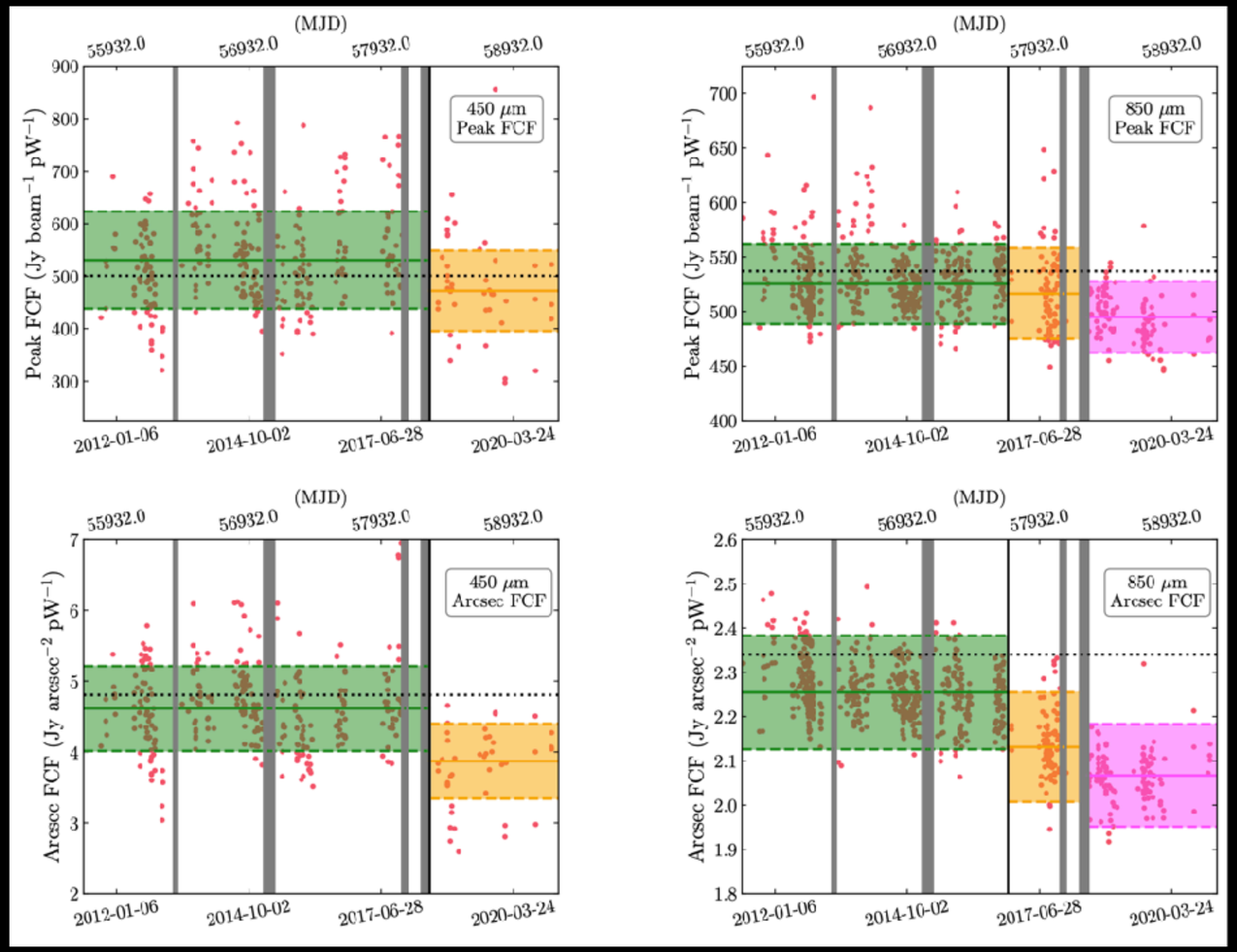


A Decade of SCUBA-2: Calibration and 10+ Year Light Curves

Mairs, S. et al. The Astronomical Journal. 2021

Goal: Quantify the SCUBA-2 Opacity Relations, FCFs, Beam Profiles, and Calibrator fluxes as a function of date and UT time over a 10-year time period (2011-2021)

The SCUBA-2 Flux Conversion Factors have are described by step functions corresponding to hardware changes at the JCMT. There is one step in 2018 after SMU work increased the beam concentrations, improving the aspect ratios. At 850 microns there is an additional step in Nov. 2016 after the thermal filter stack was replaced, improving the throughput.



