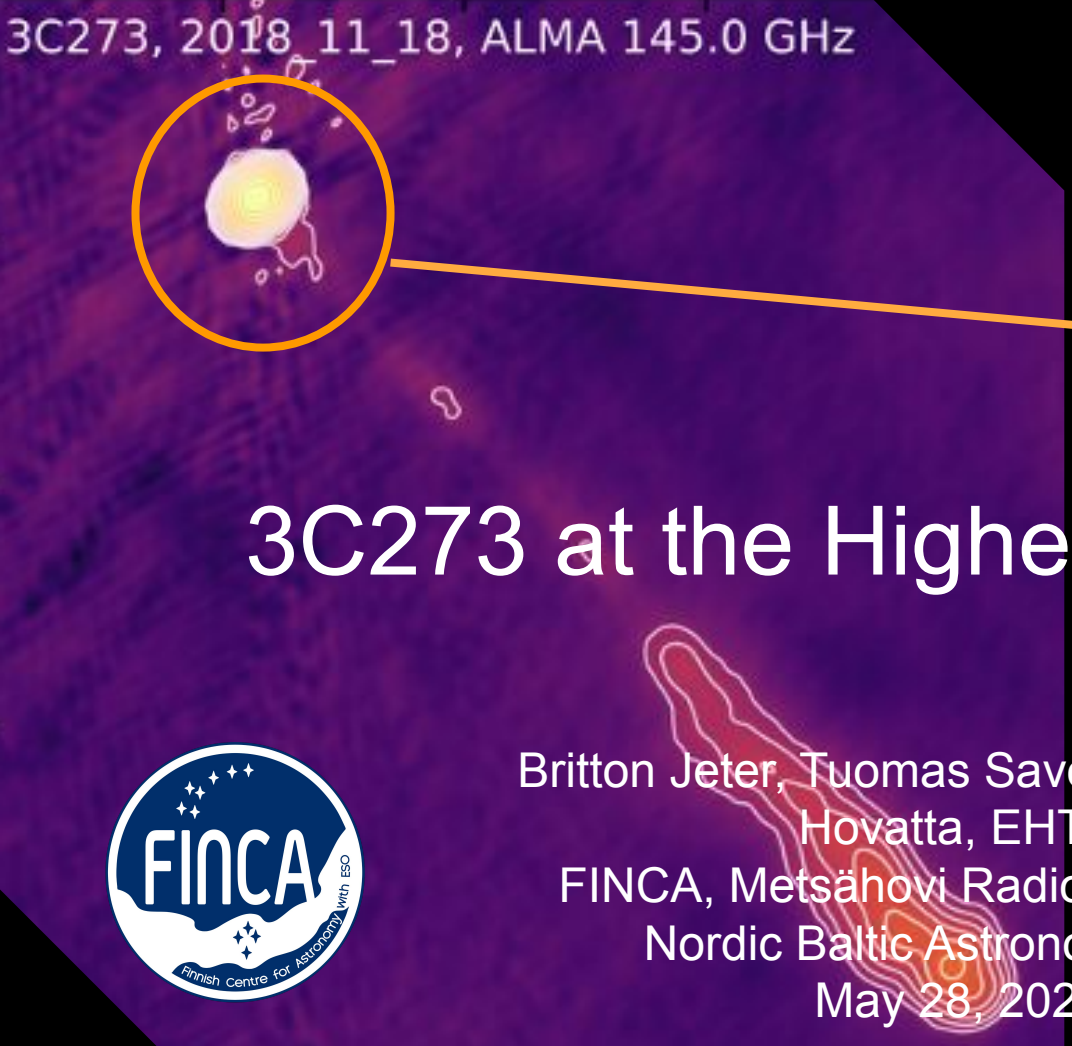
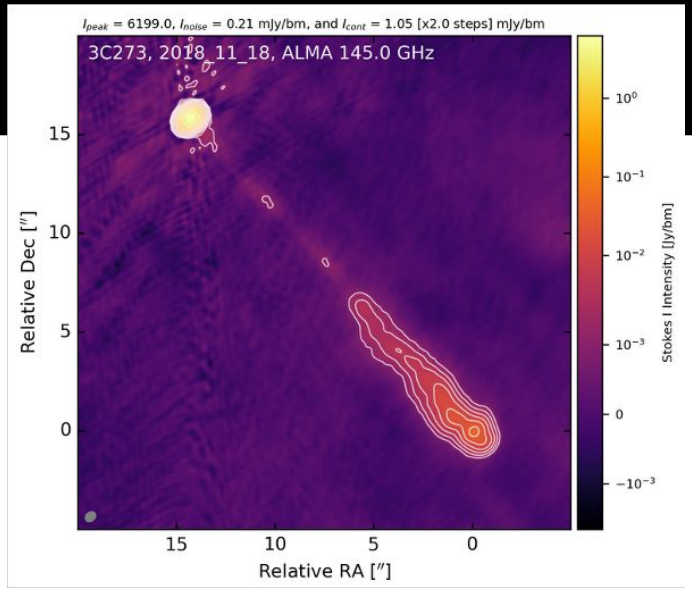


