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TALES

Time-domain Analysis to study the Life-cycle
& Evolution of Supermassive black holes



A magnetically supported disk-corona model for changing-look active galactic nuclei transitions

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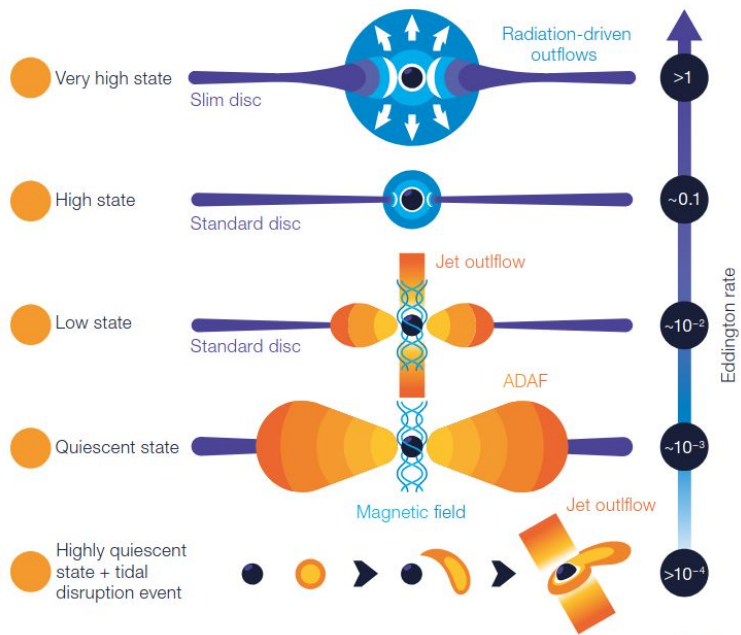


Sleep, wake up, repeat

❖ AGN are highly dynamic engines

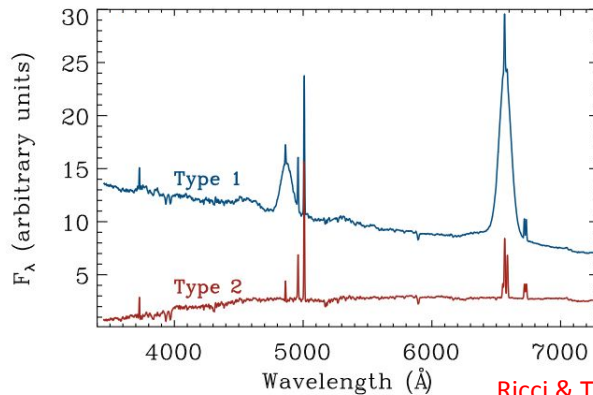


changing states

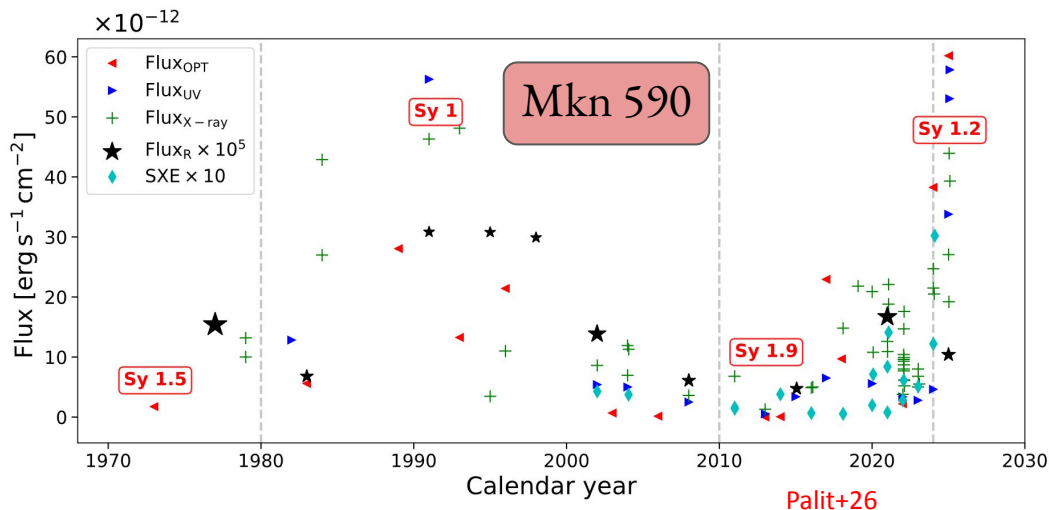


Credits: J. Utreras/F. Bauer (CATA)

UV/optical



physical driving mechanism?



diskvert to the rescue (Gronkiewicz+20,+23)

