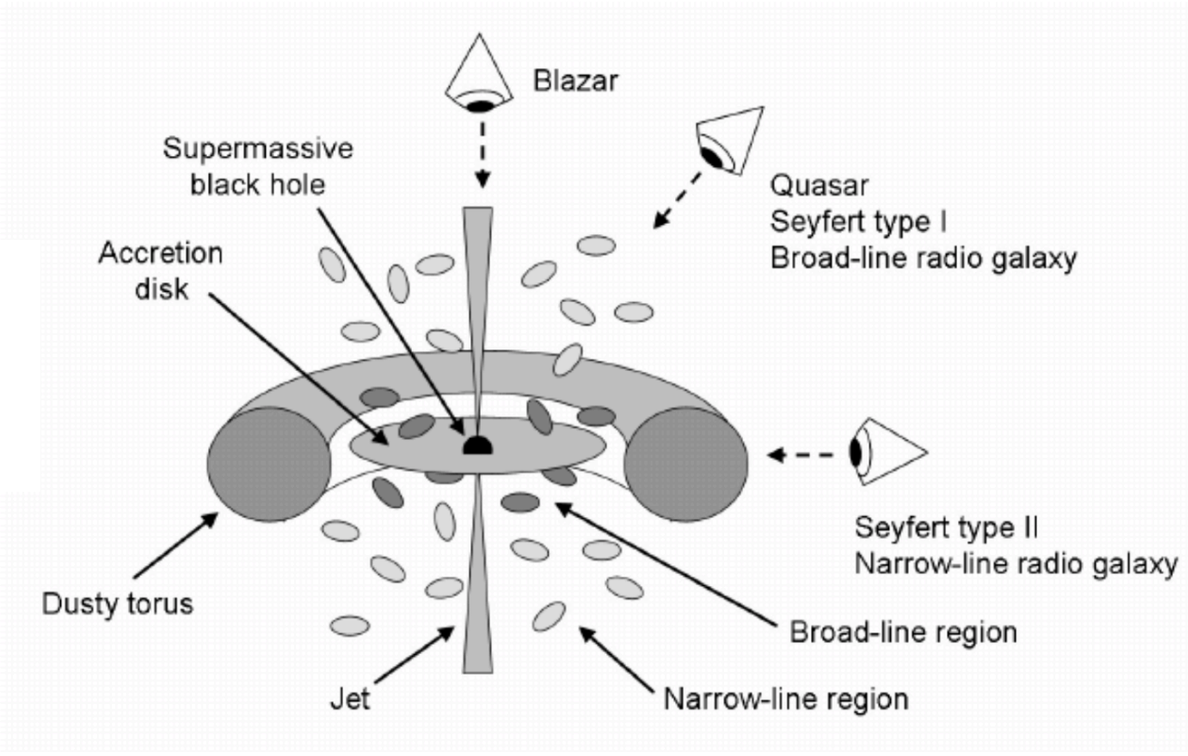
Mrk 110 multiwavelength variability
and prospects for THESEUS

Federico Vincentelli
University of Southampton

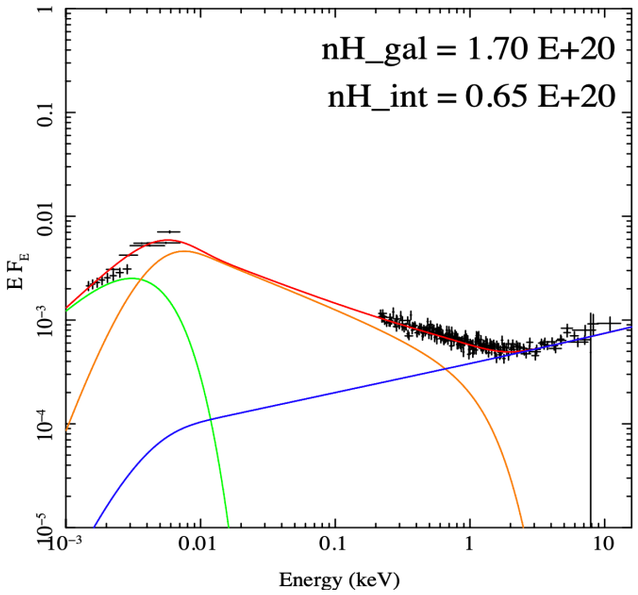
(in collaboration with
I. Mc Hardy, E. Cackett, A. Baarth, K. Horne and many others)

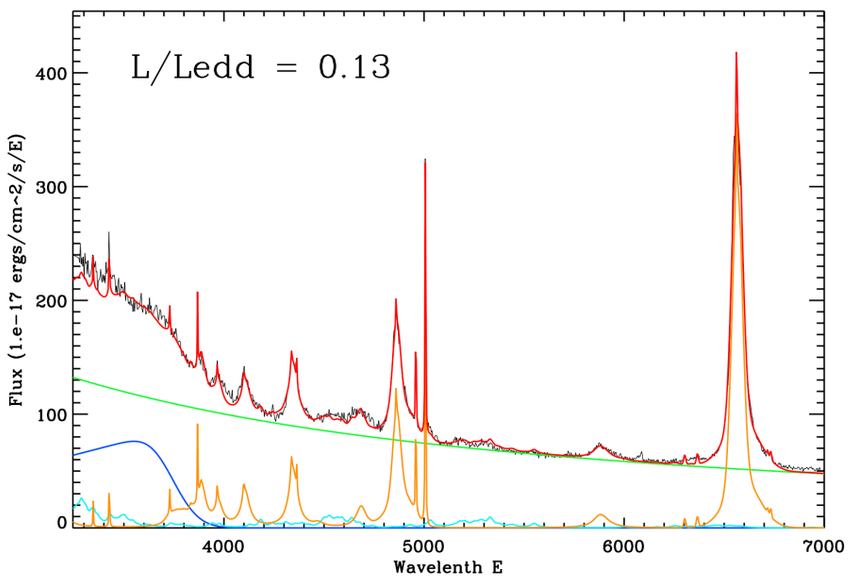
AGN powered by SMBH at center of galaxies

Complex accretion flow, with multiple components (dominating at different energies)



Corona: X-rays
Disk: optical UV
Broad Line region: optical/UV lines (possible contribution to continuum)
Torus: (IR)