Results

★ All SCUBA-2 data observed since 2011 can benefit from these new calibration results

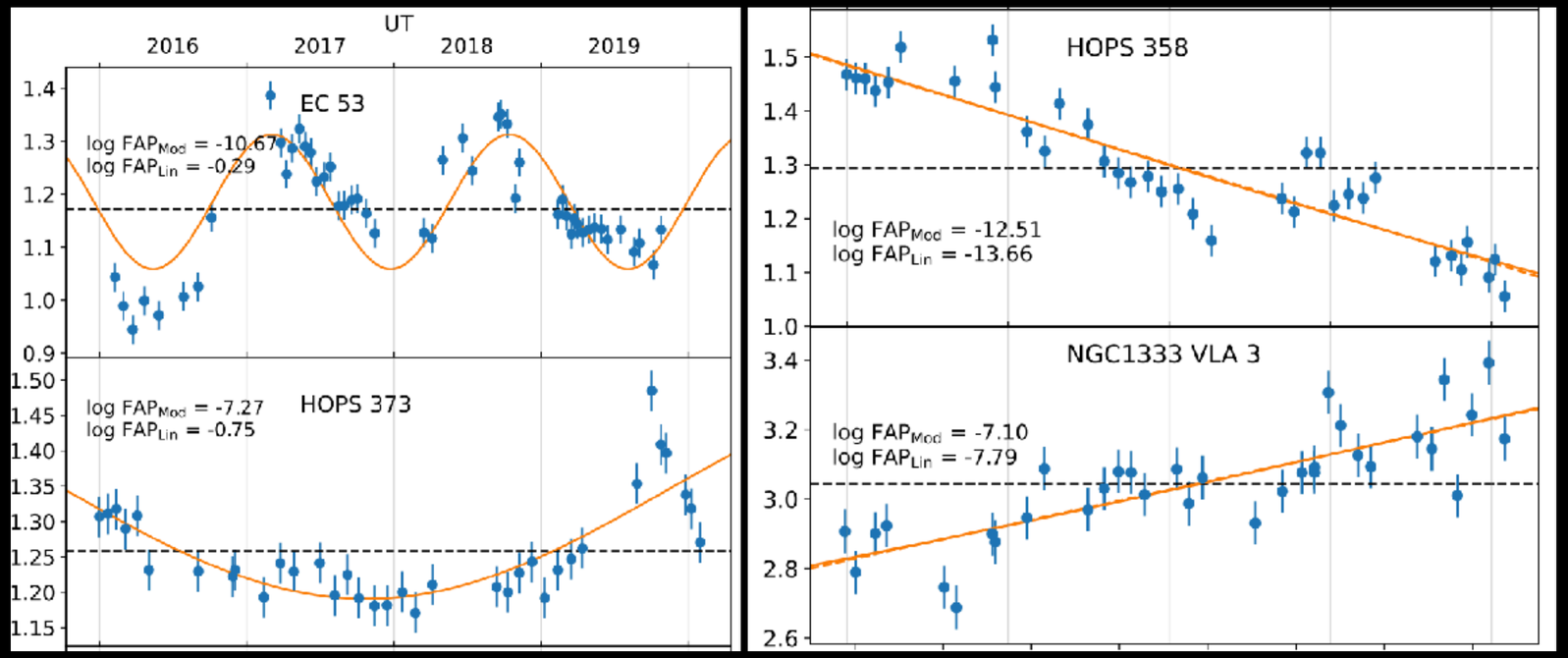
★ Variations in the beam profile due to the flexing dish have been quantified on an hourly basis from from 5pm-11am HST

★ Light curves of calibrator sources spanning 10 to 30 years reveal long term trends in flux

Four-year Summary of Monitoring the Submillimeter Variability of Protostars

Lee, Yong-Hee et al. The Astrophysical Journal, 2021

Goal: Compile a comprehensive list of submillimetre variable sources driven by changes in protostellar accretion.
This is a comprehensive study of 4 years of JCMT Transient Survey data.



Representative JCMT light curves found in this study. *Left*: Periodic and Curved light curves. *Right:* Linear light curves. The black horizontal line indicates the mean peak flux of the source over all epochs. The orange solid line shows the best-fit of the light curve. The Lomb-Scargle periodogram method was used to confirm known variables and derive properties of new variable detections.

Results

★ 18 robust variables have been discovered in the survey with continuing observations constantly improving the detection rates

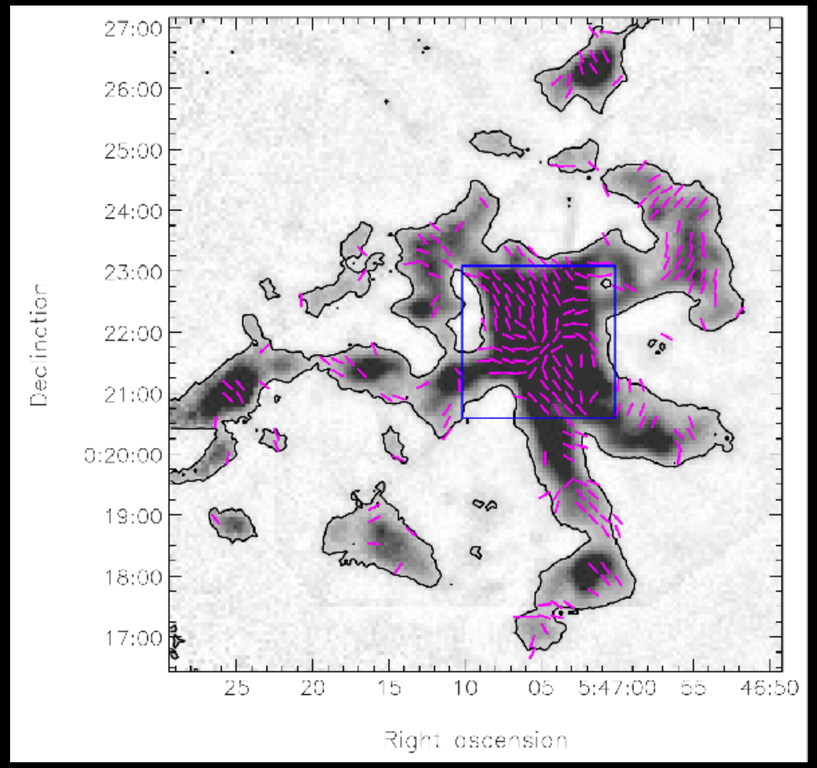
★ 40% of the submm-bright protostellar sources are found to vary over multi-year timescales (periodic, linear, and curved light curves)