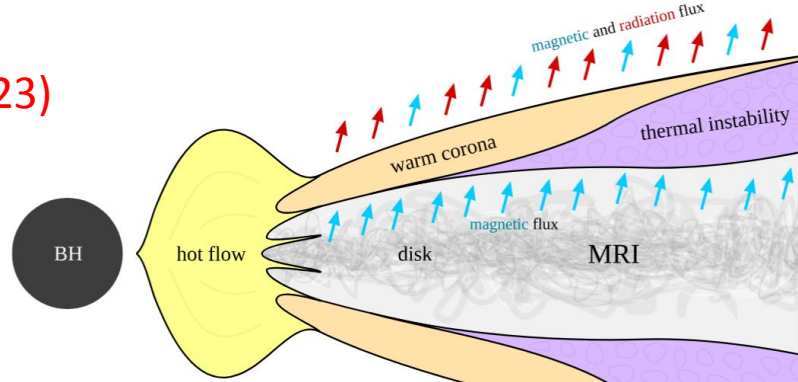
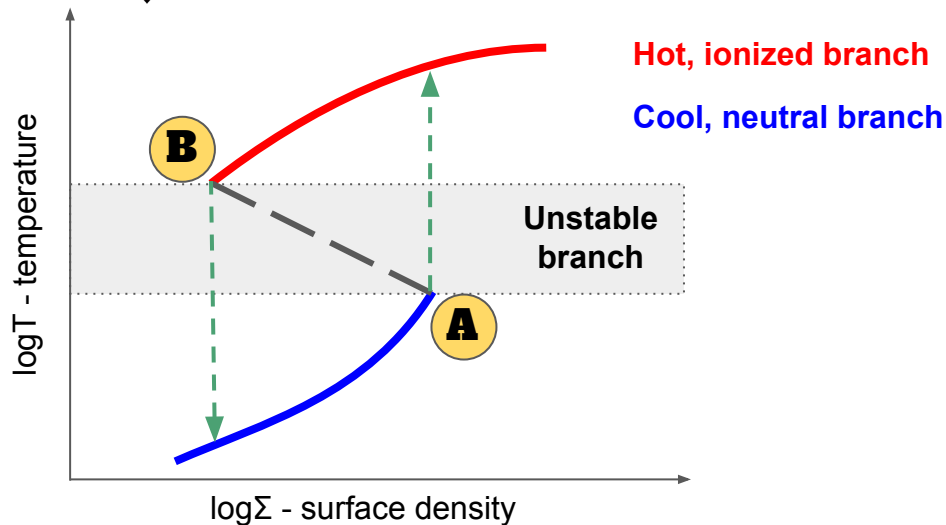
Code to compute 1D vertical structure of magnetic accretion disks around black holes

input parameters: $\dot{M}_{\text{BH}}$ R λ_{Edd} α_{B}

Two diagnostics:



-curve diagram



Credit: D. Gronkiewicz

Relevant timescales

$$t_{\text{th}} = \frac{\text{energy content}}{\text{heating/cooling rate}}$$

$$t_{\text{visc}} = \frac{R}{v_r} = \frac{2\pi R^2 \Sigma}{\dot{m}}$$

$$t_{\text{front}} = t_{\text{th}} \times \frac{R}{H}$$

Magnetic S-curves

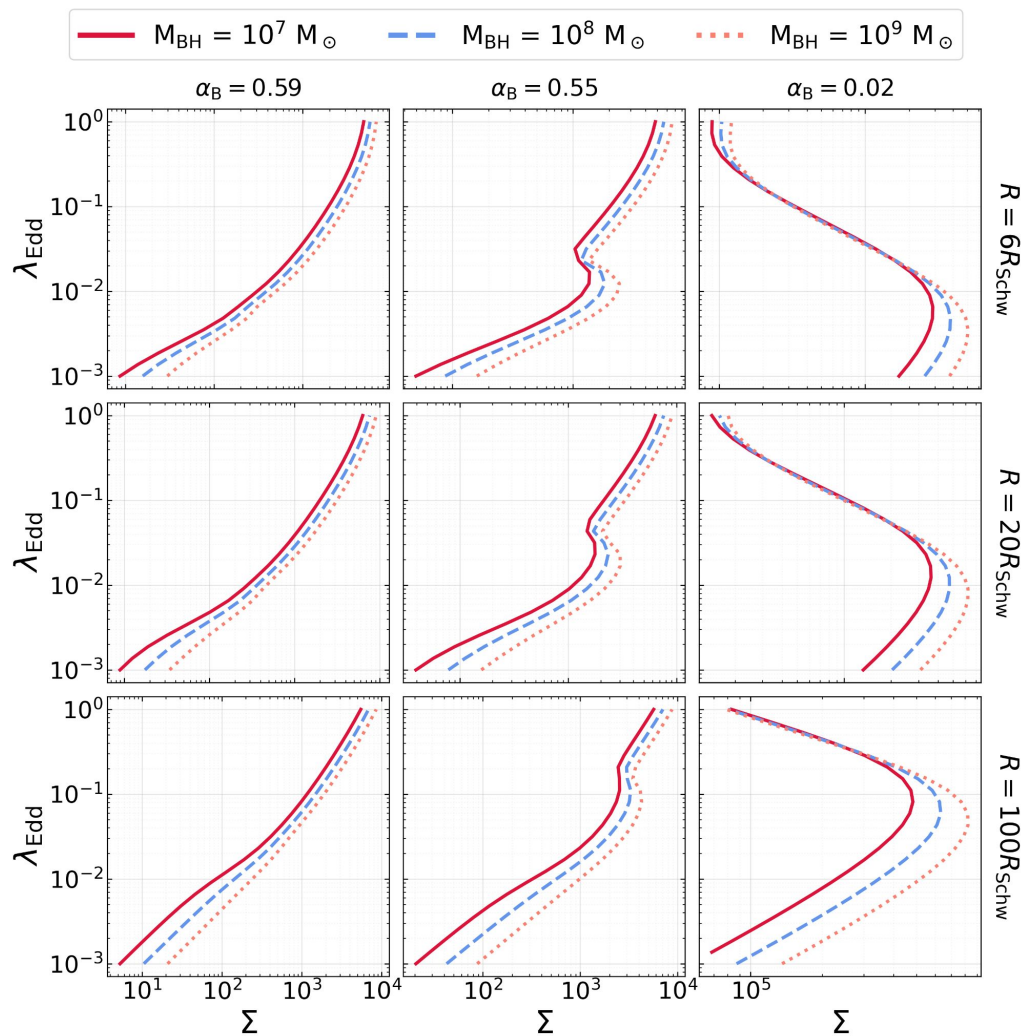