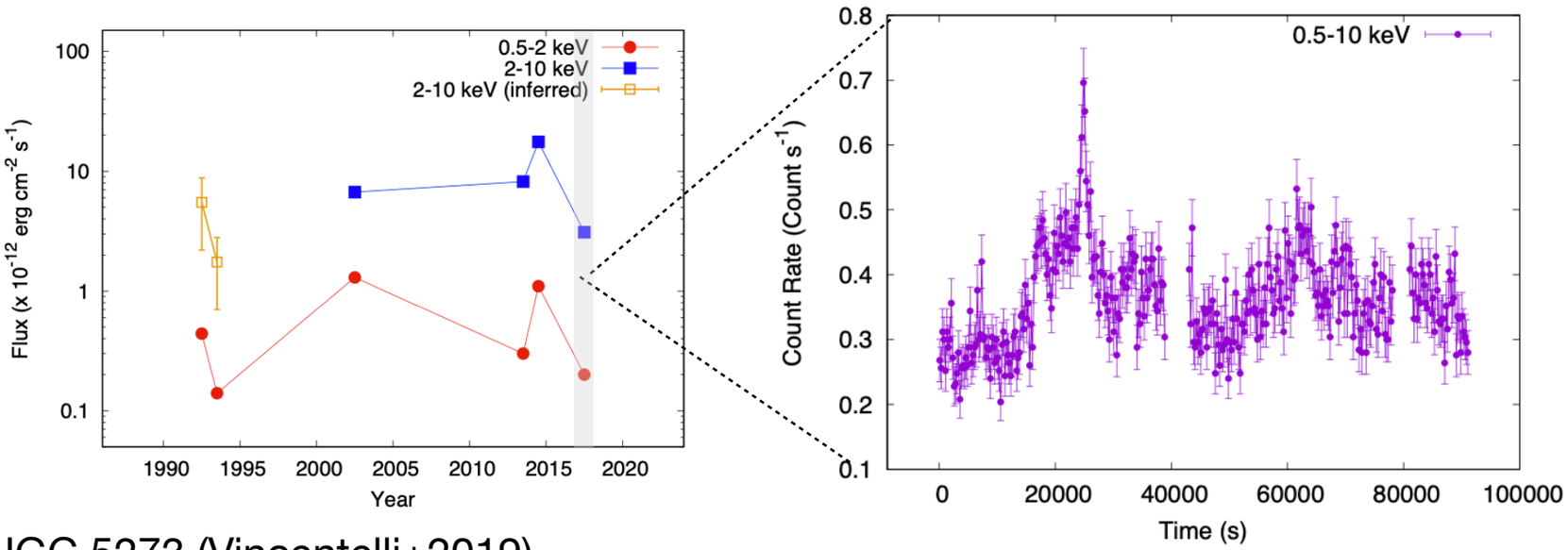


Jin+2011

Variability as a probe to constrain geometry

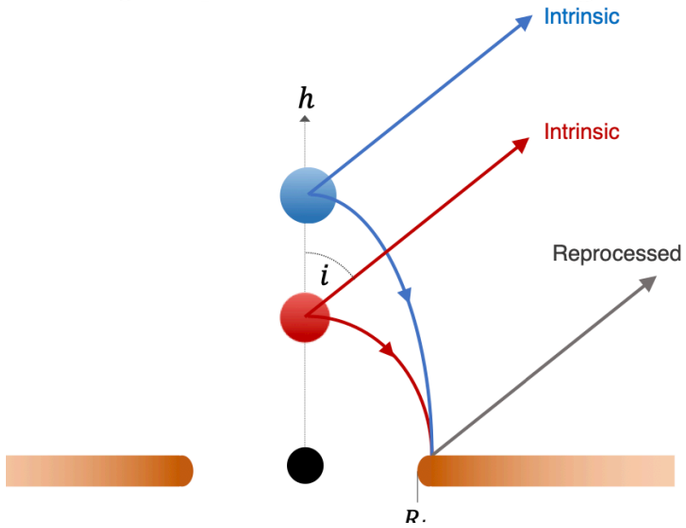
AGN are extremely variable in optical and X-rays

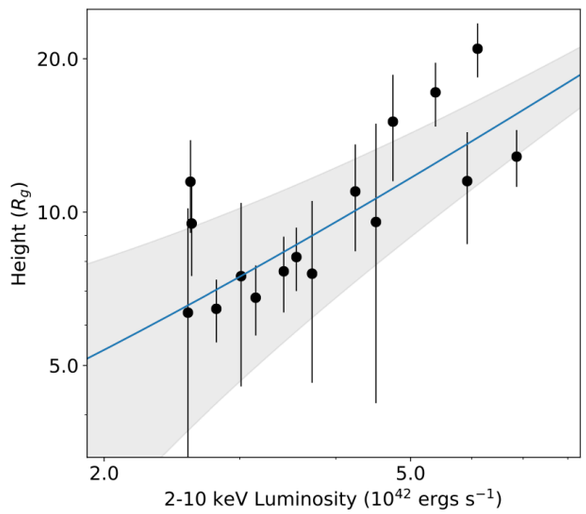
Timescales from ~100 s to years



NGC 5273 (Vincentelli+2019)

X-ray spectral-timing able to map geometry close to BH



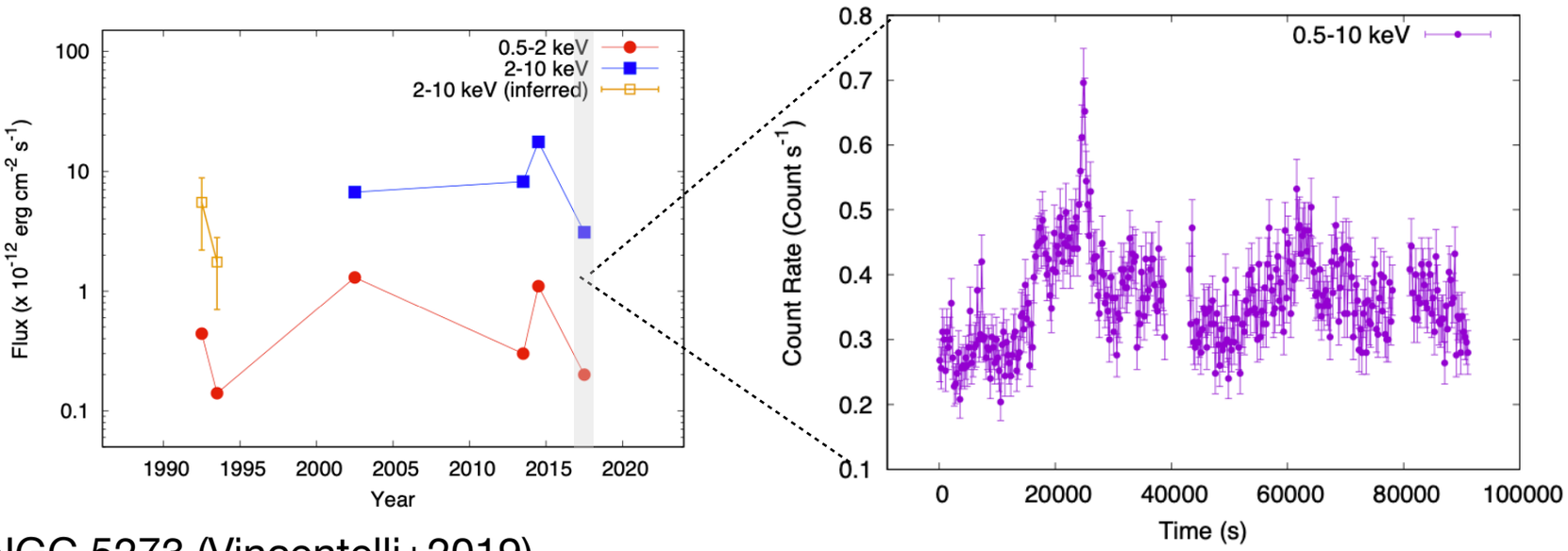


IRAS 13224-3809 (Alston+2020)

Variability as a probe to constrain geometry

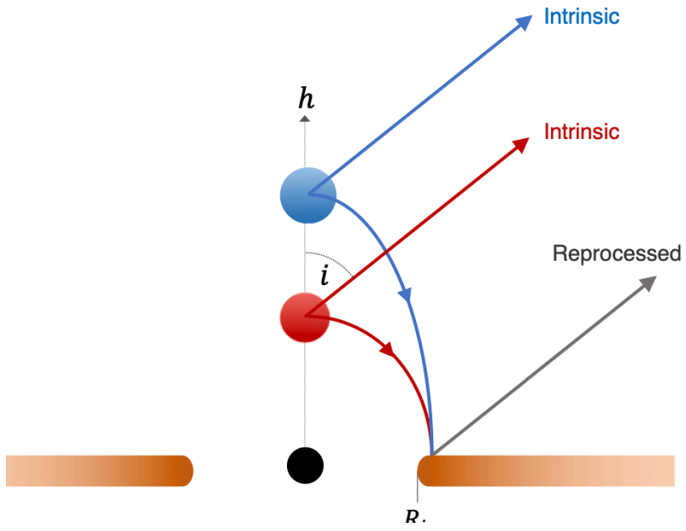
AGN are extremely variable in optical and X-rays

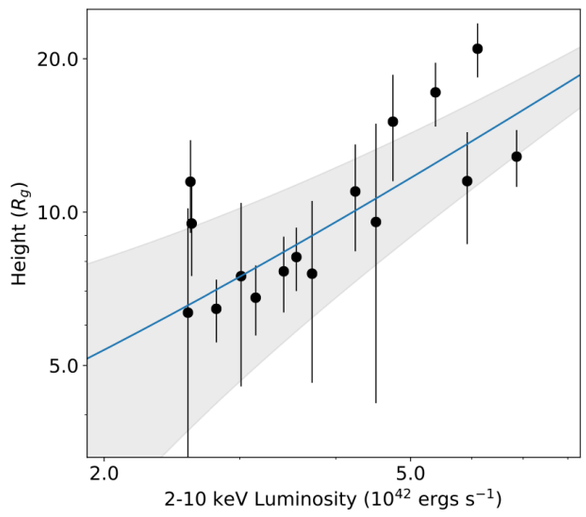
Timescales from ~100 s to years



NGC 5273 (Vincentelli+2019)