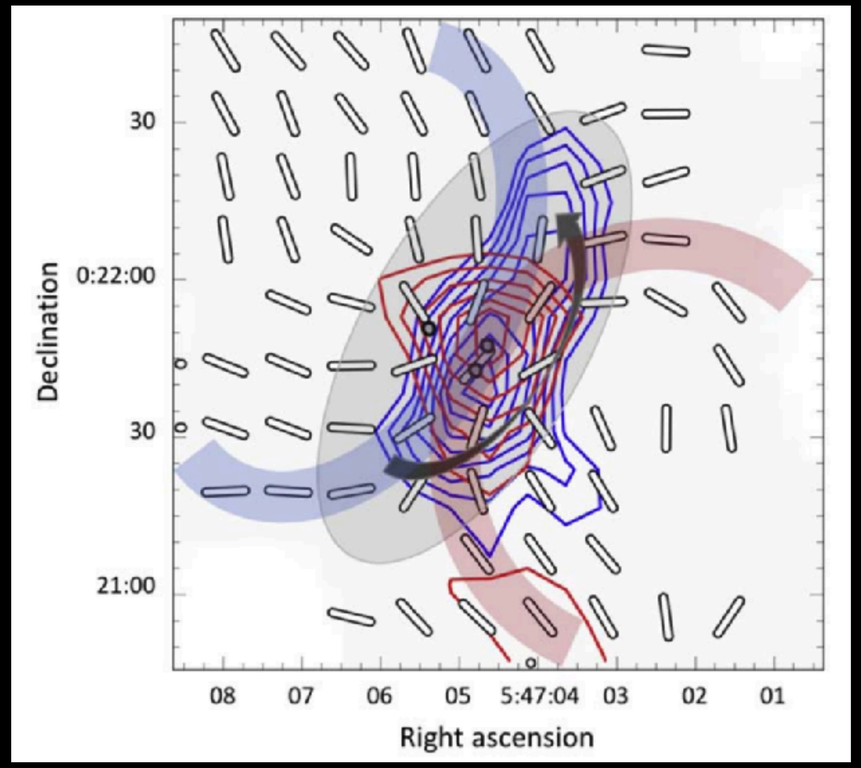
★ Both Class 0 and I protostars are found to vary, showing significant events on <5-year timescales

An 850/450 micron Polarization Study of NGC 2071IR in Orion B

Lyo, A.-Ran et al. The Astrophysical Journal. 2021

Goal: To derive the magnetic field properties and their contributions to the dynamics of a massive star-forming region as part of the BISTRO Survey





Left: 850 μm magnetic field vector map of NGC 2071IR. The blue box shows the central 2.5' region where the angle dispersion is derived for B-field strength.

Right: Blue and red contours are HARP $C^{18}O$ data. A cartoon showing the authors' suggestion of a rotating disk structure (gray) is overlaid. The shaded blue and red colors schematically represent outflow cavity walls.

Results

★ Pinched magnetic field in the central dense core region due to a rotating toroidal disk-like structure and a bipolar outflow from an embeddedYSO

