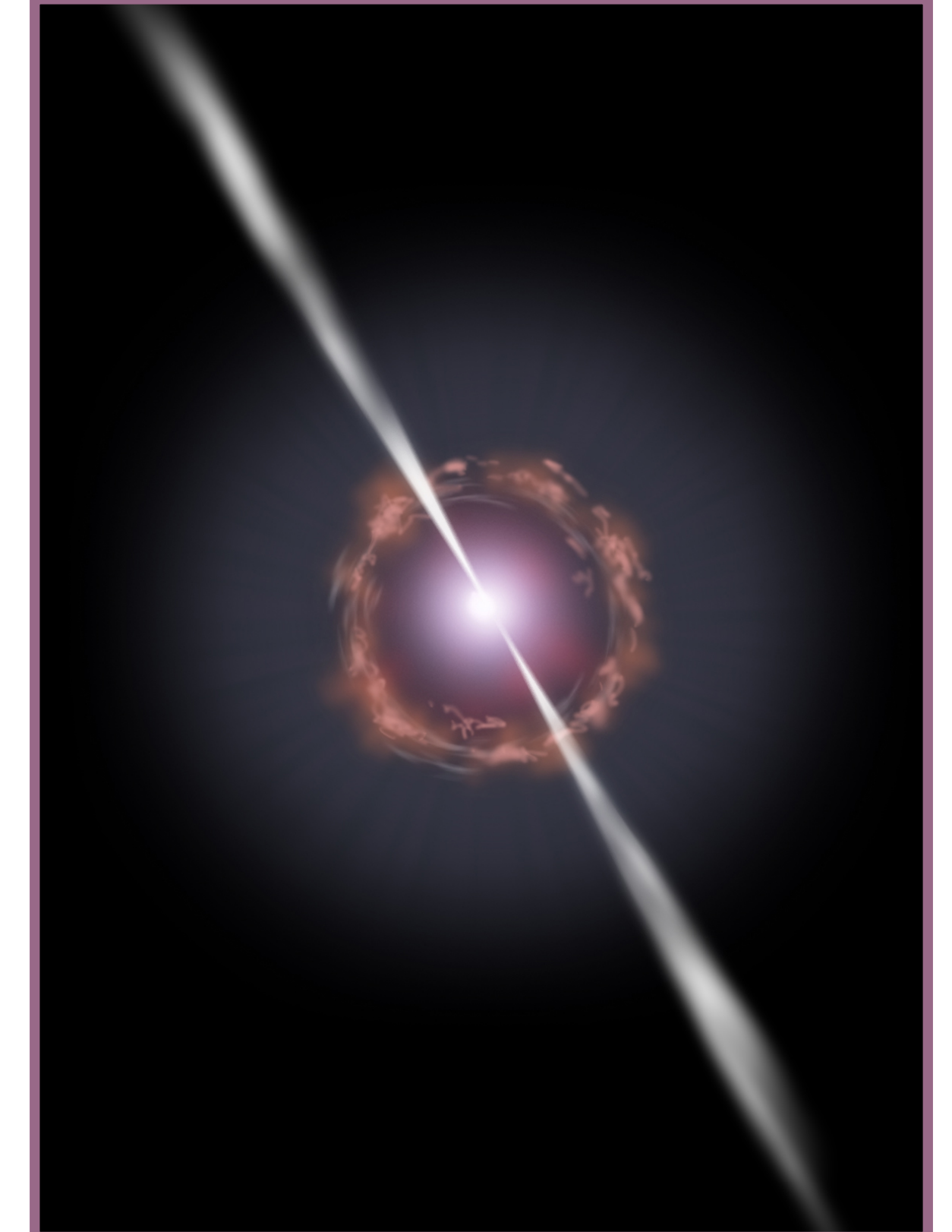


Sources & Transients AWG

Status update & introduction to breakout session



Anna Y. Q. Ho (Assistant Professor, Cornell)

with Joaquin Vieira and the sources & transients working group

Overview

- Co-conveners: Joaquin Vieira (UIUC) & Anna Ho (Cornell)
- Science driver: transient and variable sources
- Wide range of astrophysics: variable (e.g., AGN), Galactic (stellar flares), transient (GRBs, TDEs, SNe), solar system (asteroids, planets)

Recent Focus: Community Engagement

Particularly compelling to the survey is the fact that these observations open the opportunity for systematic **time-domain** studies in this part of the electromagnetic spectrum for the first time.

