

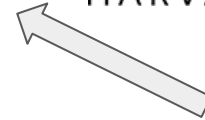
First Broad-Line-Region Reverberation Mapping of a highly-accreting IMBH



UNIVERSITÄT
HEIDELBERG
ZUKUNFT
SEIT 1386

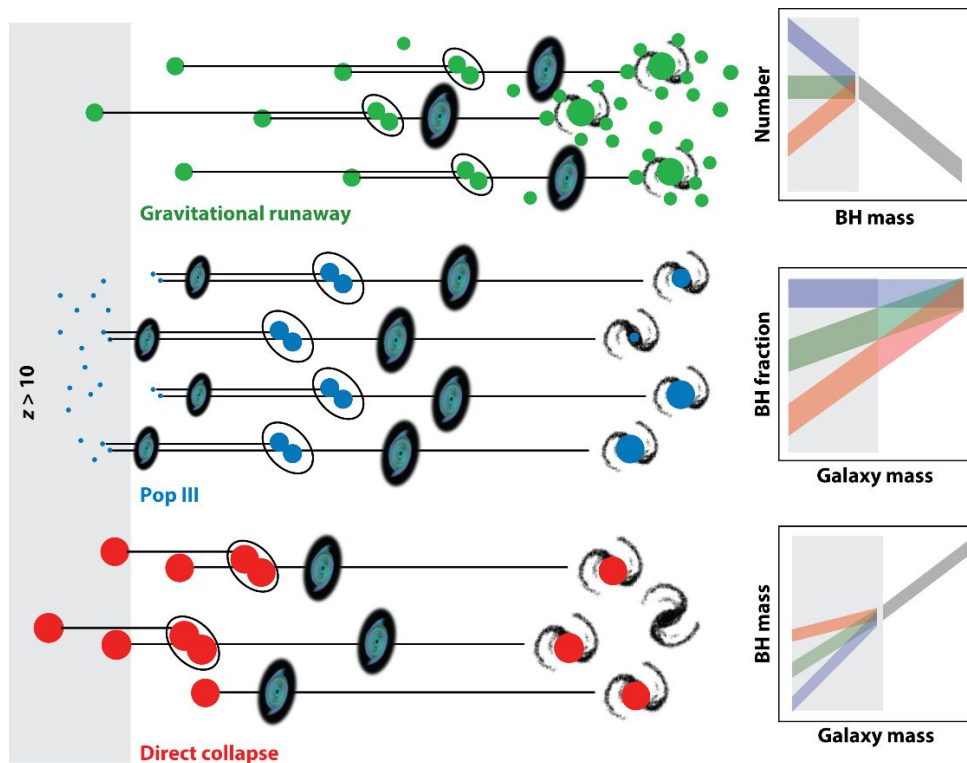


CENTER FOR
ASTROPHYSICS
HARVARD & SMITHSONIAN



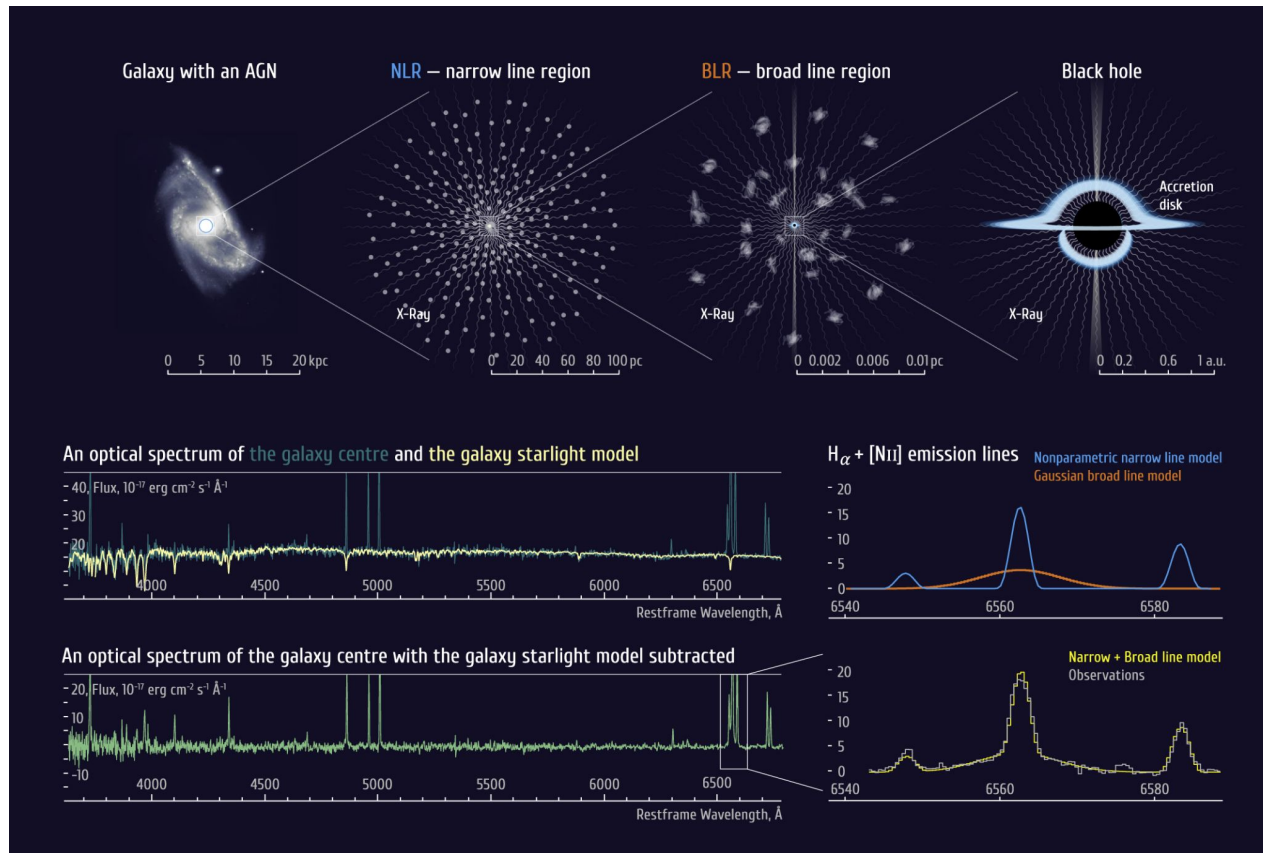
Mariia Demianenko, Anton Afanasiev, Evgenii Rubtsov, **Victoria Toptun**,
Jörg-Uwe Pott, Alexandr Belinski, Franz E. Bauer, Igor V. Chilingarian, Kirill A.