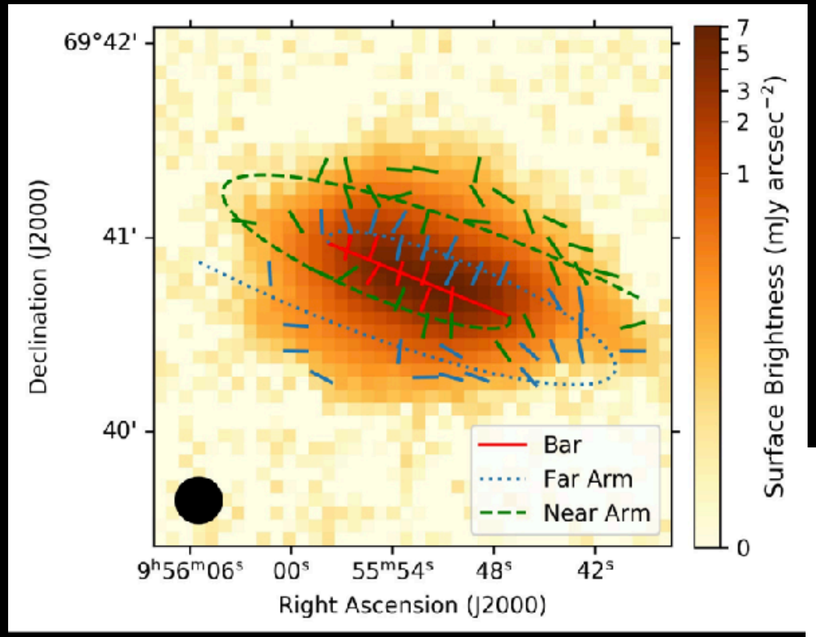
★ The magnetic field energy density is comparable to gravitational and turbulent energy

★ Central grain alignment is likely assisted by strong radiation from YSOs

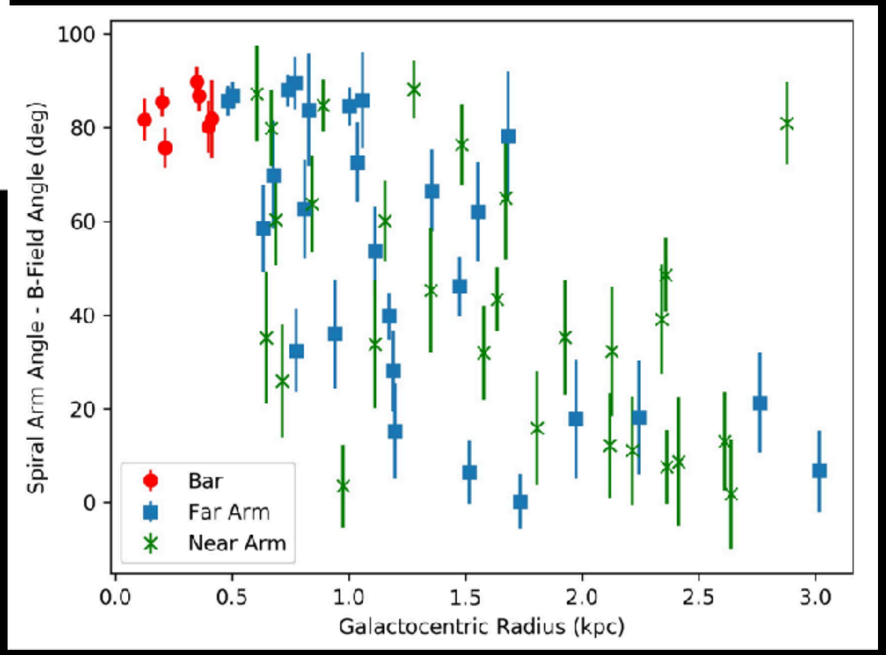
M82's Two-Component Magnetic Field

Pattle, K et al. MNRAS. 2021

Goal: Trace the magnetic field of the Starburst Galaxy using POL-2 and compare with HAWC+ observations in different galactic regions



Left: Positions of M82's Bar and spiral arms with POL-2 850 micron magnetic field vectors overlaid



Right: Angular difference between spiral arm structure and B-field as a function of galactocentric radius. The B-field transitions from being perpendicular to the bar in the galactic centre to parallel to the spiral arms, or toroidal, at high galactocentric radii.

Results

★ A two-component B-field is seen:

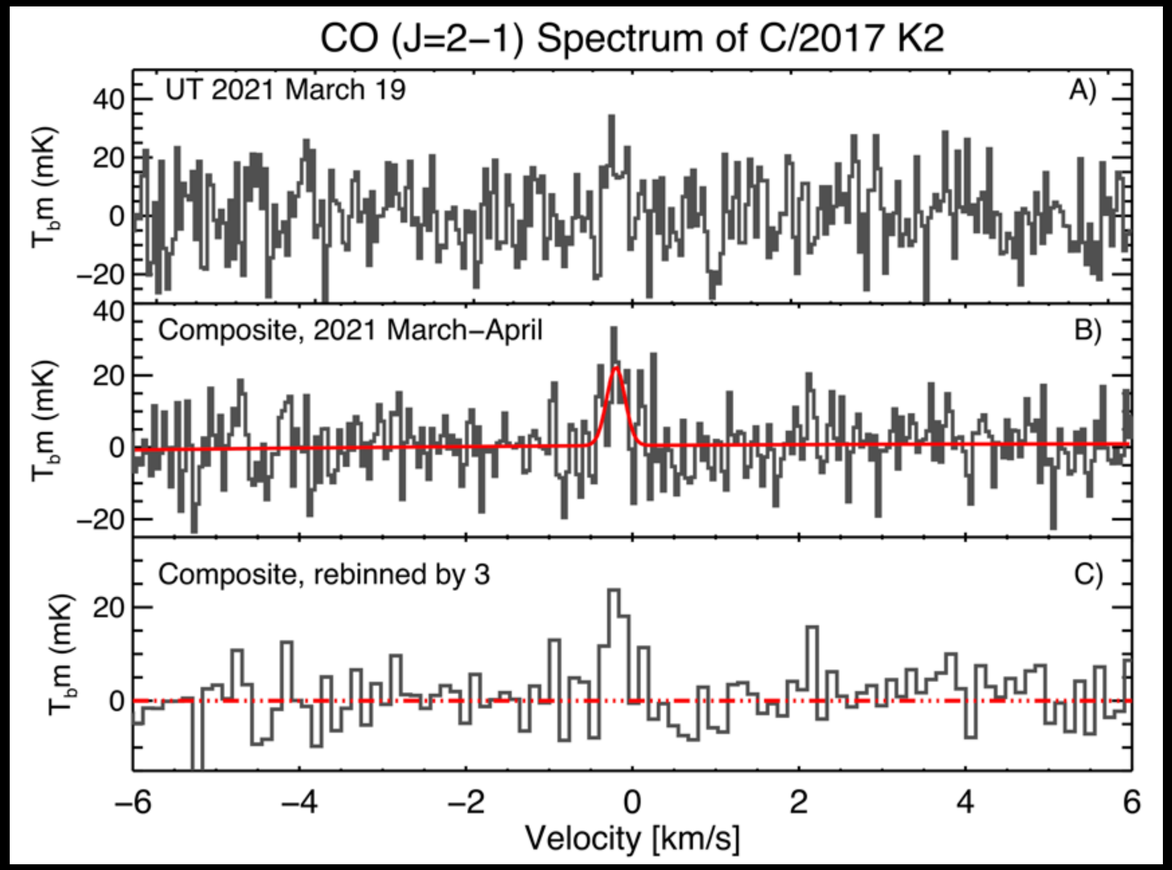
1. A Poloidal B-field in the central starburst region
2. A B-field in the disc that is parallel to the spiral arms at galactocentric radii >2 kpc

★ Good agreement between POL-2 (850μm) and HAWC+ (154μm) in the central region, but a significant difference in the outer galaxy where HAWC+ traces hot dust entrained by the superwind

Discovery of Carbon Monoxide in Comet C/2017 K2

Yen et al. The Astrophysical Journal. 2021

Goal: Investigate the abnormal long-period comet C/2017 K2 to explain its activity at large heliocentric distances



Spectrum of CO(J=2-1) emission obtained by the JCMT (ʻŪʻū).

A) The first detection of the CO line was obtained on UT 2021 March 19 (1.8 hr)

B) A composite spectrum from 2021 March to April ($6.62 \leq r_H \leq 6.83$ AU; 7.7 hr)

C) The spectrum rebinned by 3 spectral channels to a resolution of ~0.12 km/s

Results

★ First observations of a gaseous species in C/2017 K2 that can explain mass loss: Carbon Monoxide

★ The measured CO production can be explained by surface sublimation of CO from a 1 km^2 ice patch

★ This super volatile sublimation better explains the activity at large heliocentric distances than water ice

SCUBA2 Directly Funded Special Large Program

S19BP002: A Deep SCUBA-2 survey of cold GMCs in the inter-arm regions in M31

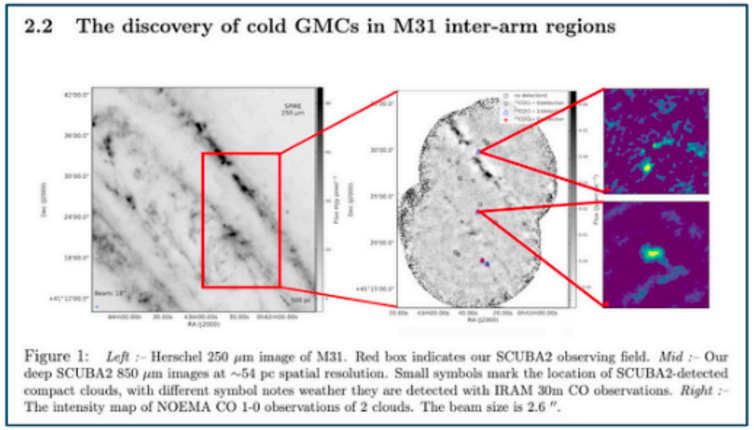
PI: Jingwen Yu

Time allocated to project: 220h, Grade 2 & 3, SCUBA-2
Completion rate: 100%

Aim: Map M31 interarm regions to: 450μm: 31 mJy/beam, and 850μm 1.0 mJy/beam

Started: 2019-10-18
Completed: 2020-12-12

Complementary to HASHTAG program (3.0 mJy/beam and 44.9 mJy/beam at 850and 450μm) just deeper.