An important requirement for our strong endorsement is that the project broadly **engage astronomers beyond the traditional CMB community**. CMB-S4 will produce data sets of unprecedented sensitivity, cadence and spectral coverage that will advance general astrophysics and open discovery space opportunities for diverse scientific communities. Previous CMB experiments have not had the charge or funding to make data rapidly available and generally usable. It is essential that CMB-S4 produce transient alerts, as well as calibrated maps in all bands and on all angular scales that are openly usable and accessible on as rapid a cadence as practical. This is not necessarily at the same level of precision needed for CMB analysis. This will both maximize and justify the significant national investment in the observatory, even if it **does require some nominal level of additional funding** to accomplish.

The RMS panel views CMB-S4 as a powerful, cosmology-focused experiment that would address Astro2020 priority science questions at a level that no other concepts can. In support of the project's long-term success, the RMS panel offers the following two suggestions for its implementation. First, the panel suggests that third-generation CMB experiments aligned with CMB-S4—specifically, the SPO and the “nominal” version of the SO—be high priorities for federal support. Besides training students and postdoctoral researchers, thereby empowering them to play vital future roles in CMB-S4, these experiments are poised to help retire technical risk for CMB-S4 and usefully inform its strategies for surveying the sky and removing foreground signals. Second, **the panel views it as appropriate for an experiment at the cost scale of CMB-S4 to be more “observatory-like” in seeking broad engagement with astronomers beyond the traditional CMB community, and ensuring that (for example) plans for data management and event alerts maximize opportunities for transient science to the extent possible without sacrificing the primary cosmology goals.** The panel therefore suggests that an articulated plan for engaging the broader astronomical community be a precondition for the start of CMB-S4 funding.



Strategies for Engagement

(1) Biweekly telecon series

- Since Spring meeting, presentations about ngVLA-CMB S4 synergy (Rachel Osten from STScI; Joan Wrobel from NRAO)
- Next presentation: radio transients in VLASS (Dillon Dong from NRAO)

(2) Astrophysics Workshop (July 6-7; hybrid)

- SOC: Anna Ho, Tom Maccarone, Rachel Osten, Giuseppe Puglisi, Joaquin Vieira

Recent Astrophysics Workshop (July)

- 26 speakers
- 77 online at peak
- Outreach: “CMB-S4 as a transients survey”
 - (i) Galactic transients/variables, (ii) Extragalactic transients, (iii) High- z galaxies, (iv) Solar system



