

Title: H0 from intensity interferometry

Speakers: Marios Galanis

Collection/Series: Future Prospects of Intensity Interferometry

Subject: Cosmology

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URL: <https://pirsa.org/24110042>

H_0 from Intensity Interferometry on AGNs



Marios Galanis

Perimeter Institute

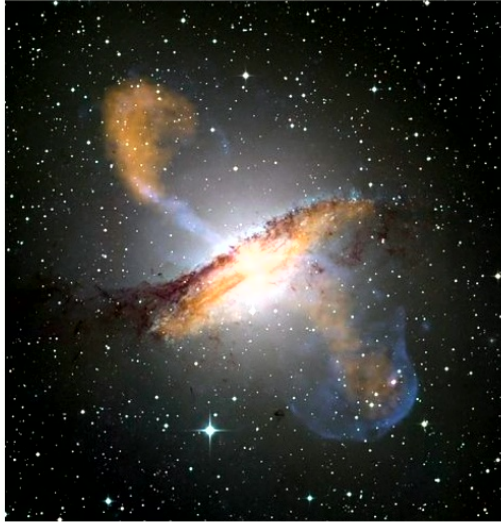
Based on: Phys. Rev. D 109, 123029, [arXiv:2403.15903](https://arxiv.org/abs/2403.15903)

with Neal Dalal (PI),

Charles Gammie (UIUC), Sam Gralla (University of Arizona), Norm Murray (CITA)

FPII - November 1, 2024

Active Galactic Nuclei



Supermassive Black Holes accreting gas

$\theta_{\text{ISCO}} \sim 0.02 - 0.2 \mu\text{as}$ Baseline $\sim 460 - 4000\text{km}$

$\theta_{\text{mean}} \sim 5 \mu\text{as}$ Baseline $\sim 20\text{km}$

Centaurus A

Two applications:

1. Resolve accretion disks of **nearby** AGNs and study their physics
2. Resolve the Broad Line Region of **distant** AGN and probe H_0

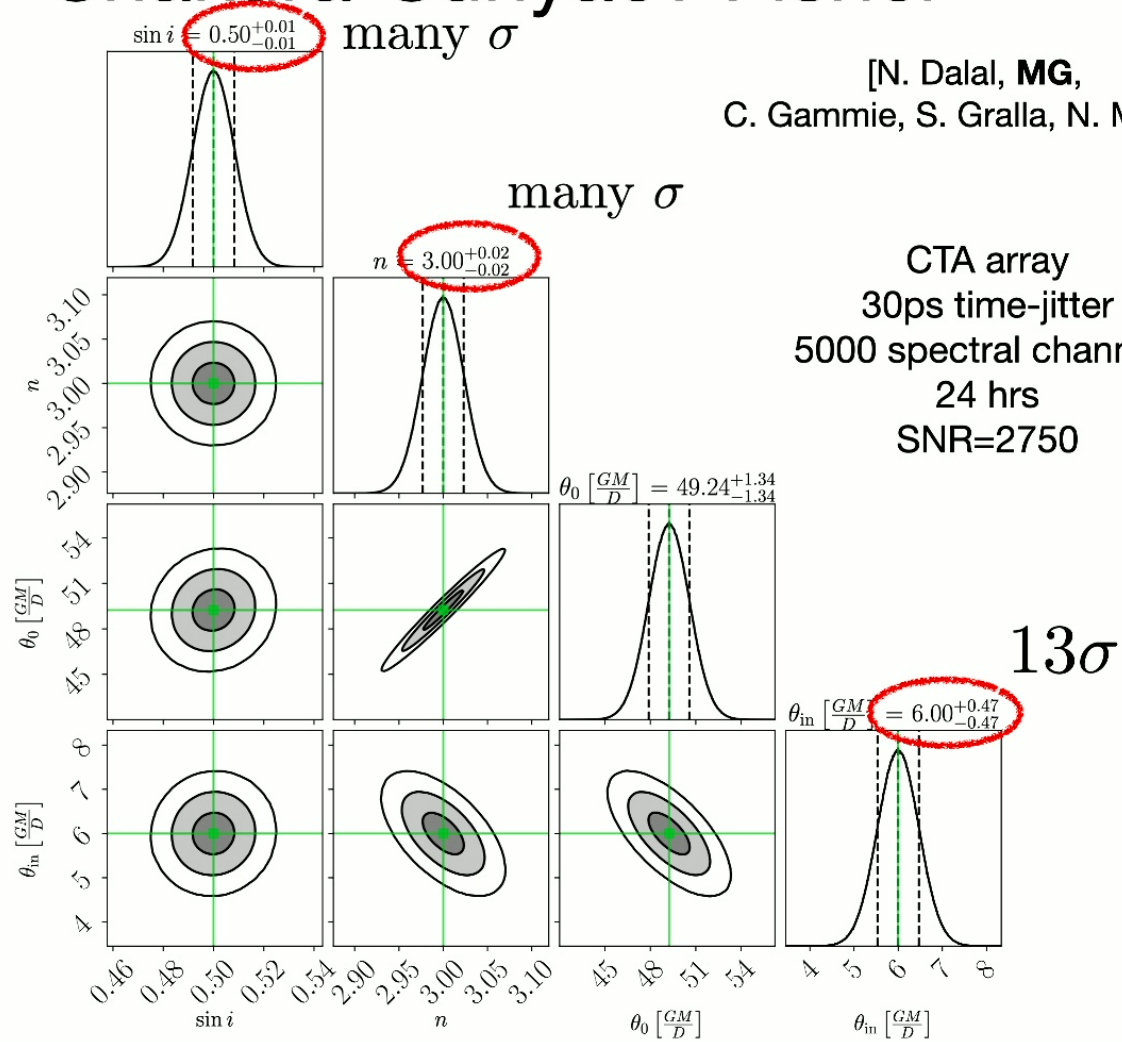
[N. Dalal, **MG**, C. Gammie, S. Gralla, N. Murray]

²
Composite image credit: ESO/WFI (Optical); MPIfR/ESO/APEX/A.Weiss et al. (Submillimetre); NASA/CXC/CfA/R.Kraft et al. (X-ray)]