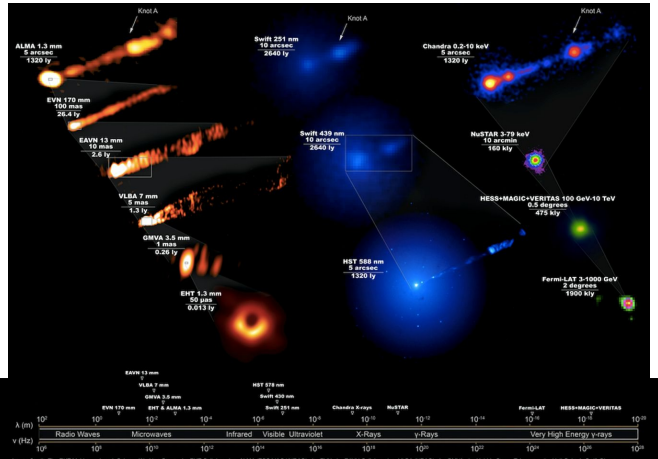
3C273 at the Highest Resolutions

Britton Jeter, Tuomas Savolainen, Talvikki Hovatta, EHTC
FINCA, Metsähovi Radio Observatory
Nordic Baltic Astronomy Days
May 28, 2026

Relativistic Jets

- Some (~10%) of AGN host extended, thin, relativistic jets
- Formation and structure likely driven by angular momentum exchange via magnetic fields in the immediate black hole environment
- Radio emission mostly from non-thermal synchrotron emission
- Exact details of particle content, energy distribution, fine magnetic field structure still poorly understood

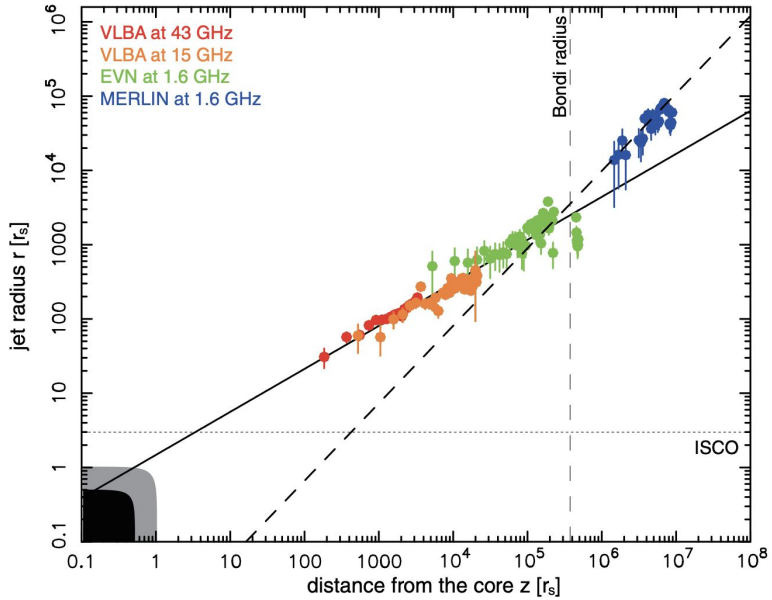




Hovatta et al. 2026 (submitted),
EHTC Multiwavelength Working Group et al 2021

Acceleration and Collimation Zone

- Outside the BH sphere of influence, jets are usually conical and (mostly) ballistic
- Within sphere of influence, winding magnetic fields actively collimate and accelerate the jet
- Different models for the magnetic environment near the BH horizon produce strong predictions for upstream acceleration and collimation profiles



Asada & Nakamura 2012

Exploring the ACZ

- Polarization information breaks observational degeneracies for estimating particle content and magnetic field properties
- Rotation Measure directly related to electron density and magnetic field strength
- Observations in the ACZ probe features connected to jet launch site (BH horizon)