Astrophysics with the CMB-S4 Survey – Part II: Source and Transient Science

Home

Participants

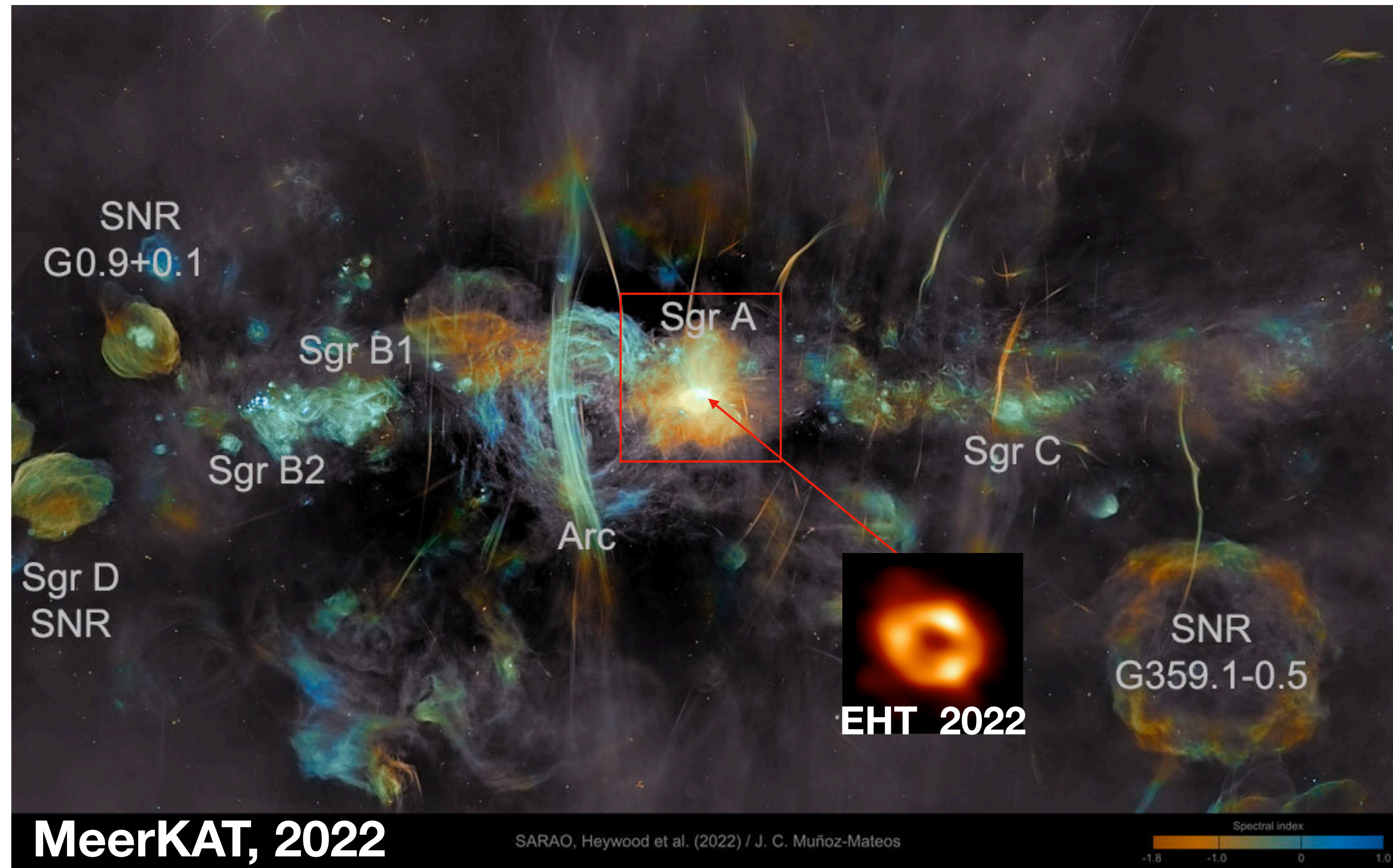
Program

Registration