X-ray spectral-timing able to map geometry close to BH



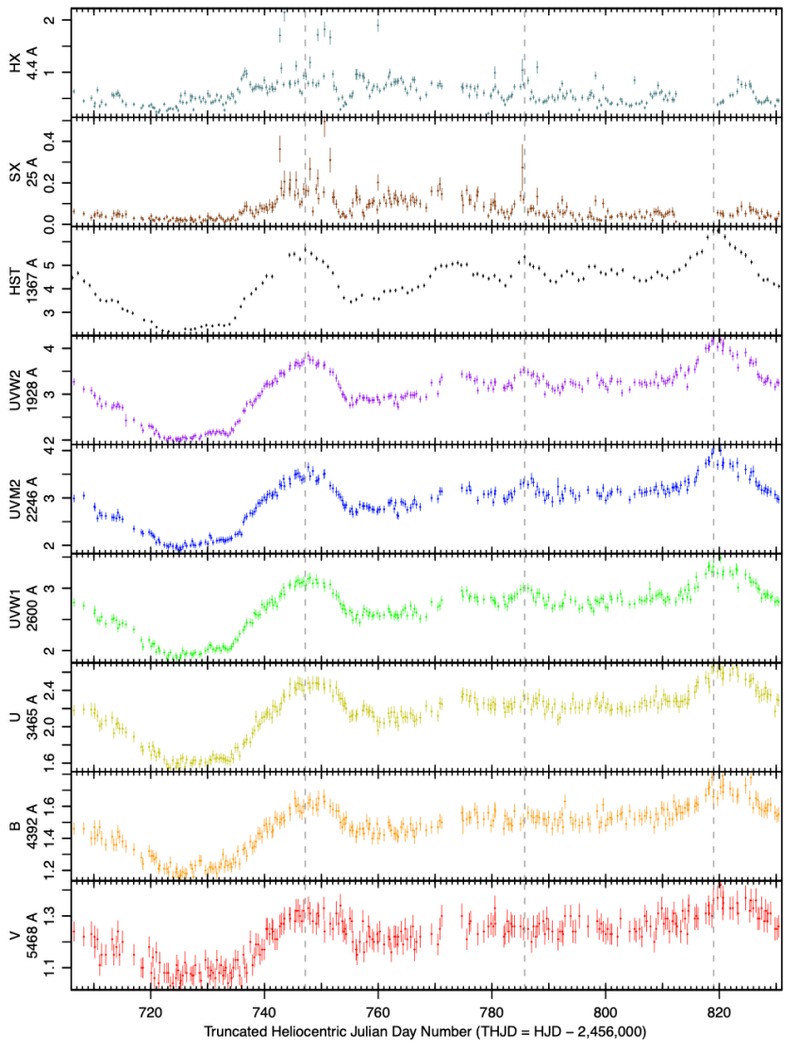


IRAS 13224-3809 (Alston+2020)

Same Experiment can be done with with X-ray/Optical observations!! (outer disk)

Swift role for AGN variability

(NGC 5548, Edelson+2017)



Thanks to Swift schedule flexibility

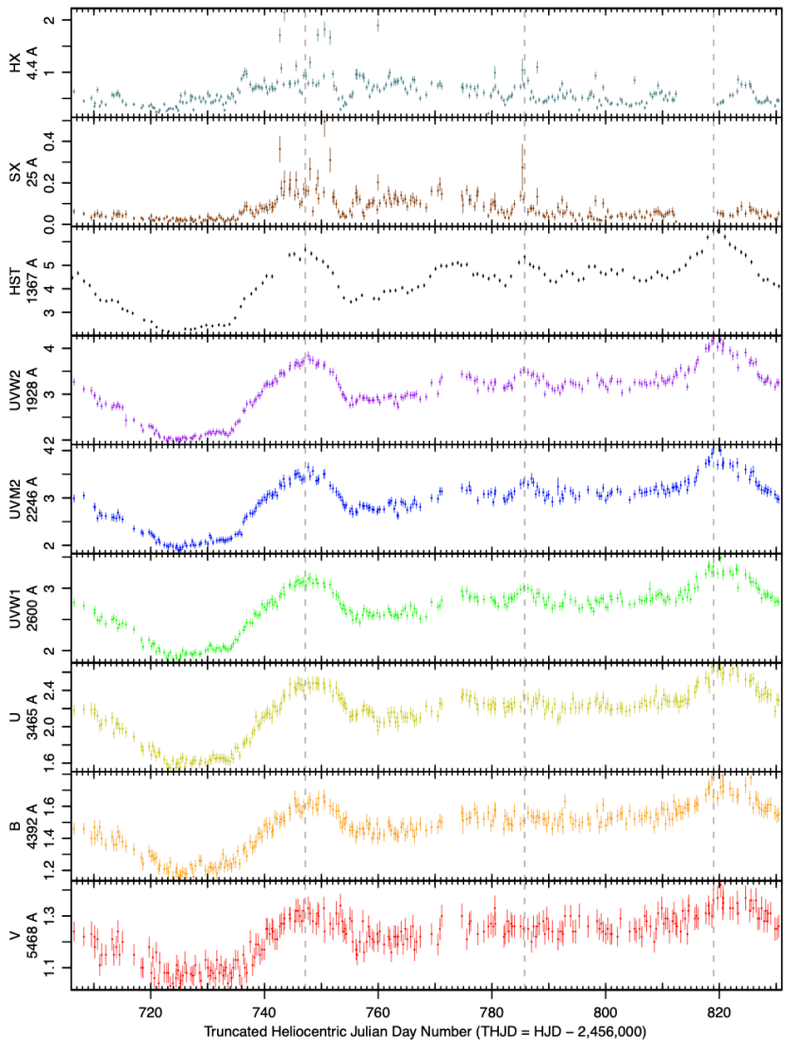
Excellent quality Optical-UV /X-ray monitoring data

~few observations per day for hundreds of days.

Very difficult to obtain from the ground

Swift role for AGN variability

(NGC 5548, Edelson+2017)



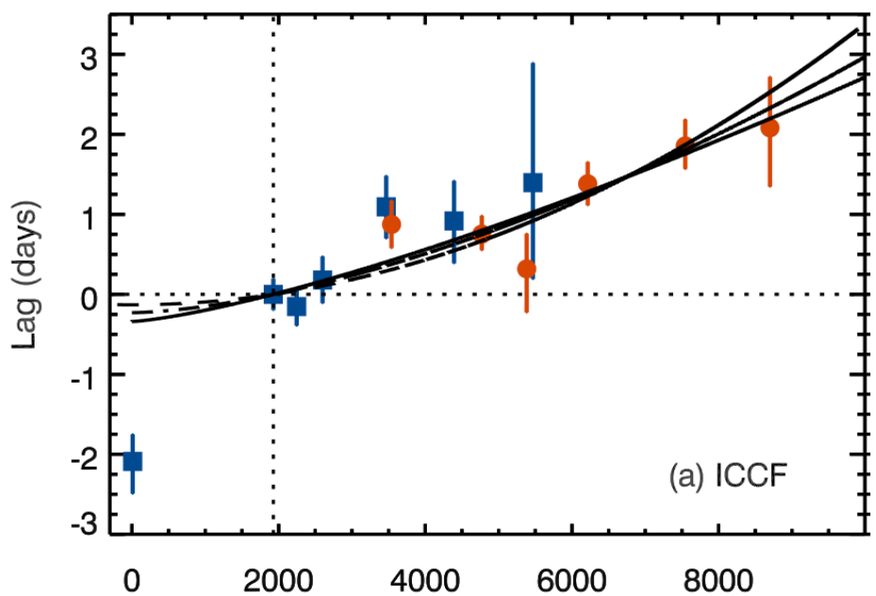
Thanks to Swift schedule flexibility

Excellent quality Optical-UV /X-ray monitoring data

~few observations per day for hundreds of days.