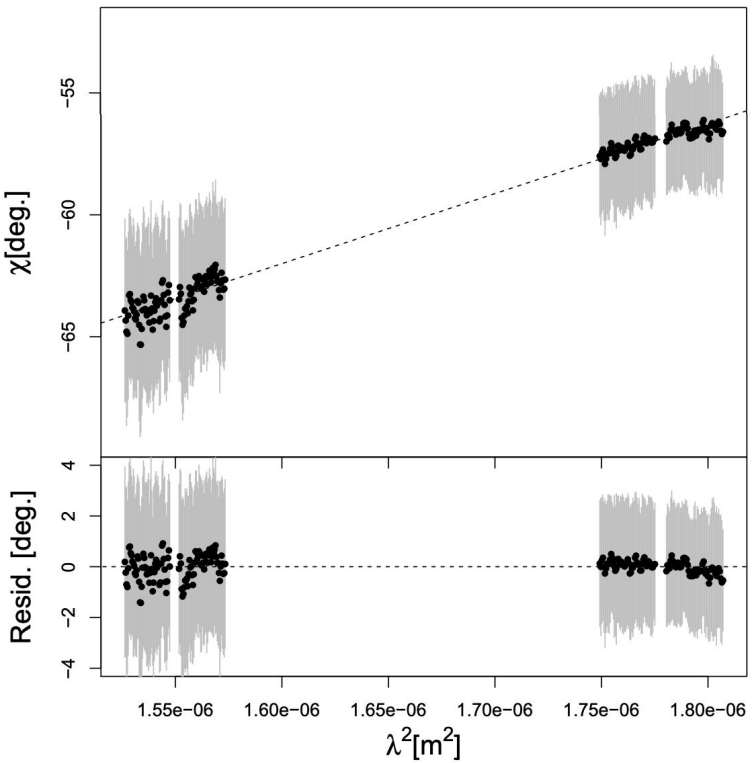
Total intensity emission

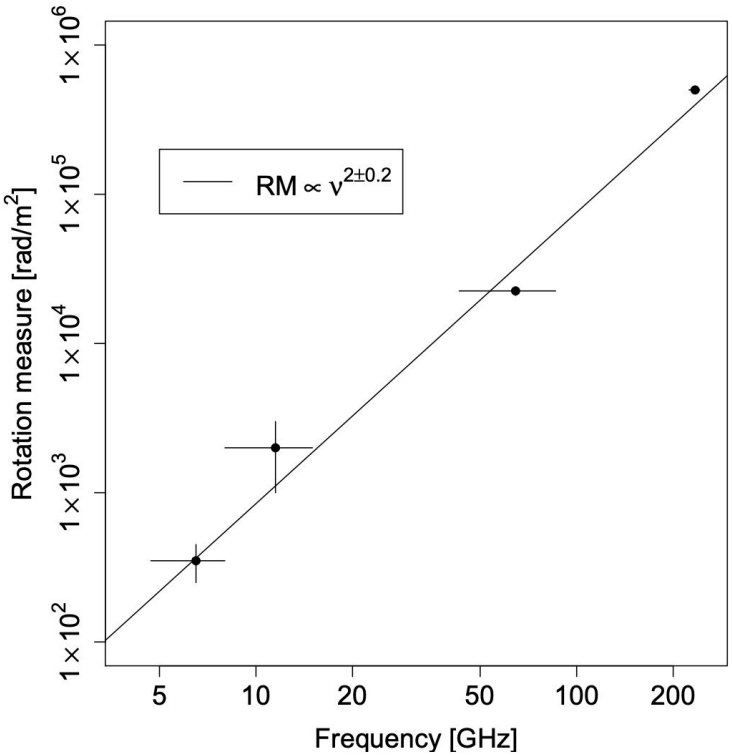
$$\mathrm{J}_I \propto n_e B^2$$

Faraday Rotation

$$\mathrm{RM} = 0.81 \int n_e \mathbf{B} \cdot \mathrm{d}\mathbf{l}\ \mathrm{rad\,m^{-2}}.$$