2.2 The discovery of cold GMCs in M31 inter-arm regions

Figure 1: *Left :–* Herschel 250 μm image of M31. Red box indicates our SCUBA2 observing field. *Mid :–* Our deep SCUBA2 850 μm images at ~54 pc spatial resolution. Small symbols mark the location of SCUBA2-detected compact clouds, with different symbol notes weather they are detected with IRAM 30m CO observations. *Right :–* The intensity map of NOEMA CO 1-0 observations of 2 clouds. The beam size is 2.6 ″.

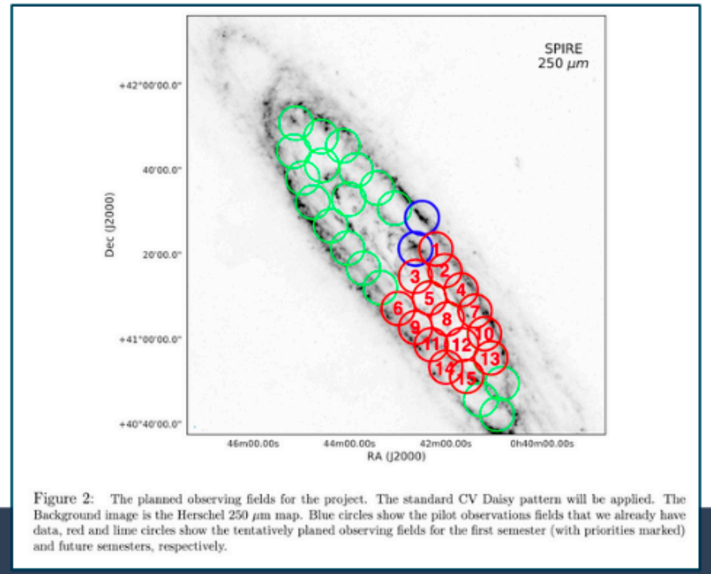


Figure 2: The planned observing fields for the project. The standard CV Daisy pattern will be applied. The Background image is the Herschel 250 μm map. Blue circles show the pilot observations fields that we already have data, red and lime circles show the tentatively planed observing fields for the first semester (with priorities marked) and future semesters, respectively.

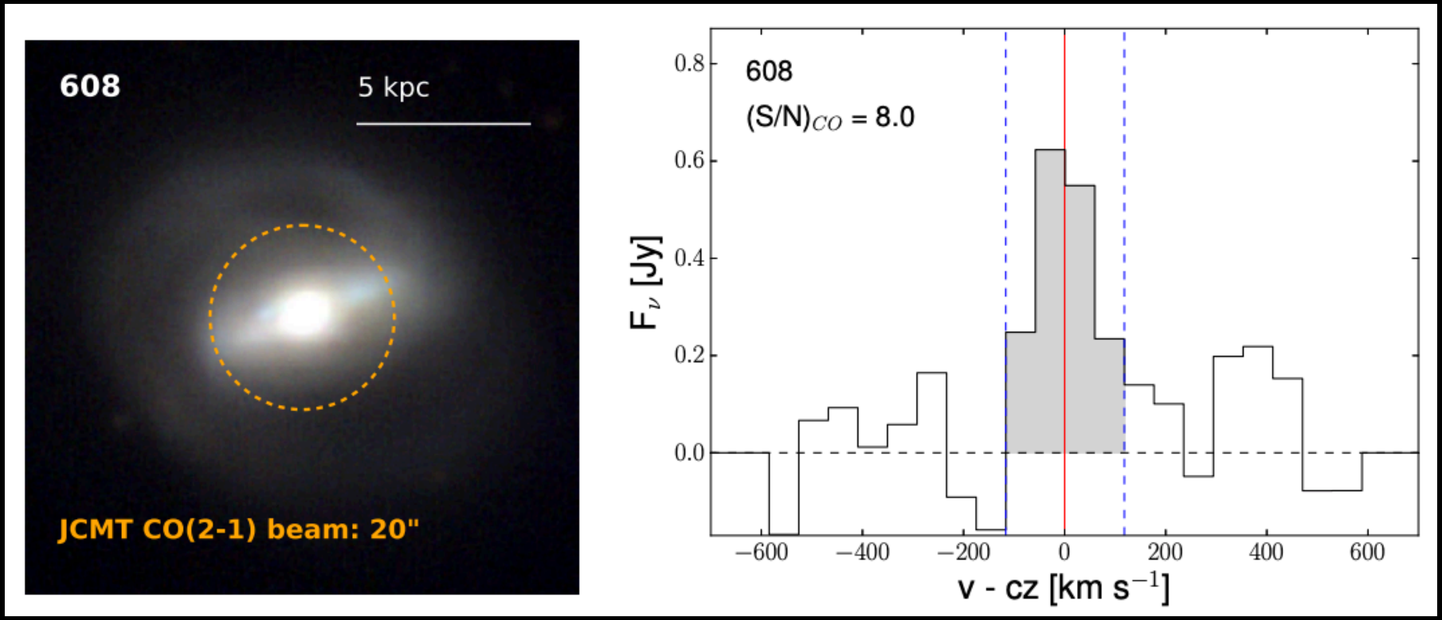
S19BP002- complete - https://omp.eao.hawaii.edu/cgi-bin/projecthome.pl?project=S19BP002