Very difficult to obtain from the ground

(Mrk 142, Cackett+2018)



Study of LAGS increased our understanding of disk:

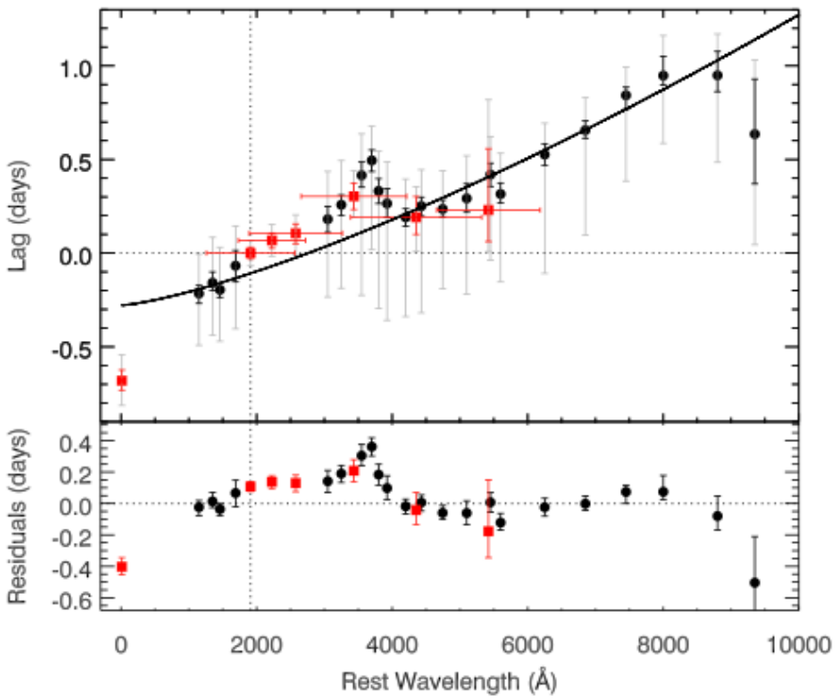
-not consistent with simple lamp-post model

- uv/optical follow expectations, but x-ray do not

Evidence for BLR also in the continuum

Spectroscopically resolved observations show extra component

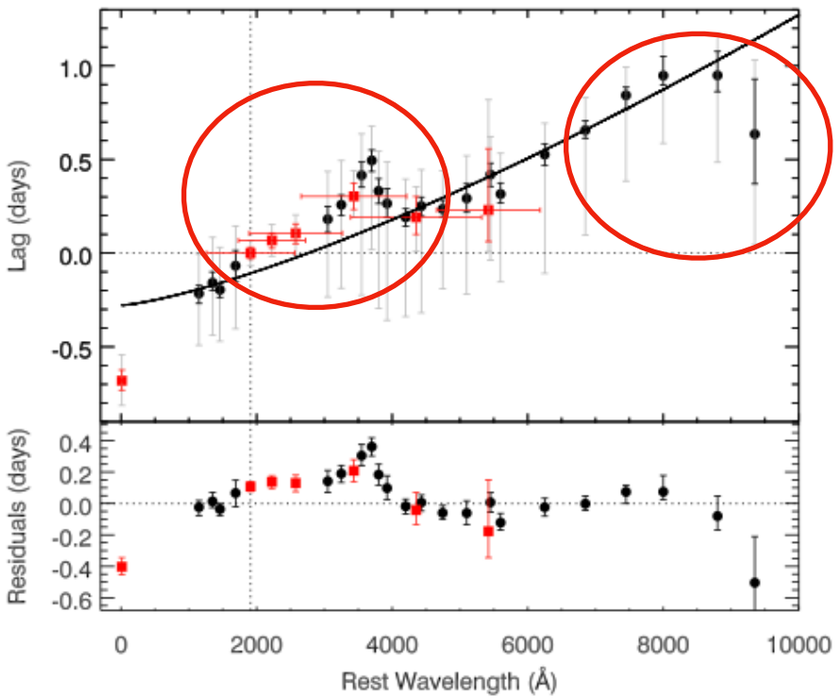
(NGC 4593, Cackett+2018)



Evidence for BLR also in the continuum

Spectroscopically resolved observations show extra component

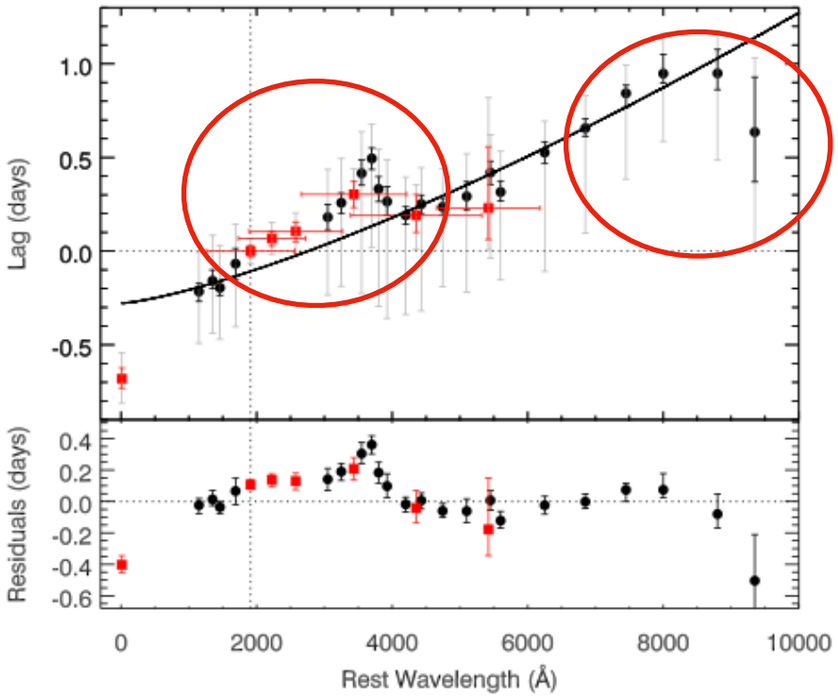
(NGC 4593, Cackett+2018)



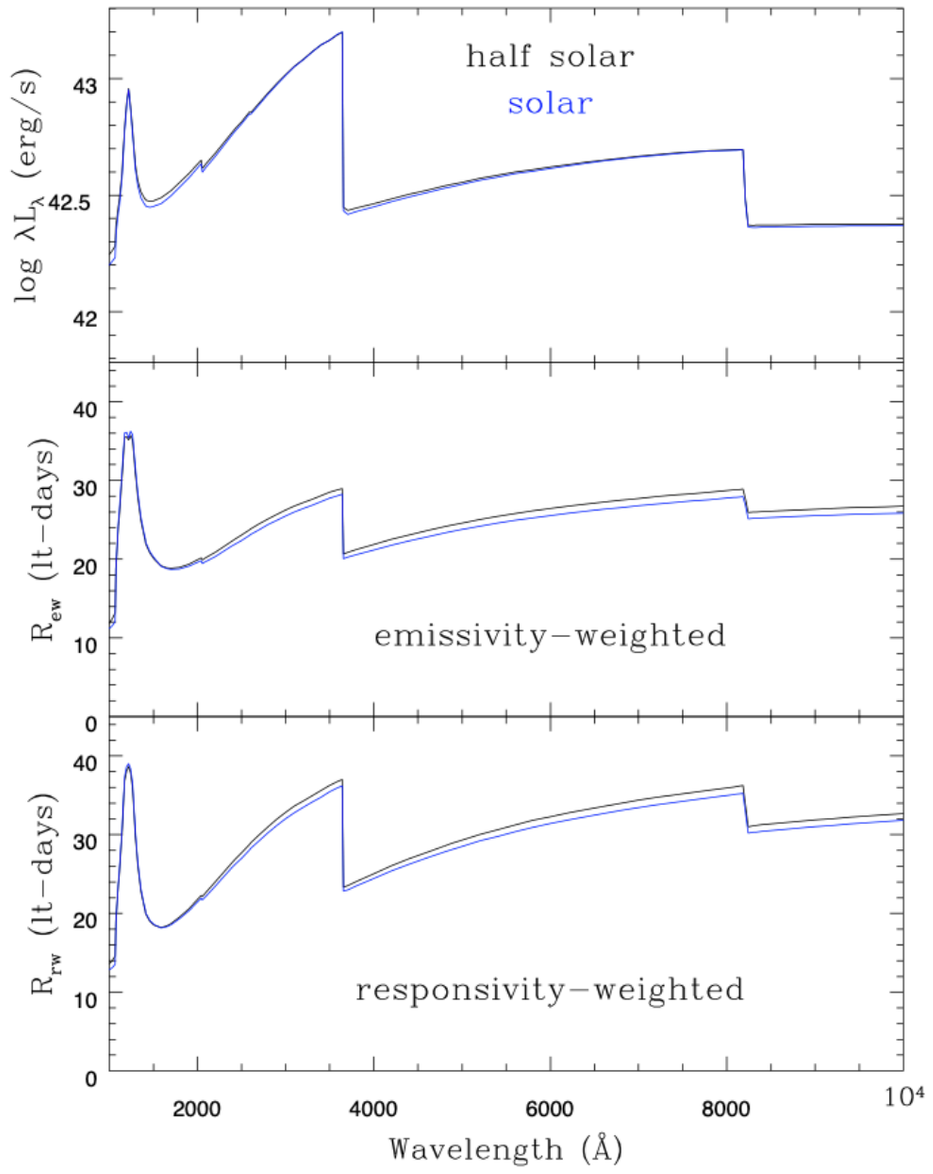
Evidence for BLR also in the continuum

Spectroscopically resolved observations show extra component

(NGC 4593, Cackett+2018)