MAGNETIC
STABILIZATION

RADIAL
DEPENDENCE

MASS
INDEPENDENCE

New **stable** upper branch:

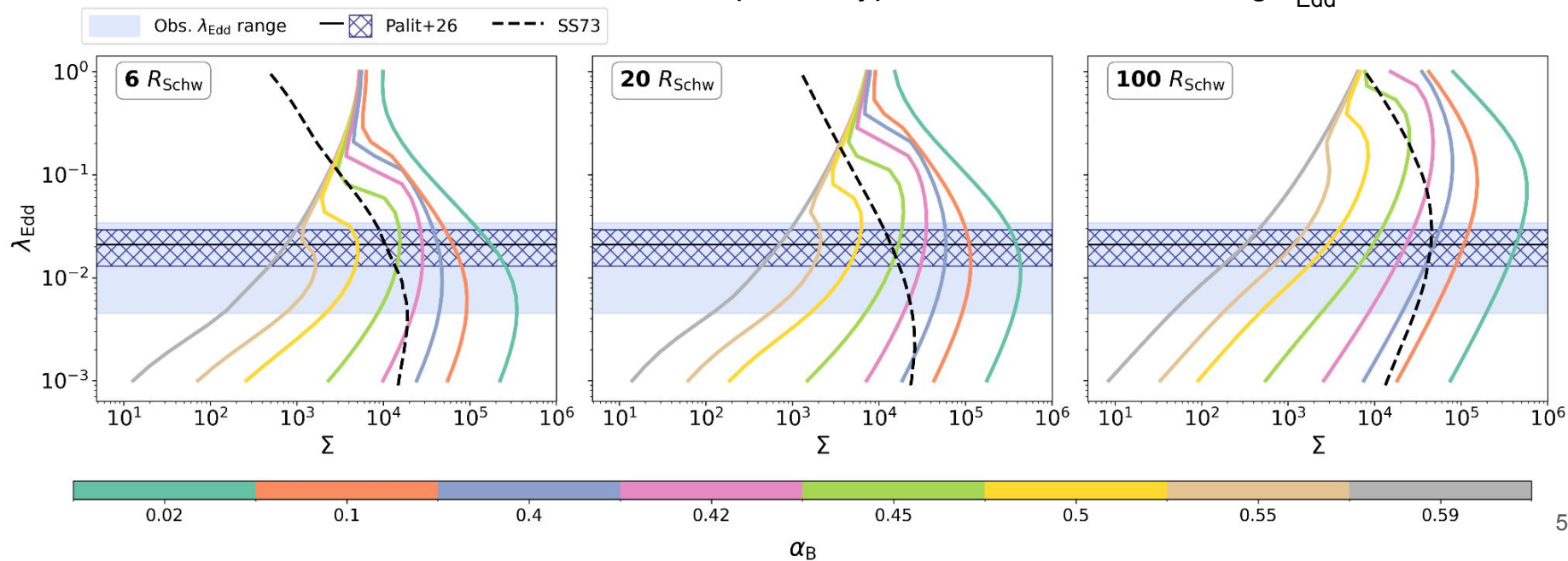
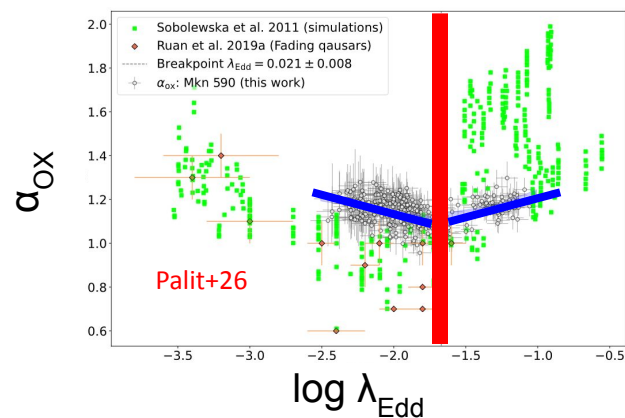
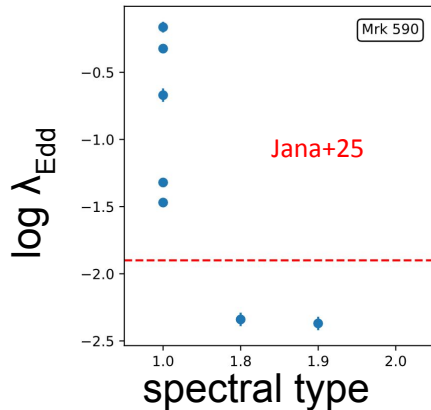
1. *radiatively efficient*
2. *radiation-pressure supported*
3. *magnetic-pressure stabilized*