Grishin, Marina Burlak, Natalia Ikonnikova

Intermediate-mass black holes (IMBHs, up to $2 \cdot 10^5 M_{\odot}$)



IMBHs and their BH mass function over redshift constrain BH seed scenario and BH evolution models

Low-mass AGNs



Broadening of
Balmer
emission lines
in AGN spectra
allows velocity
dispersion
estimation

Virial black hole mass estimation

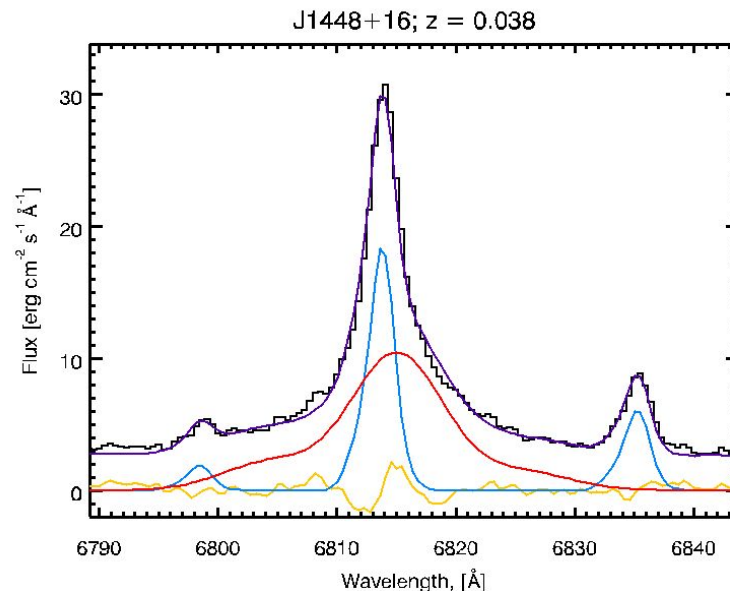
$$M_{BH} = f_{\lambda} \frac{R_{BLR,\lambda} \cdot \Delta V_{\lambda}^2}{G}$$