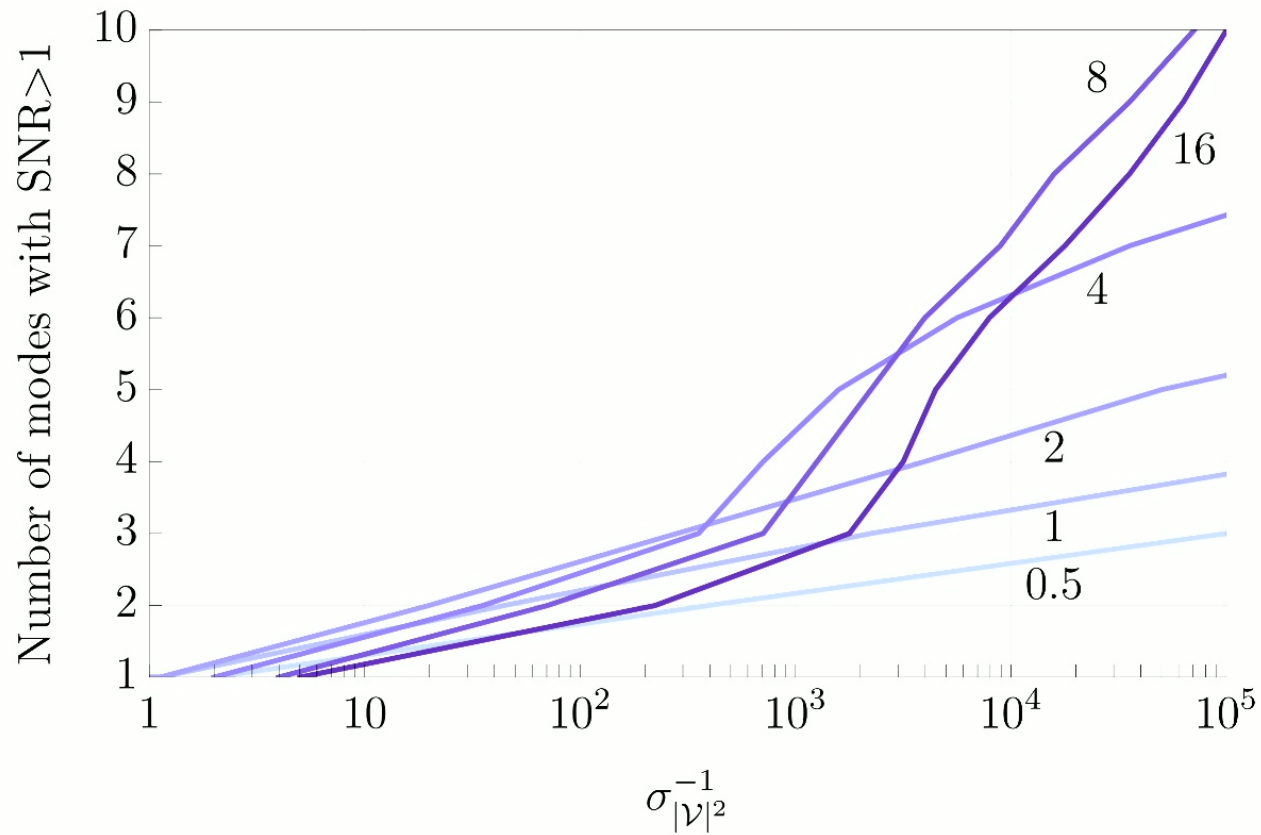
Application 1: AGN disks

Shakura-Sunyaev Fisher

[N. Dalal, **MG**,
C. Gammie, S. Gralla, N. Murray]



Principal component analysis



Application 2: H_0

- We need:
1. One angular size $\theta \sim \frac{L}{D}$
→ Intensity Interferometry
 2. The dimensionful size $\sim L$
→ Reverberation Mapping
 3. A redshift $H_0 \sim \frac{z}{D}$
→ Line emission