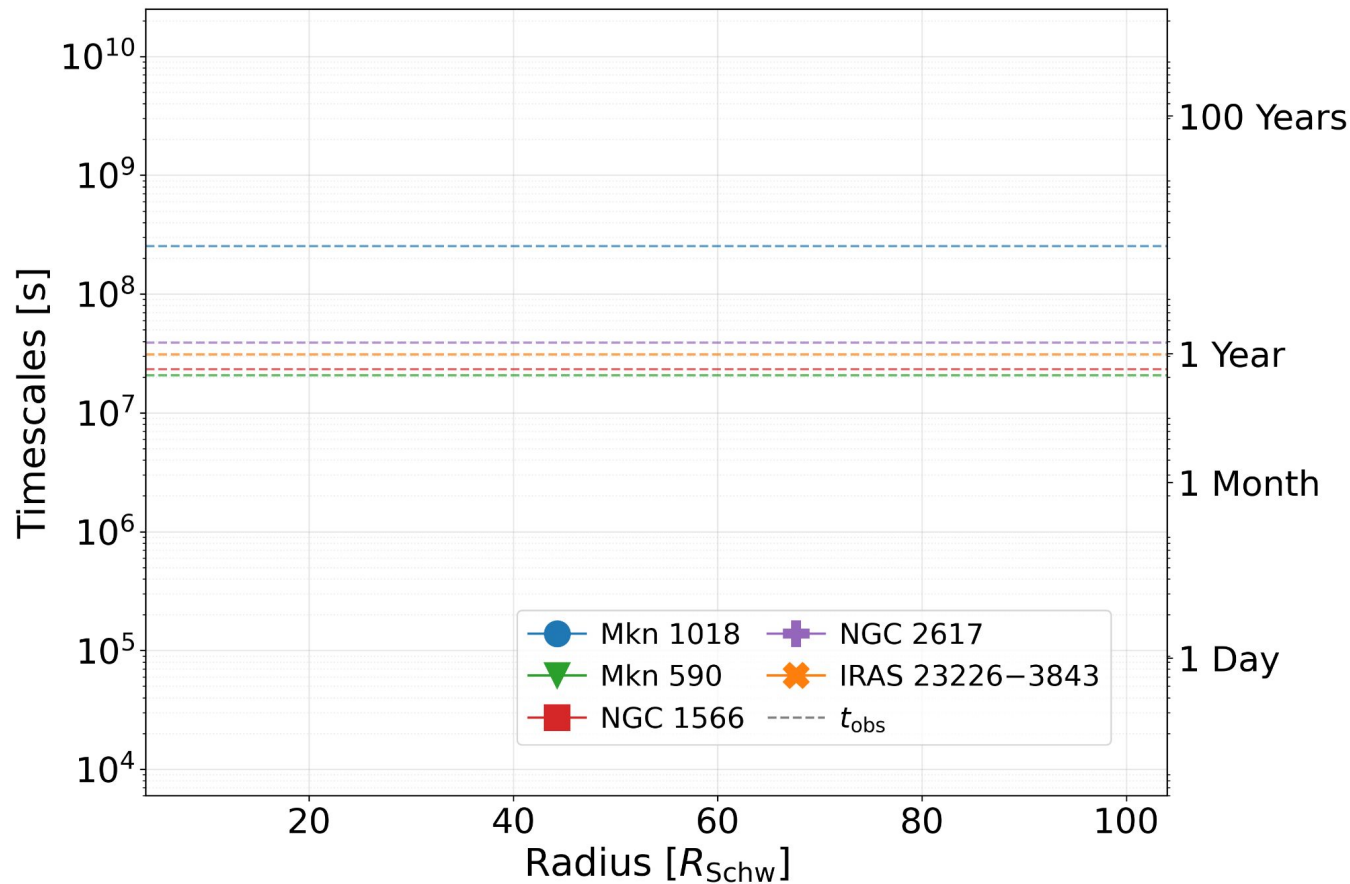
The case of Mkn 590

One of the best-studied nearby CLAGN

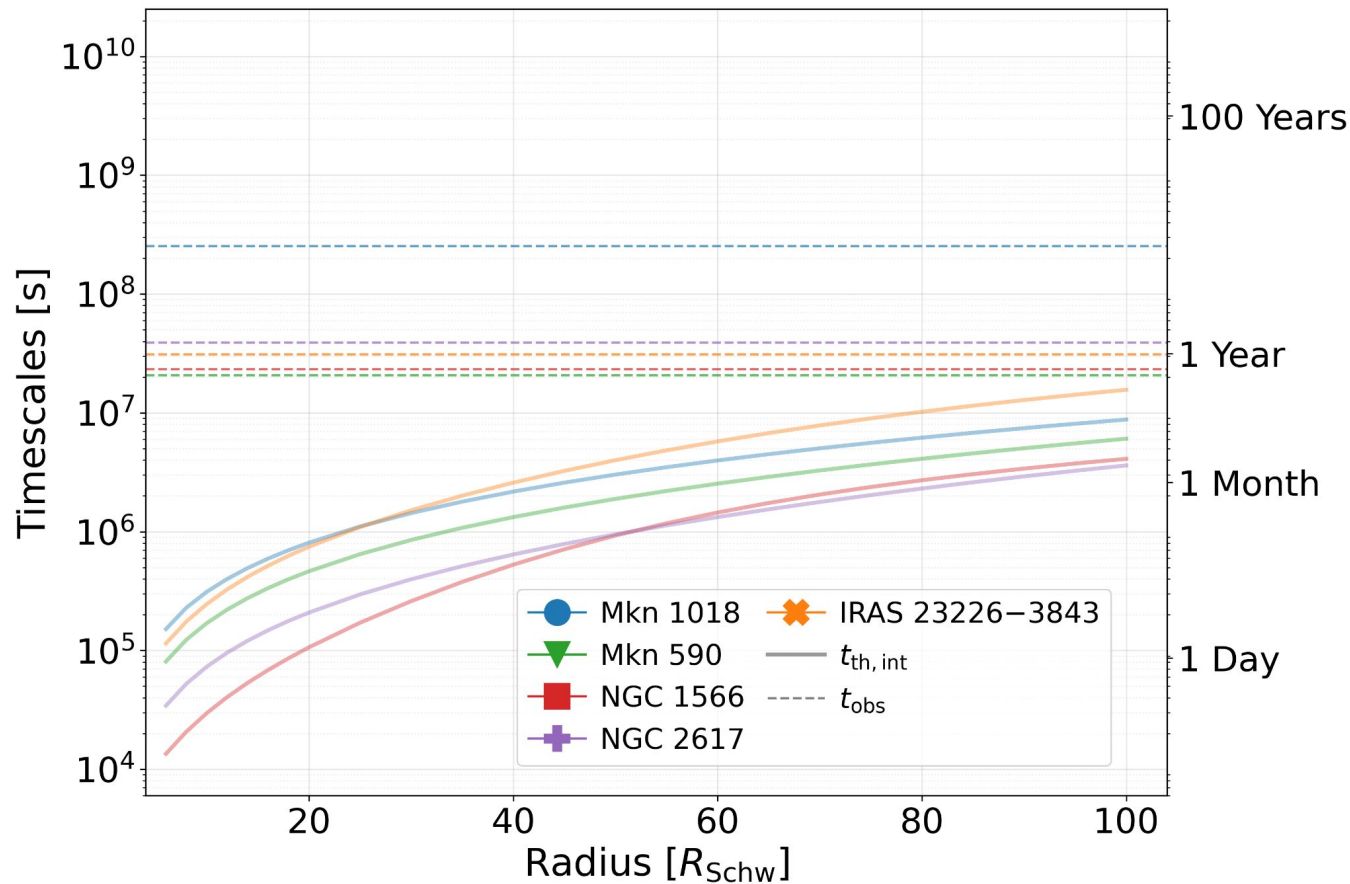
break at $\lambda_{\text{Edd}} = 0.021 \pm 0.008$