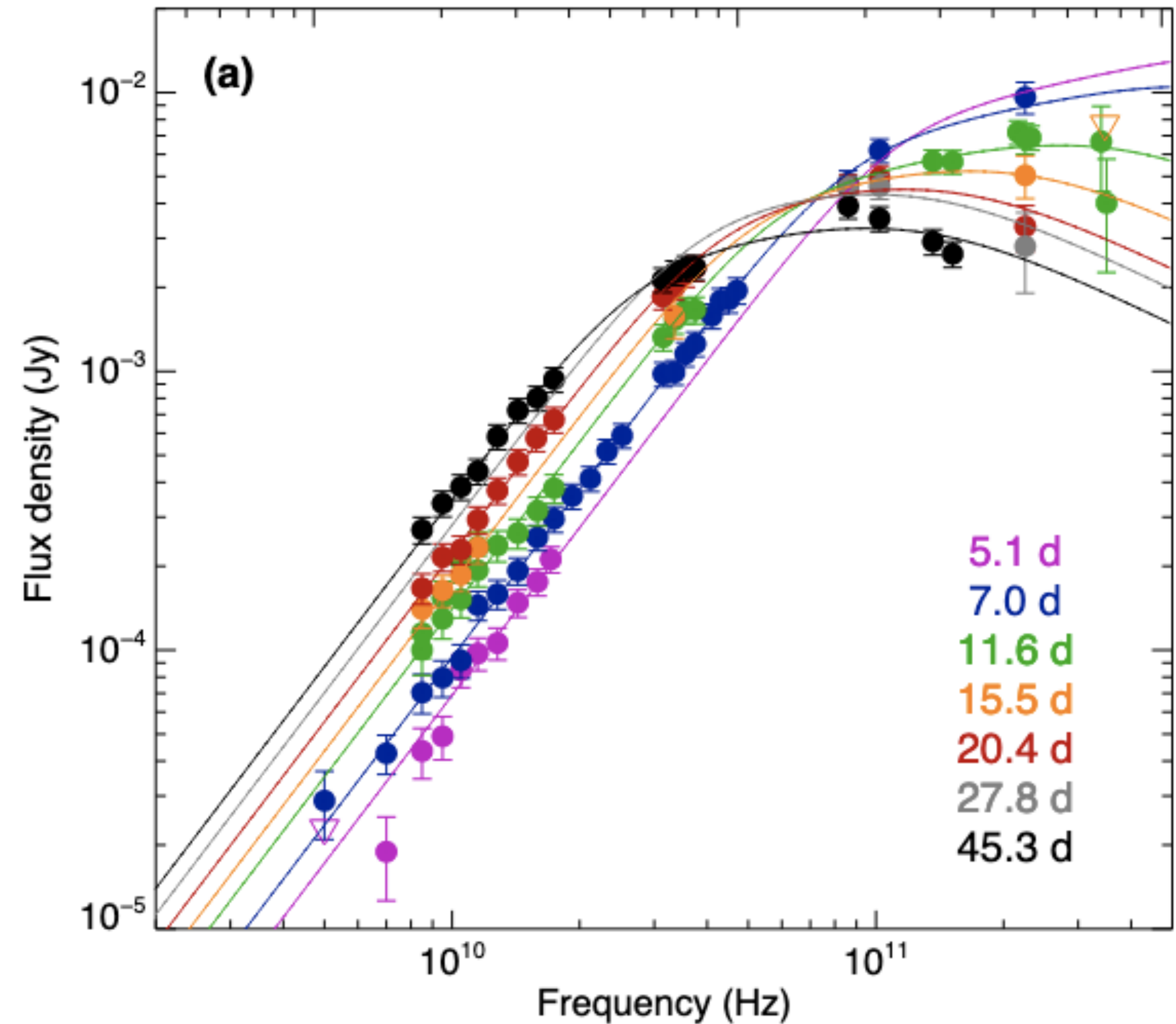
Monitoring Sgr A*

- ALMA light curves
 - X-ray flares affect mm emission
 - Less variability than expected from models
- Polarization, Faraday rotation