★ARCHIVE

AGN Host Galaxy Gas Properties

Koss et al. The Astrophysical Journal Supplementary Series. 2021

Goal: Determine the gas properties of 200 galaxies hosting hard X-ray selected AGN



Left: Pan-STARRS 1'×1' *gri* colour cutout with the beamsize of the JCMT marked in orange. Right: CO(2–1) spectrum of the galaxy. The spectrum is centered at the position of the CO(2–1) line. The solid red line marks the central velocity of the optical redshift of the AGN. The dashed blue lines indicate the velocity range within which the CO(2–1) line fluxes are integrated

Results

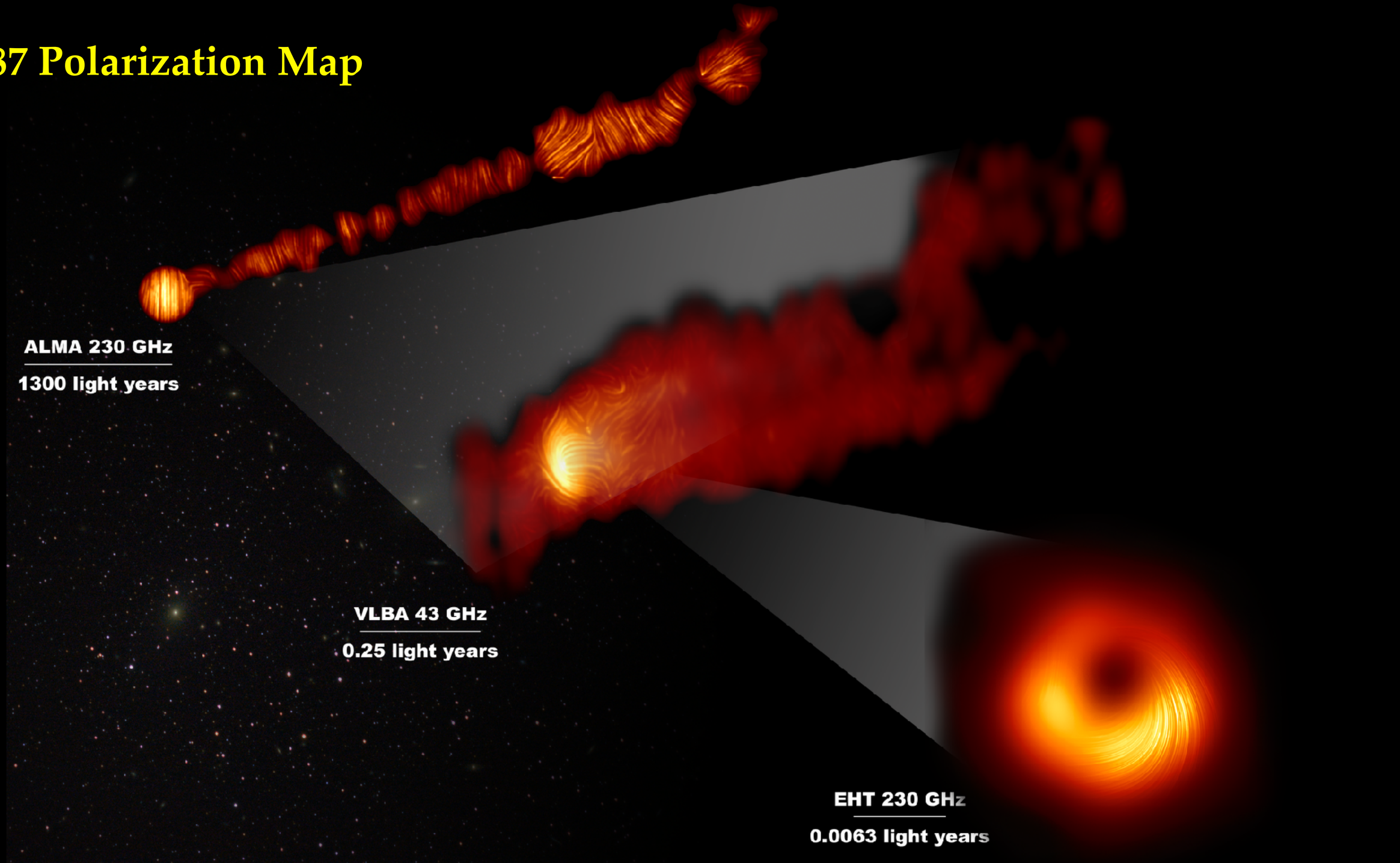
★ Galaxies with AGN have more molecular gas and higher gas mass fractions than inactive galaxies

★ There is no evidence of AGN feedback affecting the host galaxy cold molecular gas

★ Higher column density AGN galaxies are associated with lower depletion timescales