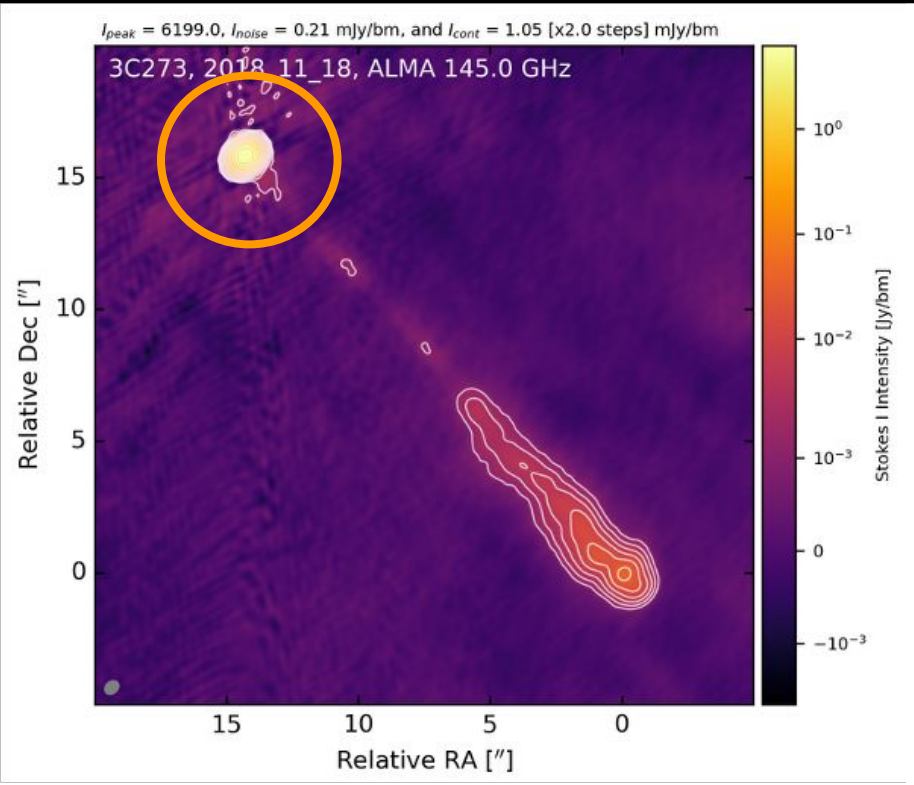
RM in 3C273

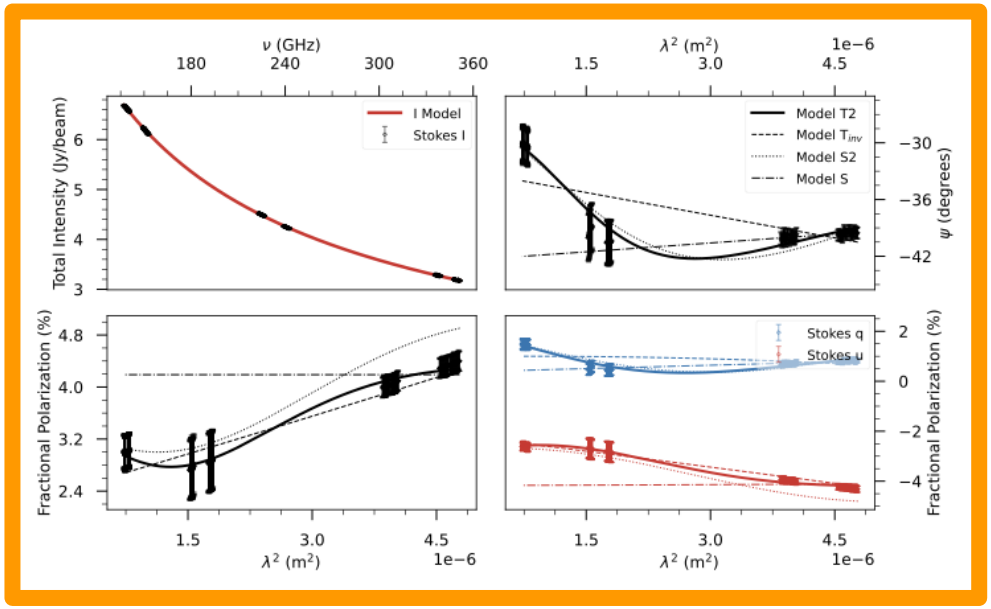




RM_{230} = 5x10^5 rad m^{-2}; Hovatta + 2019

ALMA Observations: Hovatta+ 2026

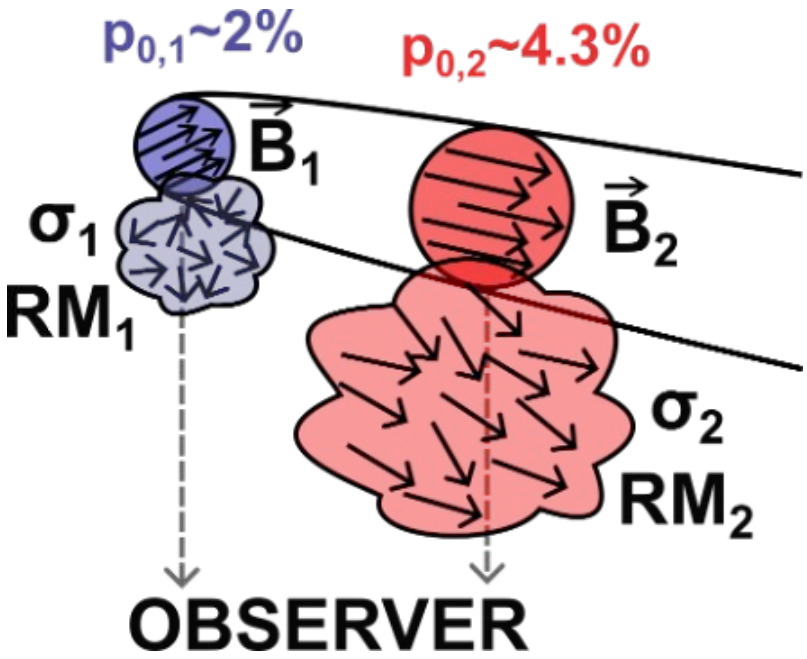




Multiple models fit unresolved core

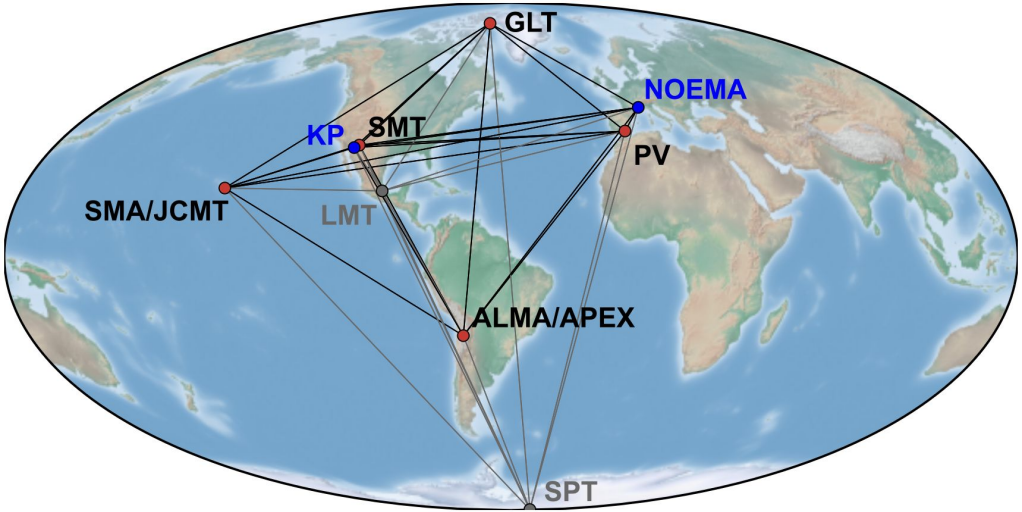
Resolving the Rotation Measure

- Constrain the magnetic field strength and geometry of 3C273 at ~10μas scales using EHT observations at 230 GHz (1.3 mm)
- Leverage large bandwidths to generate resolved rotation measure maps spanning Δv~15 GHz
  - Is the Faraday rotation internal or external?
- Compare against GRMHD simulations to constrain field structure and particle content-break $B*n_e$ degeneracy



Status of Observations

- EHT is a very “fun” array: two different polarization bases, three frequency standards, sparse coverage but high SNR, 11 (13) telescopes at 9 (11) geographic locations from Greenland to Antarctica