A Luminous Jetted TDE at $z = 1.2$

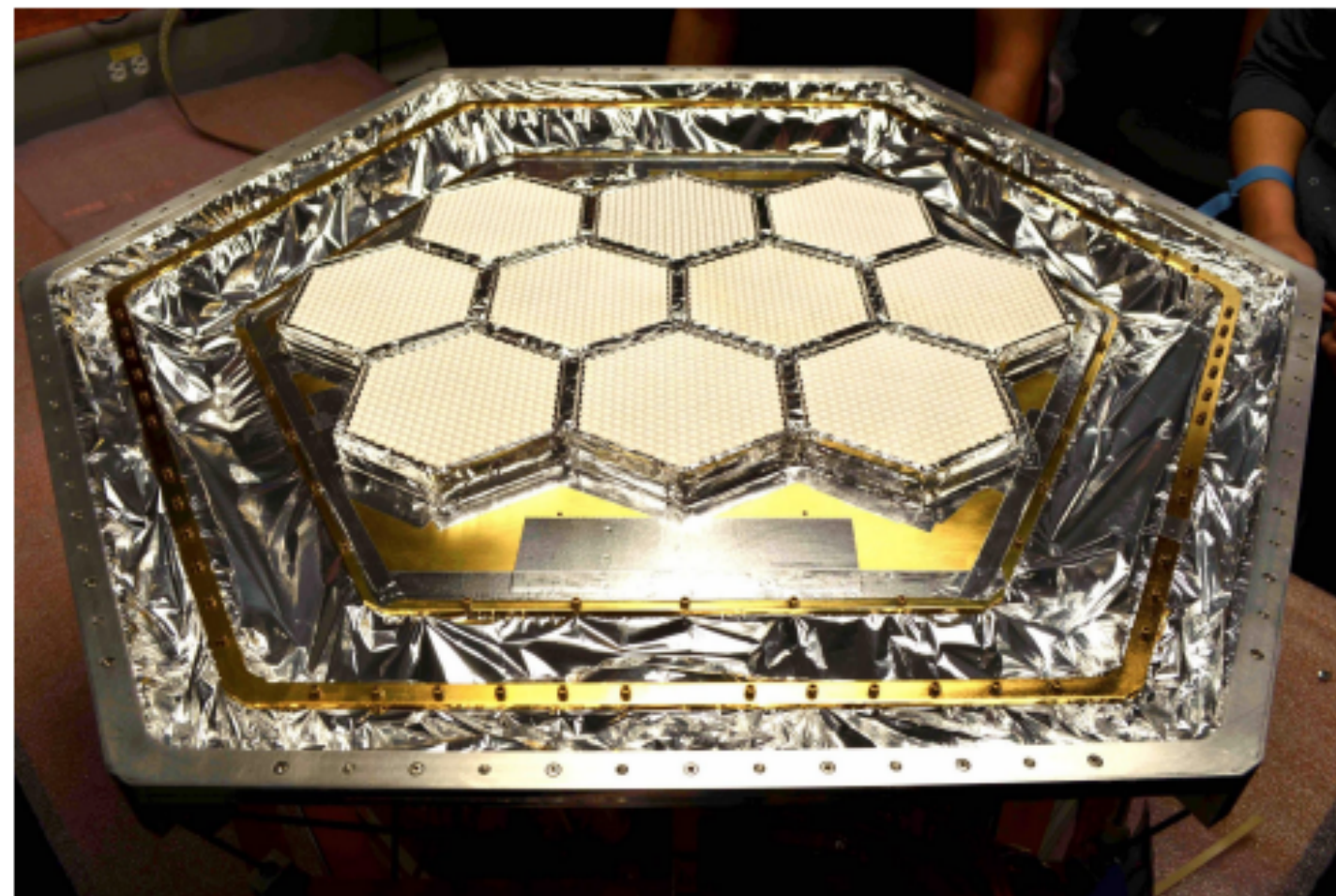
- Serendipitous optical discovery (ZTF)
- mm-bright ($F_{100\text{GHz}} = 6 \text{ mJy @ peak}$)
- GRB luminosity but months duration
- Break freq. $> 40 \text{ GHz}$ for month
- CMB-S4: 0.5-3 per year
- Strength: dust-obscured, off-axis