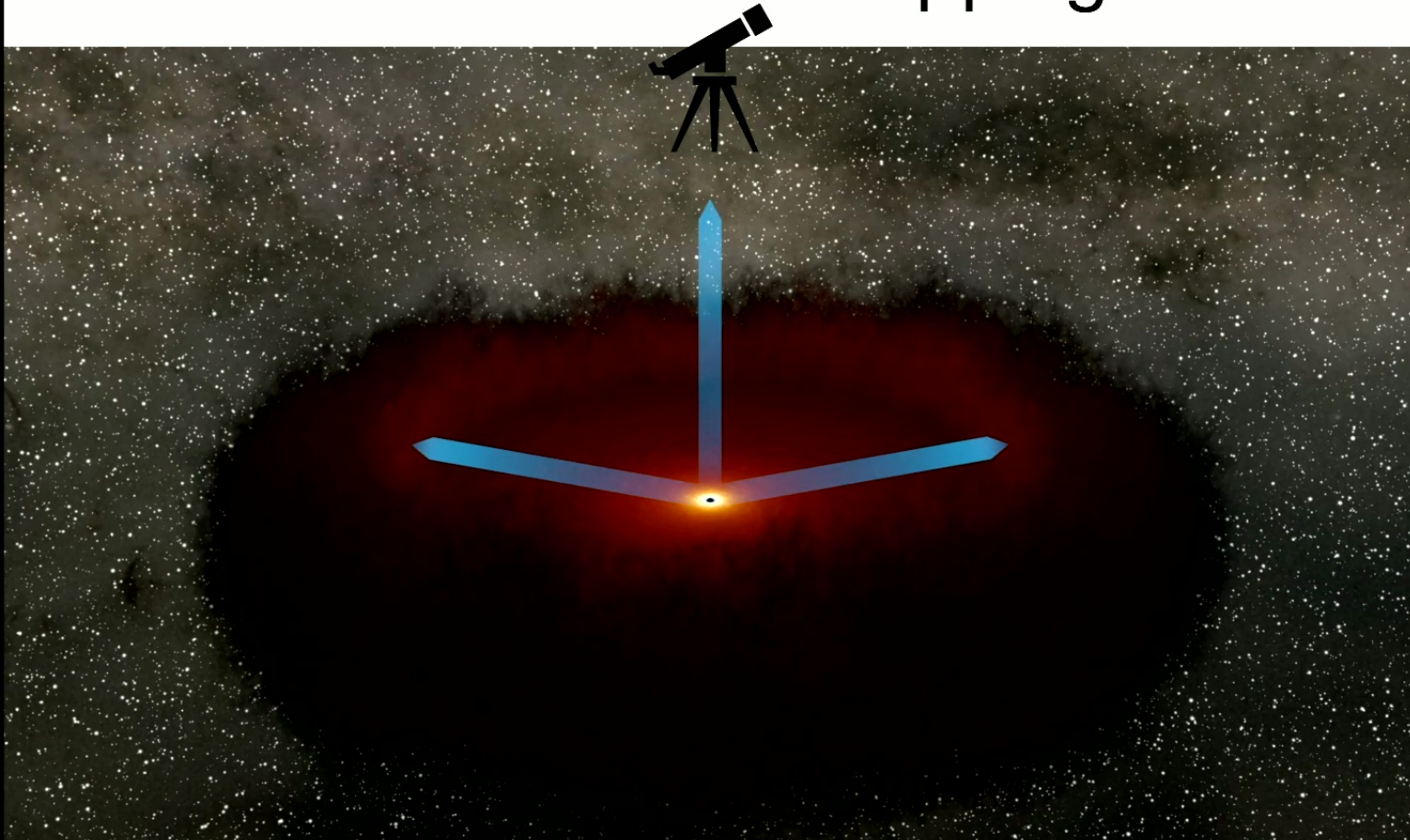
Reverberation Mapping



6
Video_credit: Wikipedia

[Blandford, McKee '82]

Reverberation Mapping



6
Video_credit: Wikipedia

[Blandford, McKee '82]

Reverberation Mapping

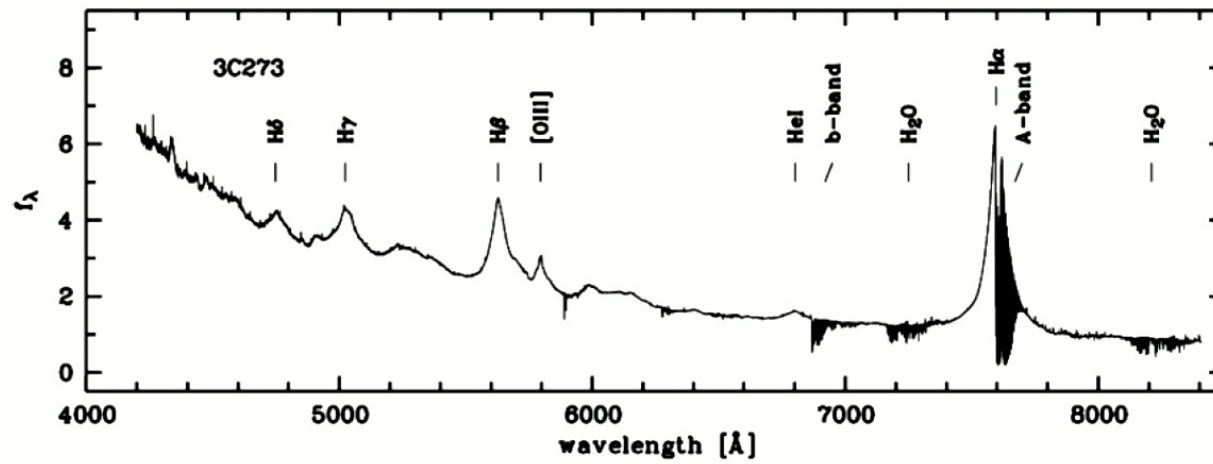


Time-delay gives physical size

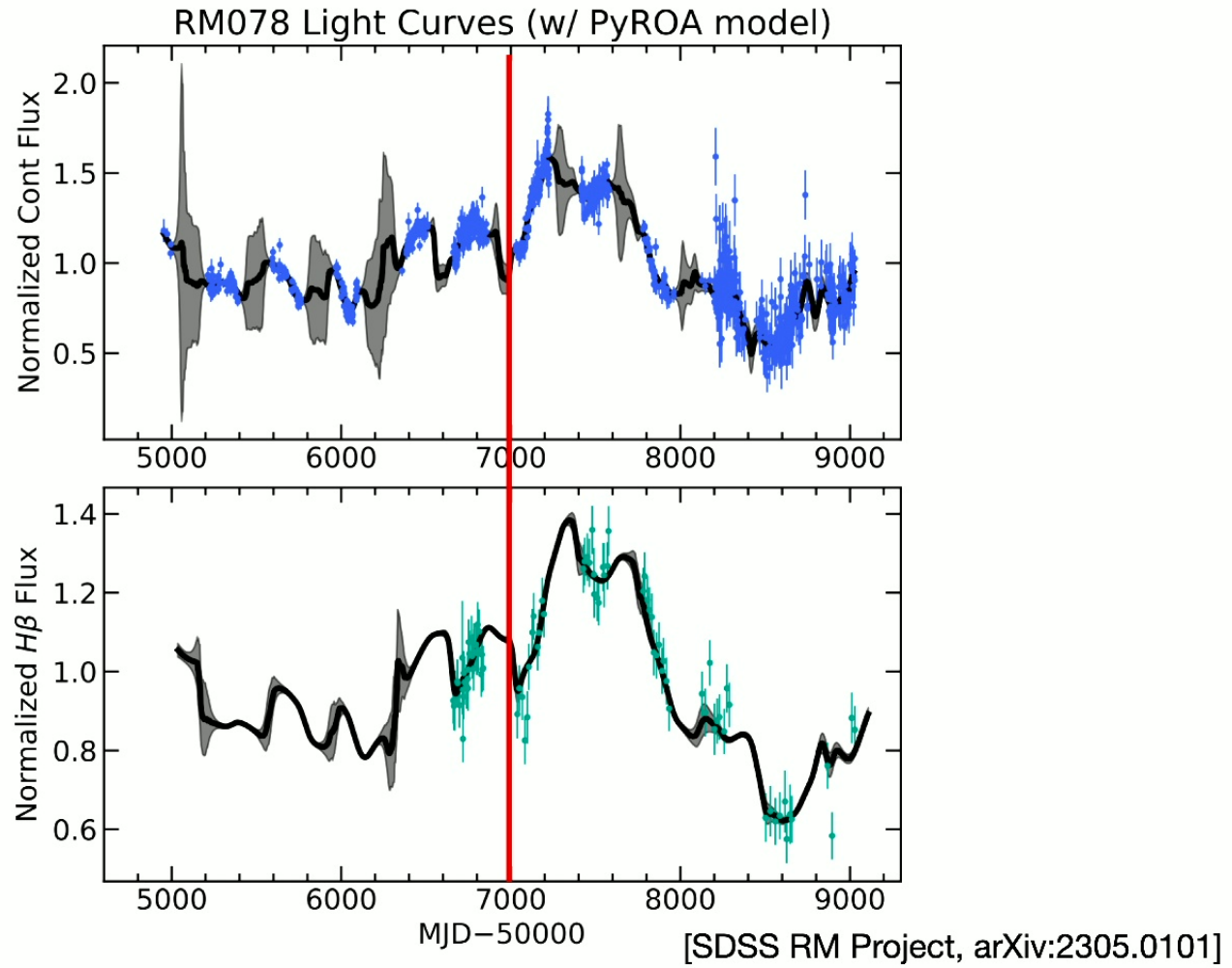
[Blandford, McKee '82]