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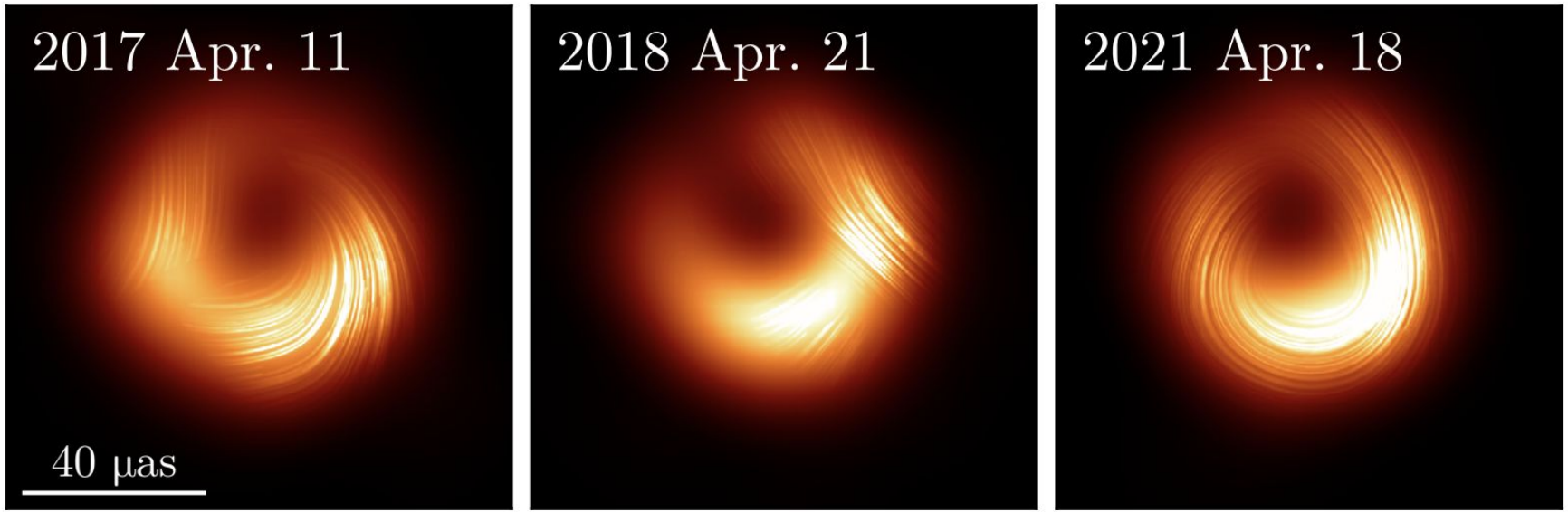
Event Horizon Telescope



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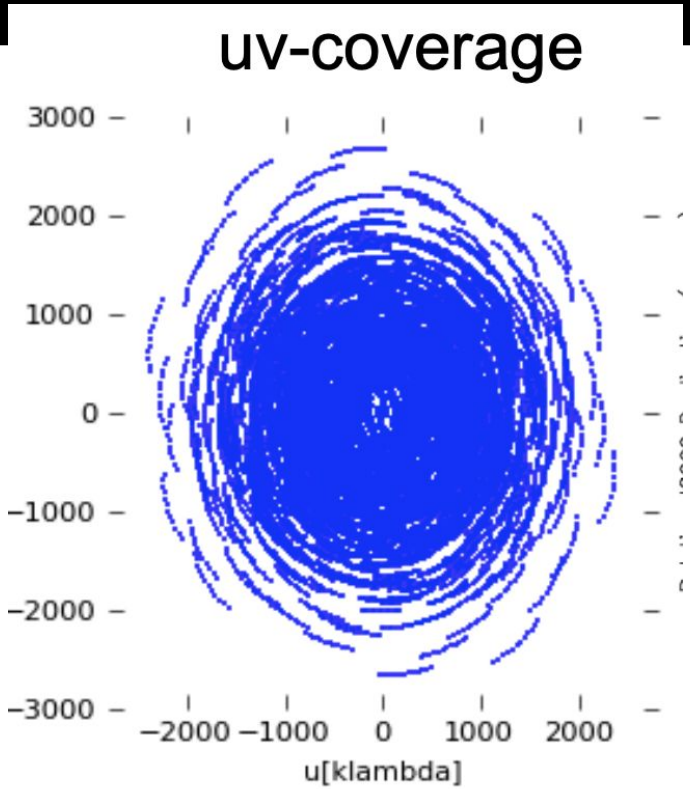

April 18, 2021 Coverage

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April 18, 2021 Coverage

Status and Outlook

- Calibrator tracks are almost ready for imaging/analysis: only require minor flagging and postprocessing (but sparse coverage)

- PI track needs special care: suboptimal weather, and ALMA calibration has errors due to unconventional observation setup (can be fixed!)

- EHT observes 3C273 every year since 2021 as a calibrator, so future projects can explore year-to-year variability