Ongoing Submillimeter Transient Searches

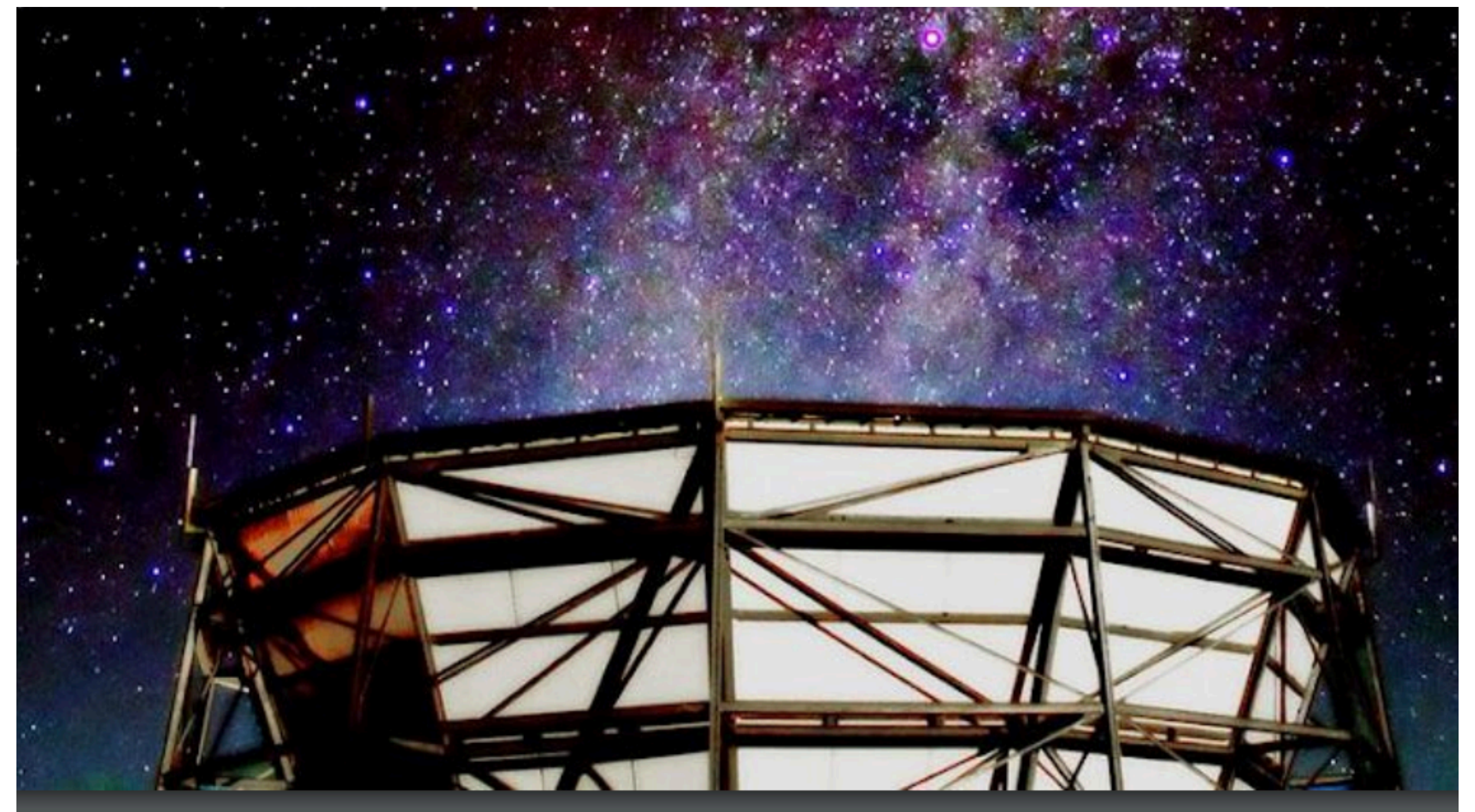
SPT

- Galactic & extragalactic discoveries (Guns et al. 2021)
- Fully operational internal alert pipeline, <24h lag
- Last year: 40+ flares and many AGN