f - virial factor

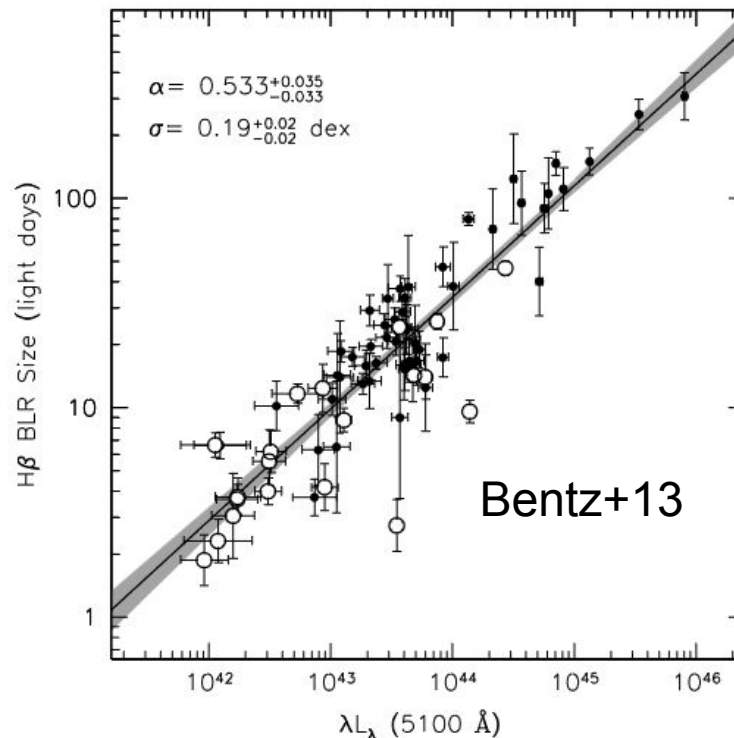
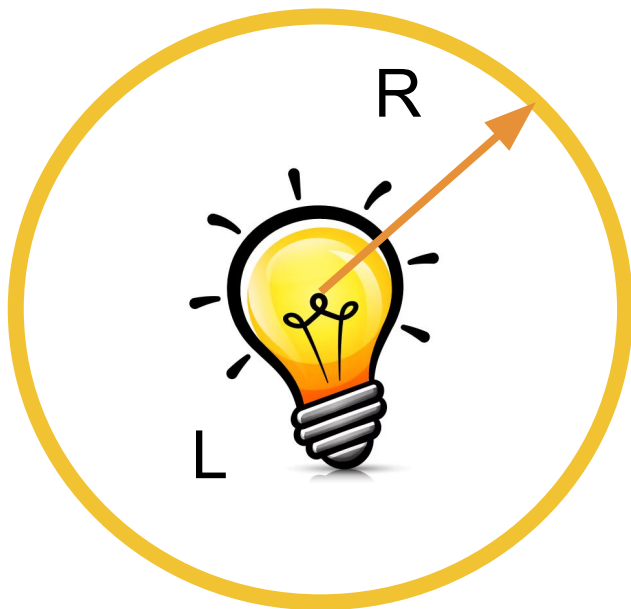
R - Broad line region radius