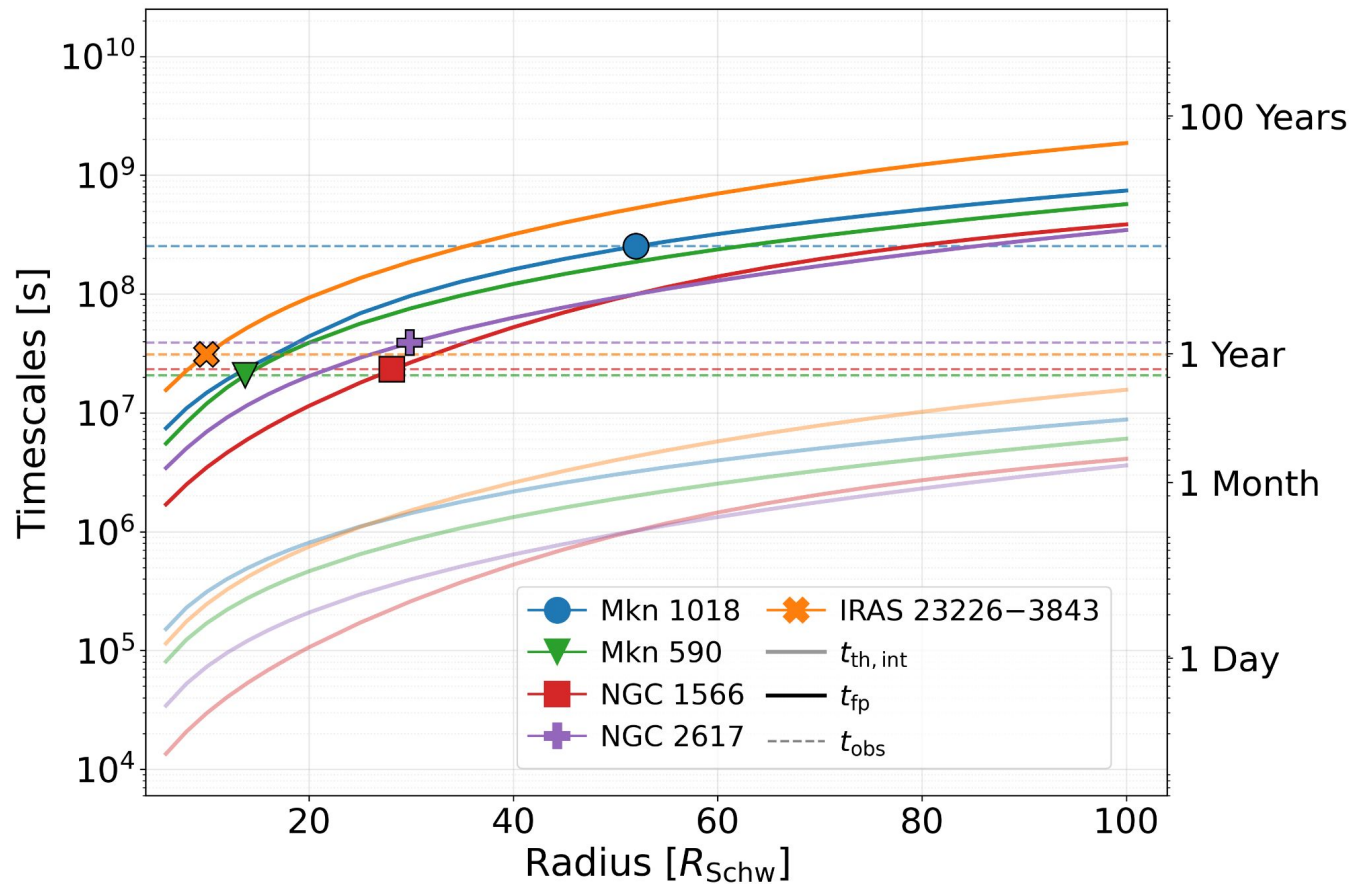
It's about time



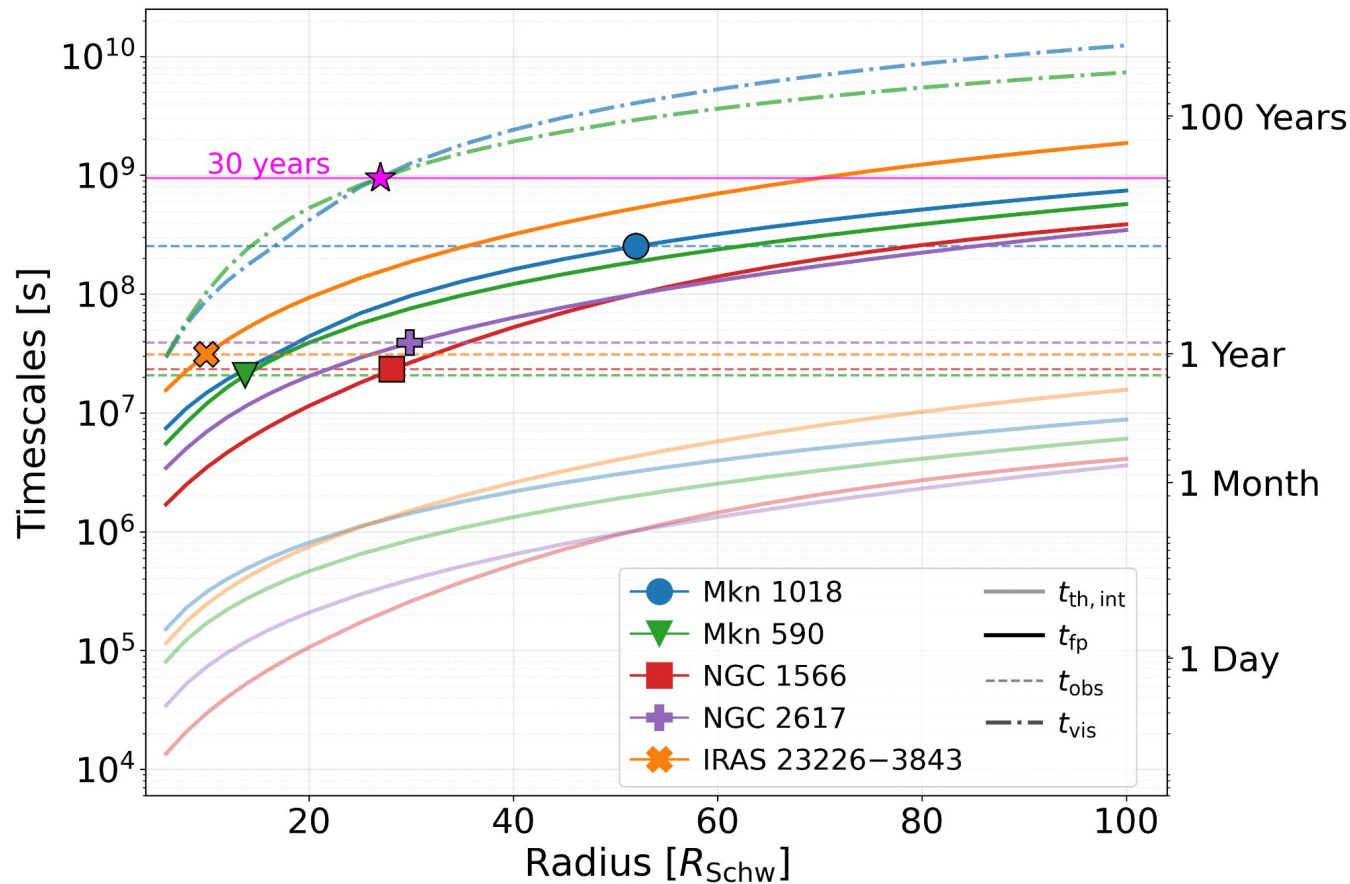