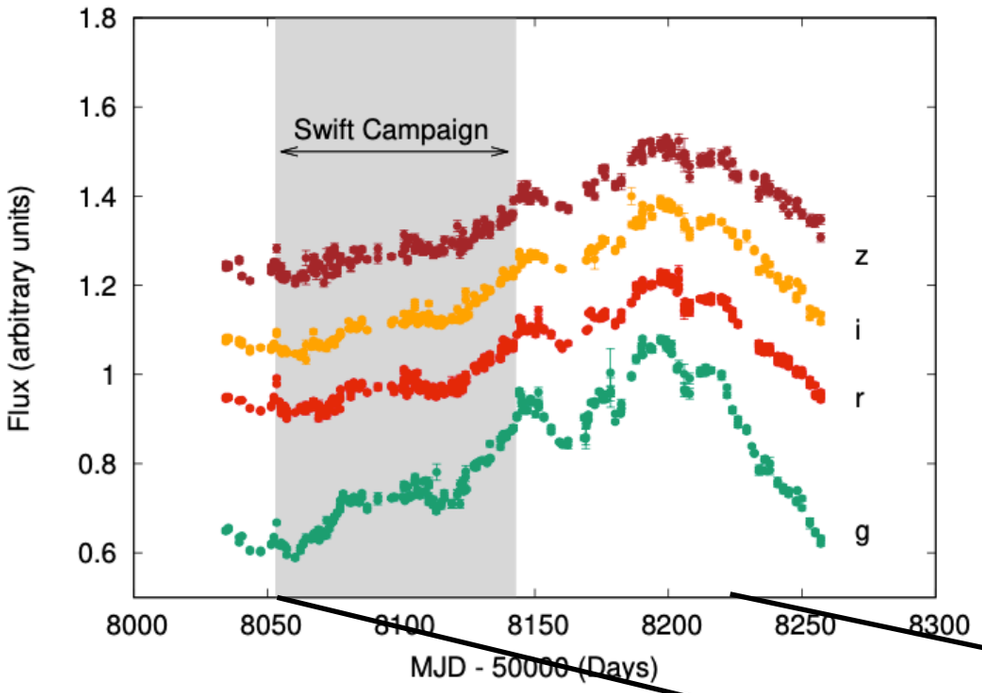
Simulations from Korista & Goad 2019

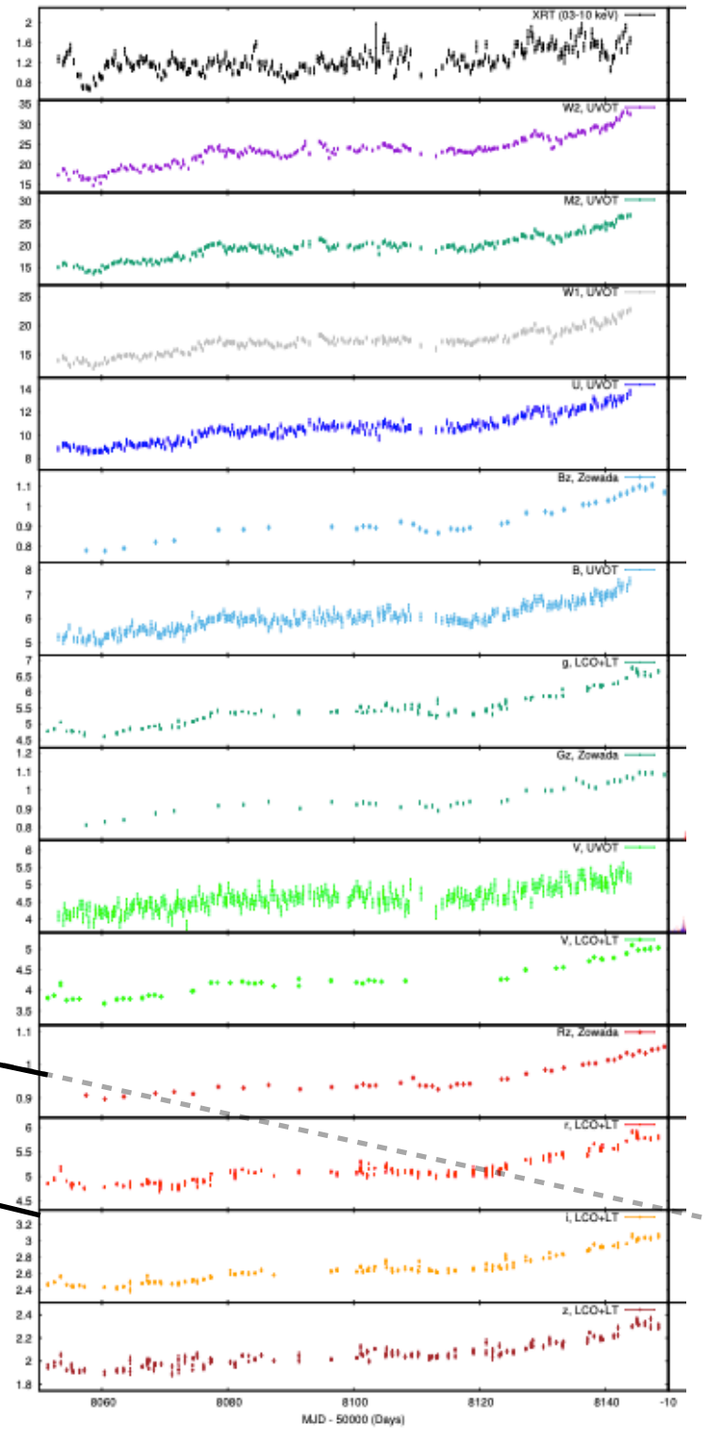


This can be explained in terms of BLR diffuse continuum!

Not only disk, but also BLR!