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Video credit: Wikipedia

Broad Line Region

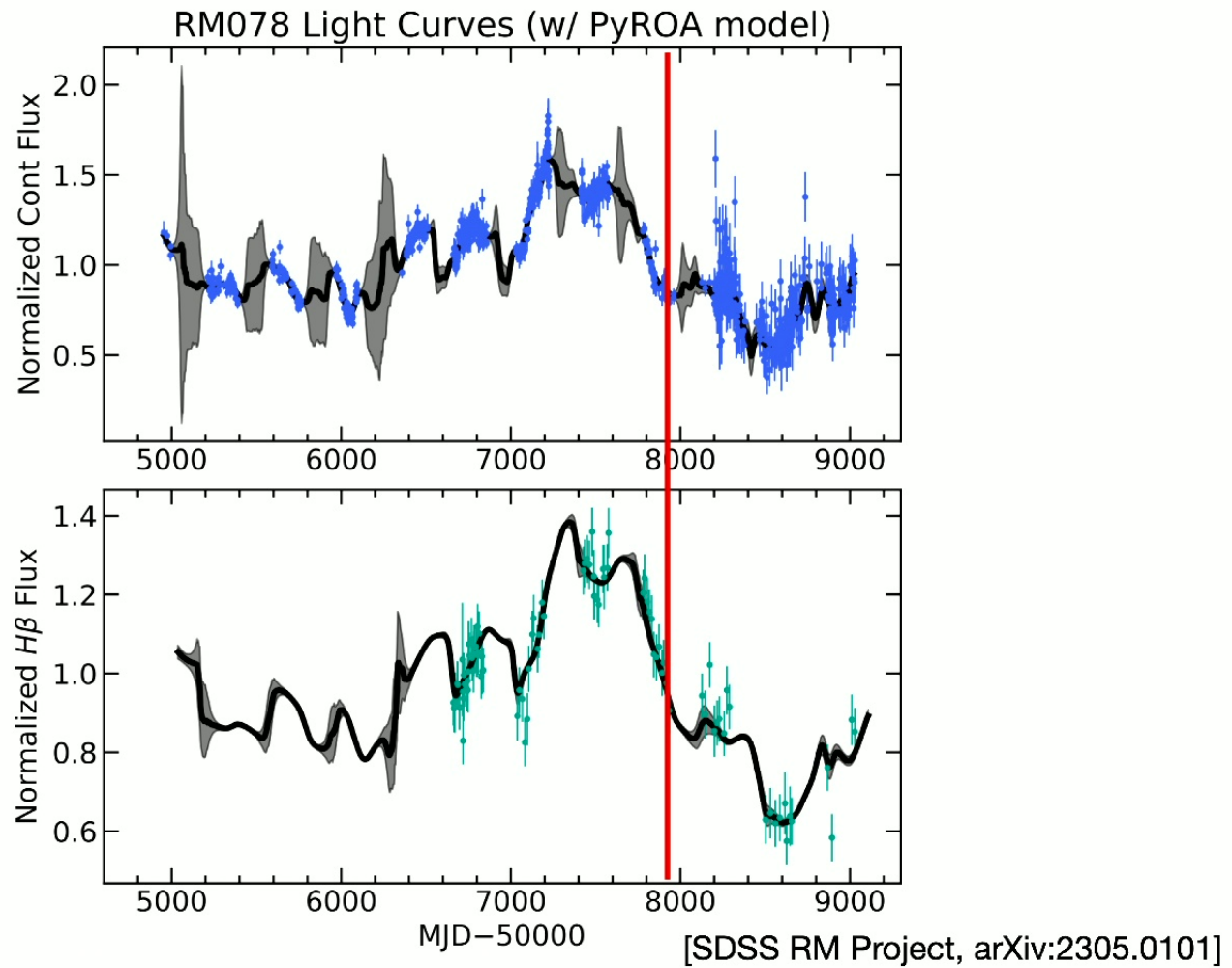


Reverberation Mapping



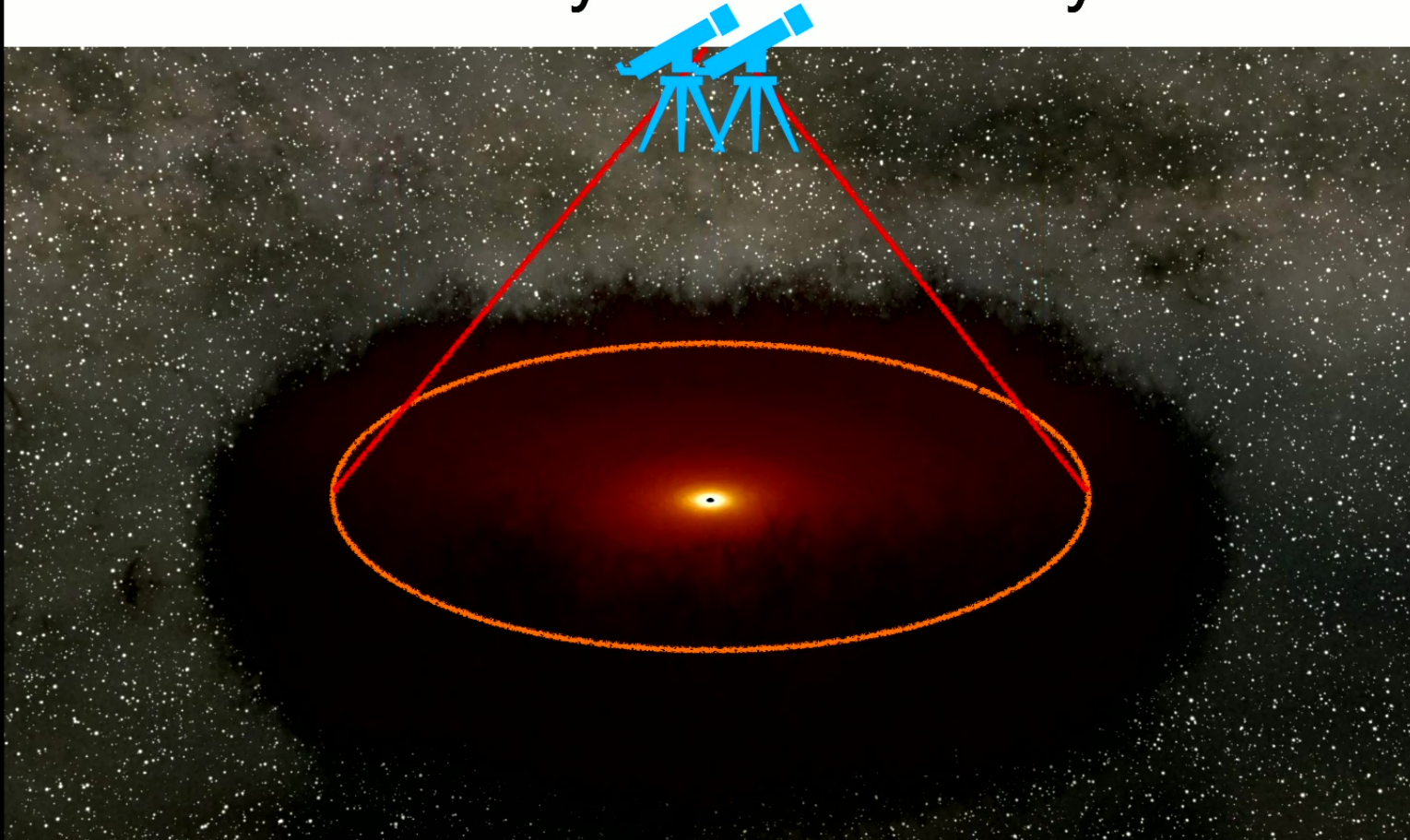
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Reverberation Mapping



8

Intensity Interferometry



Intensity Interferometry gives angular size

[N. Dalal, **MG**, C. Gammie, S. Gralla, N. Murray]

¹⁰
Video_credit: Wikipedia

Fisher Covariance for IRAS 09149-6206

CTA-like array

$$v/c \sim 0.01$$

30ps time-jitter

$$T_{\text{obs}} = 24\text{hrs}$$

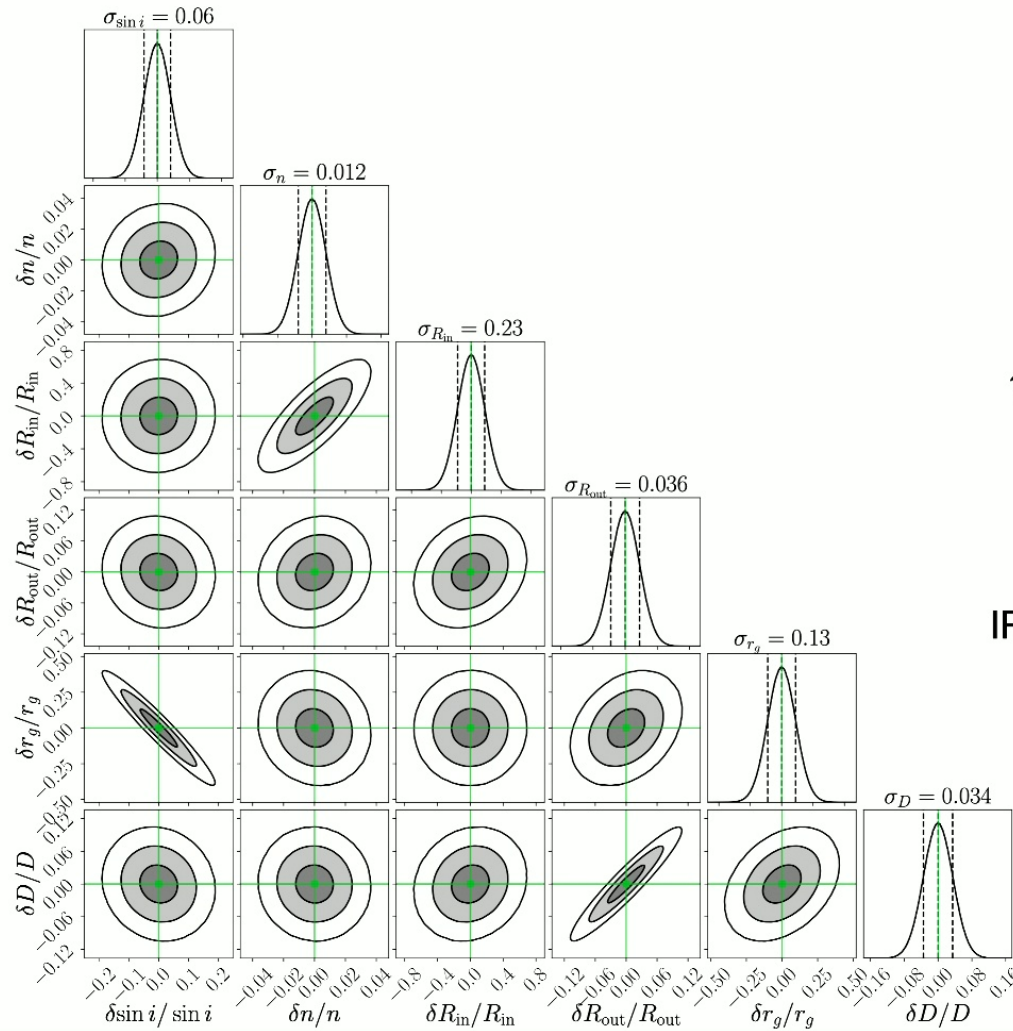
$$\mathcal{R} = 5000, \quad 50 \text{ channels}$$