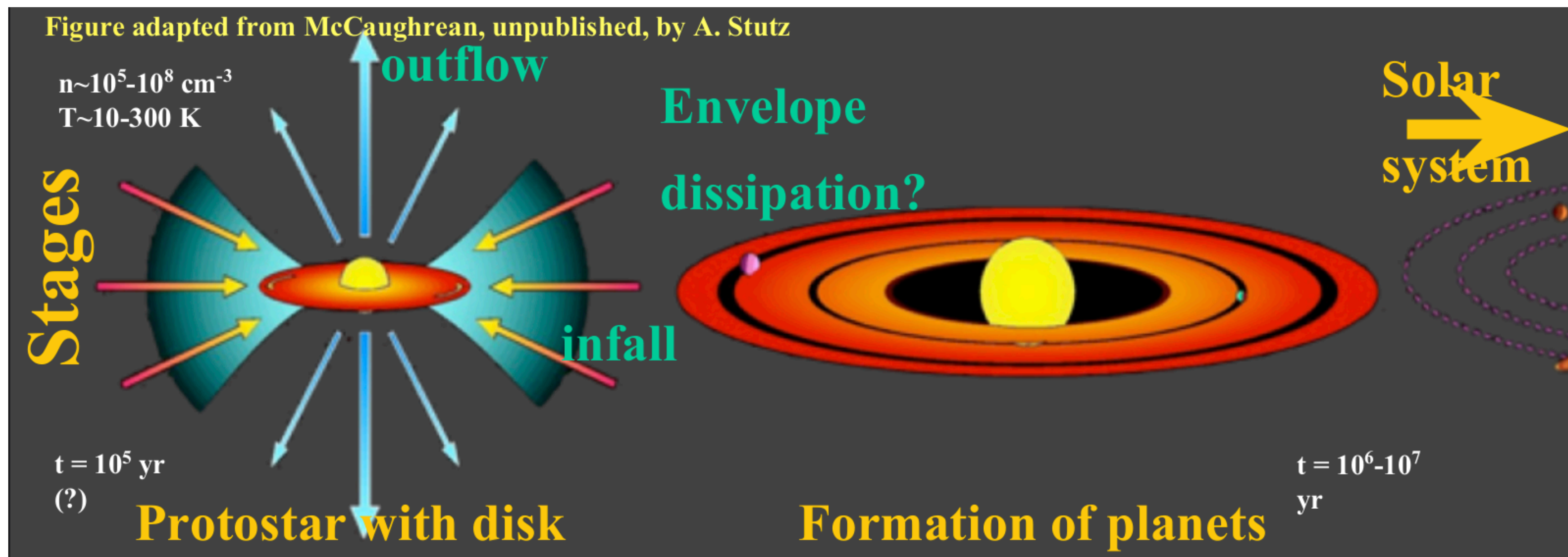
ACT

- 3-day maps from 2008-2018
- Cut on S/N, light curves
- 116 sources, many repeating, in plane