★ Molecular gas plays critical role in black hole growth

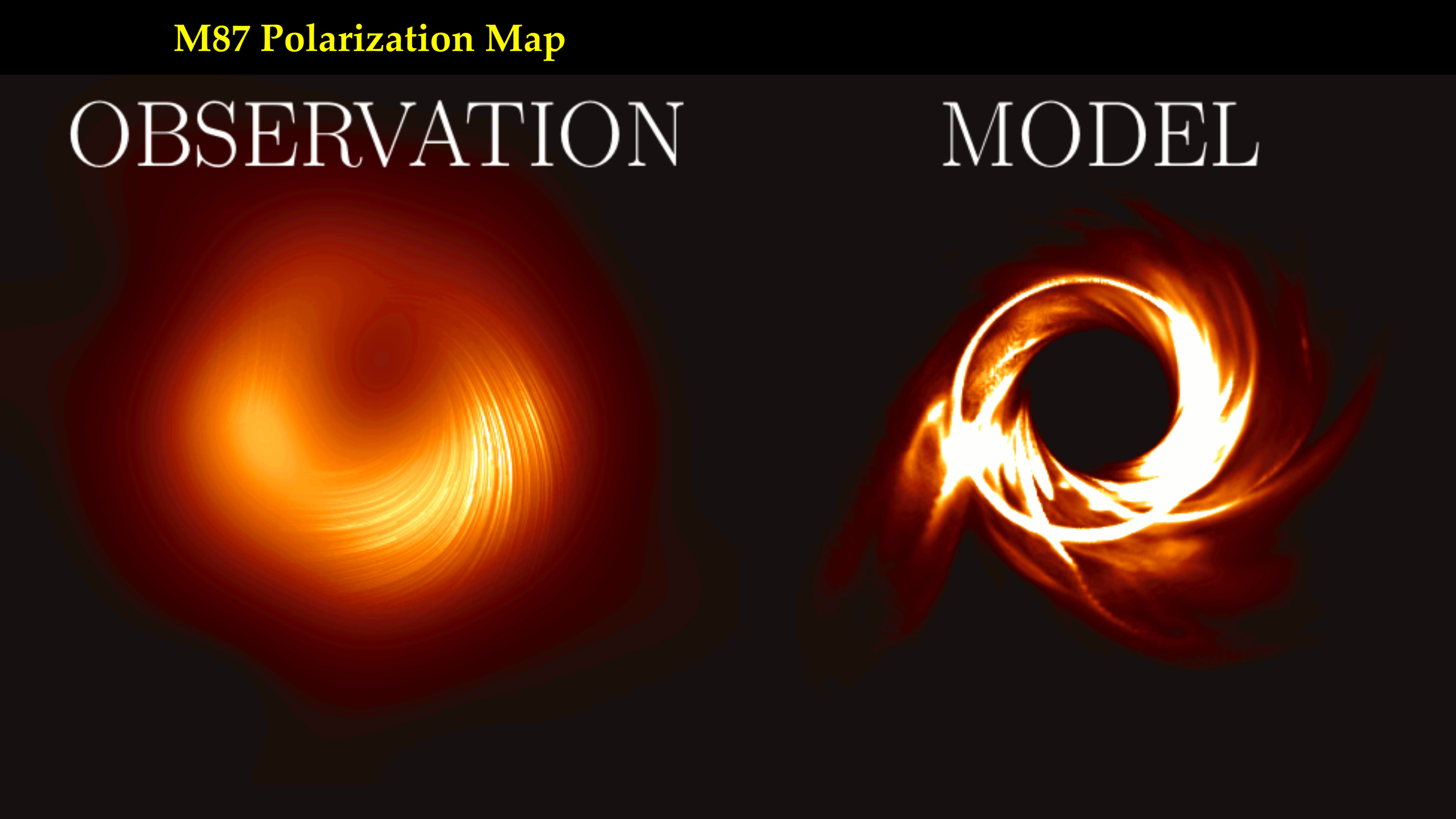
M87 Polarization Map



M87 Polarization Map

OBSERVATION

MODEL



JCMT in ALMA Cycle-4, -5, -6, -7, 8, 9?

- **Event Horizon Telescope Experiment (April 2018)**
  - **2 "Key projects" : SgrA*, M87**
  - **2 "EA projects" : OJ287, Mrk501,**
  - **2 "EHT projects" : Cent A, 1055+018**

1st 6 papers published
+ many more papers

- **Issues for EAO/JCMT**
  - **how to approve VLBI projects**
  - **how to grant access to non-JCMT partner VLBI projects**
  - **how to fund future VLBI projects**
  - **how to become part of ngEHT**

Status of EAO

- Asia recognizes Future Improvement will need more Funds
- EAO continues to work on coordinating/collaborating in Asia
- EAO consists first of ASIAA, KASI, NAOC, NAOJ
- Vietnam, Thailand, Malaysia, and Indonesia have been EAO Observers
- Thailand (NARIT) has joined EAO as partner in 2021
- Malaysia (UM) has sent LOI on joining EAO as partner in 2023
- India is considering becoming EAO Observer/Partner

- Asian economies have been impacted by Covid-19 in 2020-2021
- Asian Treaty Organization for Astronomy being worked on