Modeling the Multi-Wavelength Signature of Sagittarius A*

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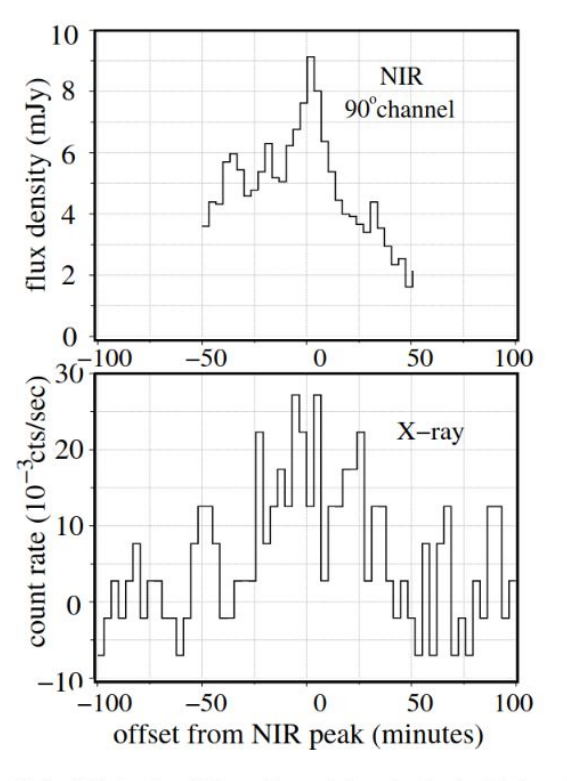
Event Horizon Telescope

BRING SPACE

THE A. G. LEVENTIS FOUNDATION

Modeling the Multi-Wavelength Signature of Sagittarius A*



Eckart et al. 2007

- ★ Near-Infrared flares occur several times a day
- ★ A fraction of NIR flares are followed by an X-ray counterpart
- ★ Image: 30 May 2005 flare

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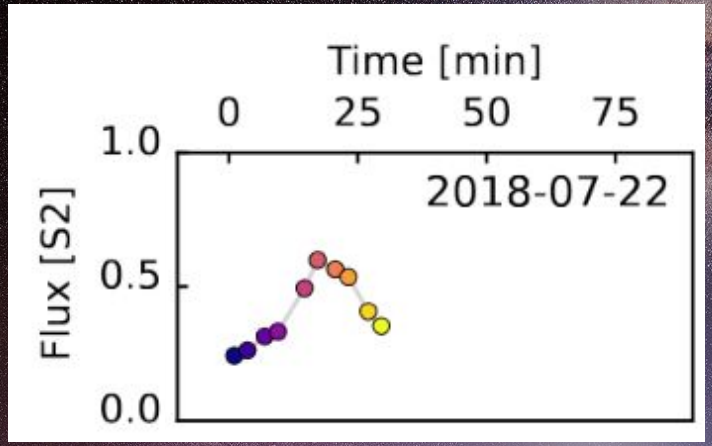
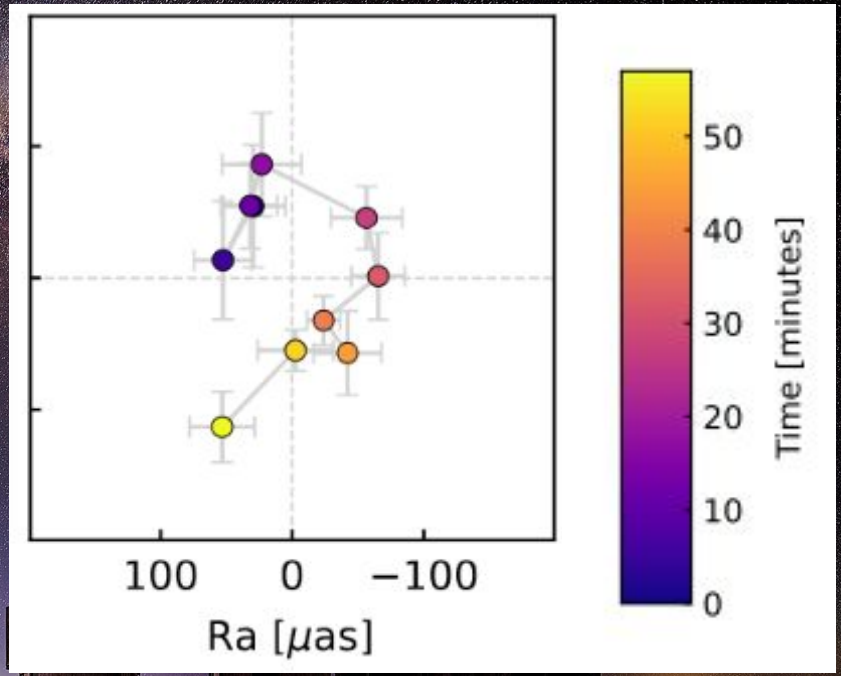


GRAVITY Collaboration 2018



GRAVITY Collaboration 2023

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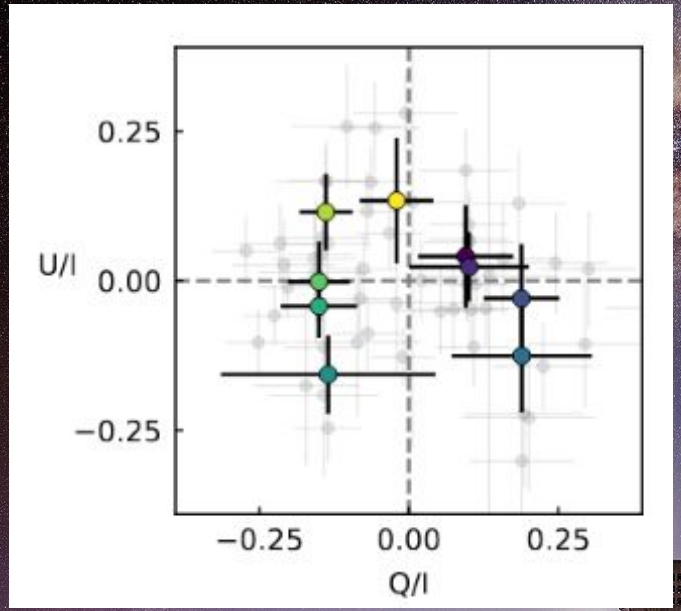

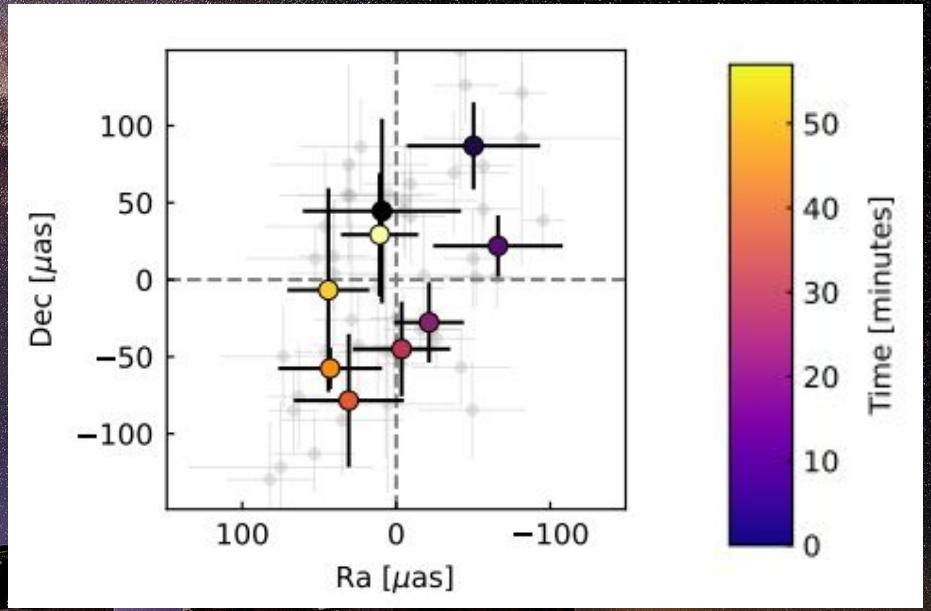

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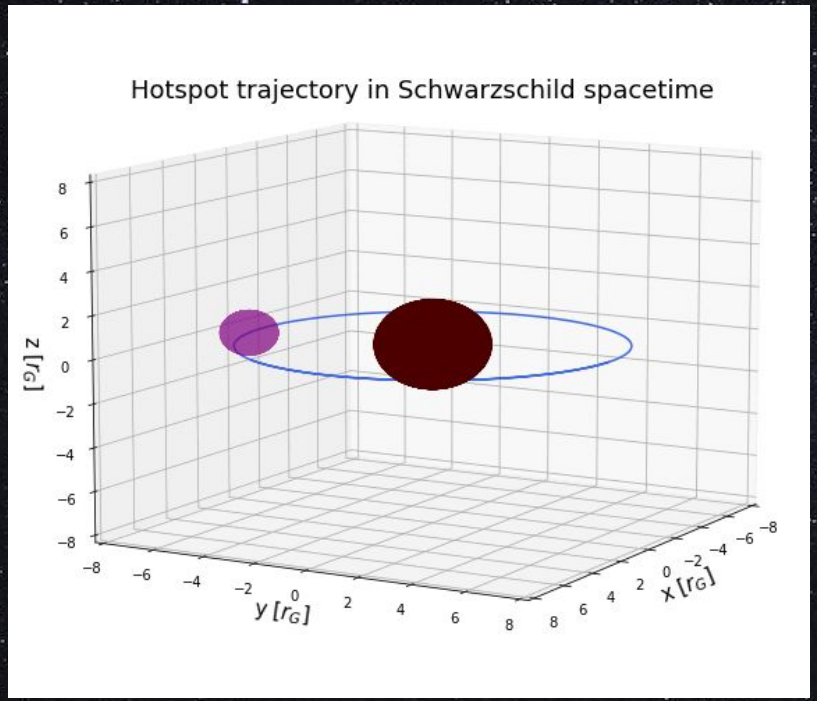
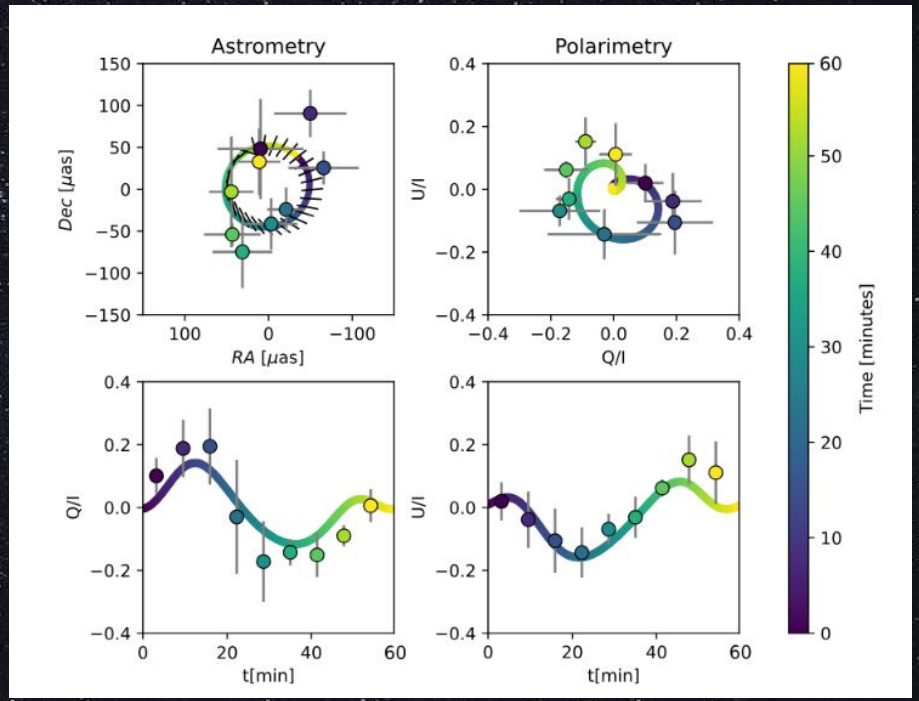


Antonopoulou & Nathanail 2024



GRAVITY Collaboration 2023

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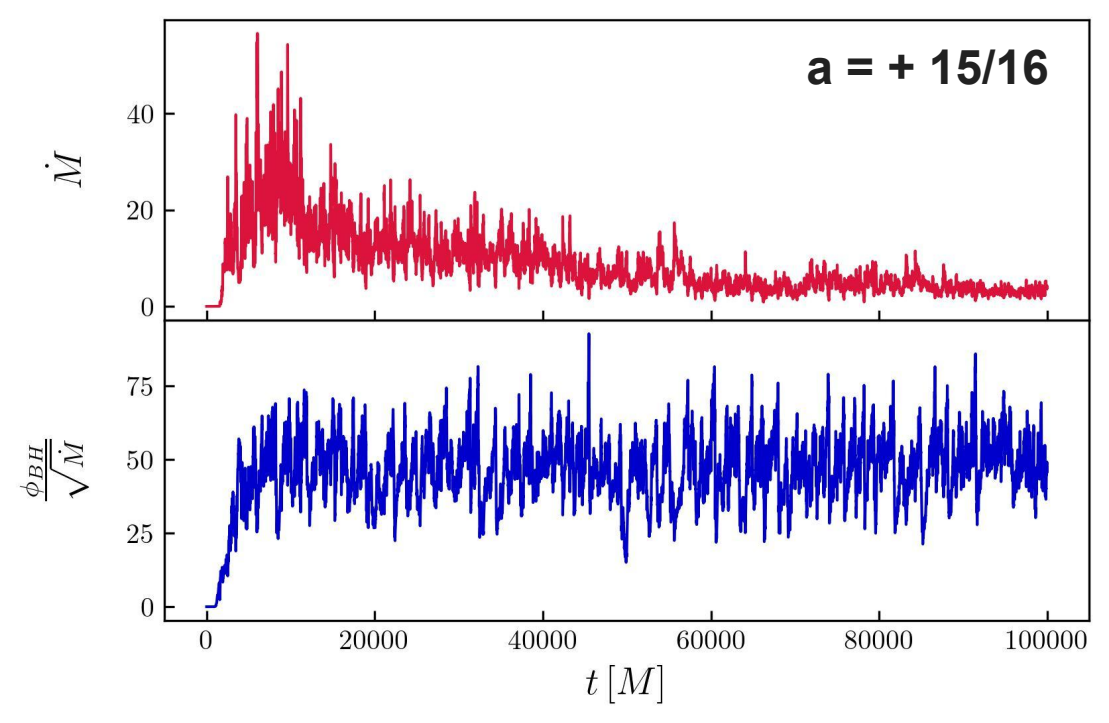
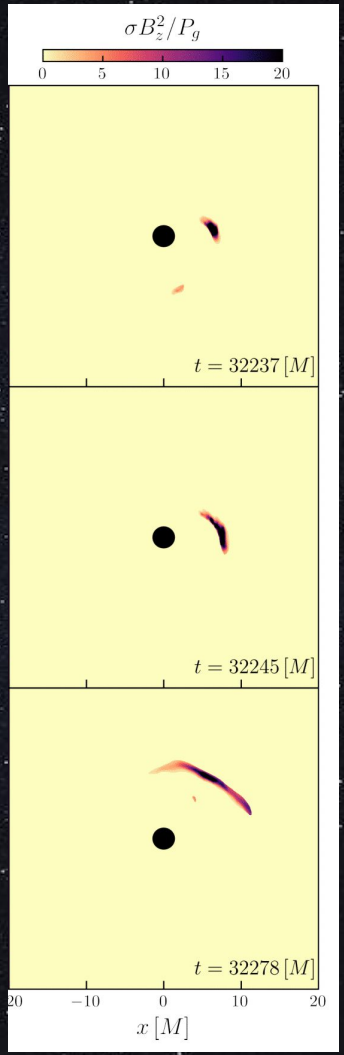
Antonopoulou, Loules, Nathanail 2025





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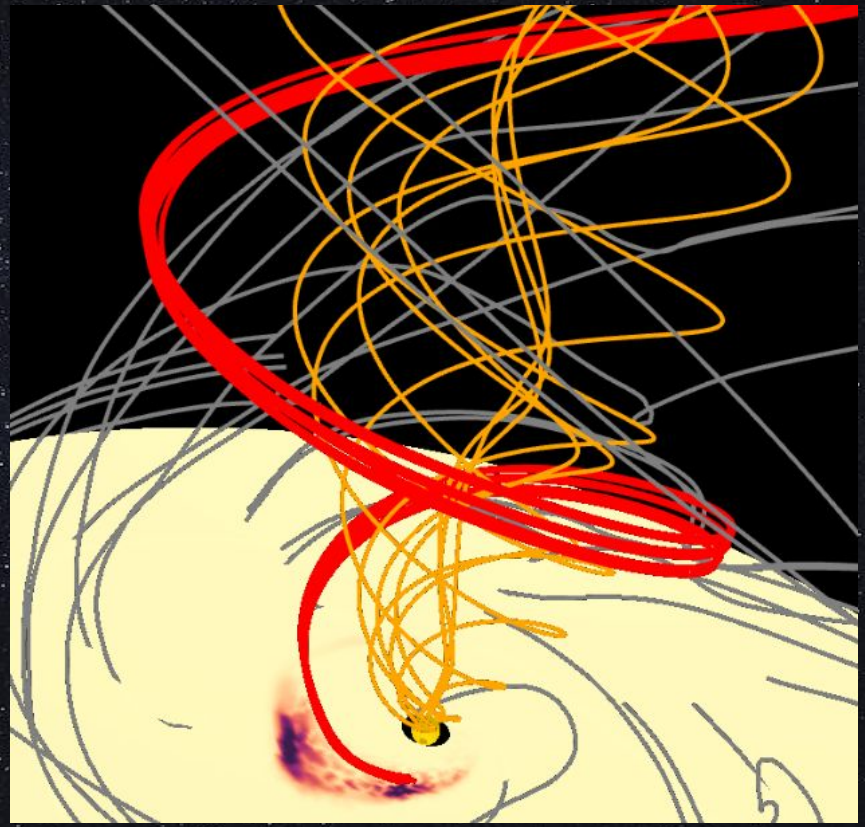
We examine the 3D morphology of the energetic flux tubes generated during a promient flux eruption event

Newly generated flux bundles

Disk's magnetic field lines

Magnetized funnel field lines



Antonopoulou, Loules, Nathanail 2025

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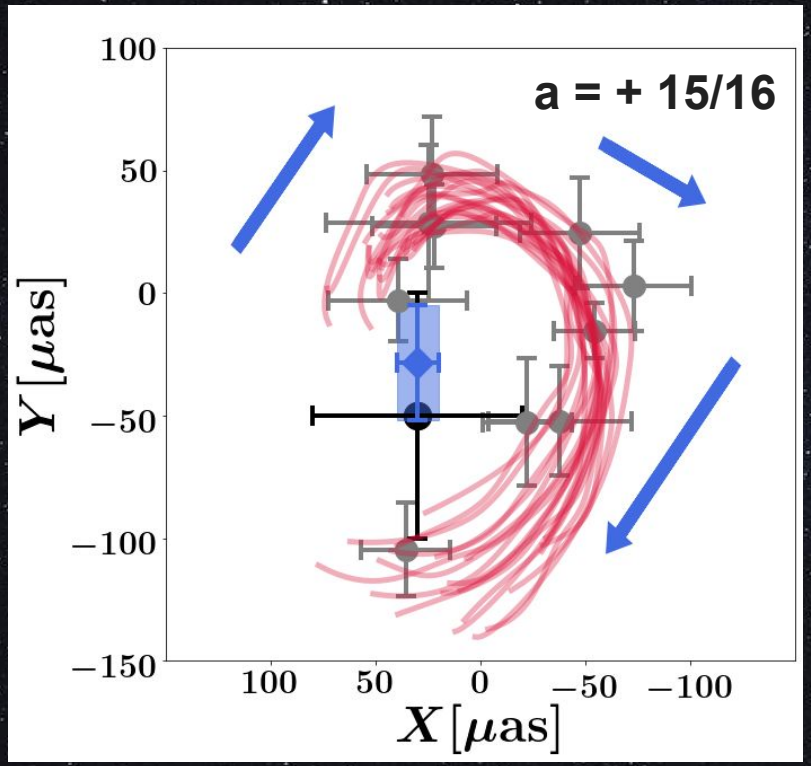
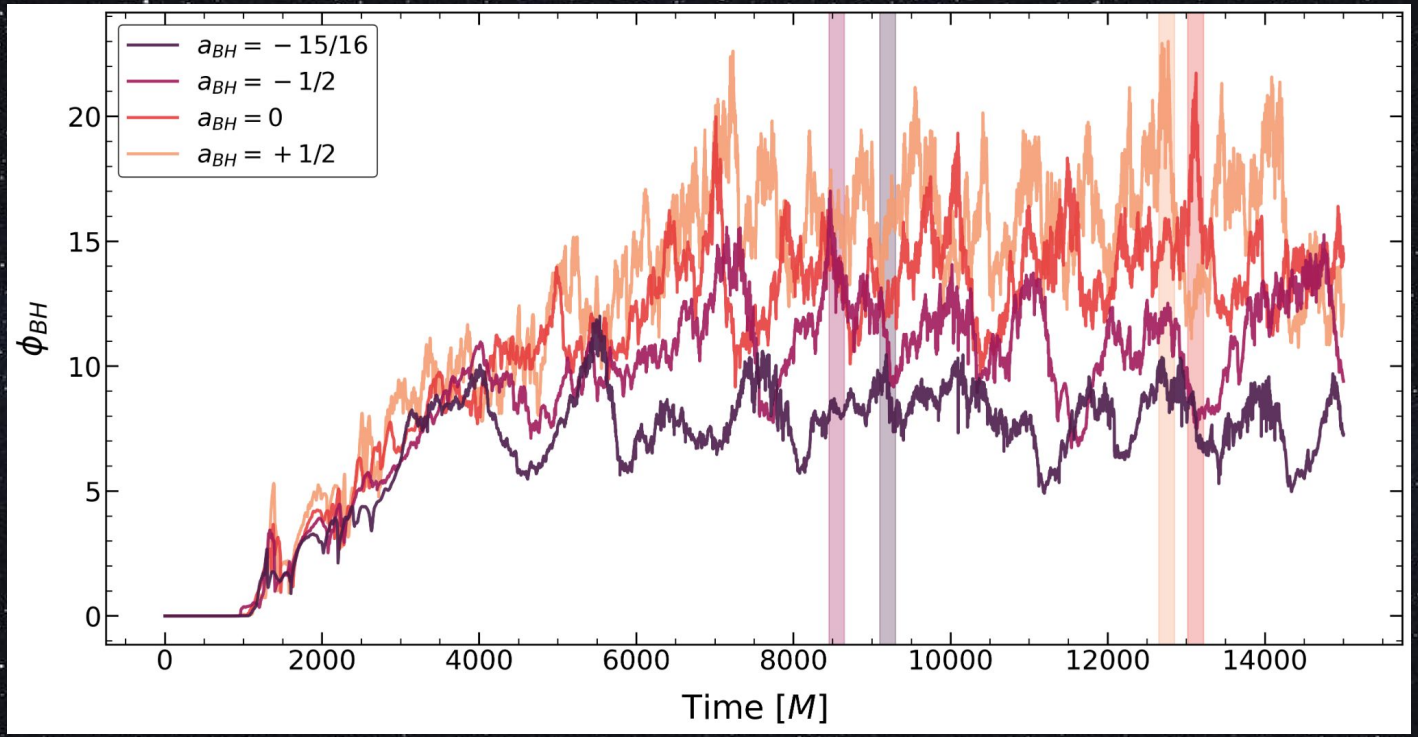


Antonopoulou, Loules, Nathanail 2025

- Flux tube: counterclockwise motion, counterclockwise field lines & upward trend
- Hot spot: moves along the clockwise field lines & continuously gains height
- Hot spots with a relativistic ejection velocity balance out the drag of the accretion flow and move clockwise in the sky

Modeling the Multi-Wavelength Signature of Sagittarius A*



Antonopoulou, Nathanail, Mizuno, Zanias in prep

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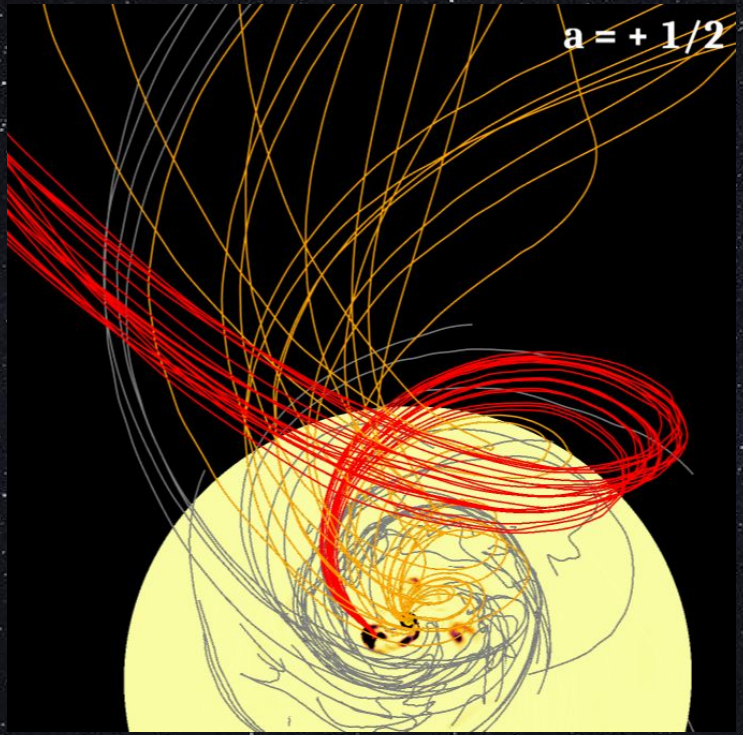

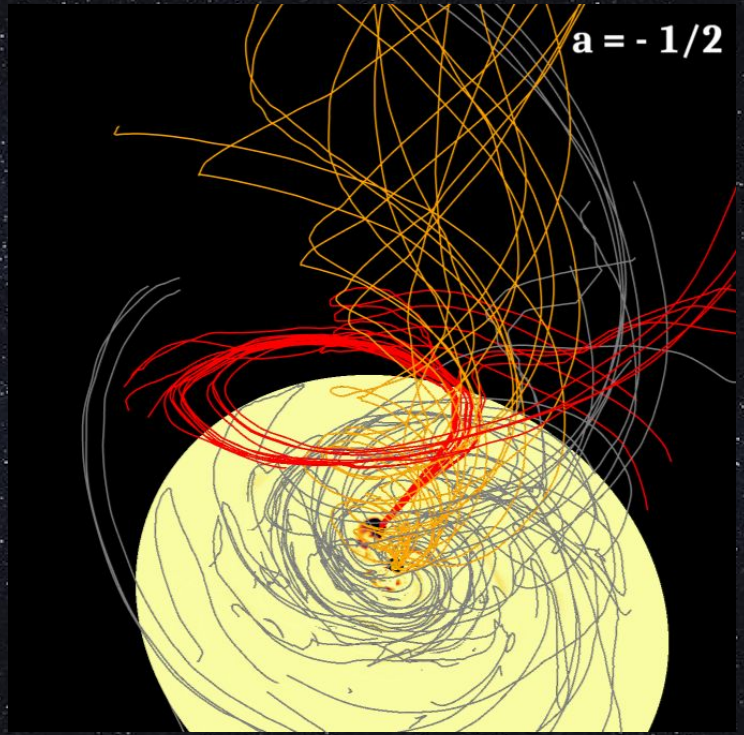

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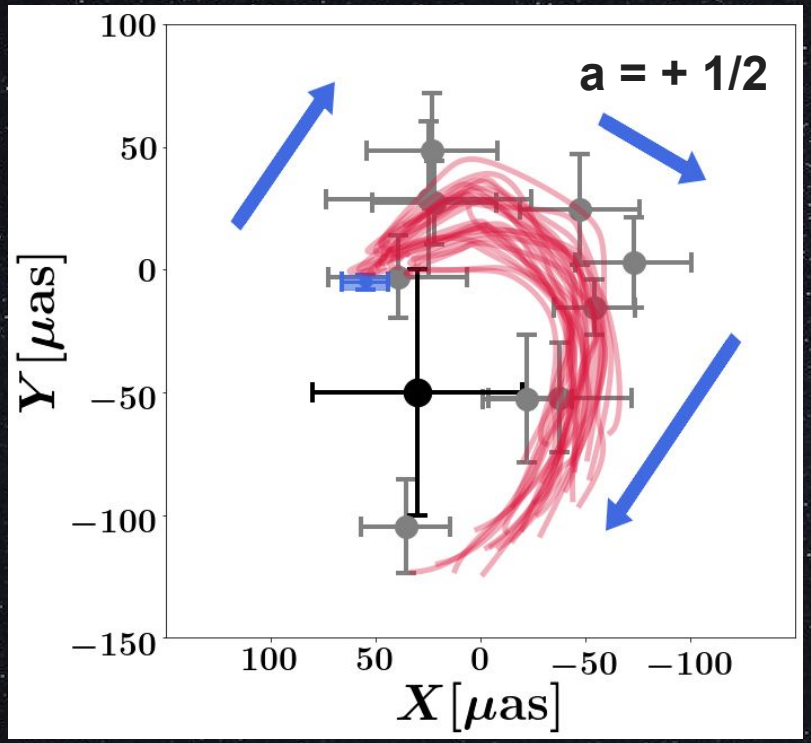

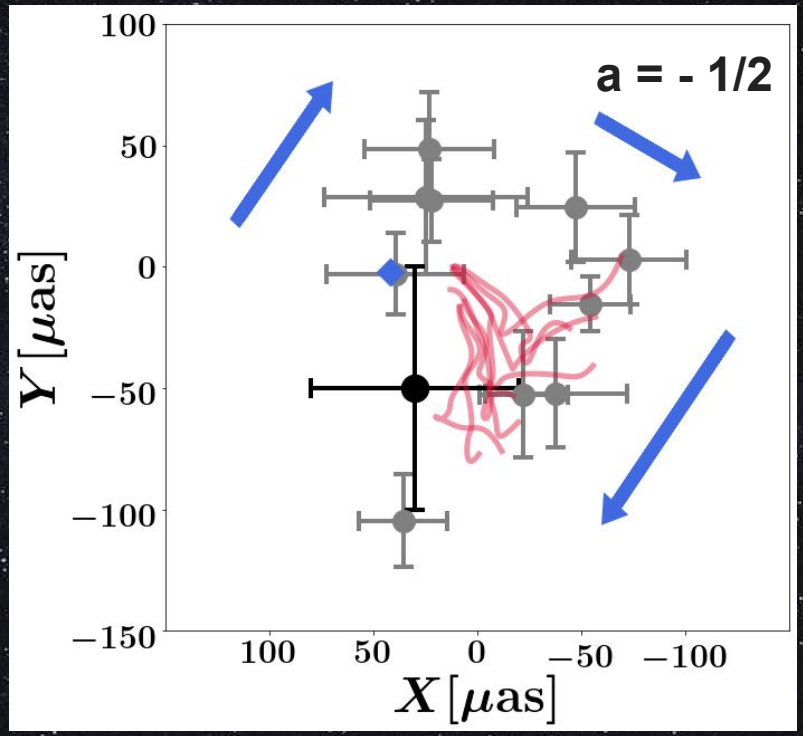

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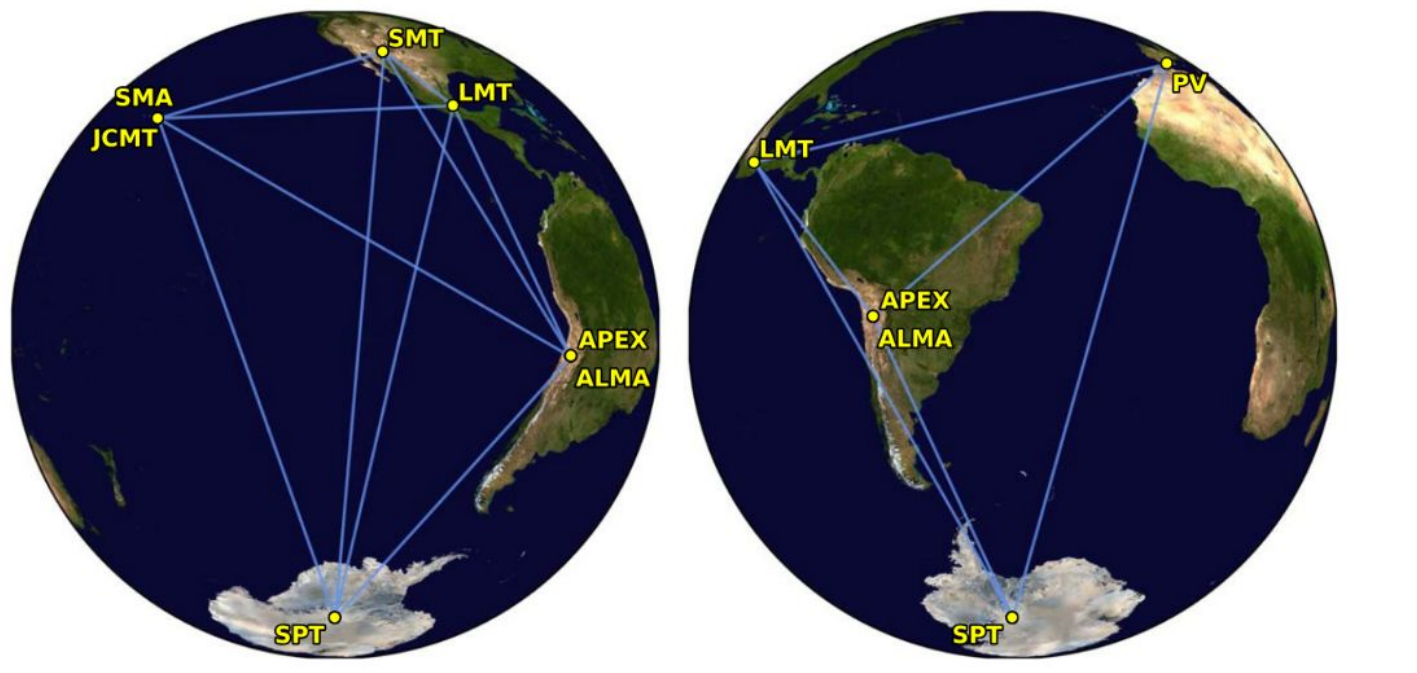
E.H.T. Collaboration 2022



Global interferometric EHT array in 2017 consisting of eight telescopes operating at λ = 1.3 mm

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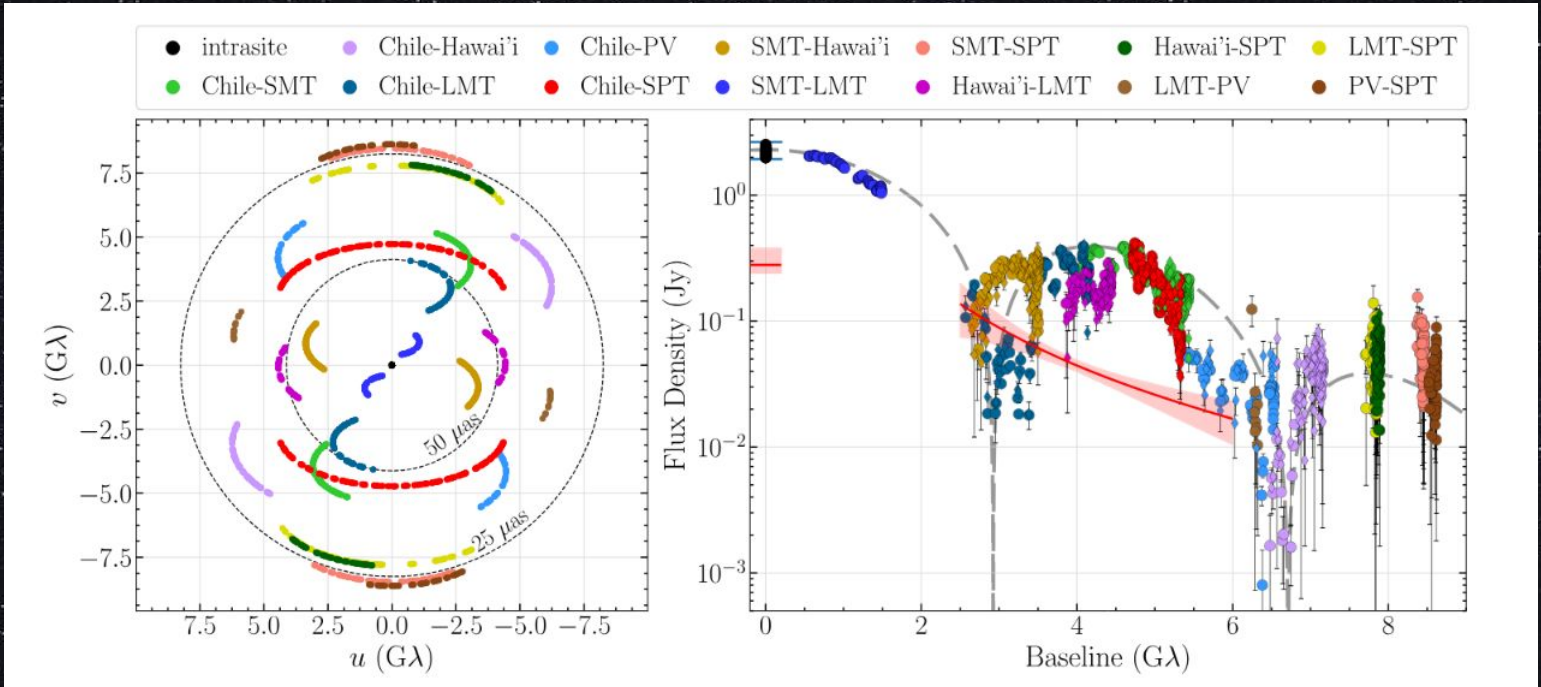

EHT baseline coverage and interferometric visibility amplitudes for SgrA*

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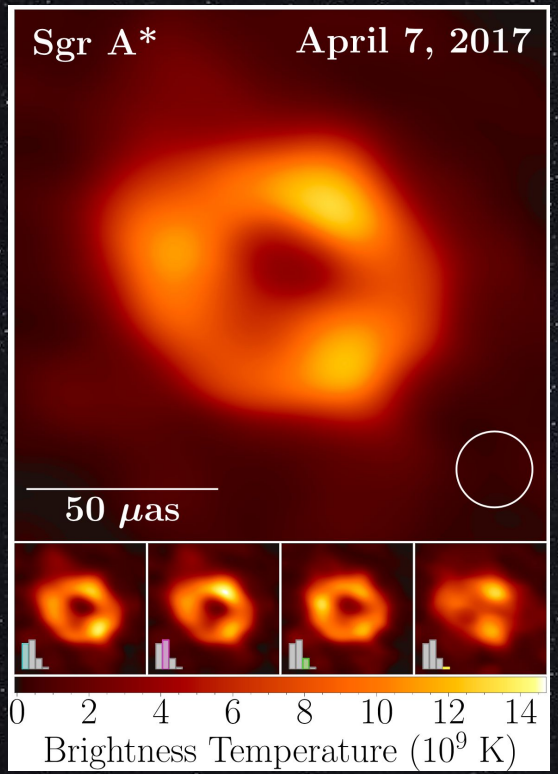

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- ★ Bright ring morphology
- ★ Diameter: 51.8 ± 2.3 μas
- ★ Azimuthal brightness asymmetry
- ★ Small light curve variability

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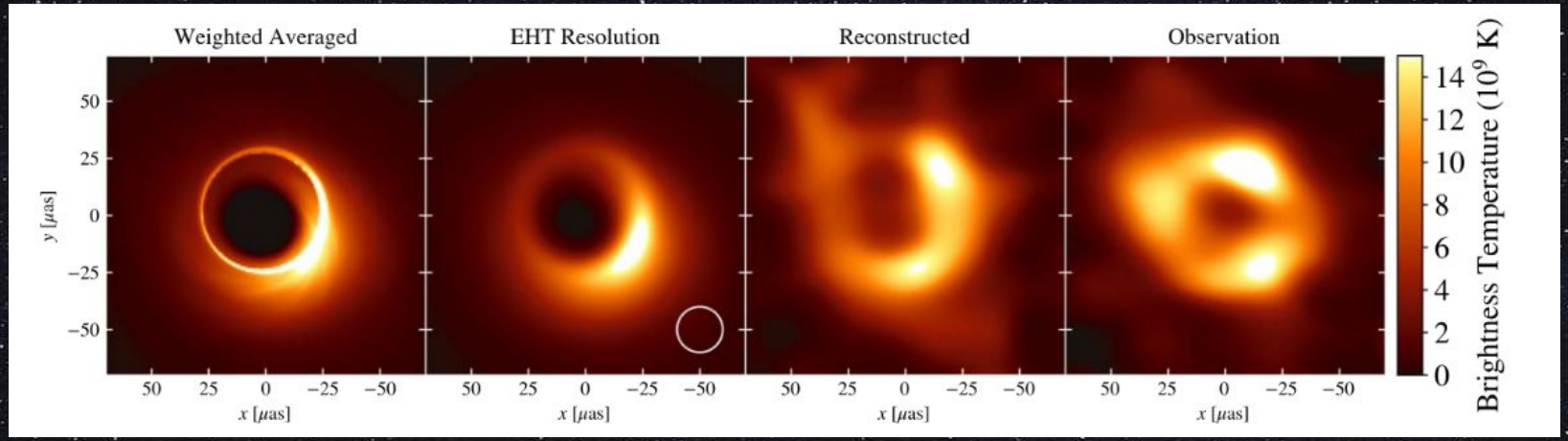

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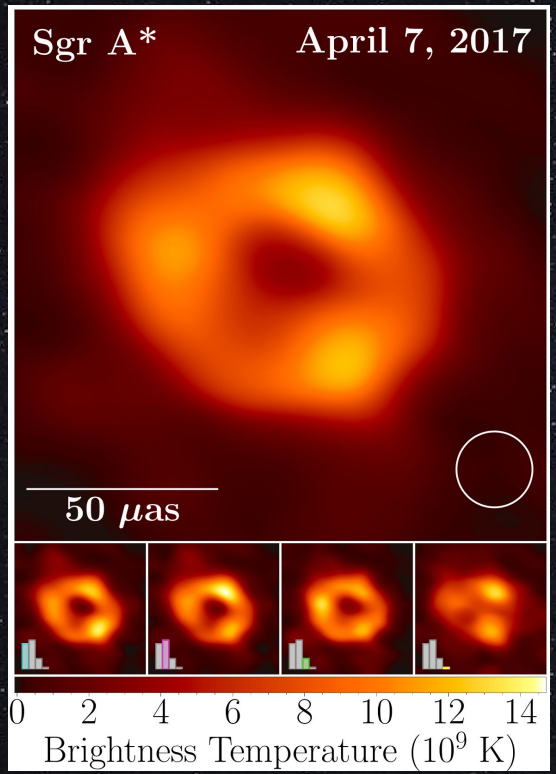

Constraint/Model	Thermal
230 GHz size	0.98
VA morphology	0.83
M-ring diameter	0.65
M-ring width	0.21
M-ring asym.	0.95
86 GHz flux	0.68
86 GHz size	0.59
2.2 μm flux	0.55
X-ray flux	0.70
Light-curve variability	0.27
4 Gλ variability	0.72
EHT constraints	0.19
Non-EHT constraints	0.19
Variability constraints	0.27

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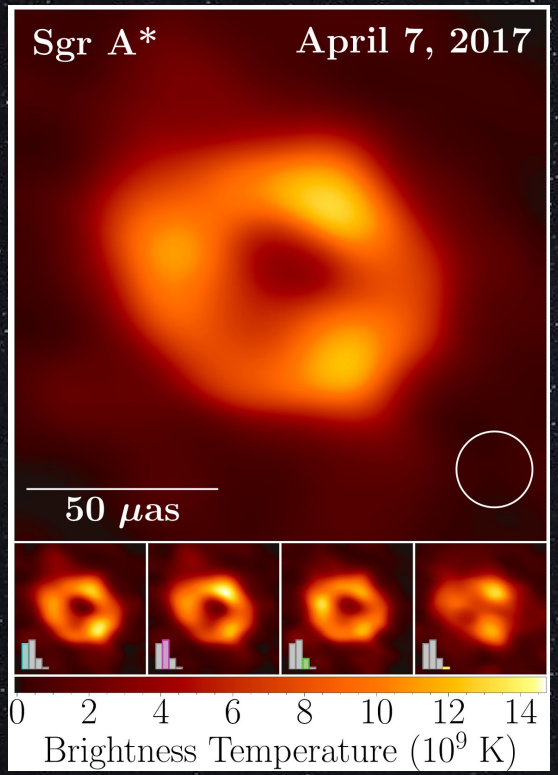

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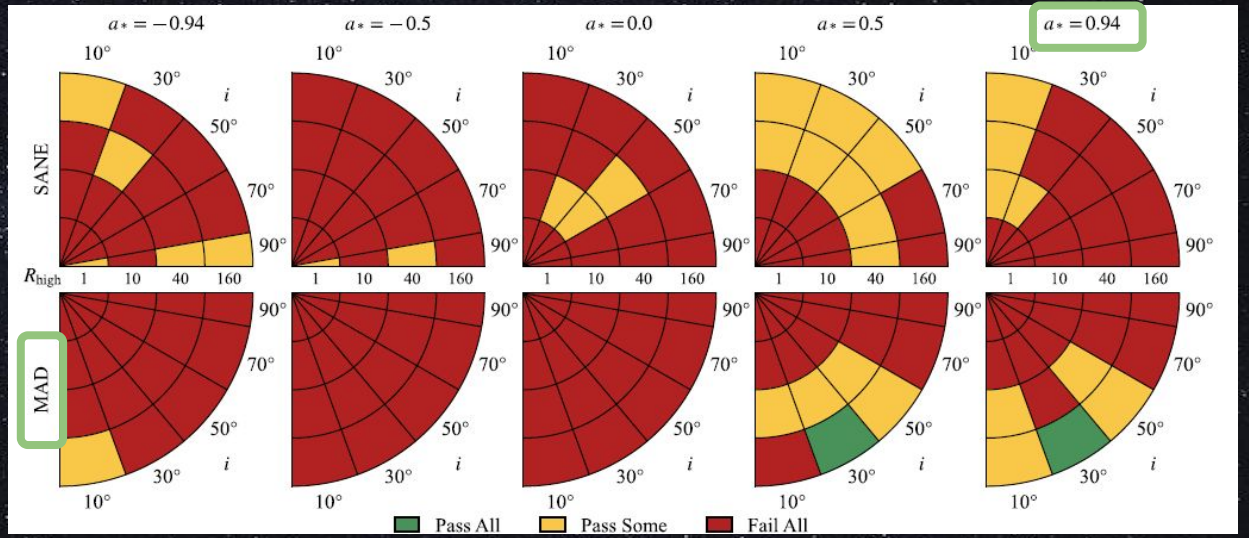
Best-bet region



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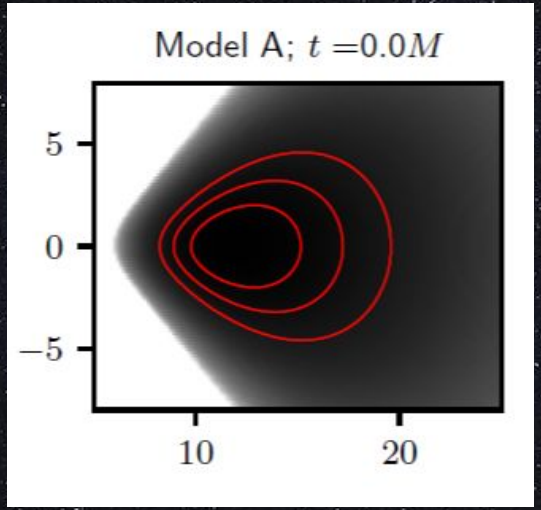
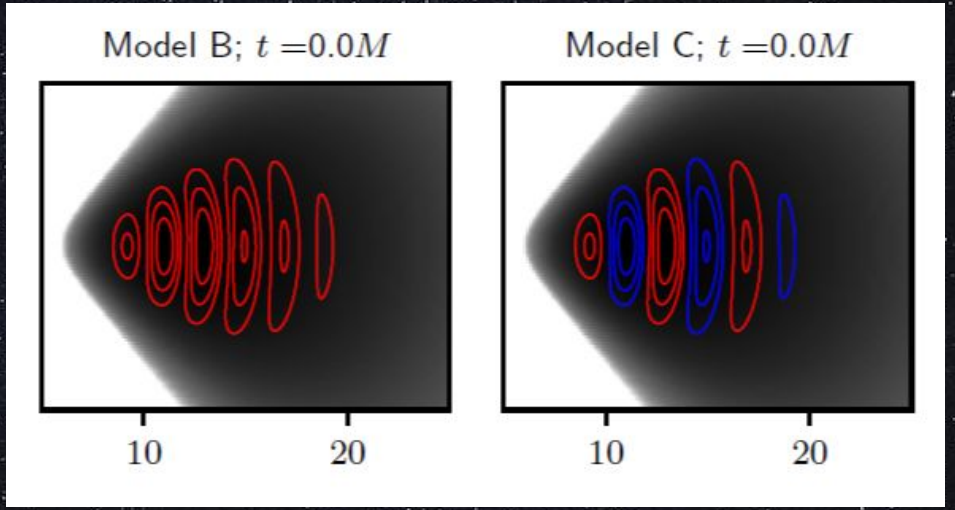
MAD



Multi-loop



Nathanail et al. 2020

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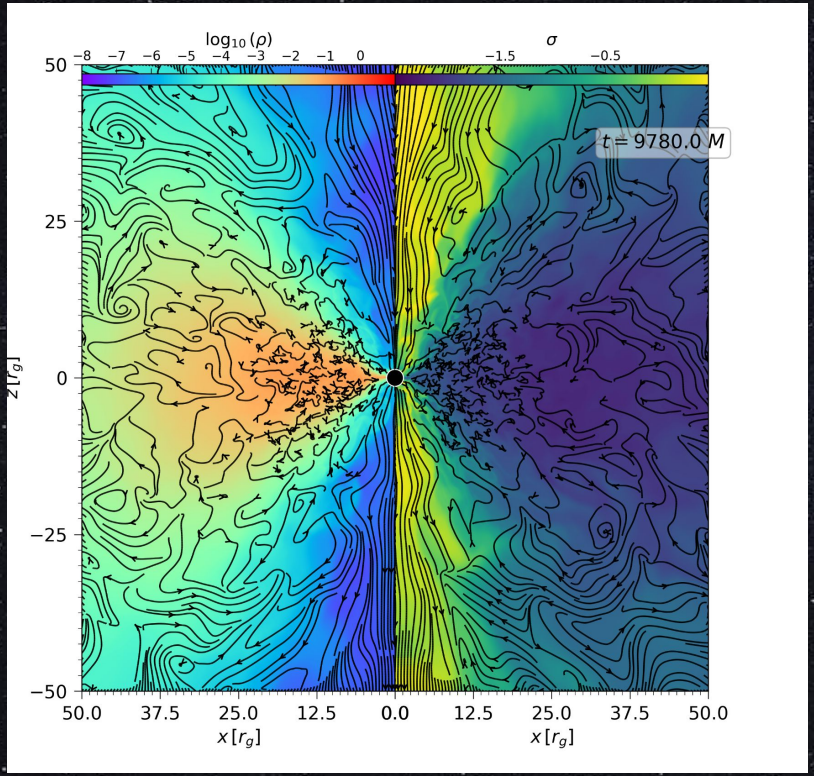
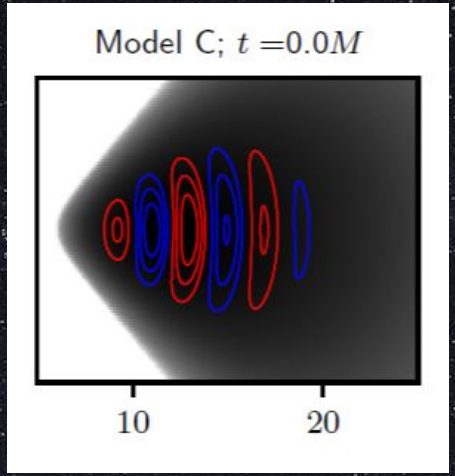


Antonopoulou, Nathanail, Stanway+ in prep



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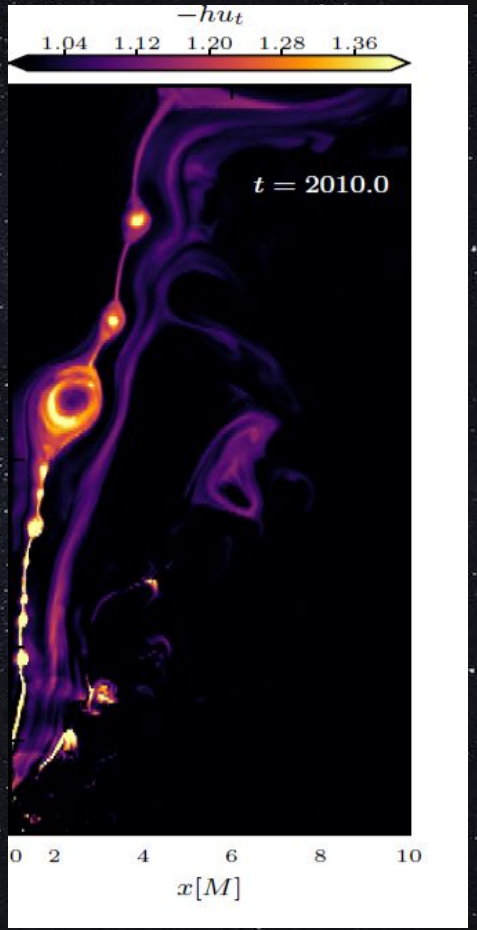

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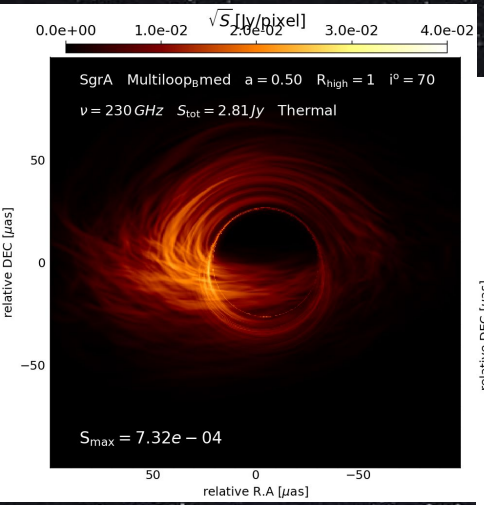

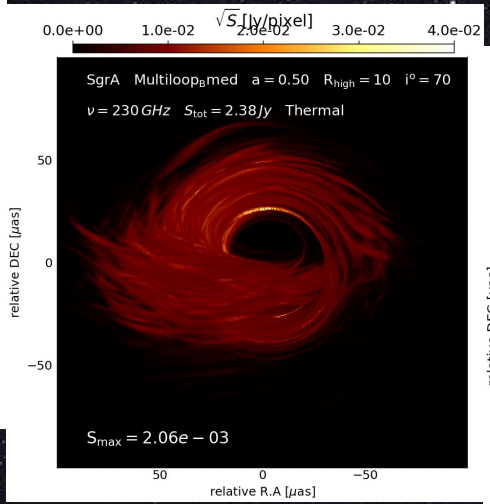

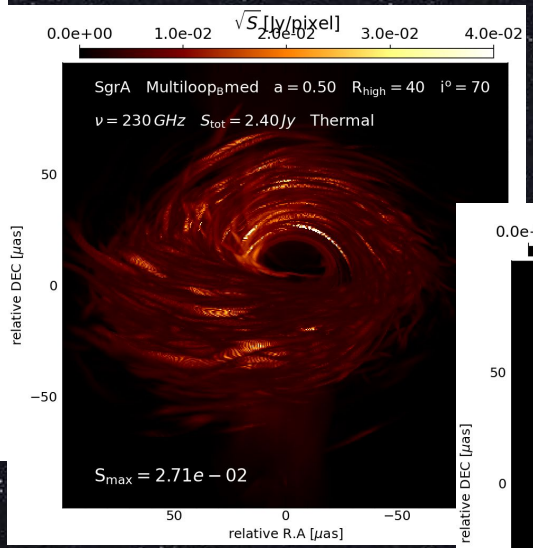

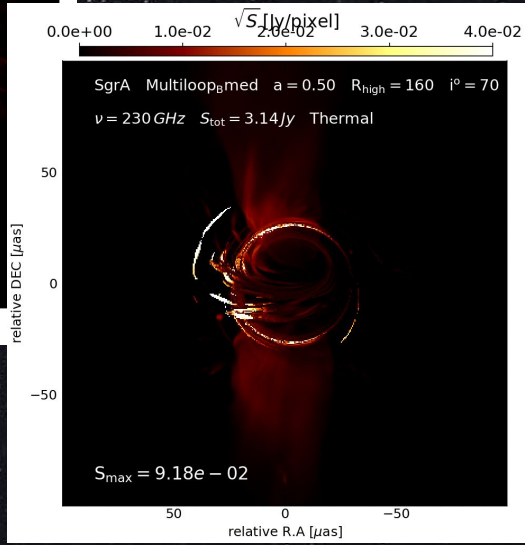

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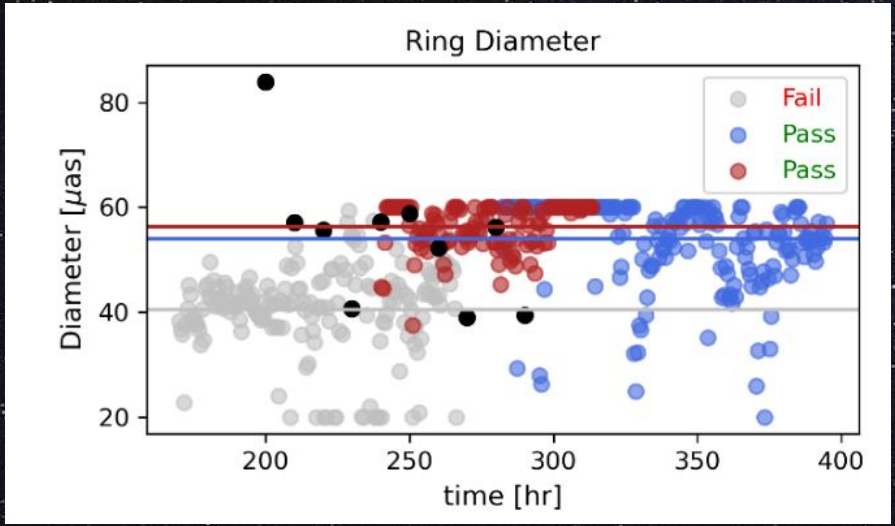

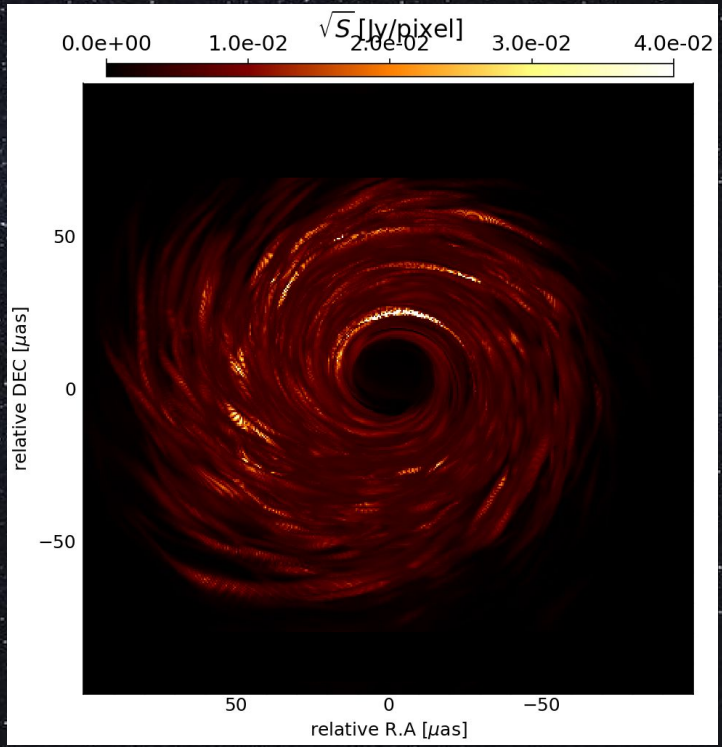

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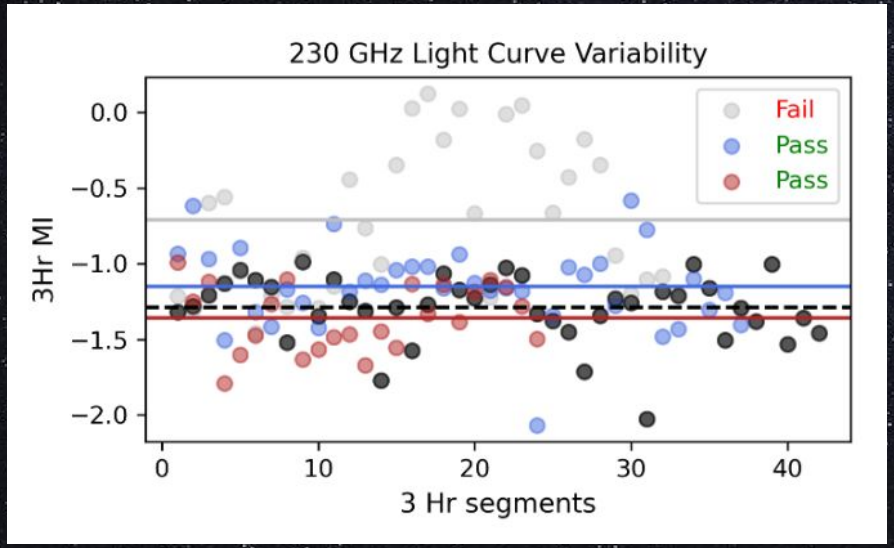

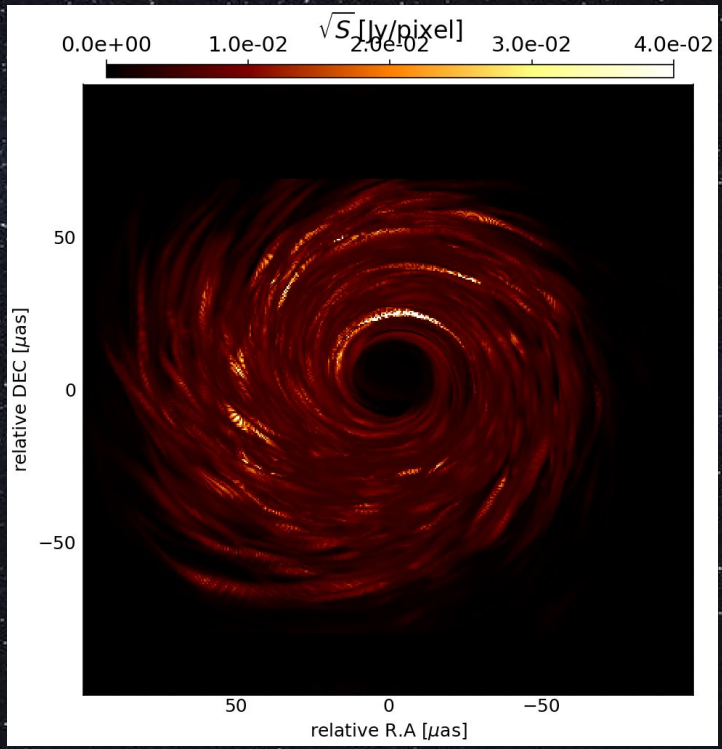

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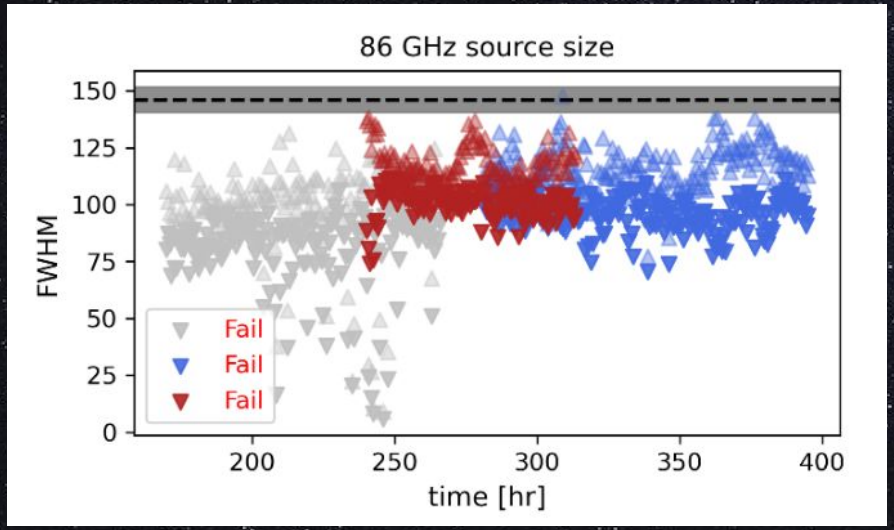

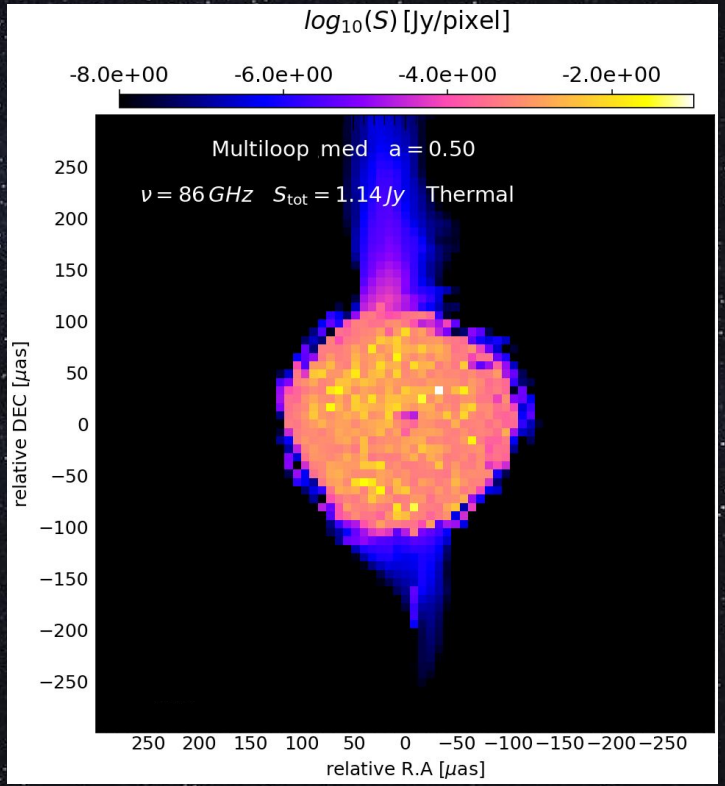

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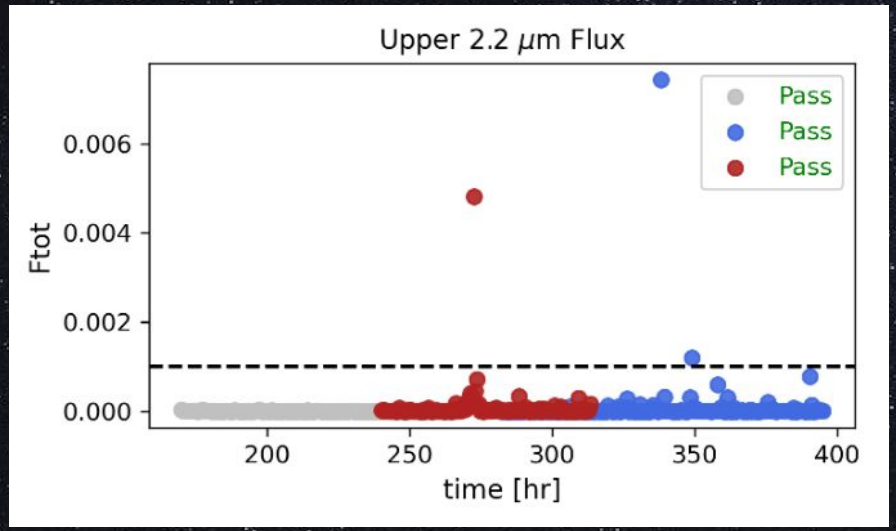

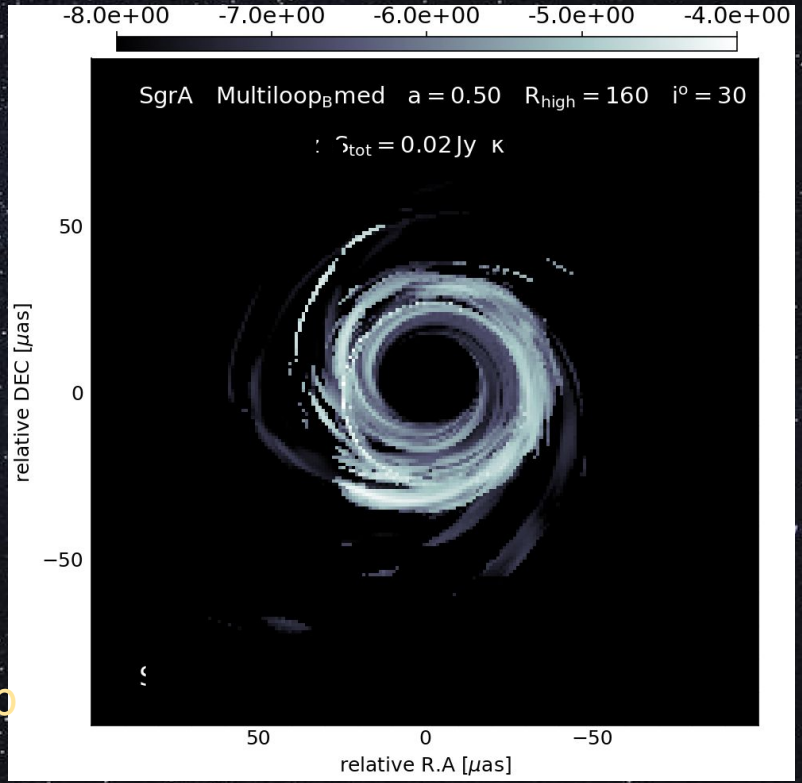

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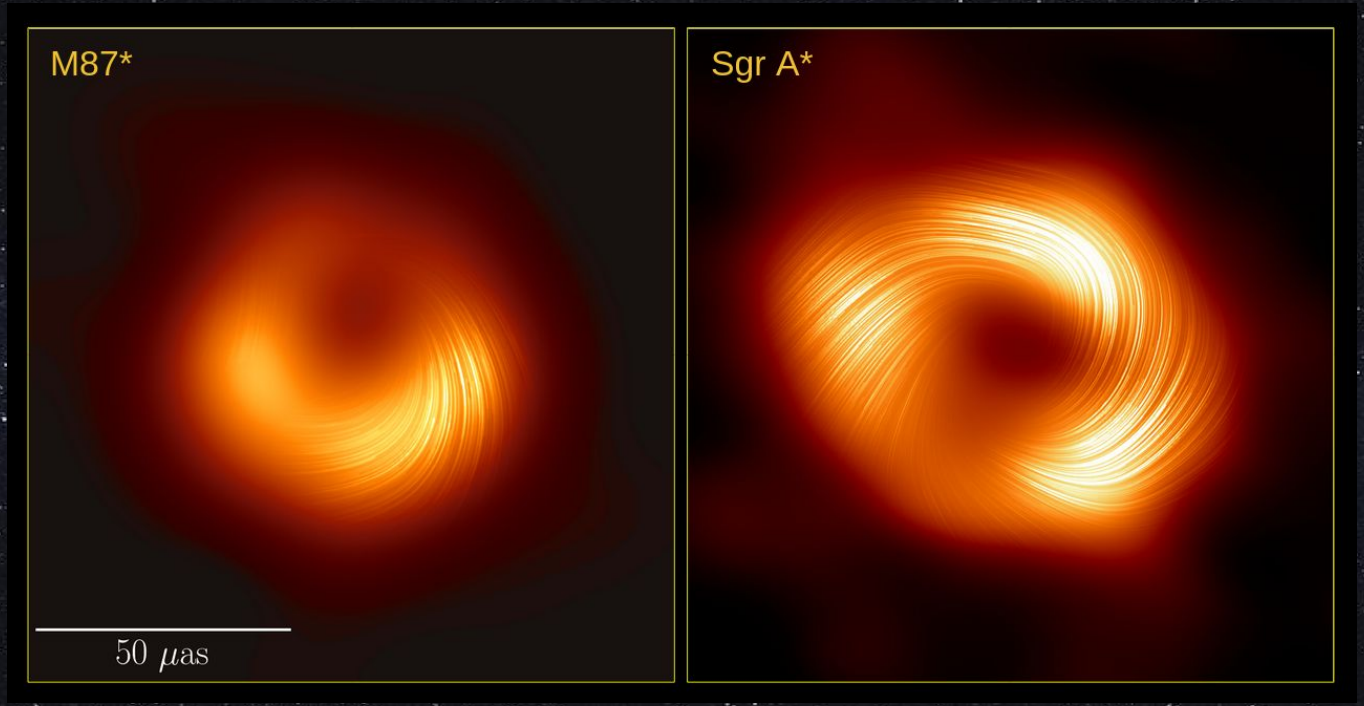

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Consistency with General Relativity over three orders of magnitude in central mass

Modeling the Multi-Wavelength Signature of Sagittarius A*

E.H.T. Collaboration 2025

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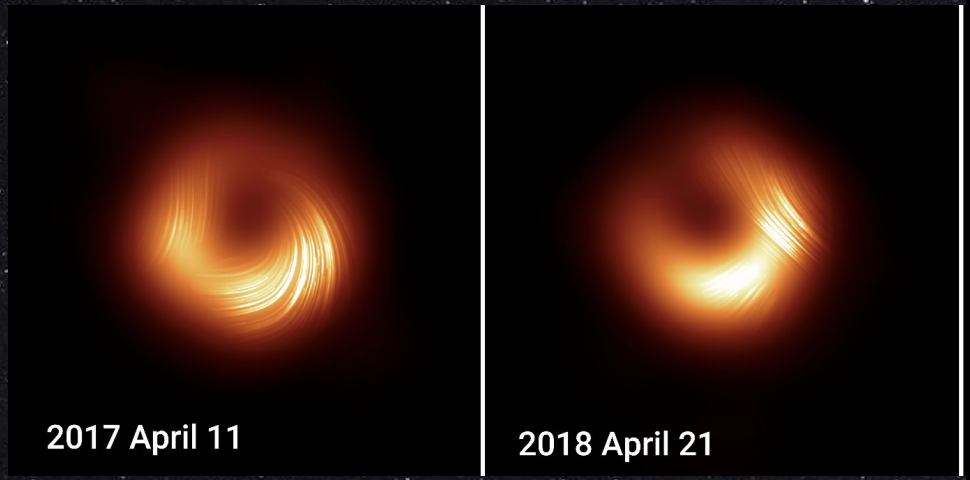

E.H.T. Collaboration 2025

Conclusions

- ★ Frequent NIR and Xray flares in the Galactic center
- ★ NIR astrometry and polarimetry: GRAVITY
- ★ MAD flux eruptions provide promising candidates to reproduce the observed flaring behavior
- ★ EHT radio observations provide the first ever image of a supermassive black hole
- ★ Multi-loop models show promising characteristics and reduced light curve variability