Mrk 110 campaign





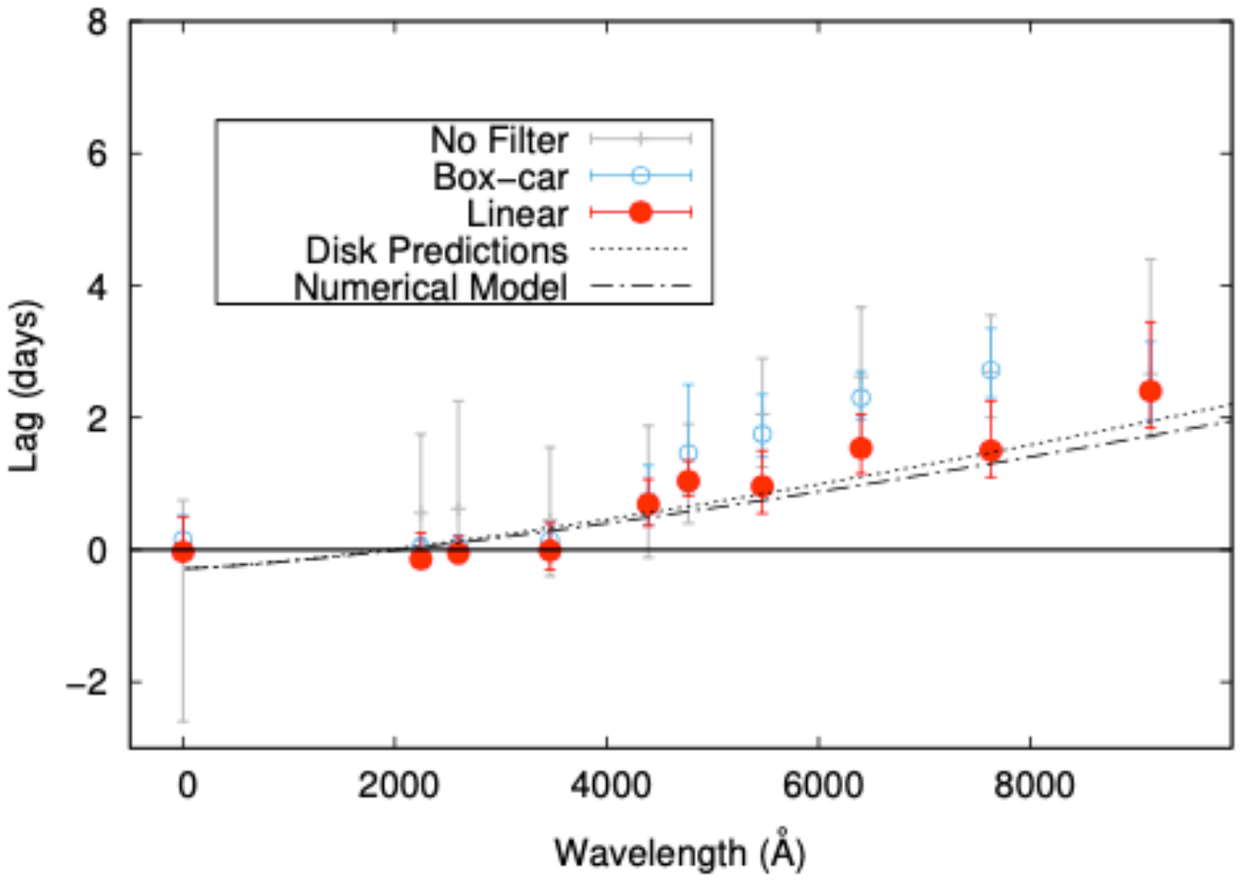
>250 days campaign including:
XRT
UVOT
LCO
LT

2 Clear Behaviours:

-Short term variation
-Long term trend

Vincentelli+subm.

Short term lags



Lags vs UVW2 band (1928 ang.)

Long term trend present in data

Different methods used to filter it

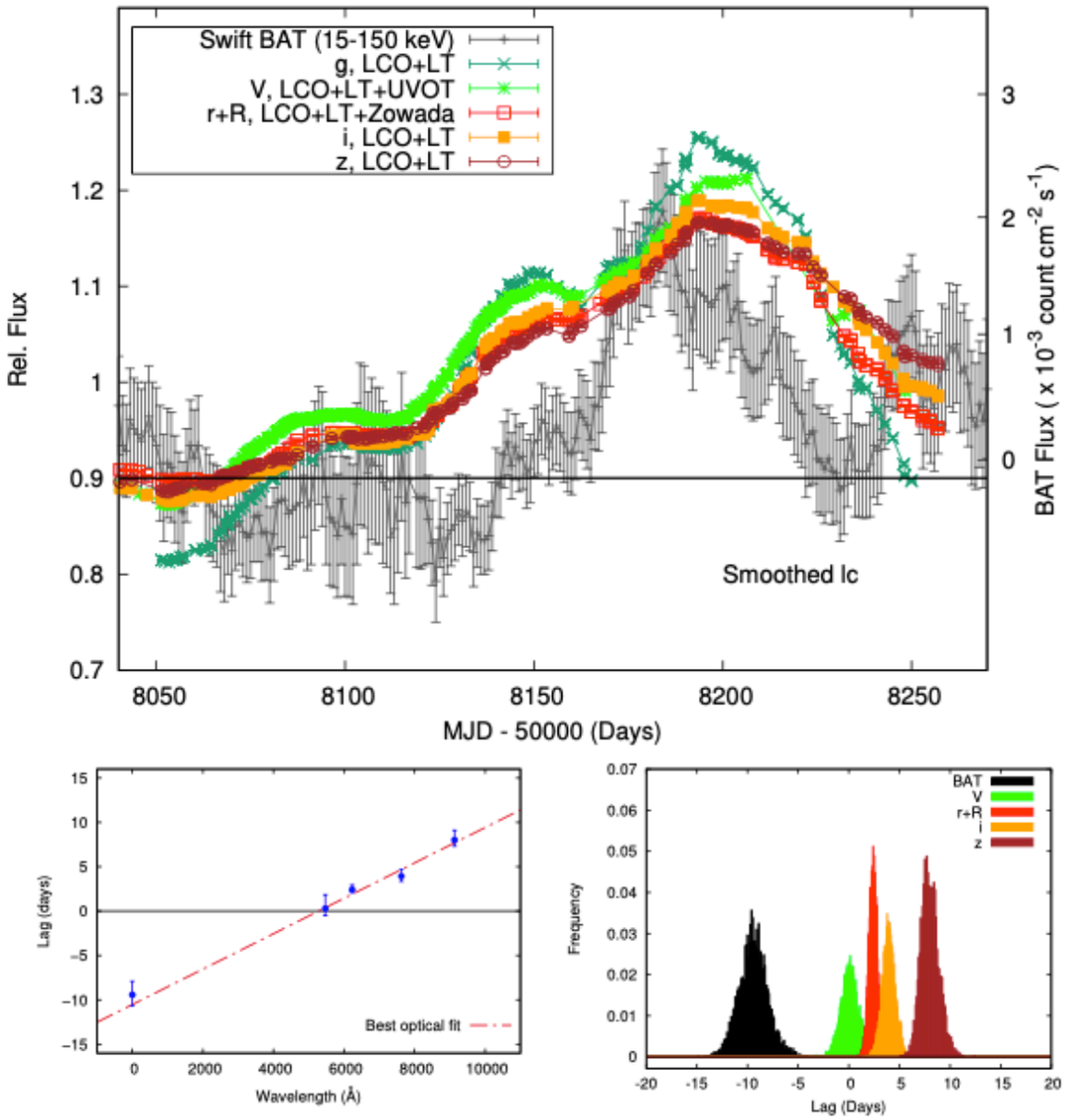
Lags consistent with disk predictions

ONLY WHEN FILTERING OUT LONG TIMESCALES

X-ray/UV consistent with 0, no UV excess

Vincentelli+subm.