It's about time



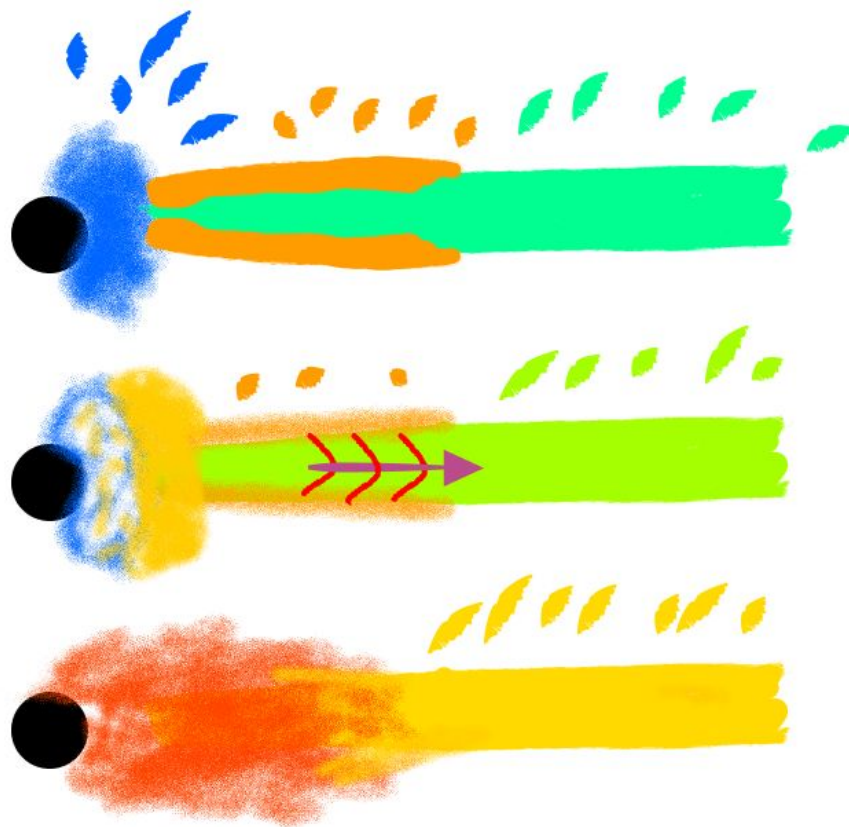
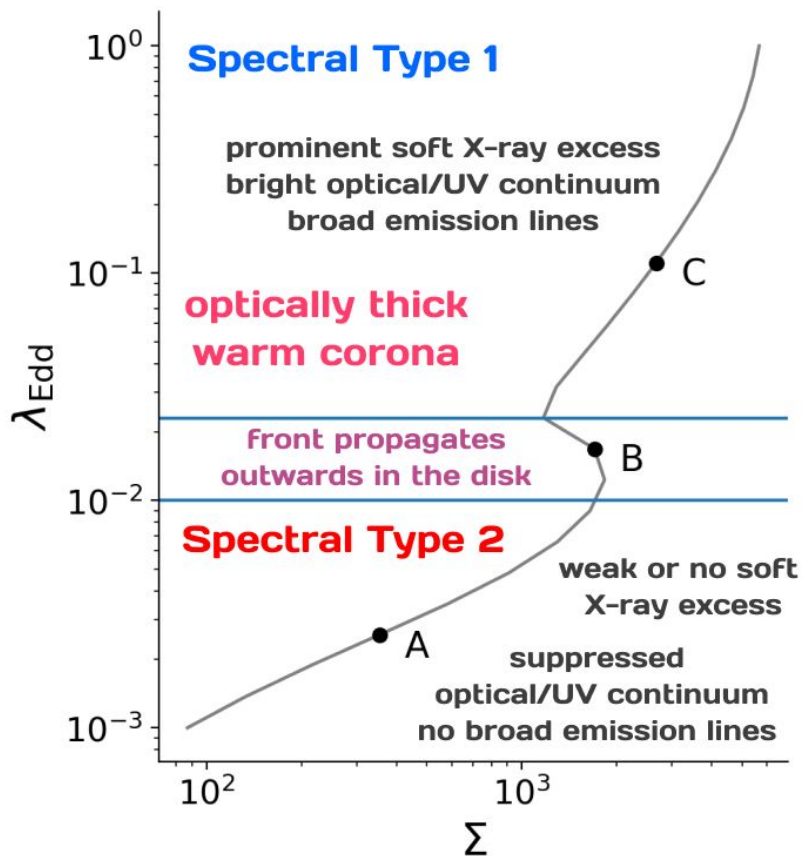
It's about time