ΔV - velocity dispersion

G - gravitational constant

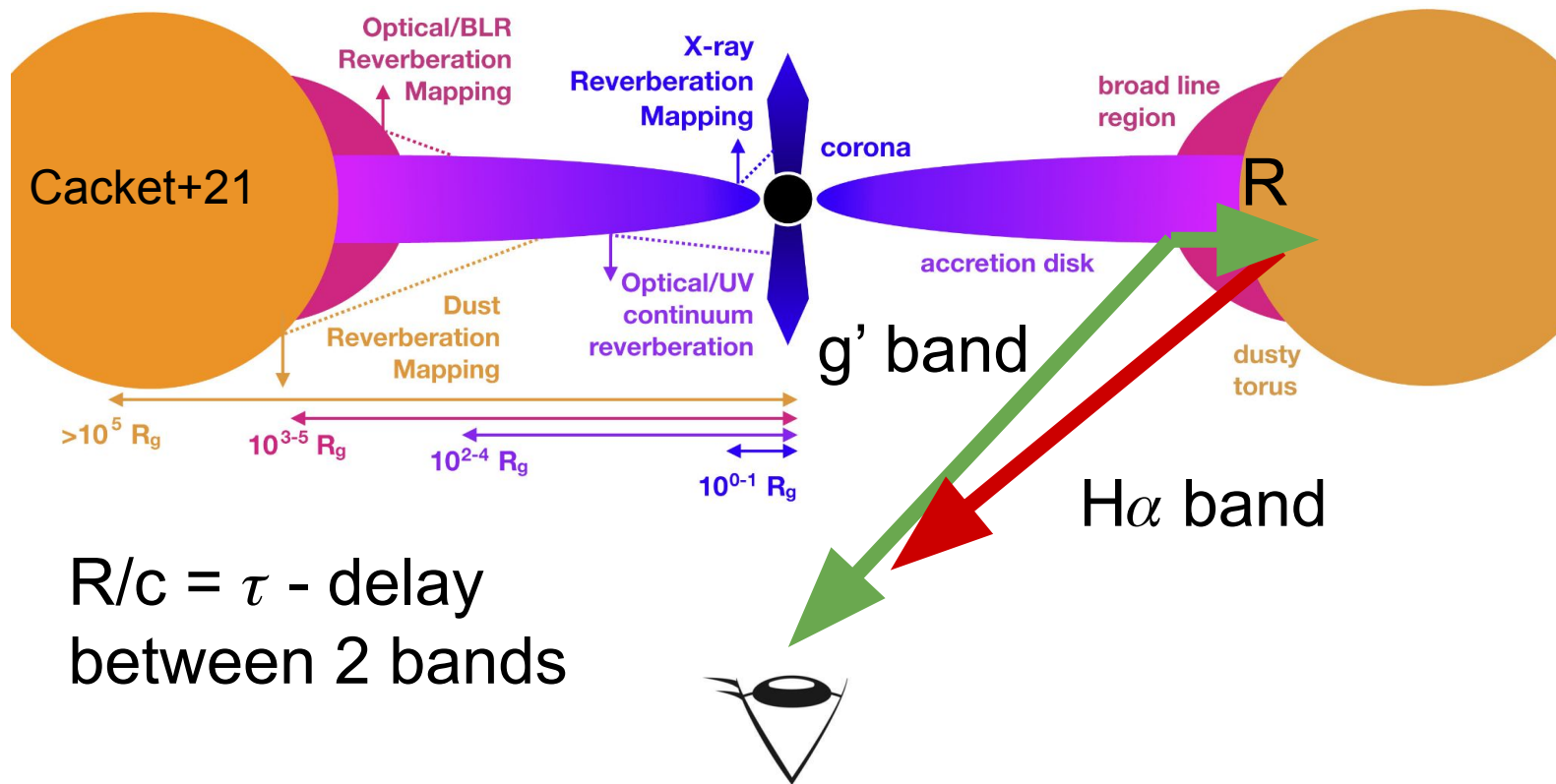


Empirical R-L relations

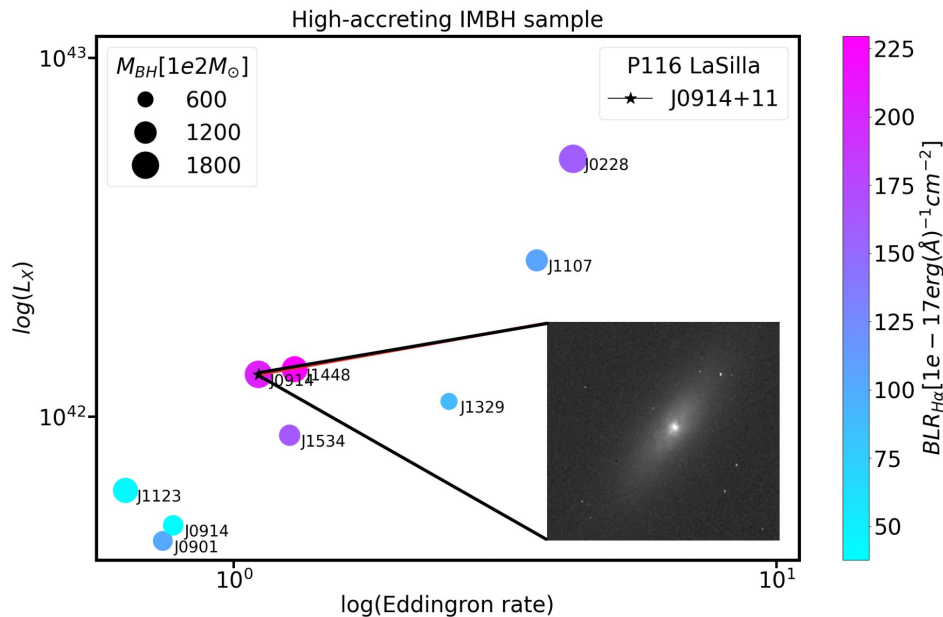
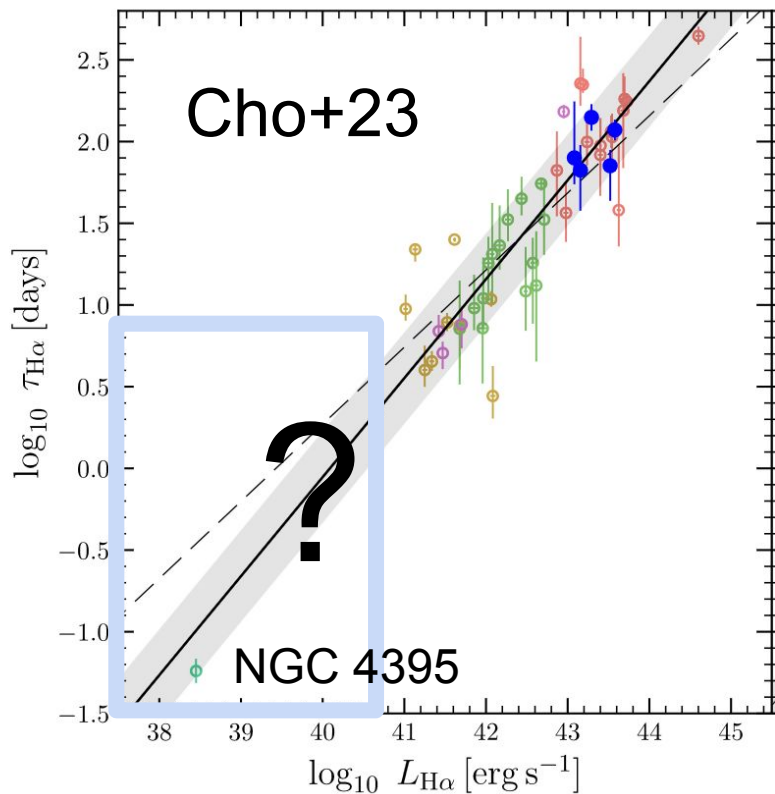