Long term trend

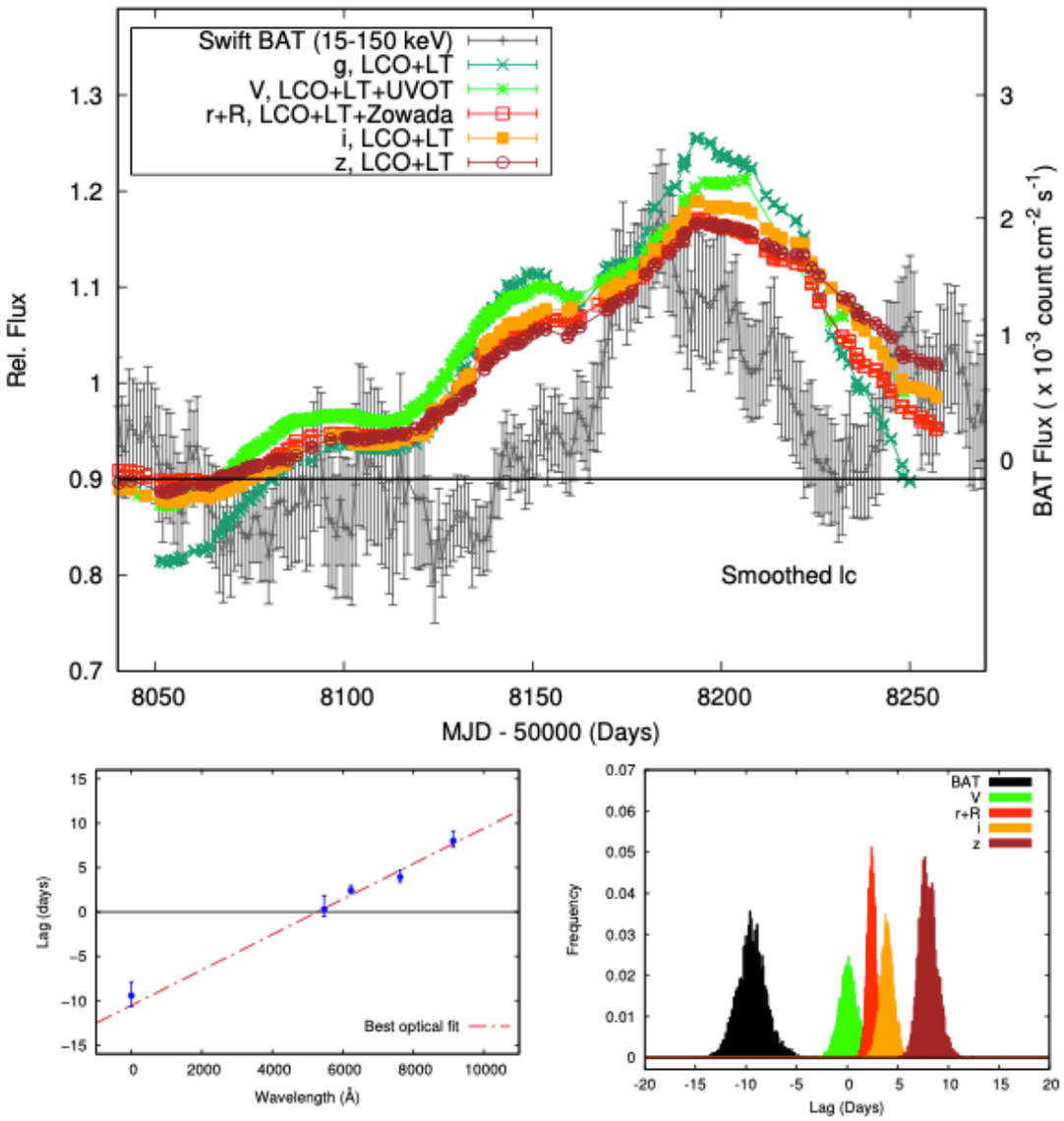


Longer variations show a much longer lag

Not consistent with disk predictions.

Vincentelli+subm.

Long term trend



Longer variations show a much longer lag

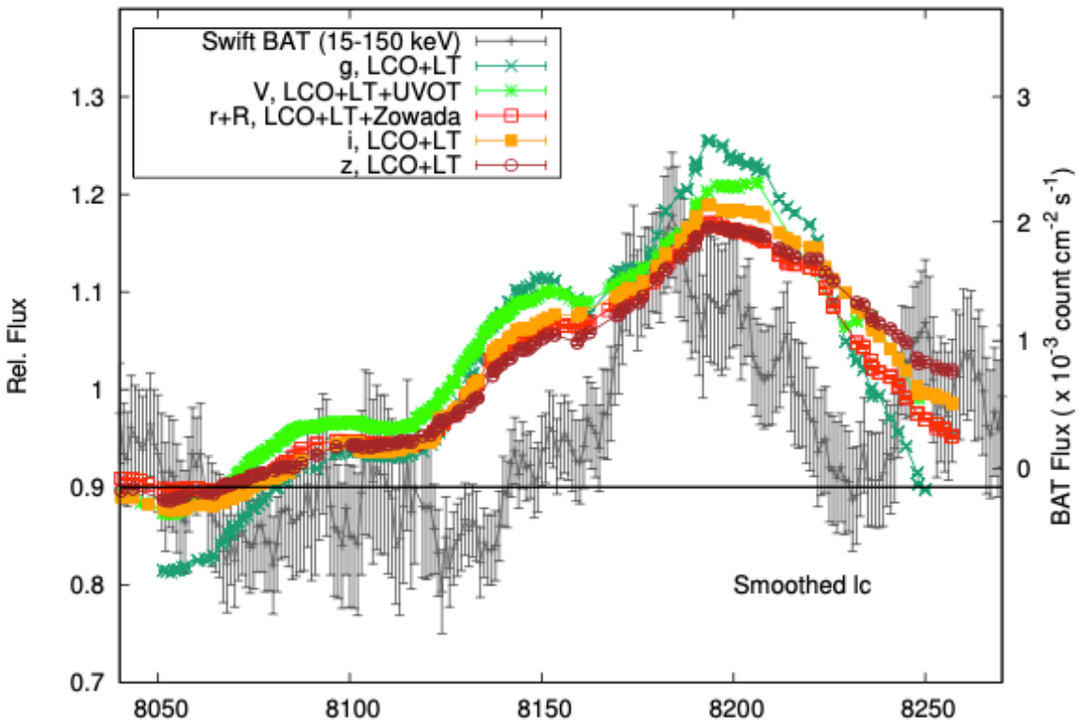
Not consistent with disk predictions.

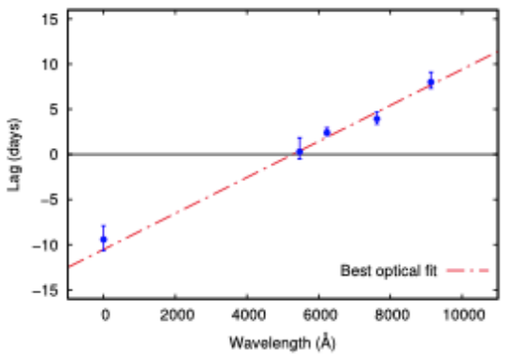
SED evolves time, flare observed in BAT

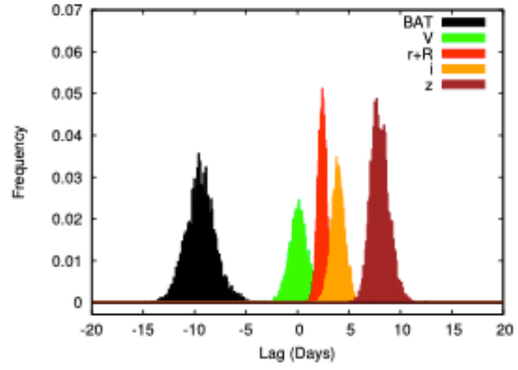
This suggests stronger contribution of BLR

Vincentelli+subm.

Long term trend





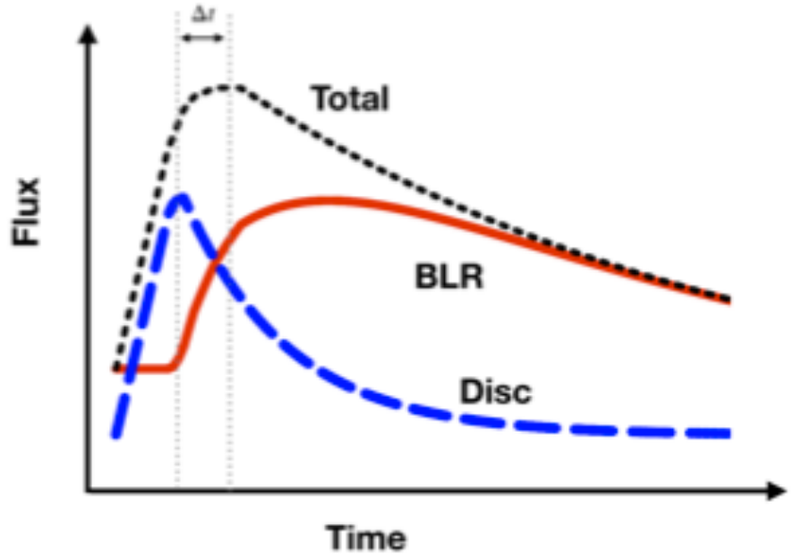


Longer variations show a much longer lag

Not consistent with disk predictions.

SED evolves time, flare observed in BAT

This suggests stronger contribution of BLR



Possible change in inner geometry could trigger it

but no pointed observation to test hypothesis (perfect case for Theseus)

Why THESEUS can be crucial?

THESEUS is the evolution of Swift

Not only flexibility and sensitivity…but also extension to IR!

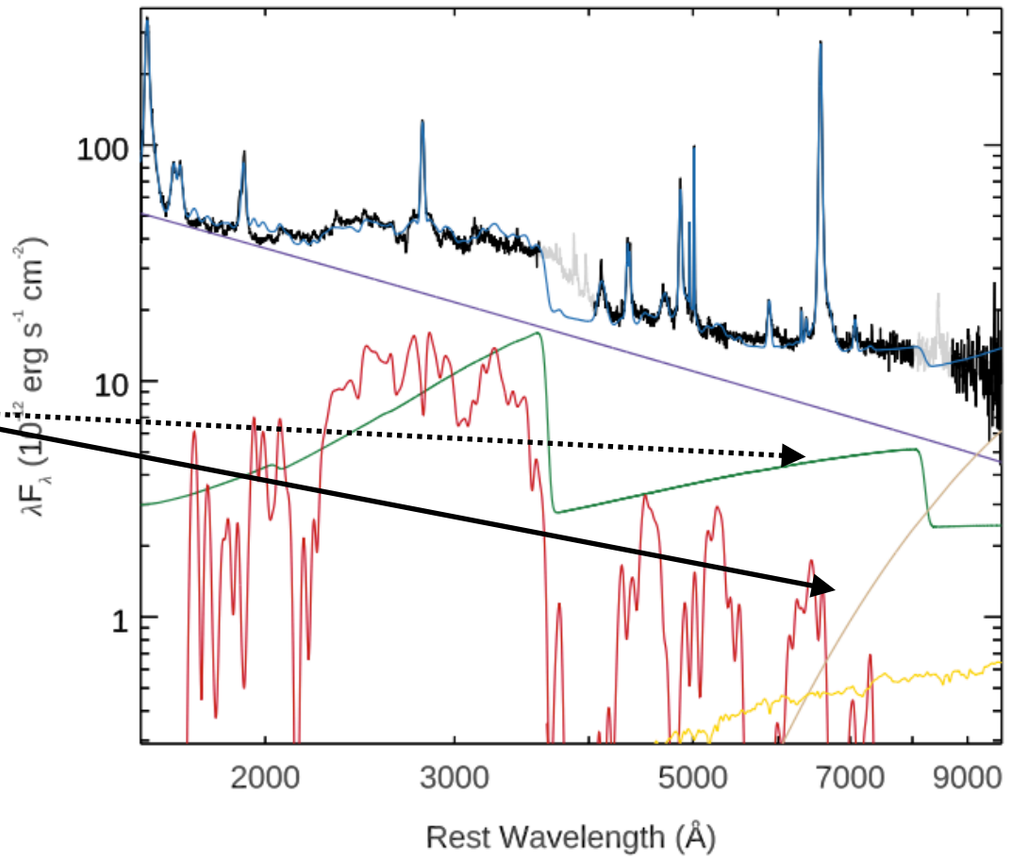
Why THESEUS can be crucial?

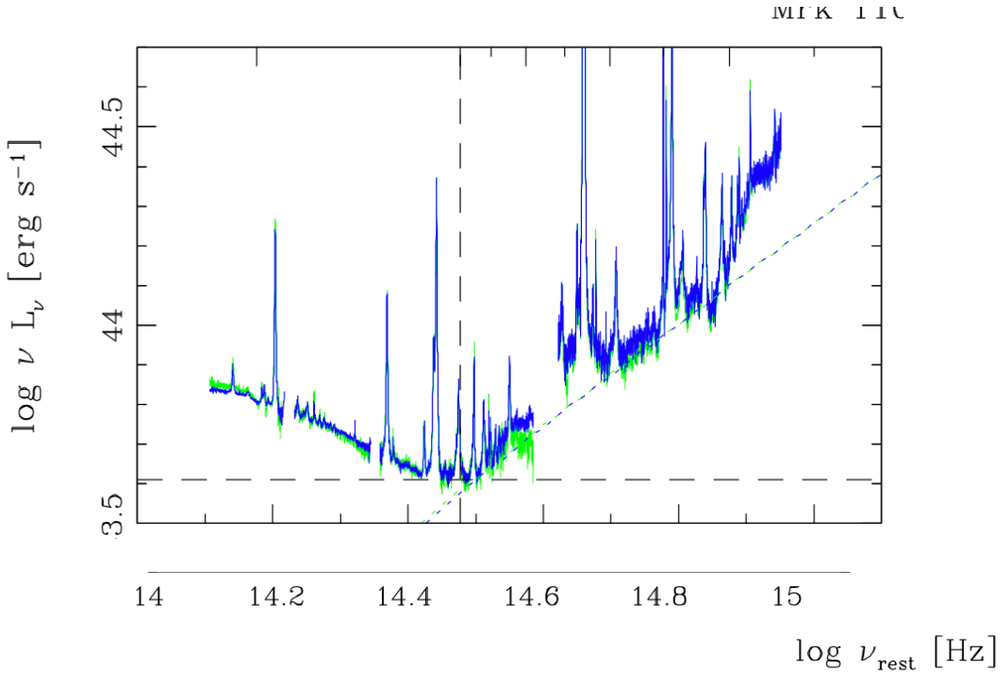
THESEUS is the evolution of Swift

Not only flexibility and sensitivity…but also extension to IR!

Vincentelli+subm.

Covering >800 nm can probe
BLR Diffuse continuum and Torus variability





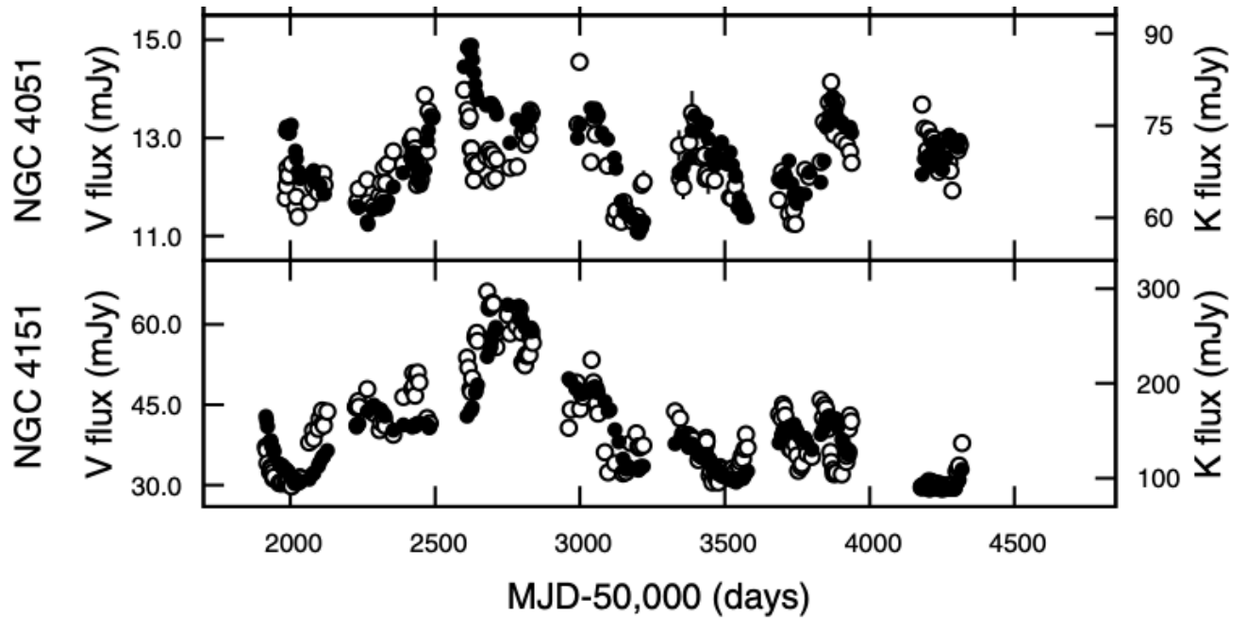
Why THESEUS can be crucial?

THESEUS is the evolution of Swift

Not only flexibility and sensitivity…but also extension to IR!

Covering >800 nm can probe
BLR Diffuse continuum and Torus variability

Longer wavelengths lightcuve data are mainly from ground very sparse sampling



THESEUS (as Swift) is able to perform ~few obs. per day

probe with much higher detail the X-ray/IR (depending on the observing window)

CONCLUSIONS

Swift intensive monitoring of AGN is changing our view of AGN accretion flow

A ground base+ Swift campaign of Mrk 110
revealed the presence of multiple components at different timescales

THESEUS thanks to its flexibility and multiwavelength coverage
can play a crucial role, especially for the BLR

CONCLUSIONS

Swift intensive monitoring of AGN is changing our view of AGN accretion flow

A ground base+ Swift campaign of Mrk 110
revealed the presence of multiple components at different timescales

THESEUS thanks to its flexibility and multiwavelength coverage
can play a crucial role, especially for the BLR

THANK YOU