SNR ≈ 73 per channel

IRAS 09149-6206, $z=0.057$

[N. Dalal, **MG**, C. Gammie,
S. Gralla, N. Murray]

Fisher Covariance for IRAS 09149-6206



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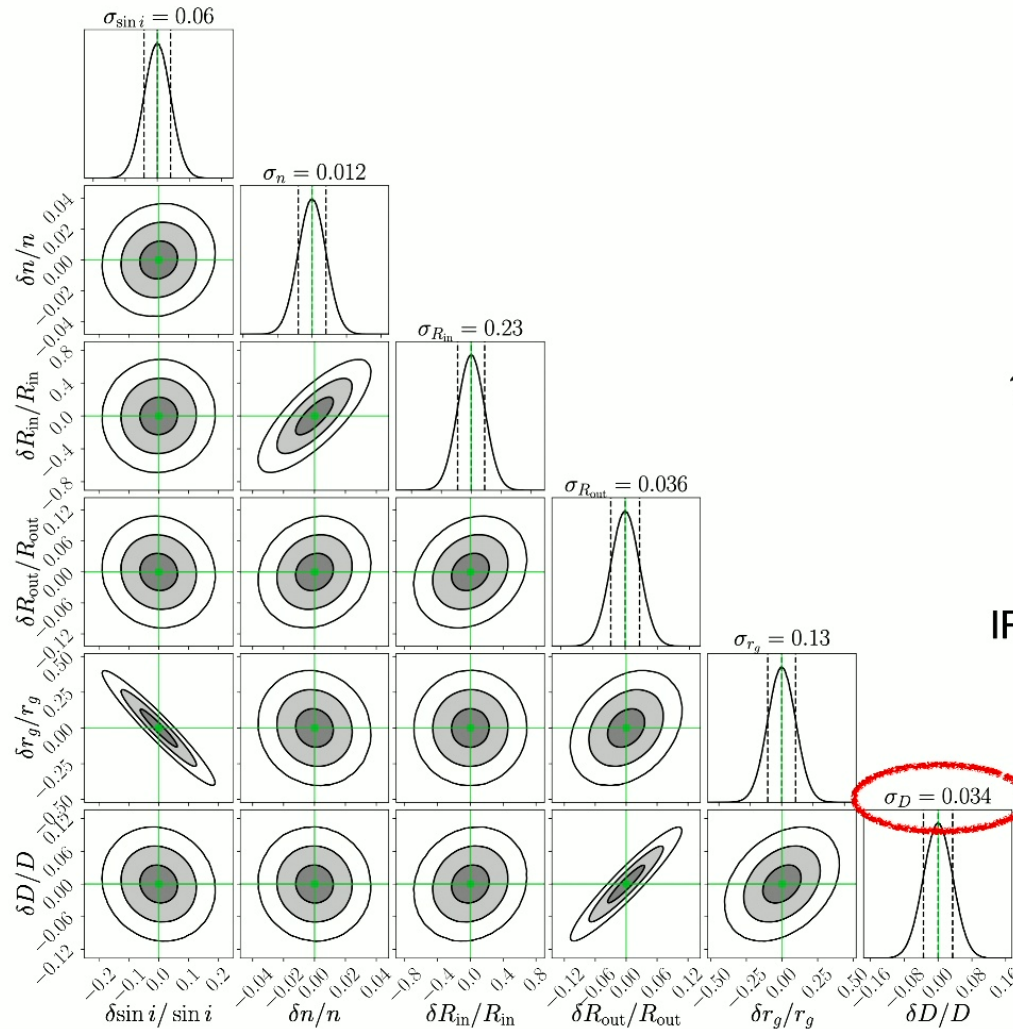
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[N. Dalal, **MG**, C. Gammie,
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Fisher Covariance for IRAS 09149-6206



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SNR \approx 73 per channel

IRAS 09149-6206, $z=0.057$

3.4%
Distance error!

[N. Dalal, **MG**, C. Gammie,
S. Gralla, N. Murray]

Distance error *per* AGN - spectroscopy

CTA-like array

$$v/c \sim 0.01$$

30ps time-jitter

$$T_{\text{obs}} = 24\text{hrs}$$

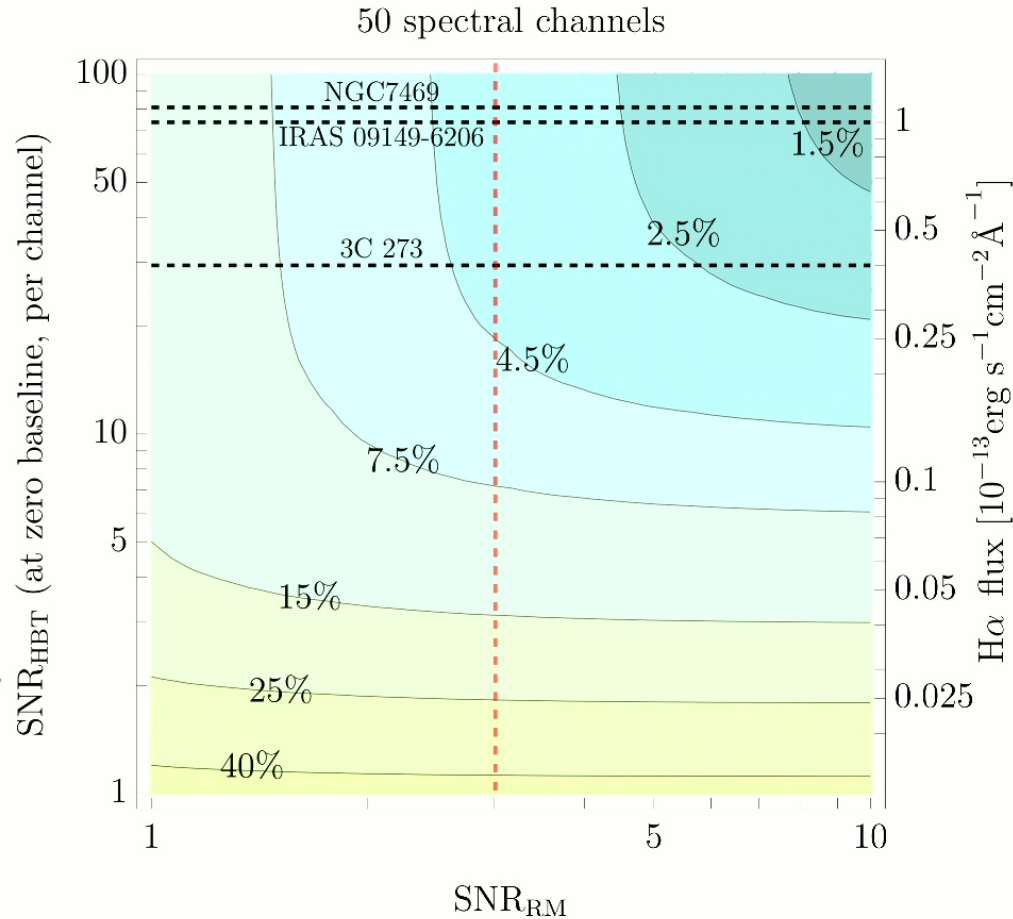
$\mathcal{R} = 5000$, 50 channels

SNR ≈ 73 per channel

IRAS 09149-6206, $z=0.057$

NGC 7469, $z=0.016$

3C 273, $z=0.158$



[N. Dalal, **MG**, C. Gammie, S. Gralla, N. Murray]