Flux = $L/4\pi R^2$ $\square$ $R \sim L^{0.5}$ For IMBHs $R/c \sim$ hours to days

Reverberation mapping



Where IMBHs lie on R-L relation?



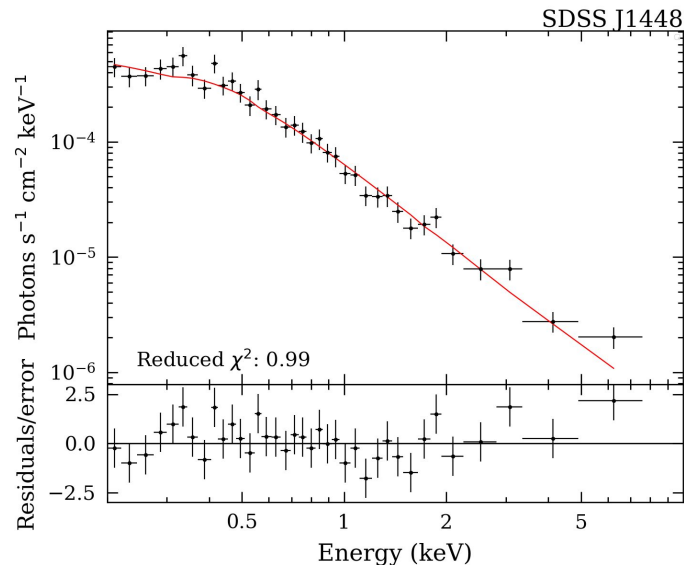
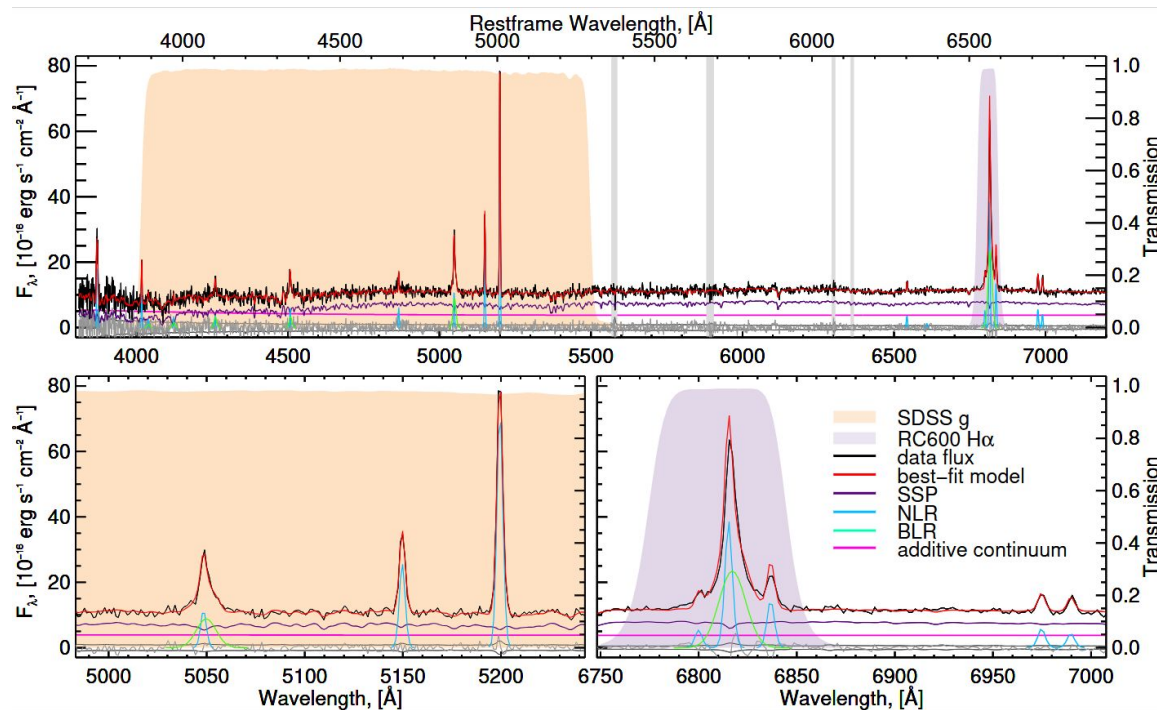
Highly-accreting:
accretion rate $> 10\%$

Reverberation campaign of highly-accreting IMBHs

RC600
60 cm telescope

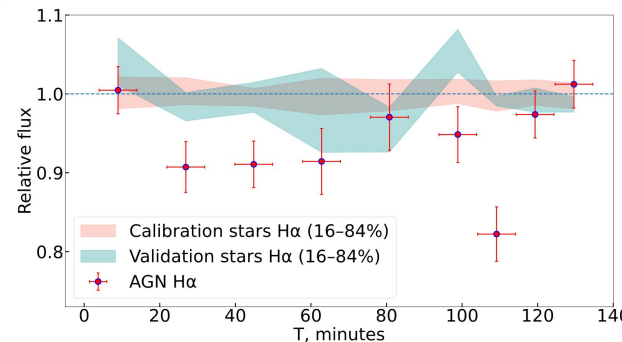
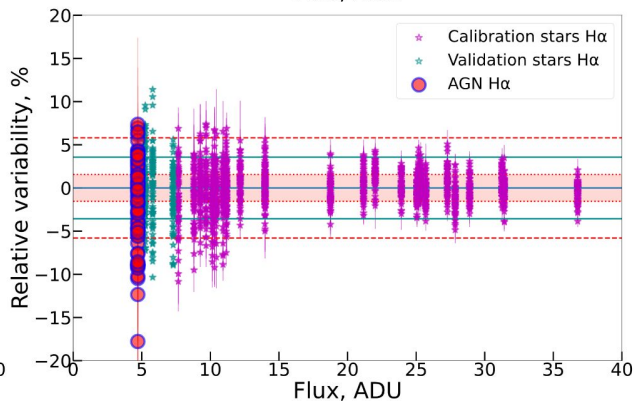
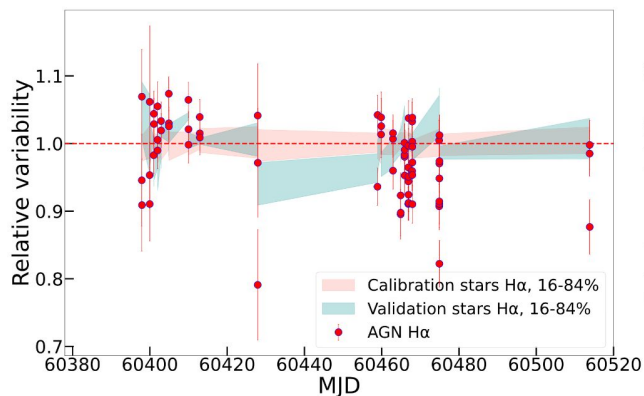
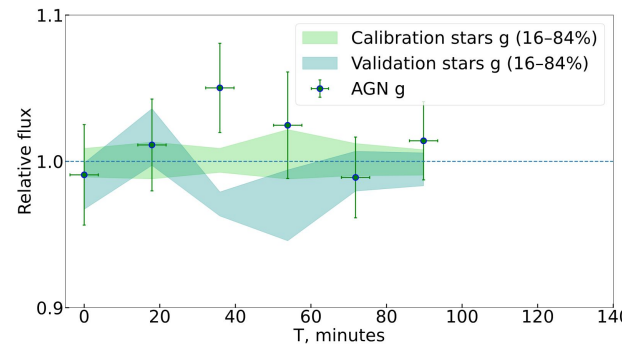
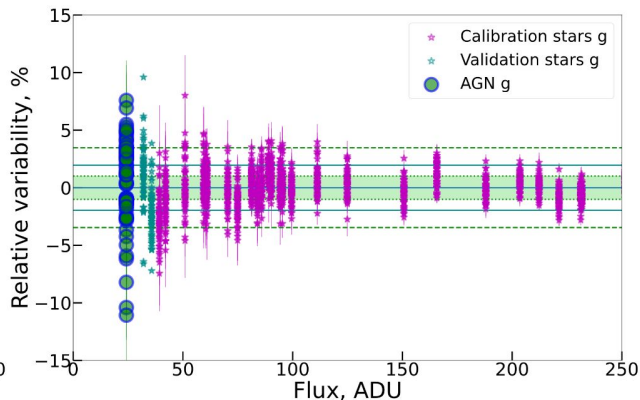
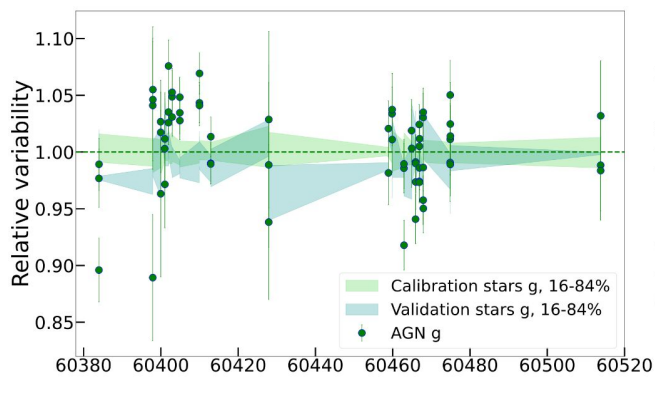


J1448+16, highly-accreting IMBH



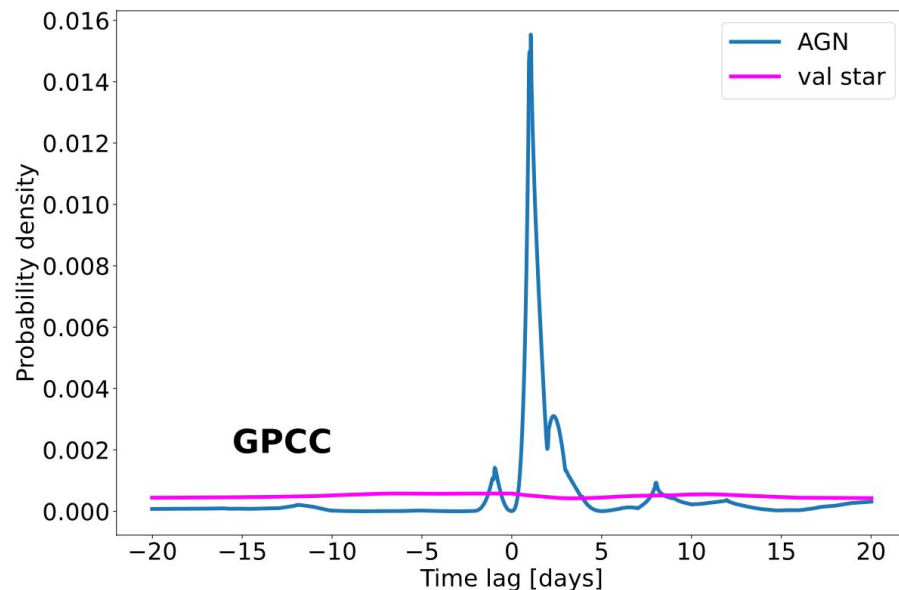
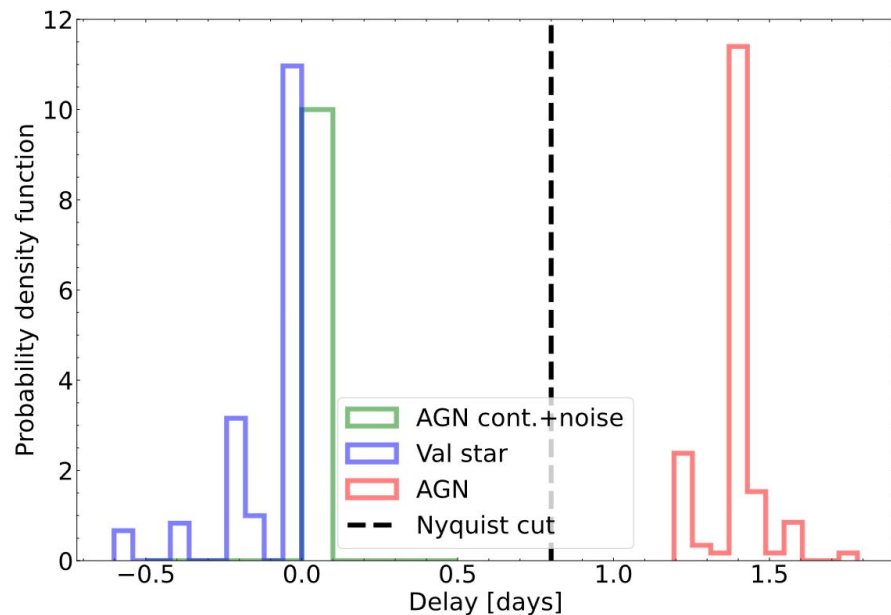
$$M_{BH} = 0.9^{+0.9}_{-0.5} - 2.1^{+2.1}_{-1.0} \times 10^5 M_{\odot} \quad L_{X, 2-10 \text{ keV}} = 3.33^{+0.49}_{-0.44} \times 10^{41} \text{ erg s}^{-1}$$

Reverberation campaign of highly-accreting IMBH

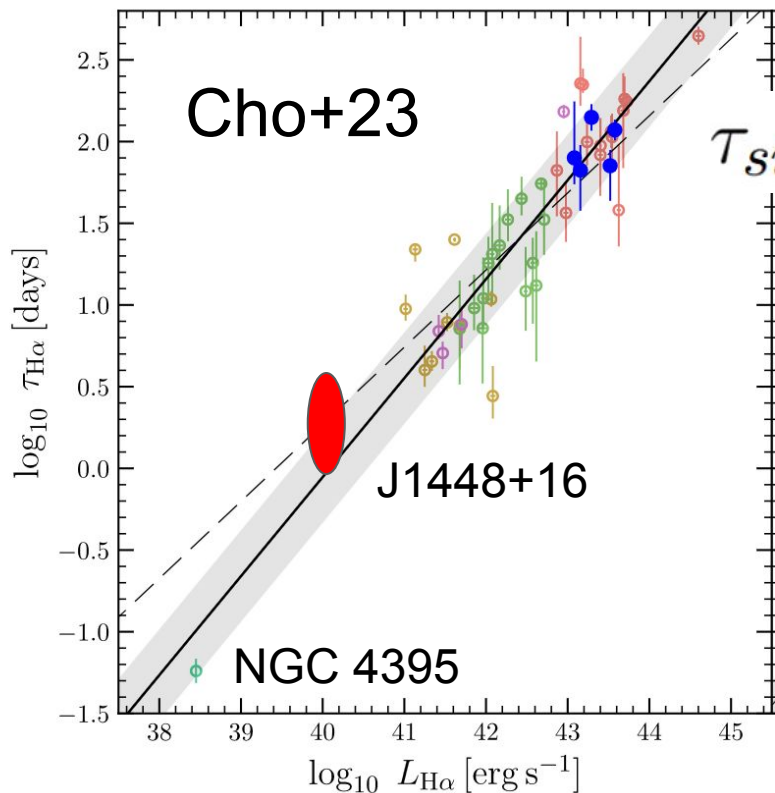


Reliability of the extracted delay

$$\tau_{ICCF, median} = 1.35^{+3.97}_{-3.07} \text{ days} \quad \tau_{GPCC} = 1.31^{+2.66}_{-0.56} \text{ days}$$



Where IMBHs lie on R-L relation?



$$\tau_{sim} = 0.78^{+0.49}_{-0.29} - 2.21^{+1.32}_{-0.81} \text{ days}$$

Corresponds to AD inclination,
Accretion rate, BH mass errors

$$\tau_{GPCC} = 1.31^{+2.66}_{-0.56} \text{ days}$$

Reverberation campaign of highly-accreting IMBHs

2.5m
telescope



1.9m
telescope



2.2m
telescope