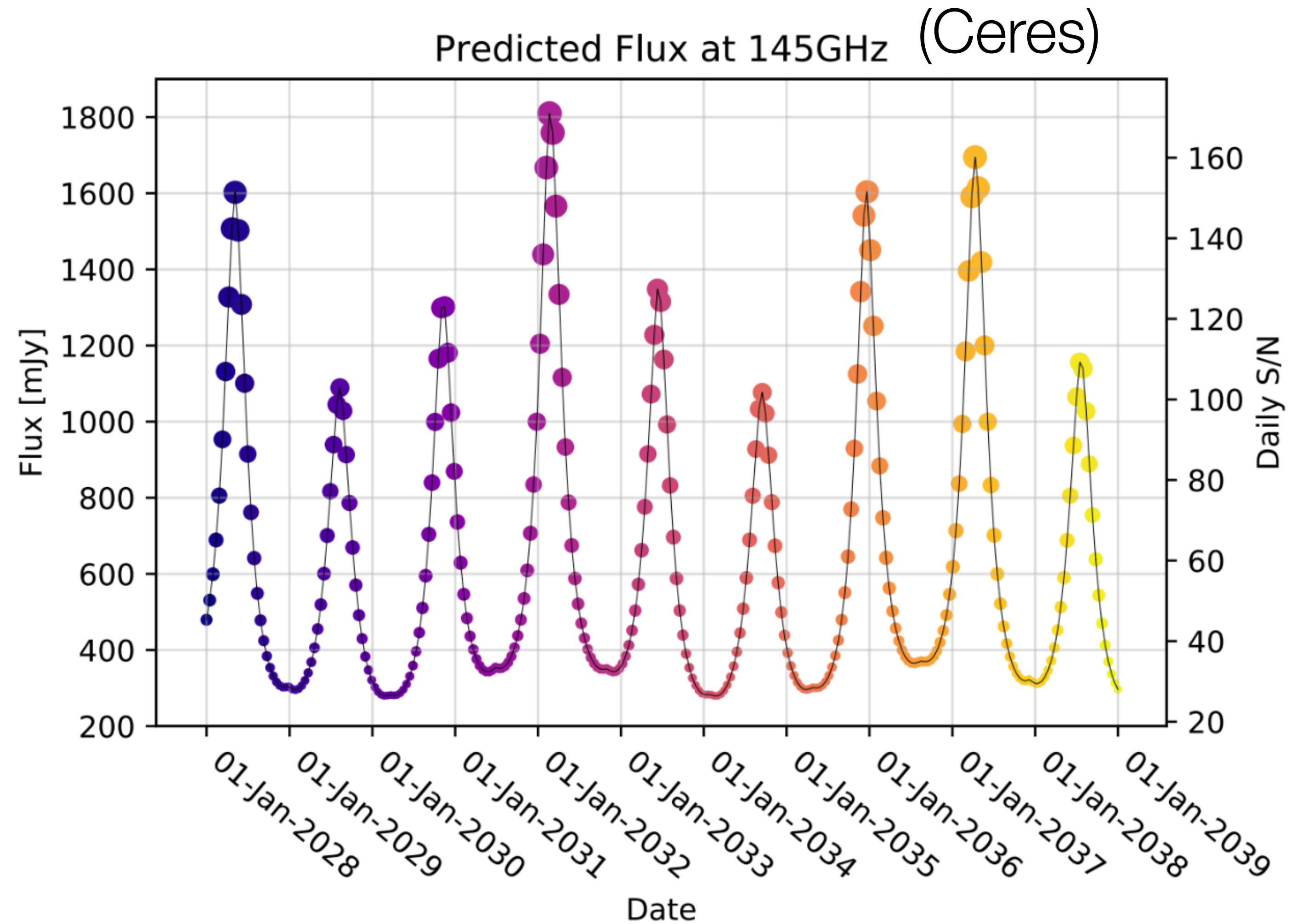
Young Stellar Objects

- Variability common, according to mm surveys (e.g., JCMT; Johnstone+18)
- CMB-S4: large sky area with repeating observations on range of timescales
- Burst mechanism, impact on protoplanetary disk, accretion/outflow connection



Asteroids

- Thermal emission under surface
- Density, grain size, conductivity, emissivity
- Solar-system evolution
- CMB-S4: wide field will observe hundreds of objects



Planned Activities for Breakout

Set goals for the next year

- Develop science case
- Plans for community engagement
 - Debrief from workshop
 - Who to invite for telecon series
 - Start planning next in-person event (next summer, survey science?)

Agenda for Friday Session (10-11am)

- CMB-S4's complementary astrophysics (Rachel Osten; STScI)
- Exo-Oort Clouds (Eric Baxter; U. Hawaii)
- Galactic Transients (Tom Maccarone; TTU)
- Optical and Radio Transients (Vikram Ravi; Caltech)

How to Get Involved

- Meeting: Alternating Thursdays, 10am PT / noon Central / 1pm ET
- Minutes
- Mailing list: sources@cmb-s4.org
- Talk to Anna (annayqho@cornell.edu) or Joaquin (jvieira@illinois.edu)