Distance error *per* AGN - one pixel

CTA-like array

$$v/c \sim 0.01$$

30ps time-jitter

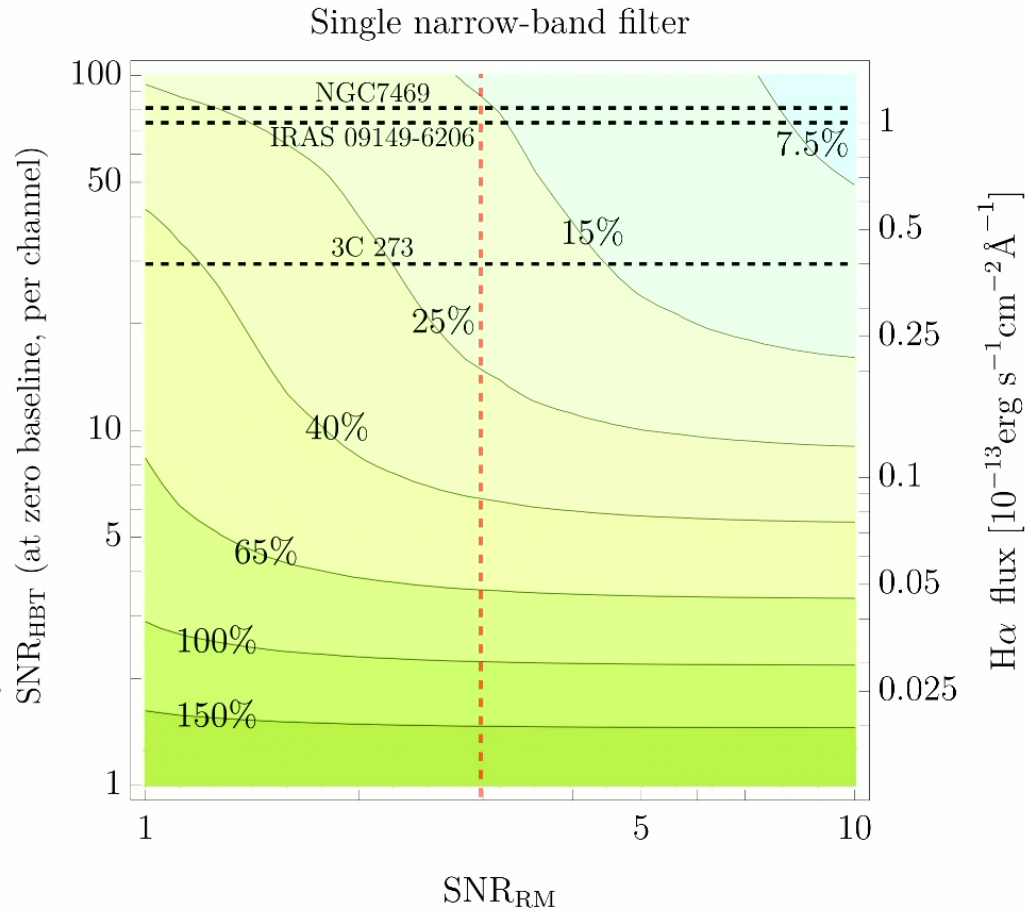
$$T_{\text{obs}} = 24\text{hrs}$$

SNR ≈ 73 per channel

IRAS 09149-6206, $z=0.057$

NGC 7469, $z=0.016$

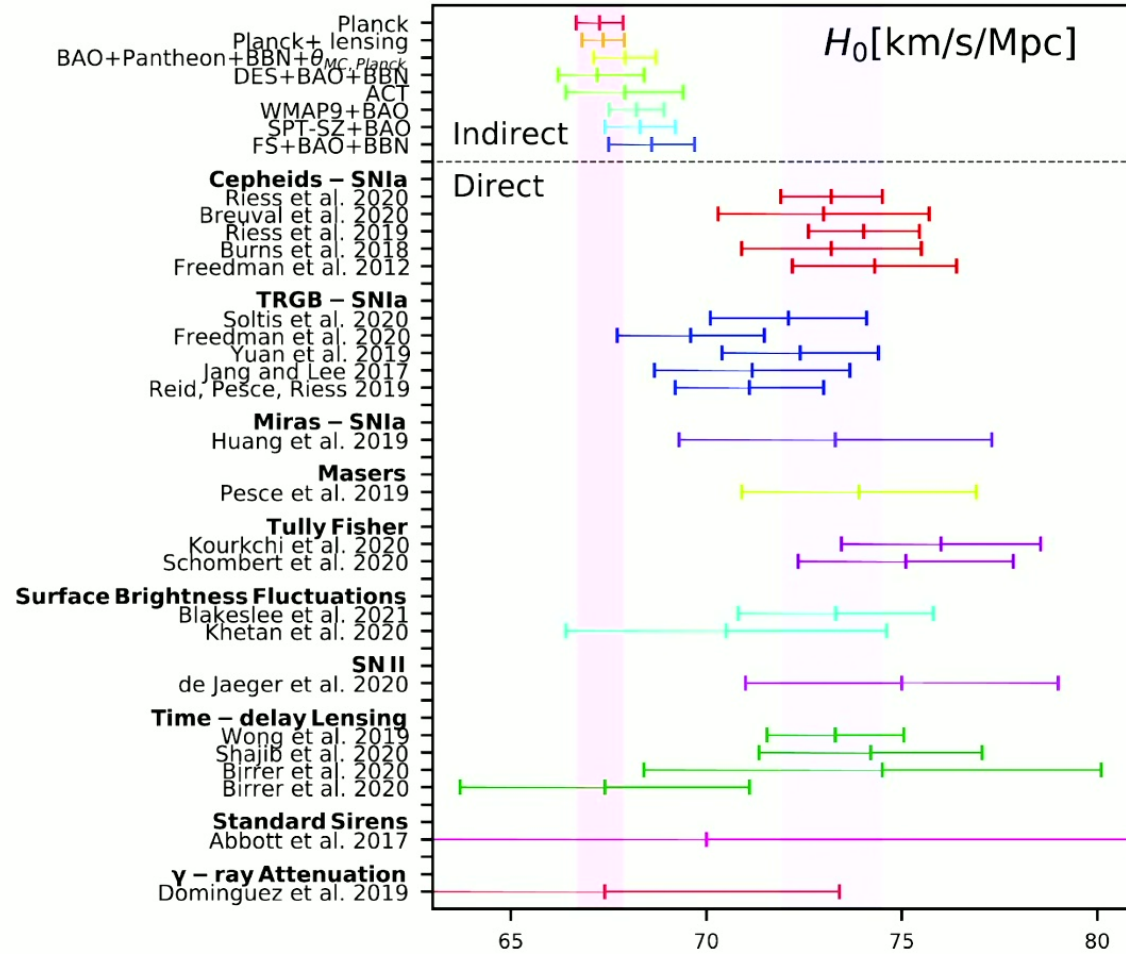
3C 273, $z=0.158$



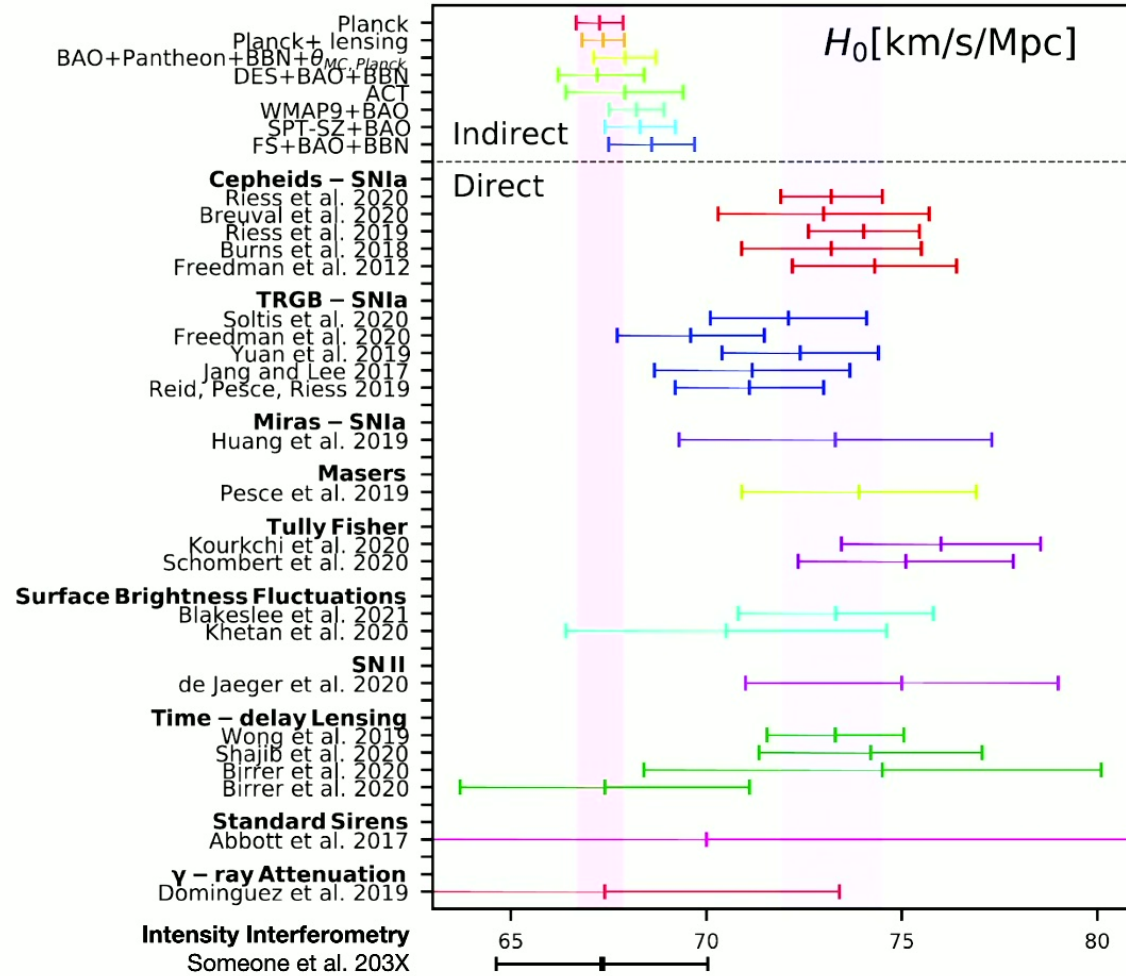
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[N. Dalal, **MG**, C. Gammie, S. Gralla, N. Murray]

Hubble Tension



Hubble Tension



Principal component analysis