It's about time



A new magnetic limit cycle



Conclusions

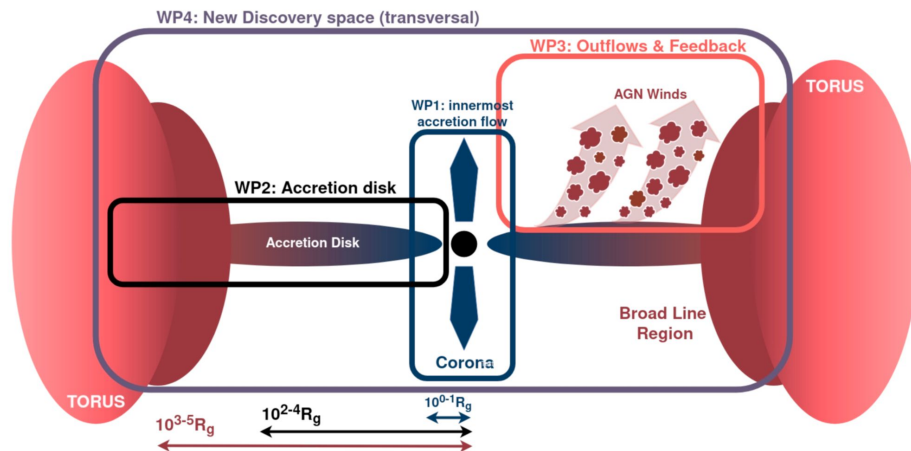
- ❑ Strongly magnetized configurations necessary to match CL transition λ_{Edd}
- ❑ Both diagnostics localize the instability inside $\sim 10\text{-}30 R_{\text{Schw}}$
- ❑ Magnetic S-curve introduces **new stable upper branch**. Indication for a new limit cycle!
- ❑ CL events are predicted to occur at a universal λ_{Edd}
- ❑ Mkn 590 provides the best test yet. $\alpha_B = 0.55$ and $R \sim 6\text{-}20 R_{\text{Schw}}$
- ❑ t_{fp} explains singular CL events, t_{vis} explains repetitive ones - both at few tens of R_{Schw}

Want to learn more?
Read the full article!



Thank you! 

TALES: Time-domain Analysis to study the Life-cycle and Evolution of Supermassive black holes



WP2: Accretion disk

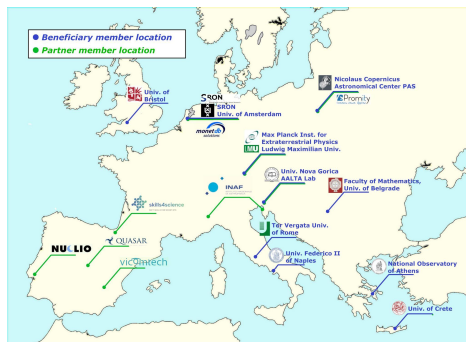
Lead: prof. Dragana Ilic, Faculty of Mathematics, University of Belgrade

KEY QUESTIONS

- ❑ Accretion disk structure
- ❑ Black hole properties
- ❑ Testing unified models

Team:

10 astrophysics research groups
11 partners (industrial and academic)



<https://tales.astro.noa.gr/>

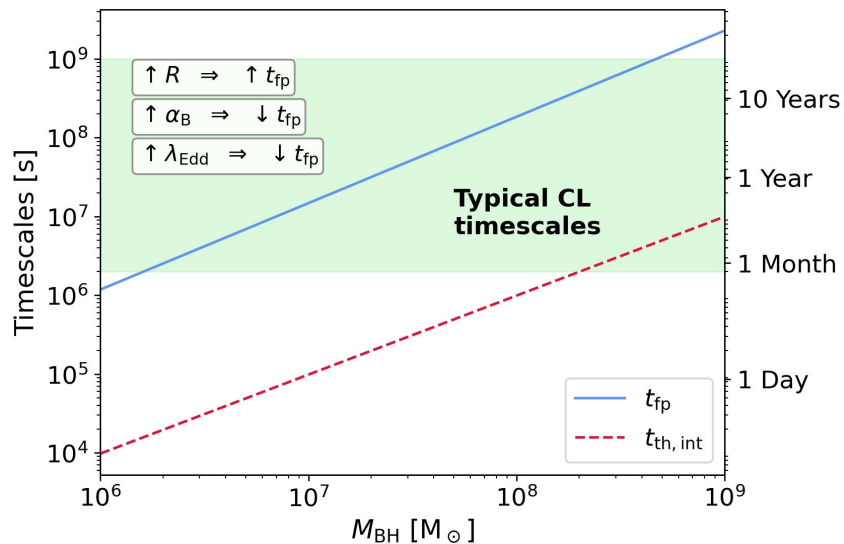
Backup slides

t_{fp} vs M_{BH}

$$t_{\text{th}}(z) = \frac{E_t(z)}{\mathcal{H}(z)}, \quad \text{for}$$

$$E_t(z) = \frac{5}{2} P_{\text{gas}}(z) + 4 P_{\text{rad}}(z) + 2 P_{\text{mag}}(z)$$

$$t_{\text{th,int}} = \frac{\int_{-H}^H E_t(z) dz}{\int_{-H}^H \mathcal{H}(z) dz}$$



Full sample:

