RESULTS FROM SPECTROSCOPIC MONITORING OF A HYPERVARIABLE AGN

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Introduction

AGN are known to vary ~10 %

Large-amplitude (factors of a few – tens) variability much rarer, may be due to:

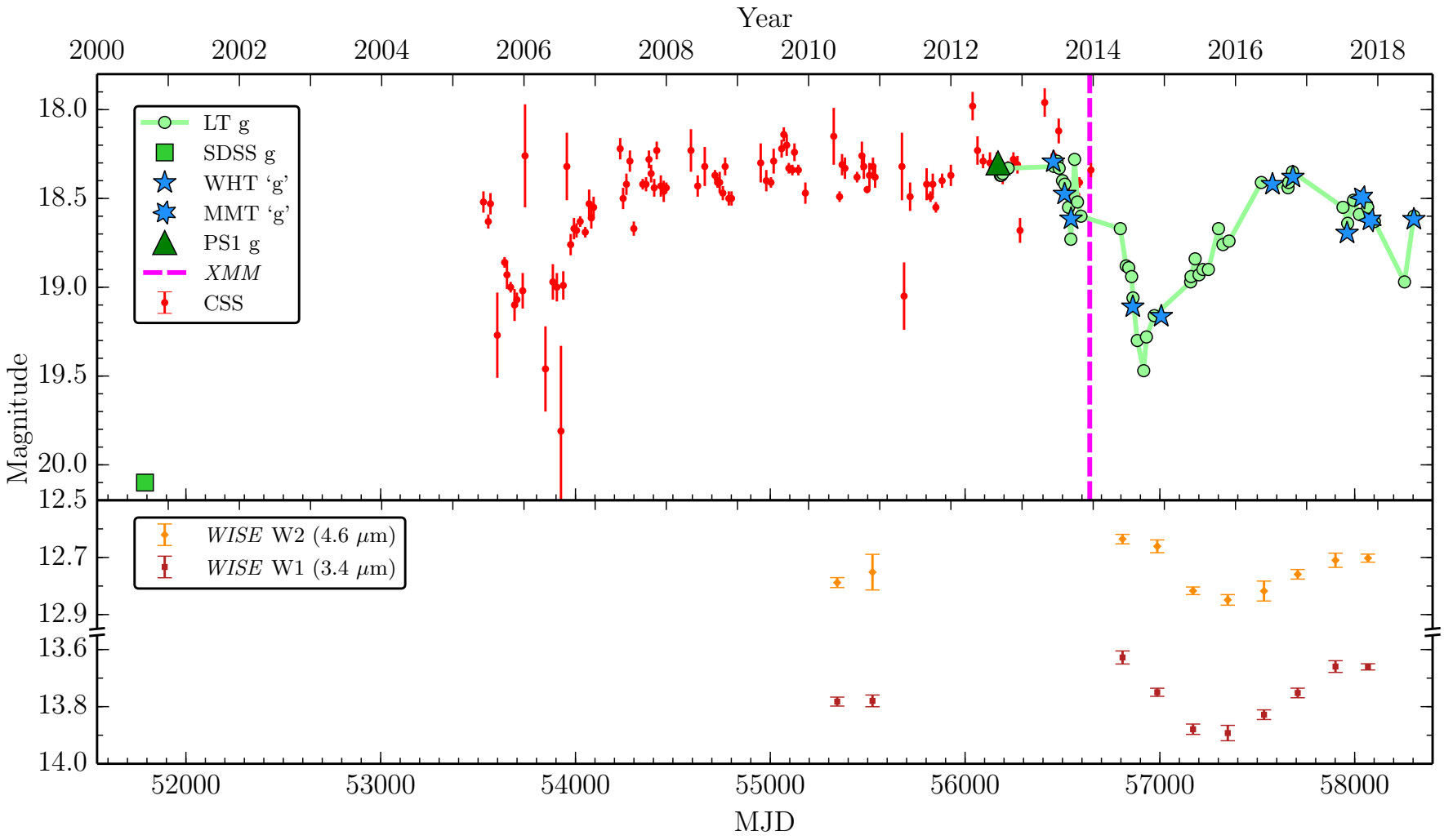
- Obscuration
- Microlensing
- Tidal disruption events
- Accretion disc instabilities
- …

} Extrinsic

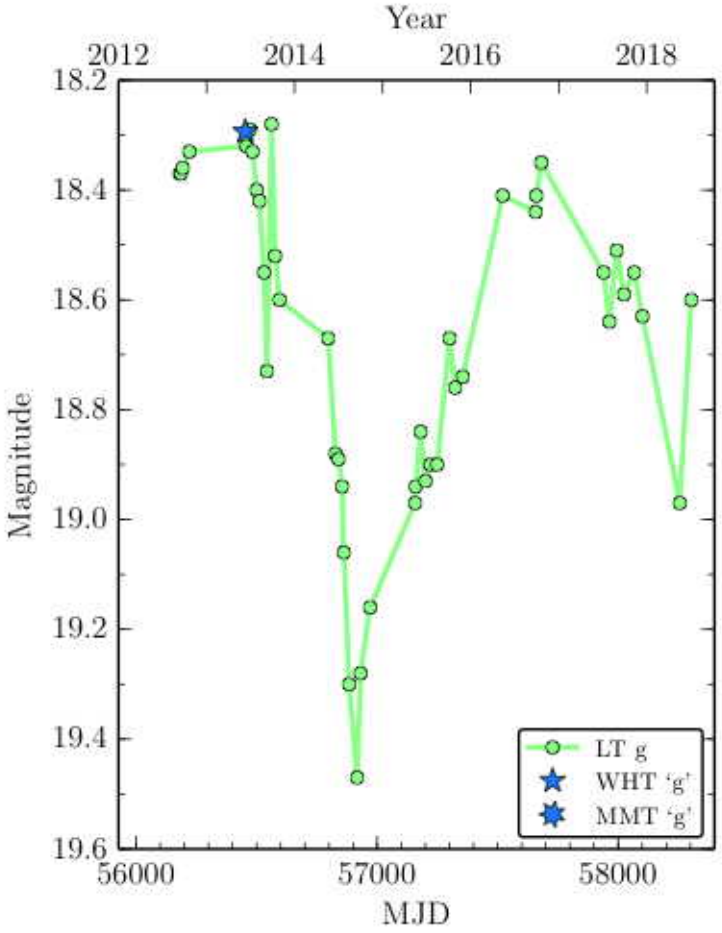
} Intrinsic

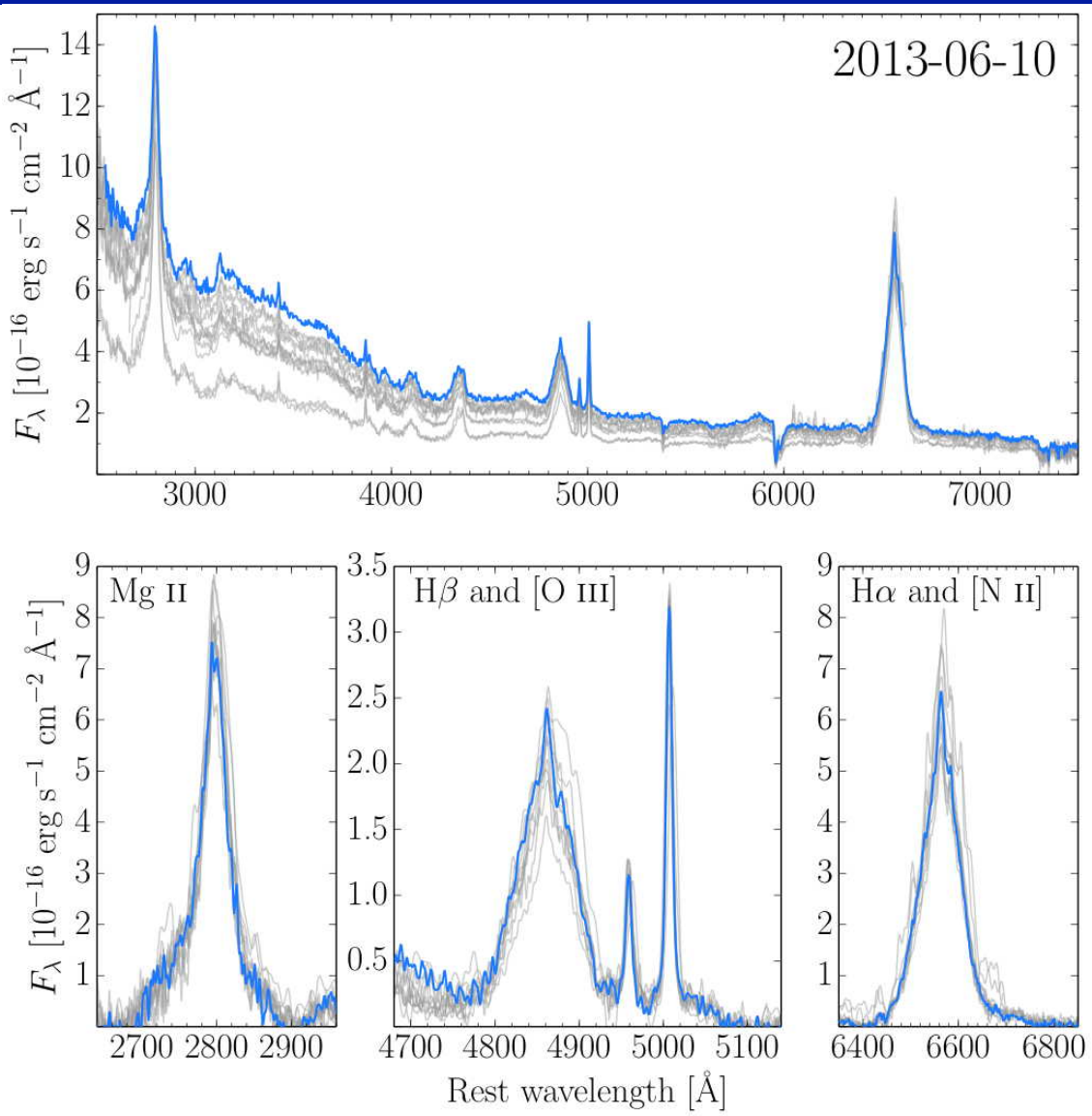
Lightcurves

SDSS J2232-0806: The ‘Big Dipper’



Optical spectral variability





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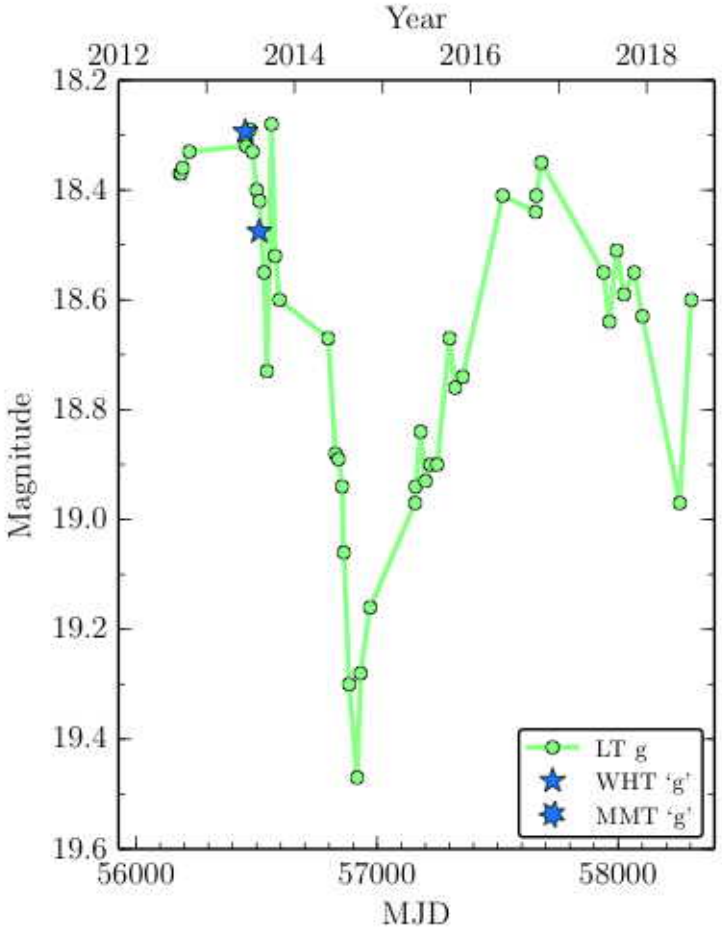

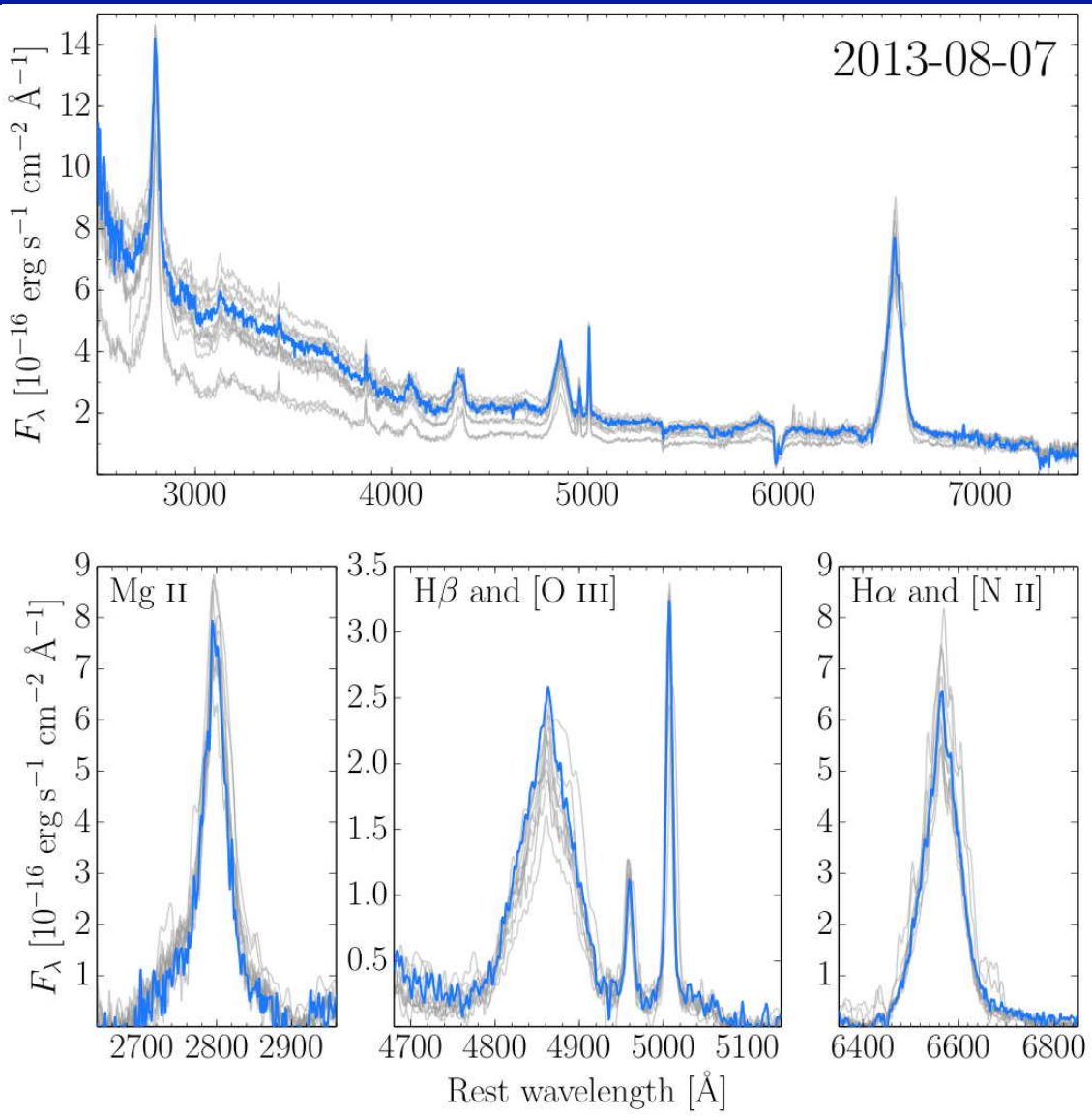

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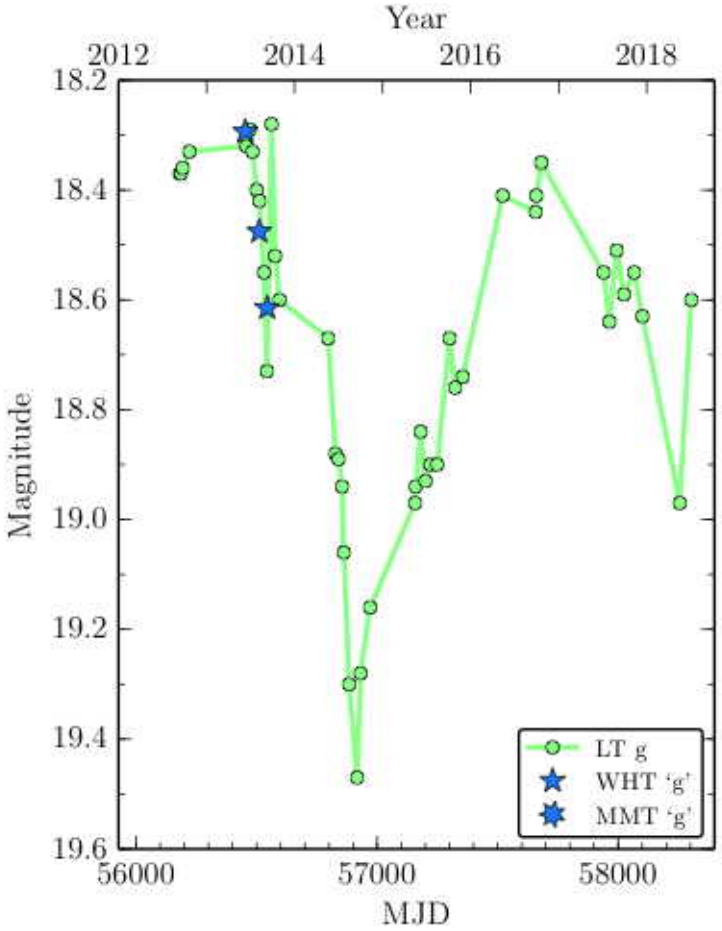

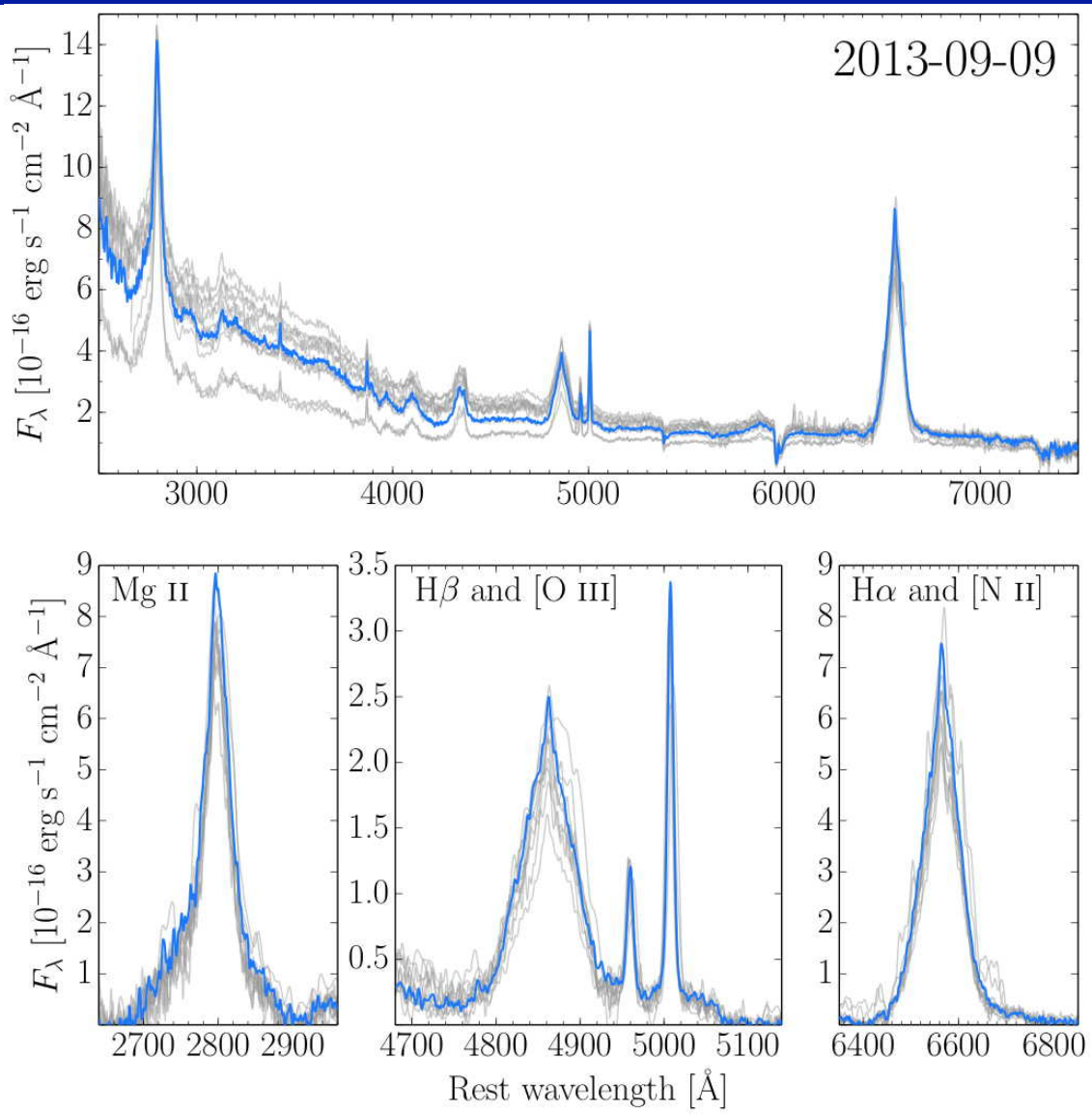

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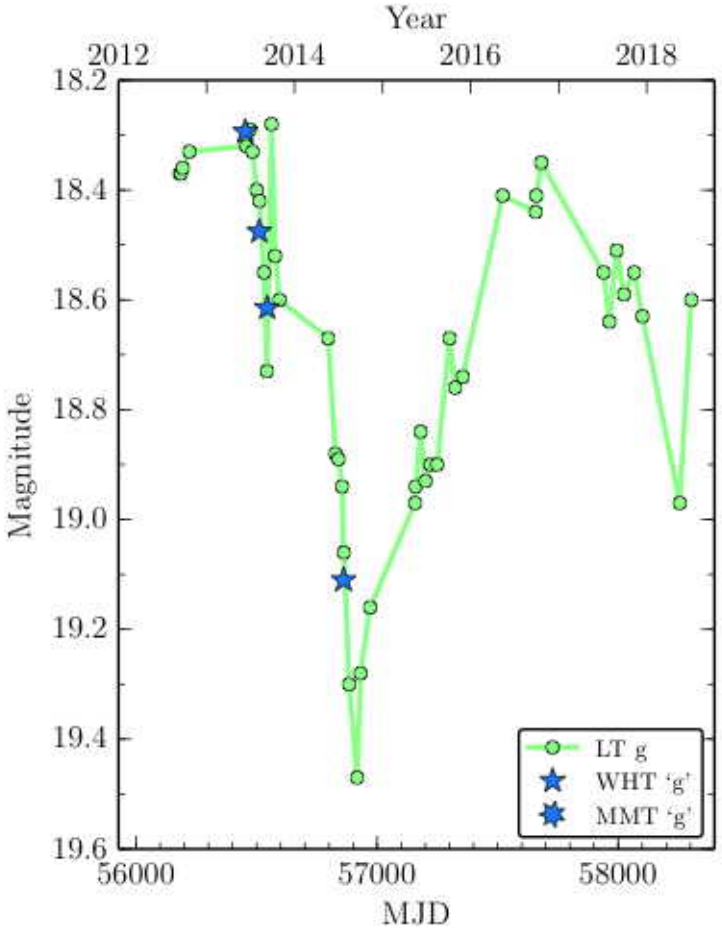

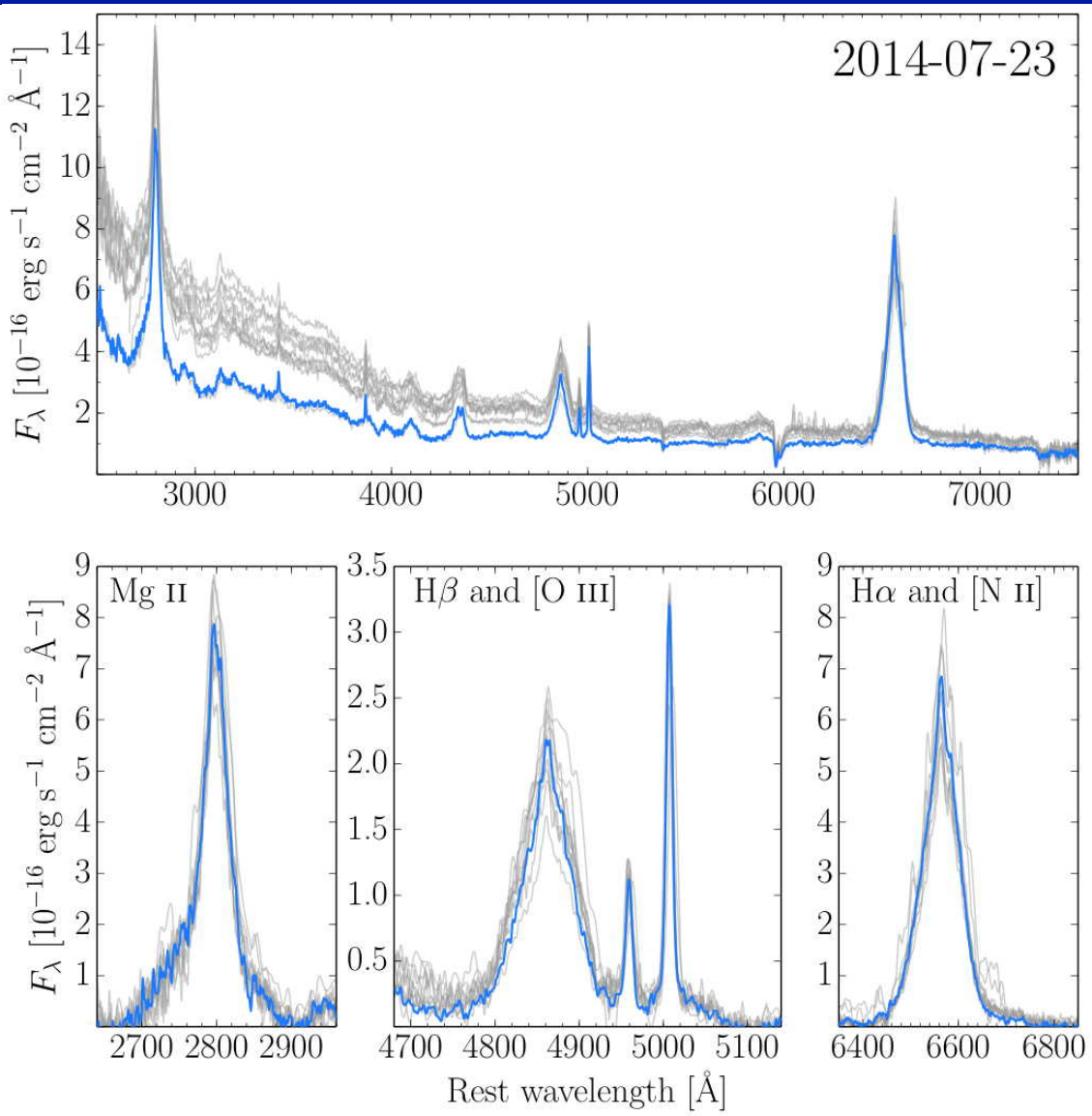

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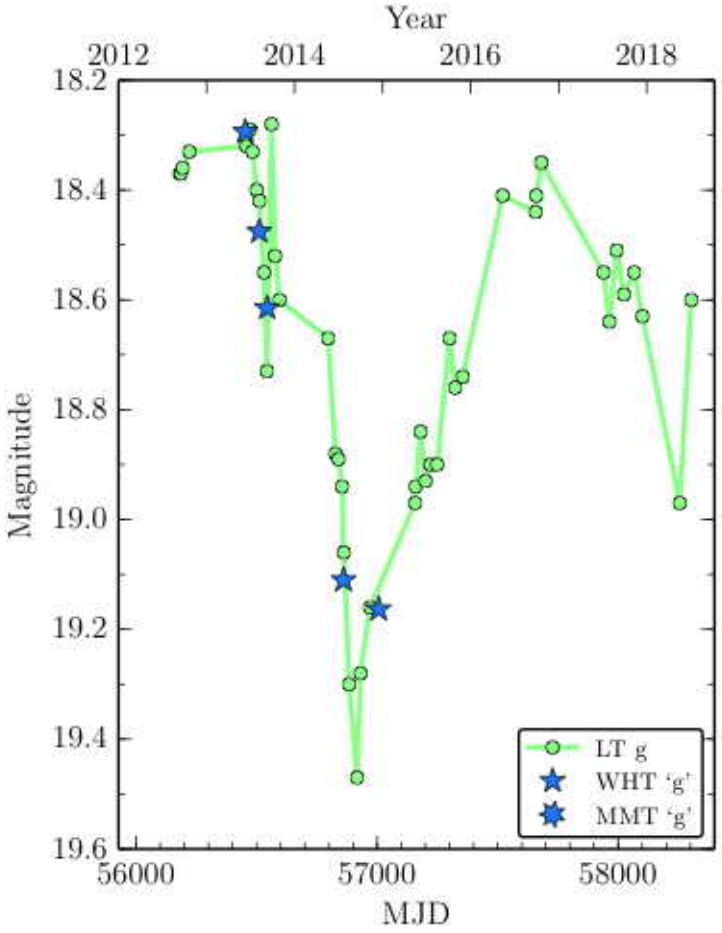

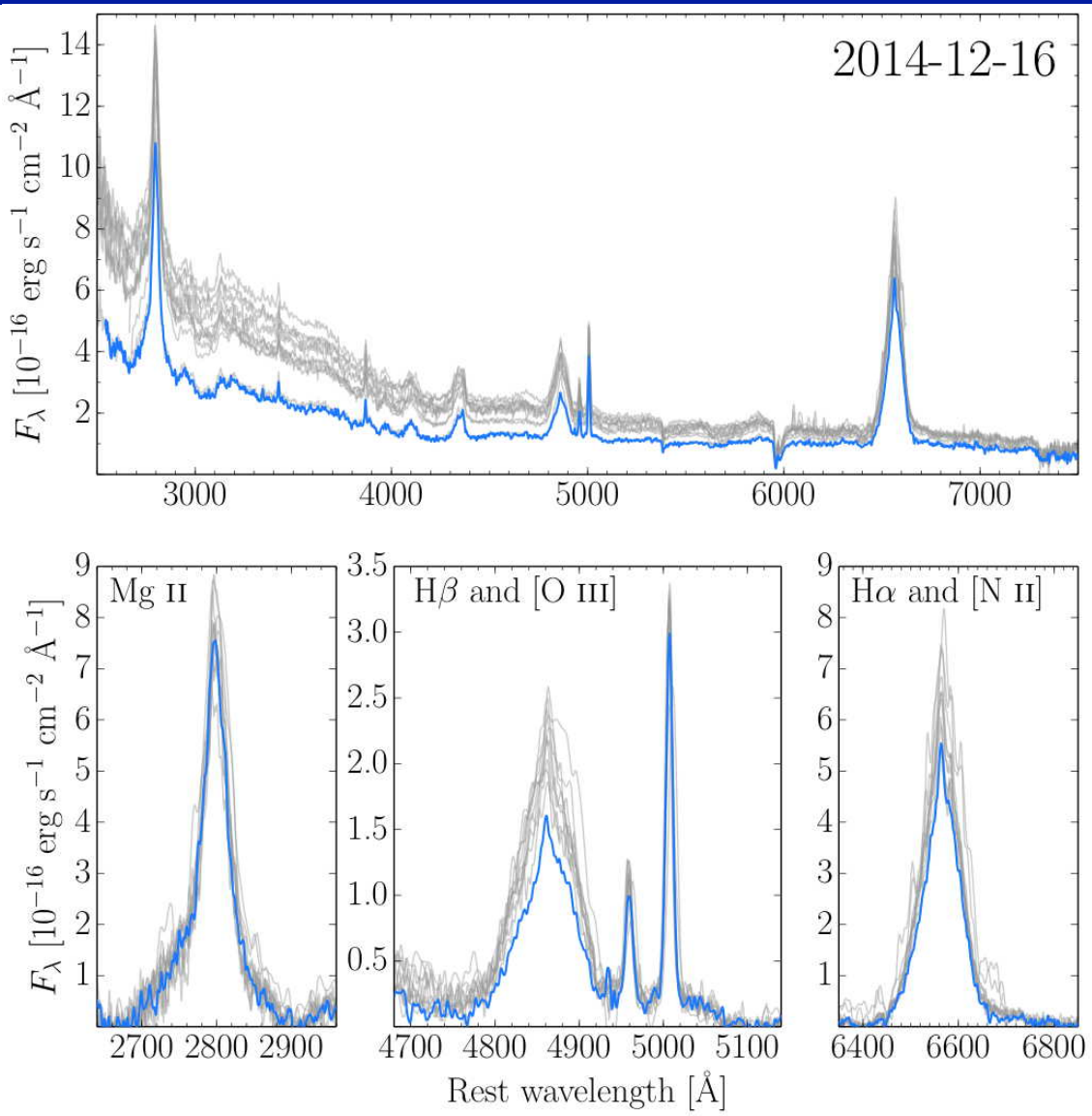

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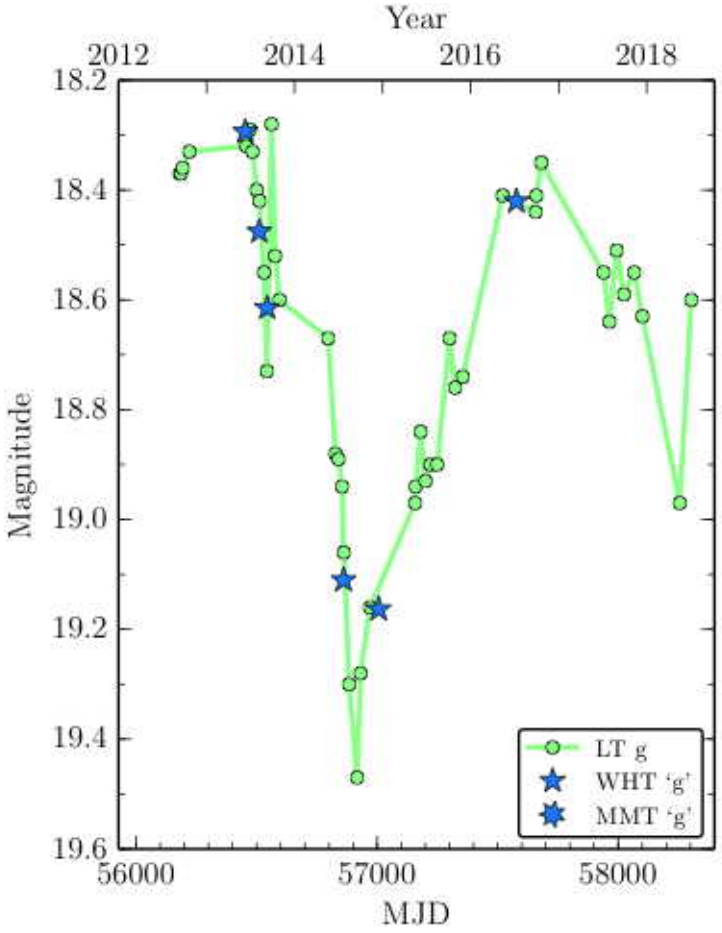

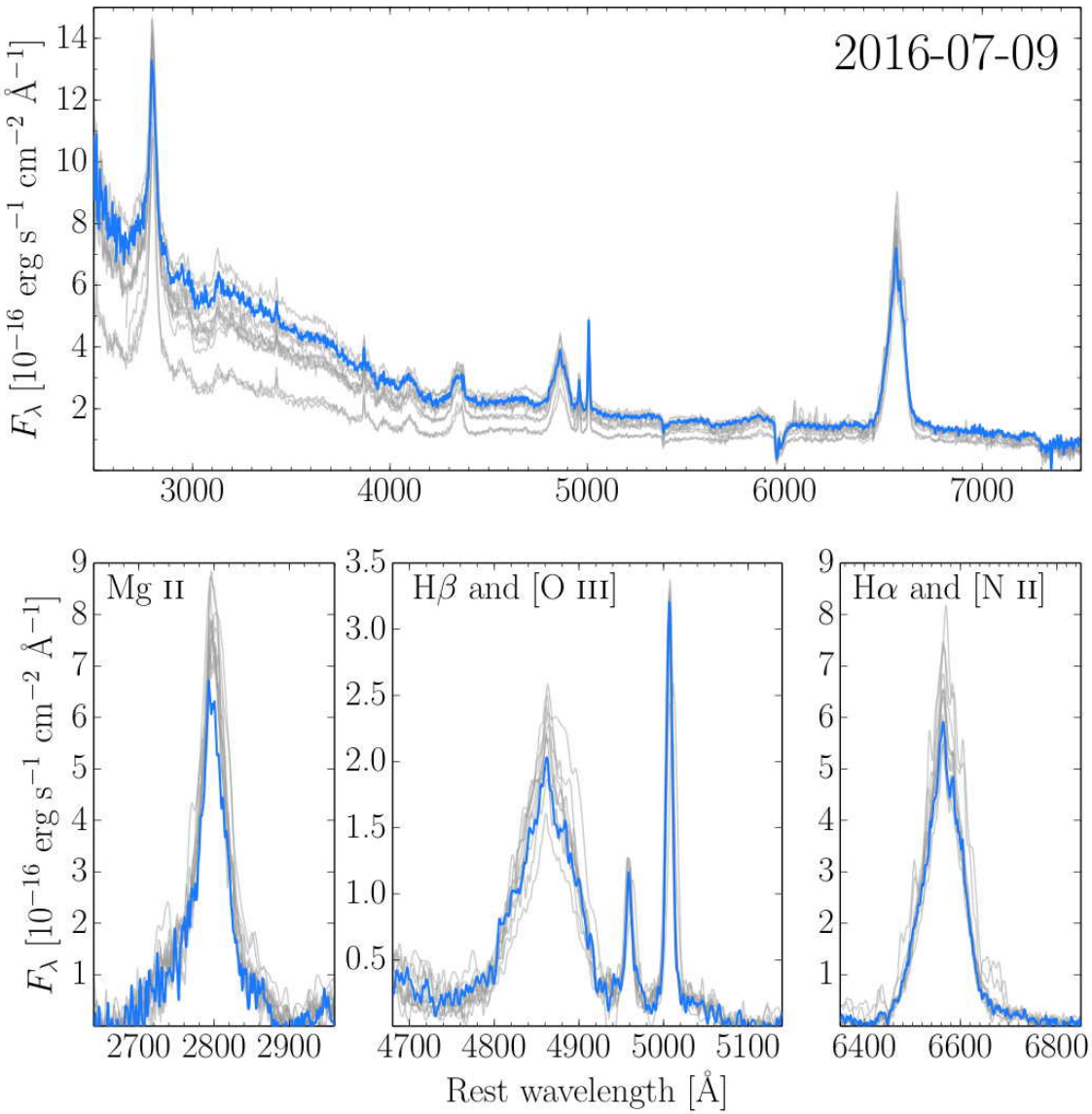

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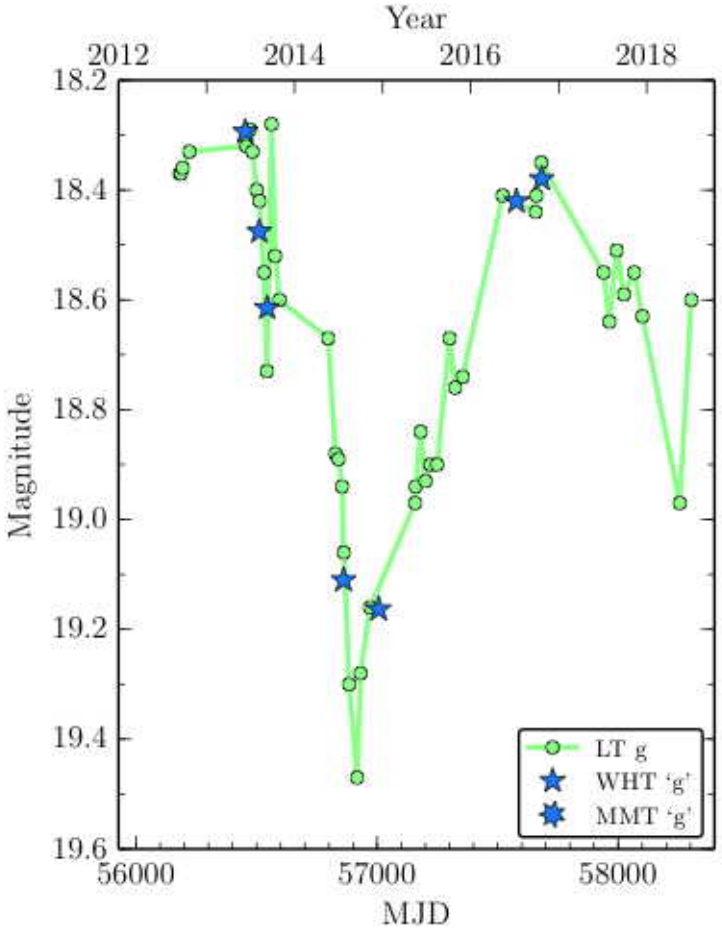

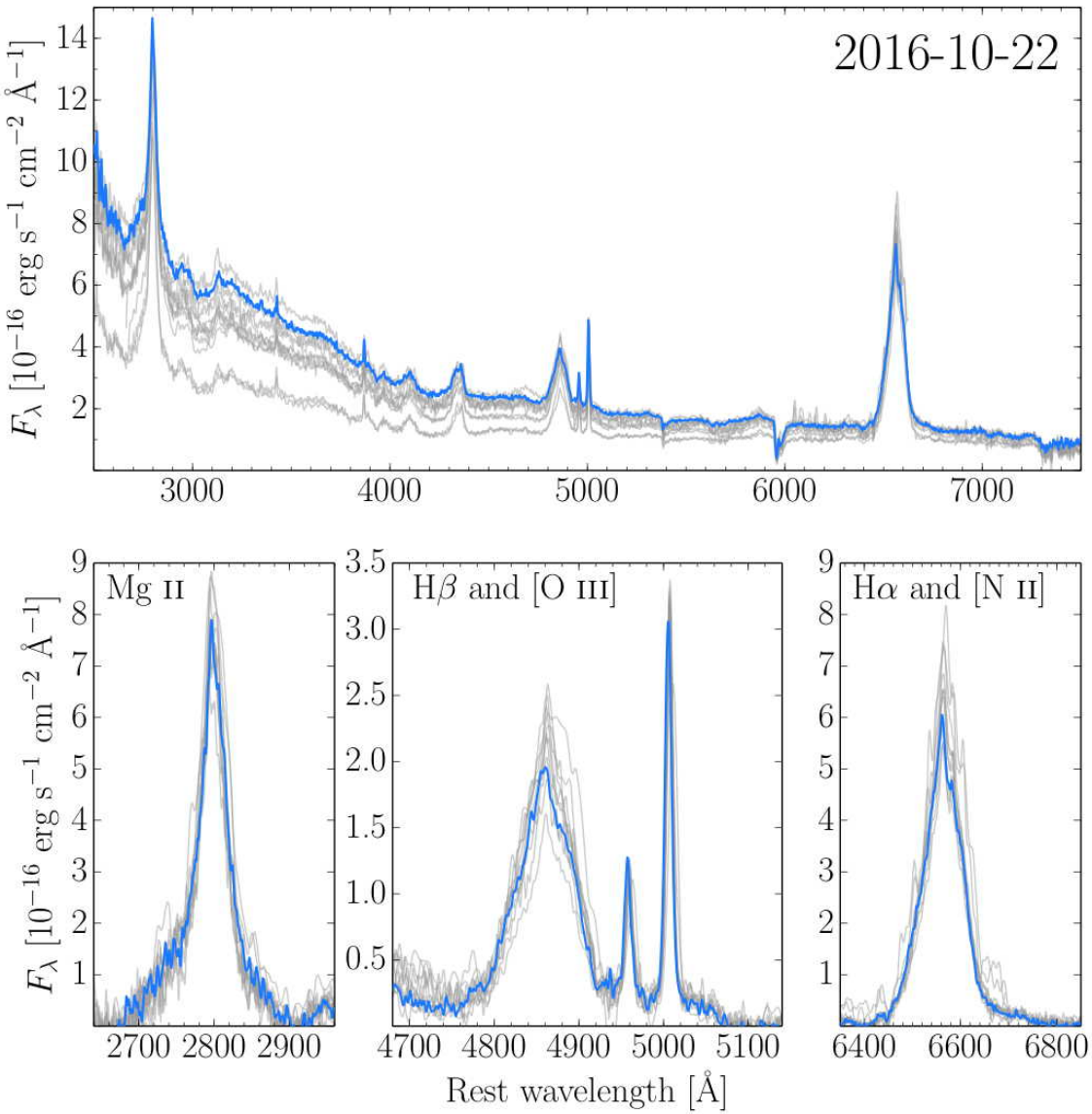

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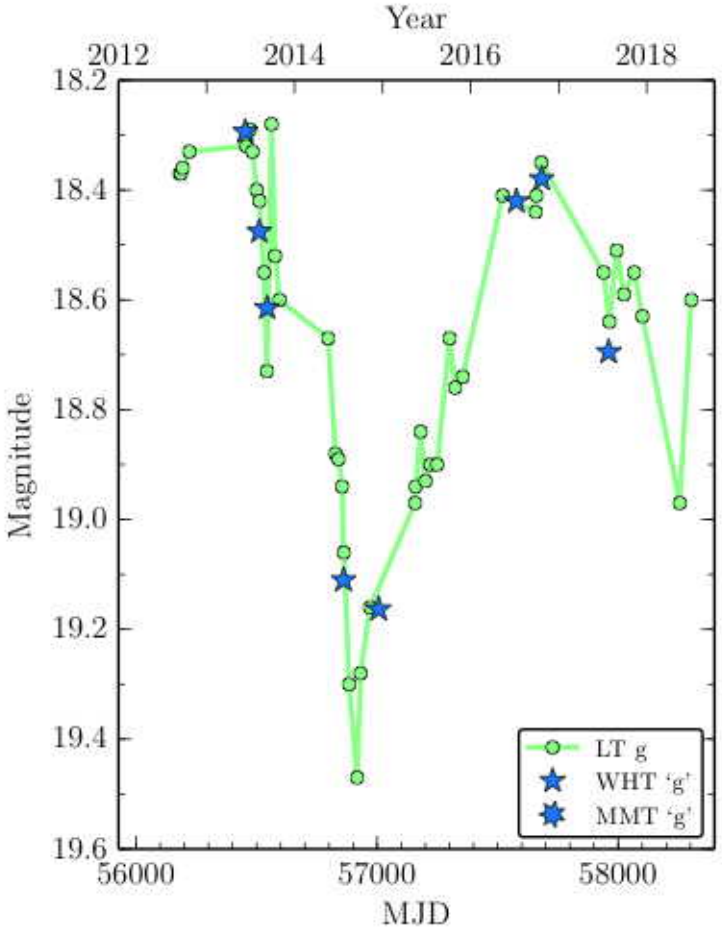

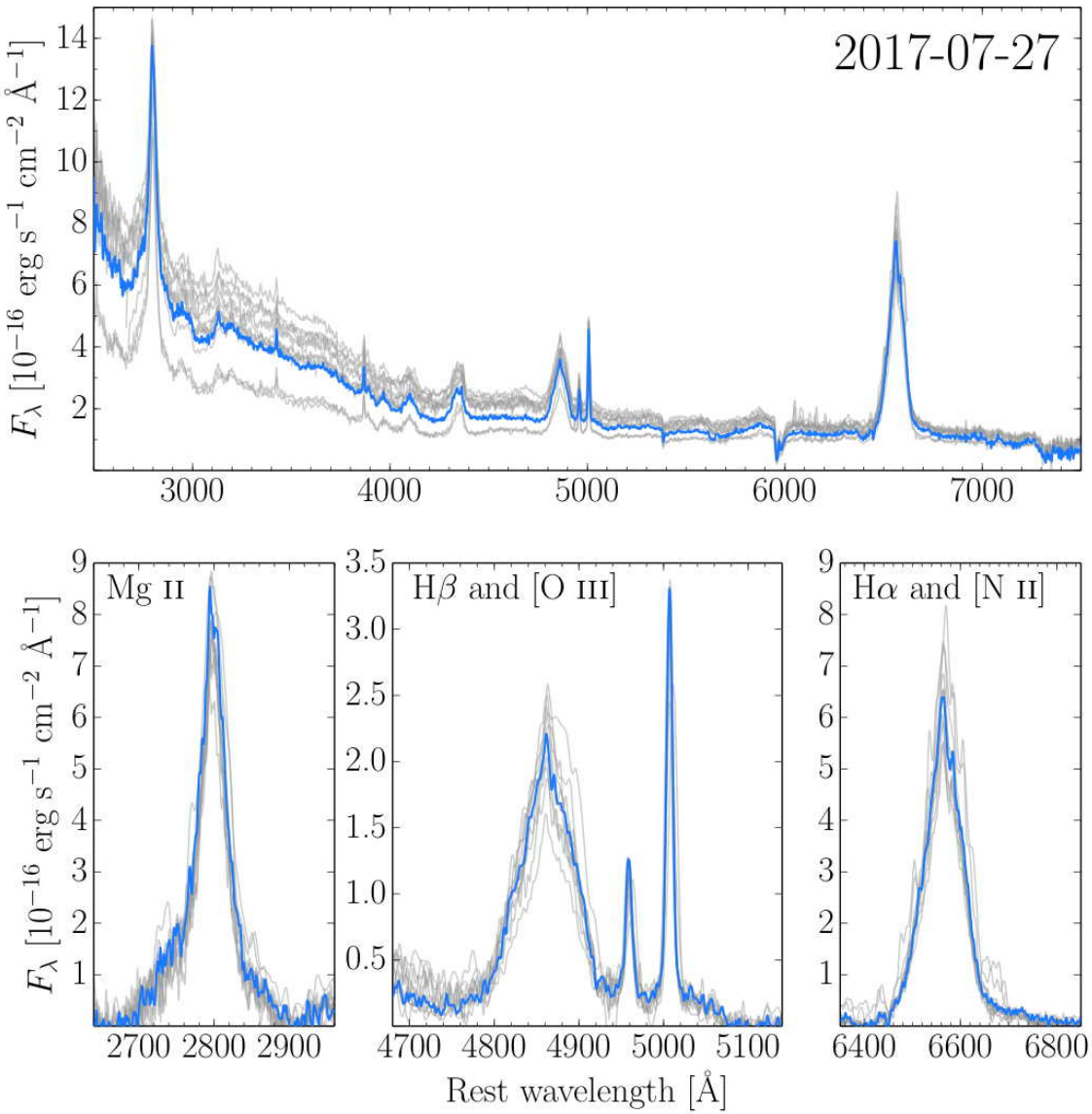

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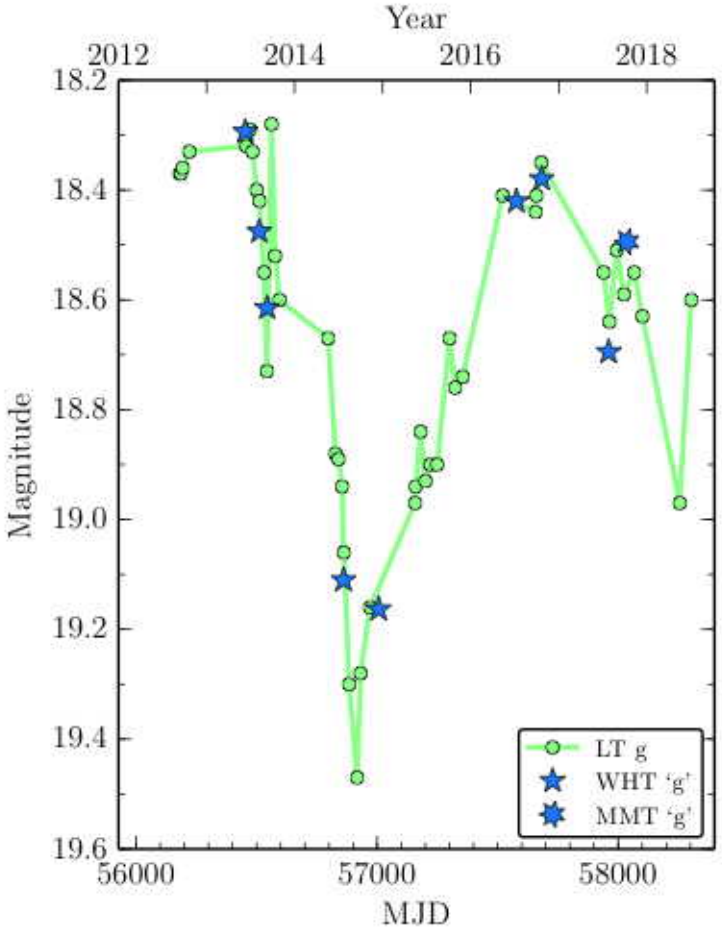

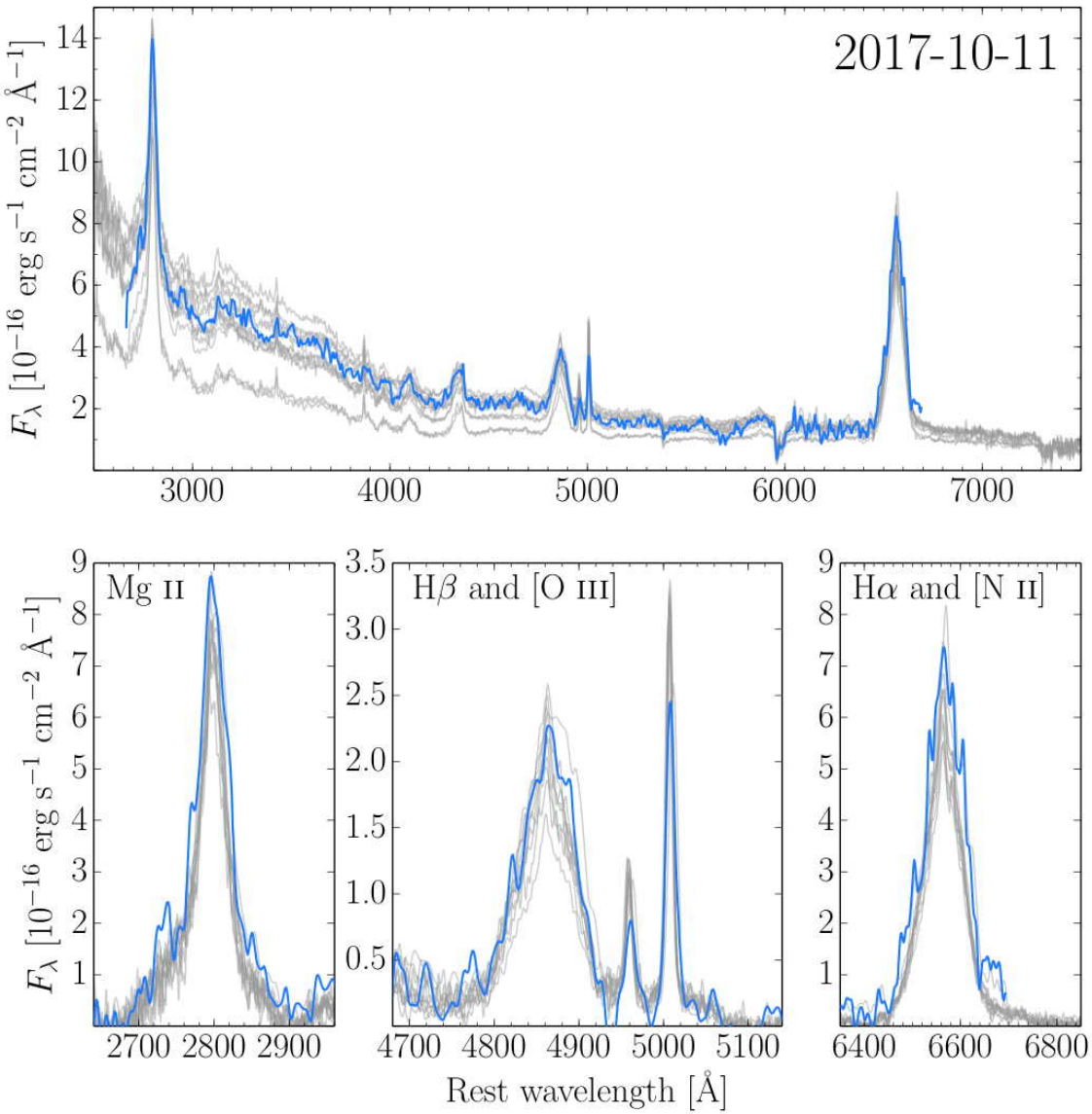

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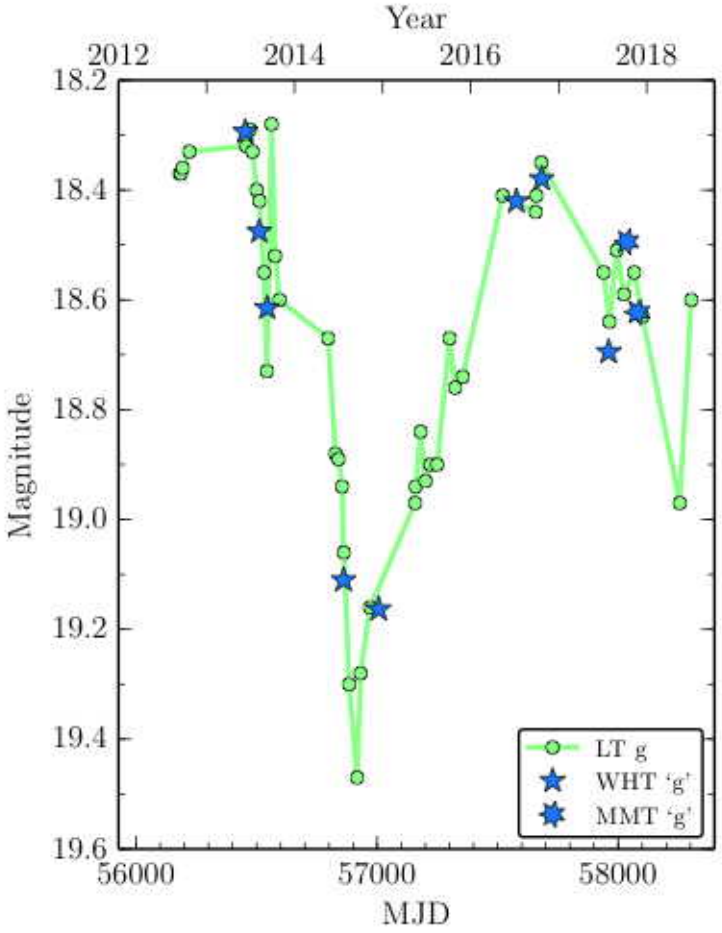

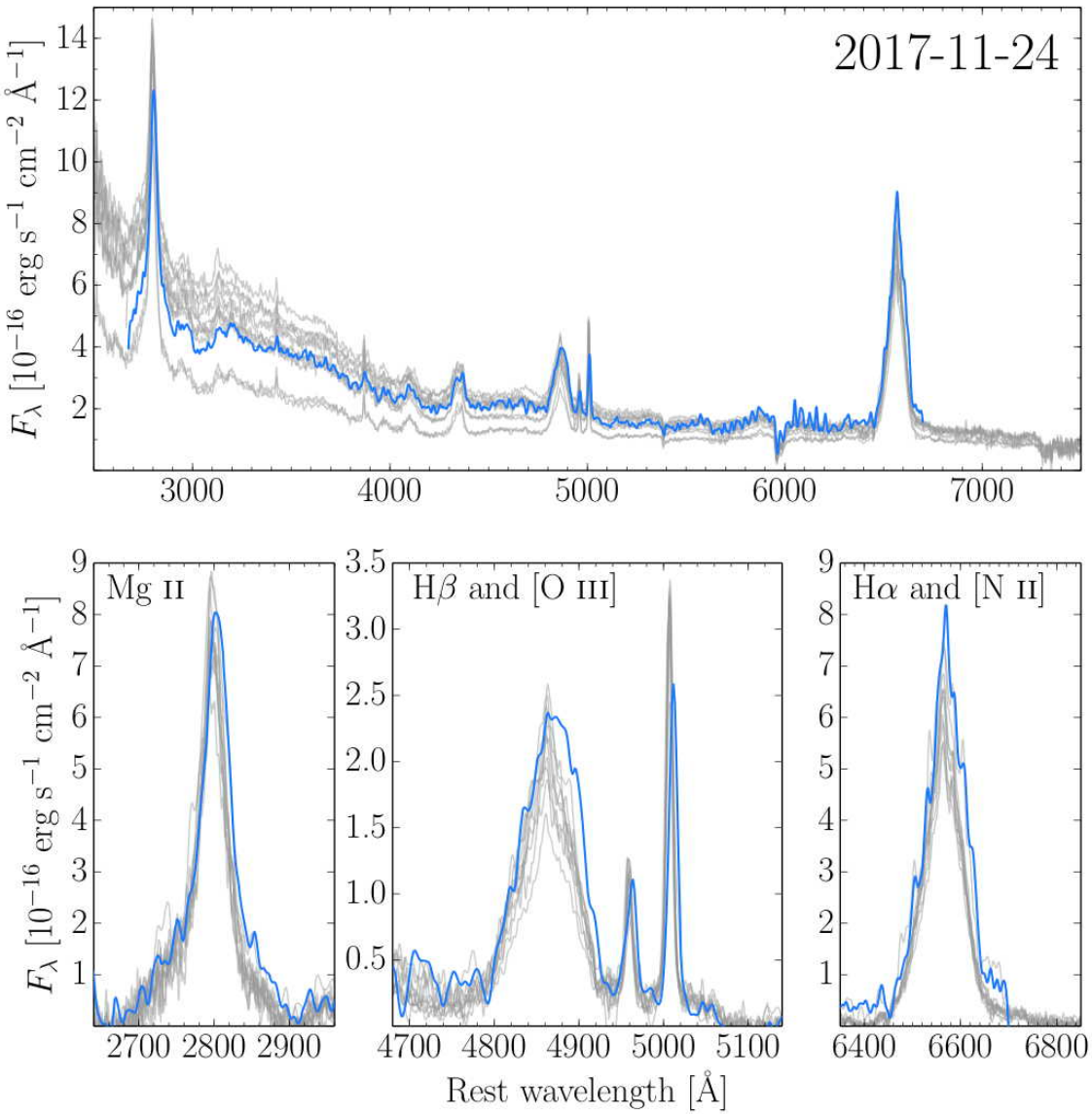

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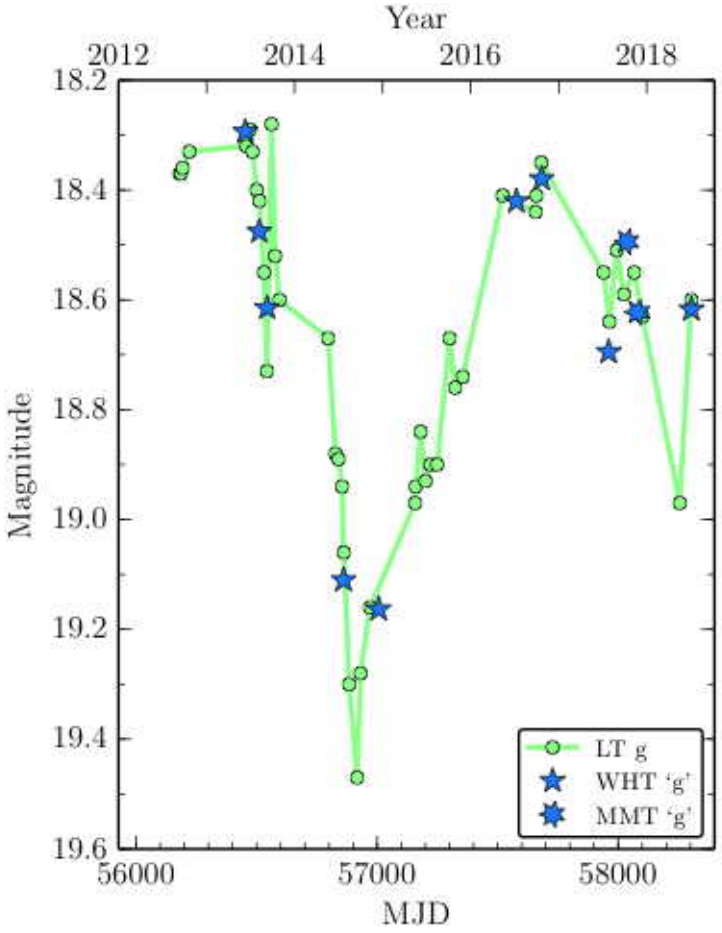
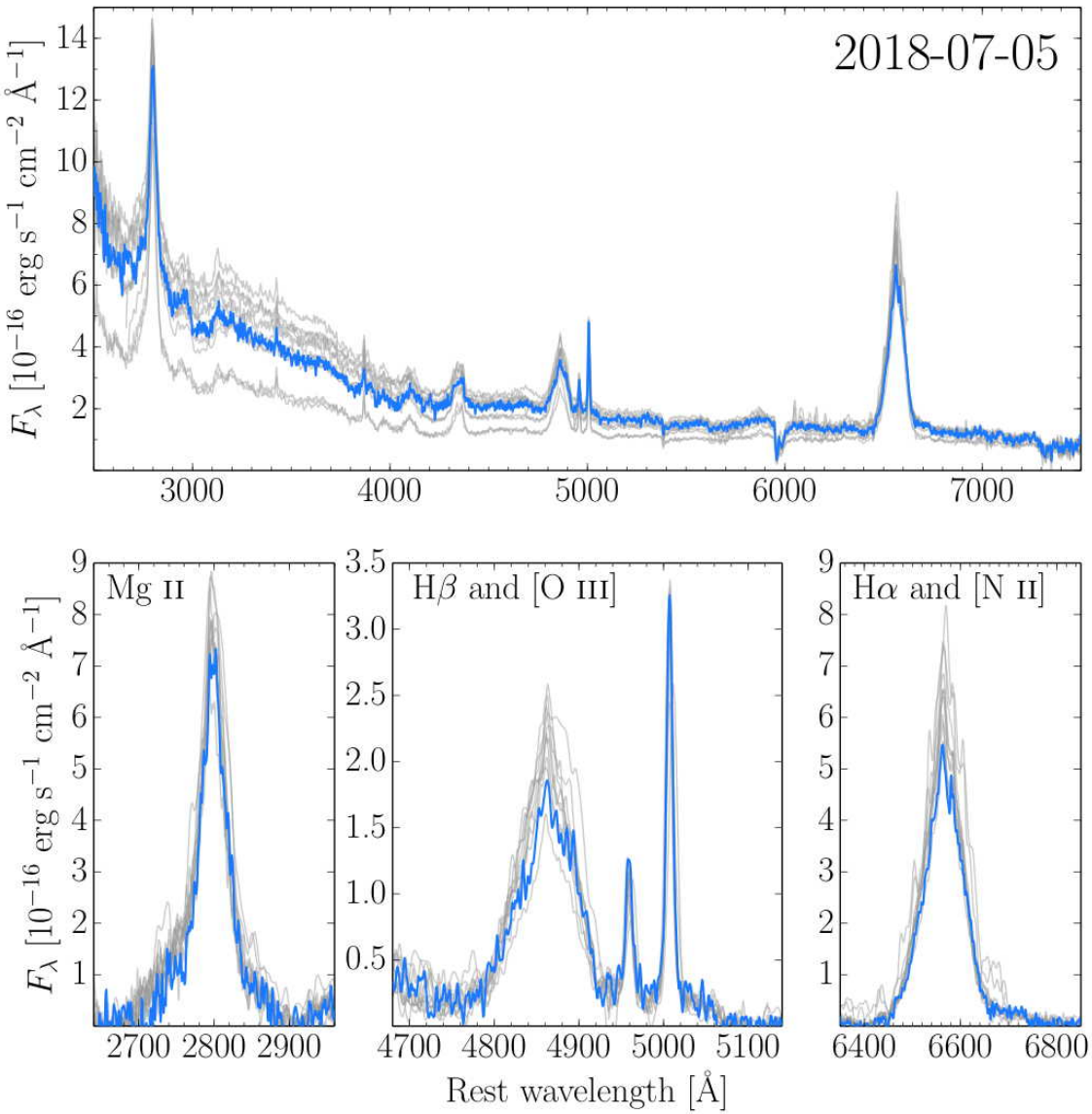
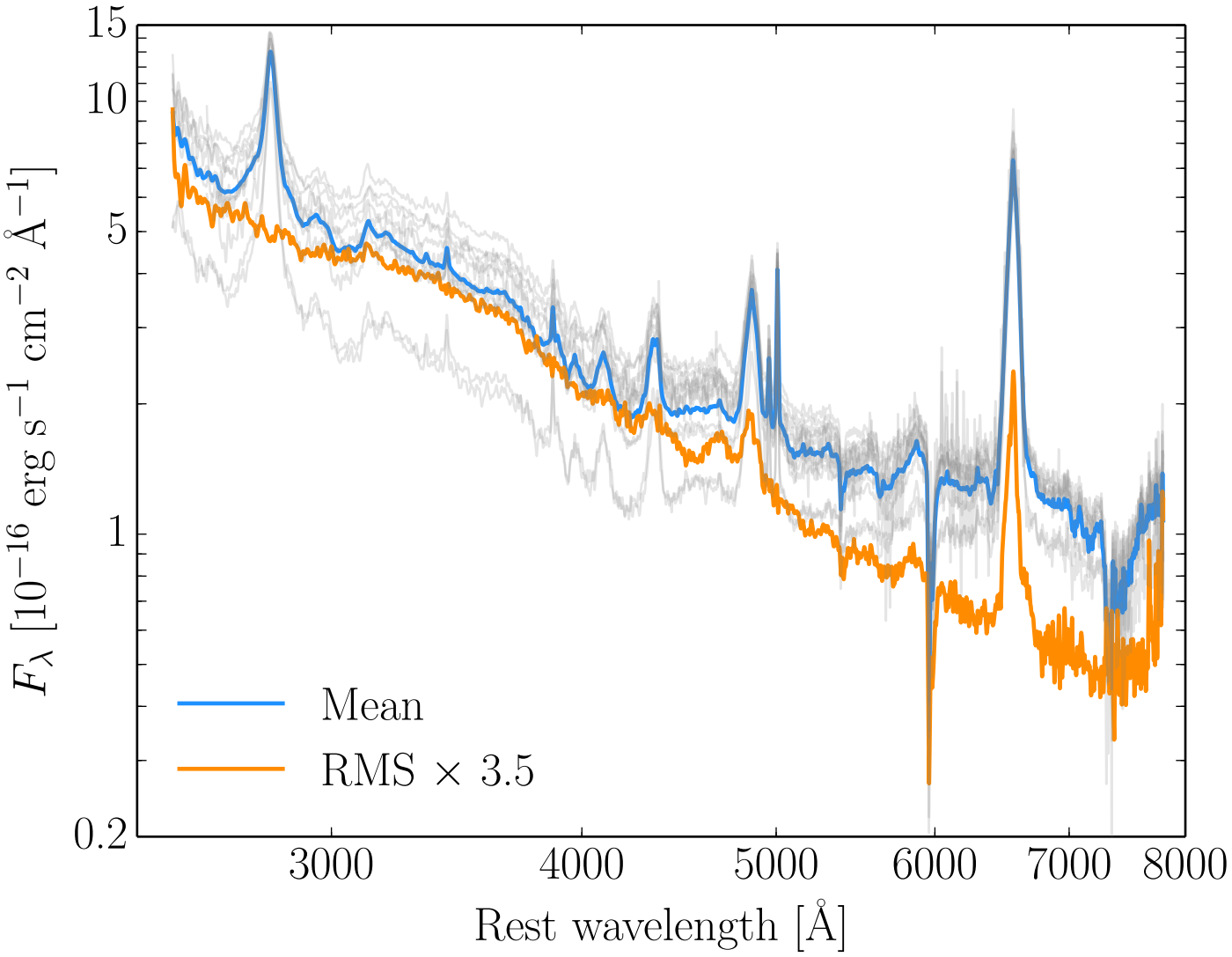




Mean and RMS optical spectra

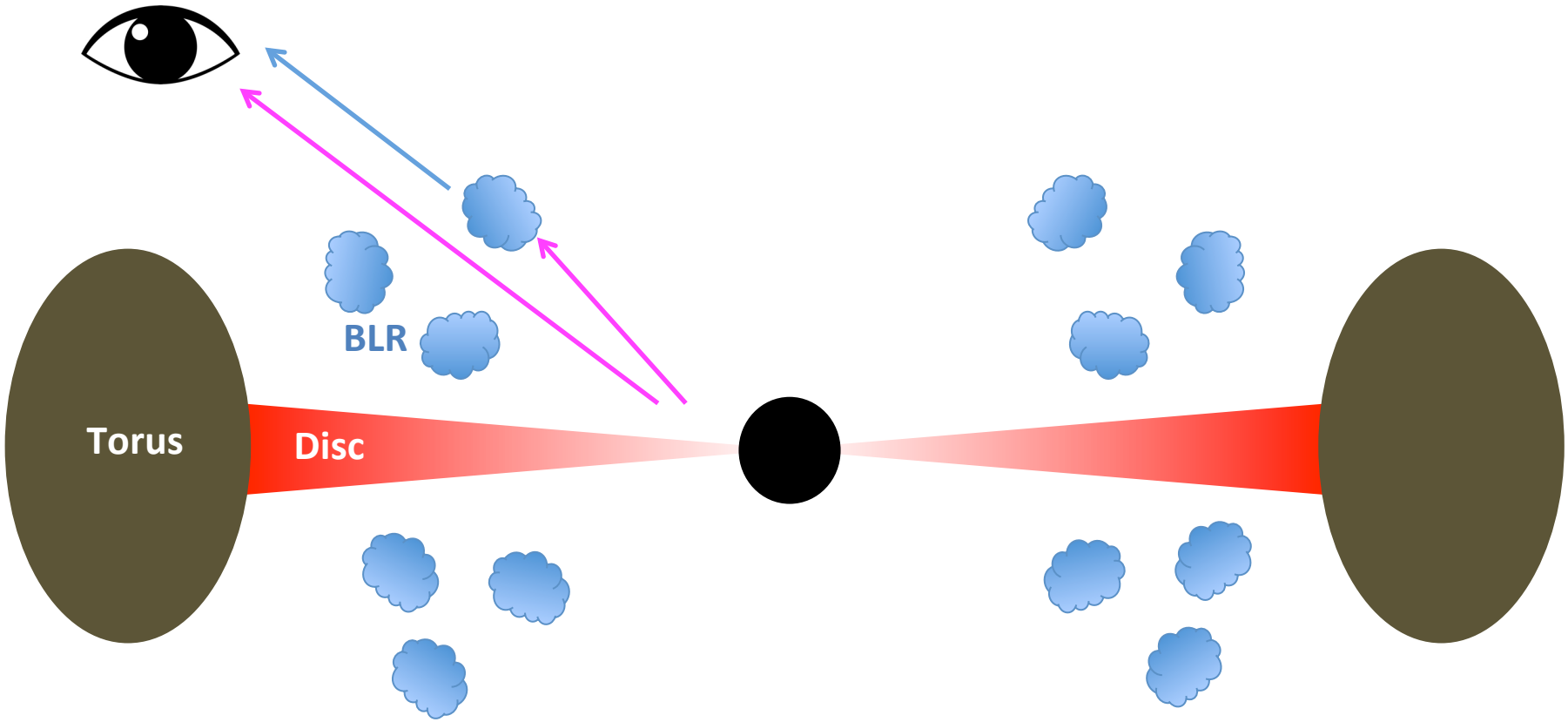


Optical spectral variability

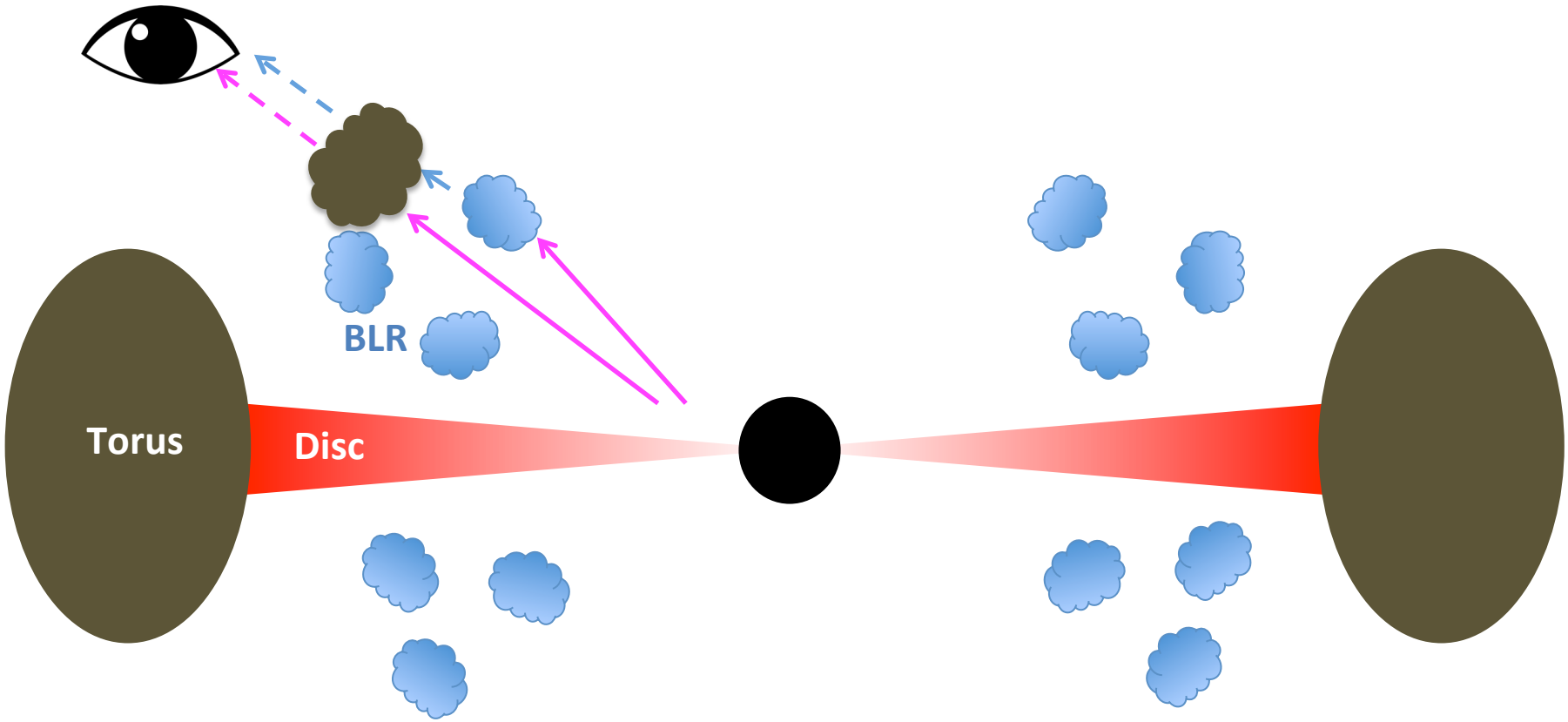
Is the cause of the variability

- Extrinsic? (i.e. variable obscuration); or
- Intrinsic? (i.e. change in accretion disc)

Obscuration scenario



Obscuration scenario



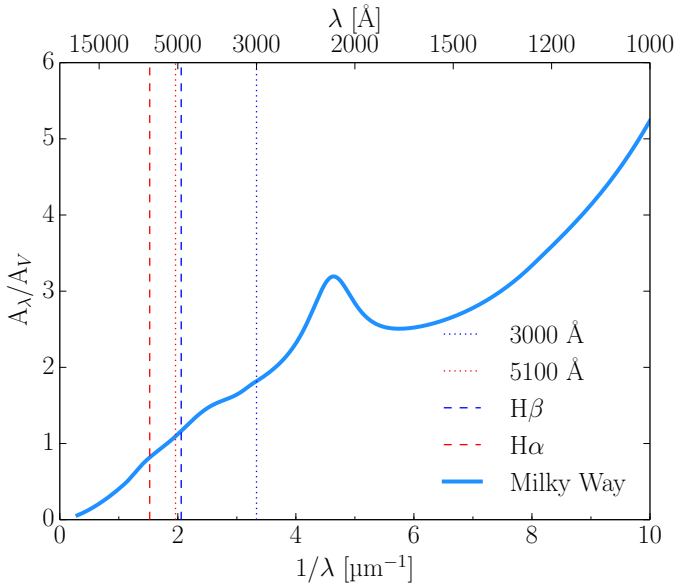
Broad line region radius $R_{BLR} \approx 40 - 60$ light days (scaled from $L_{5100Å}$)

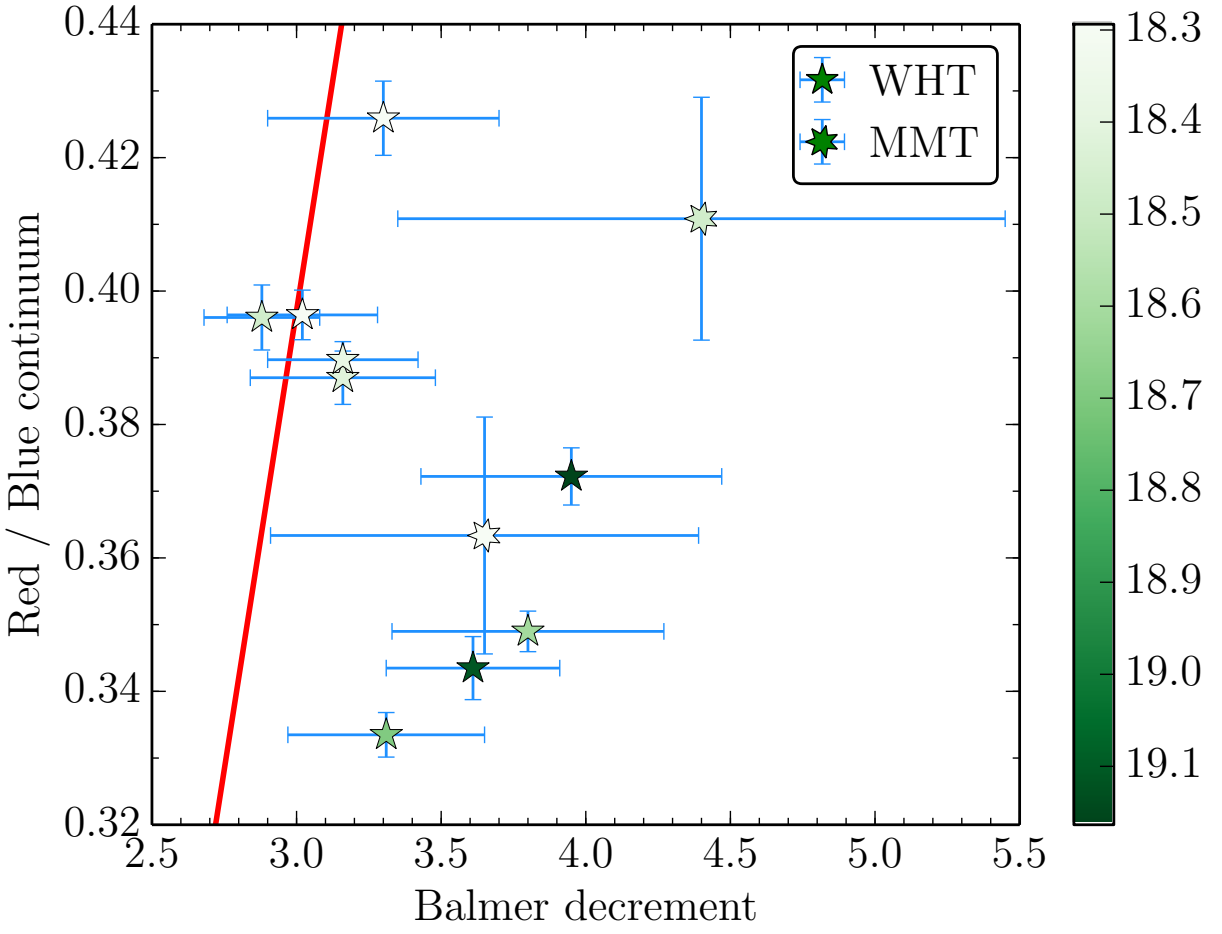
Cloud crossing time $t_{cross} \approx 27$ years

Observed dipping event $t_{event} \approx 3$ years

} ~ order of mag discrepancy

Optical spectral variability





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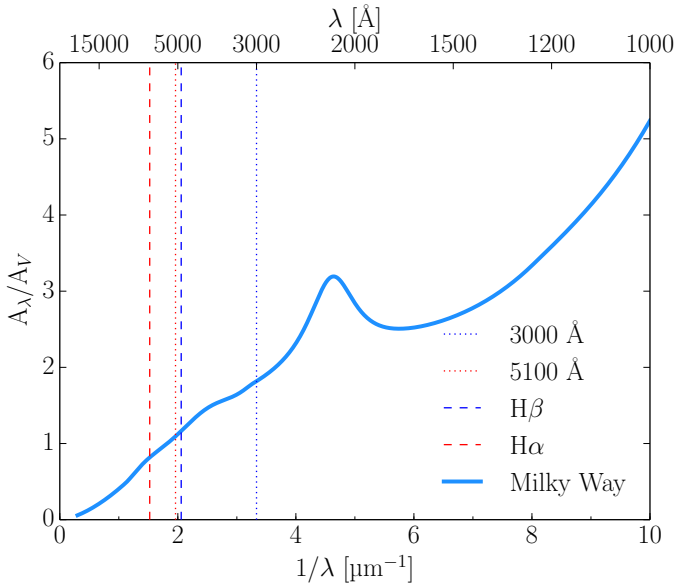
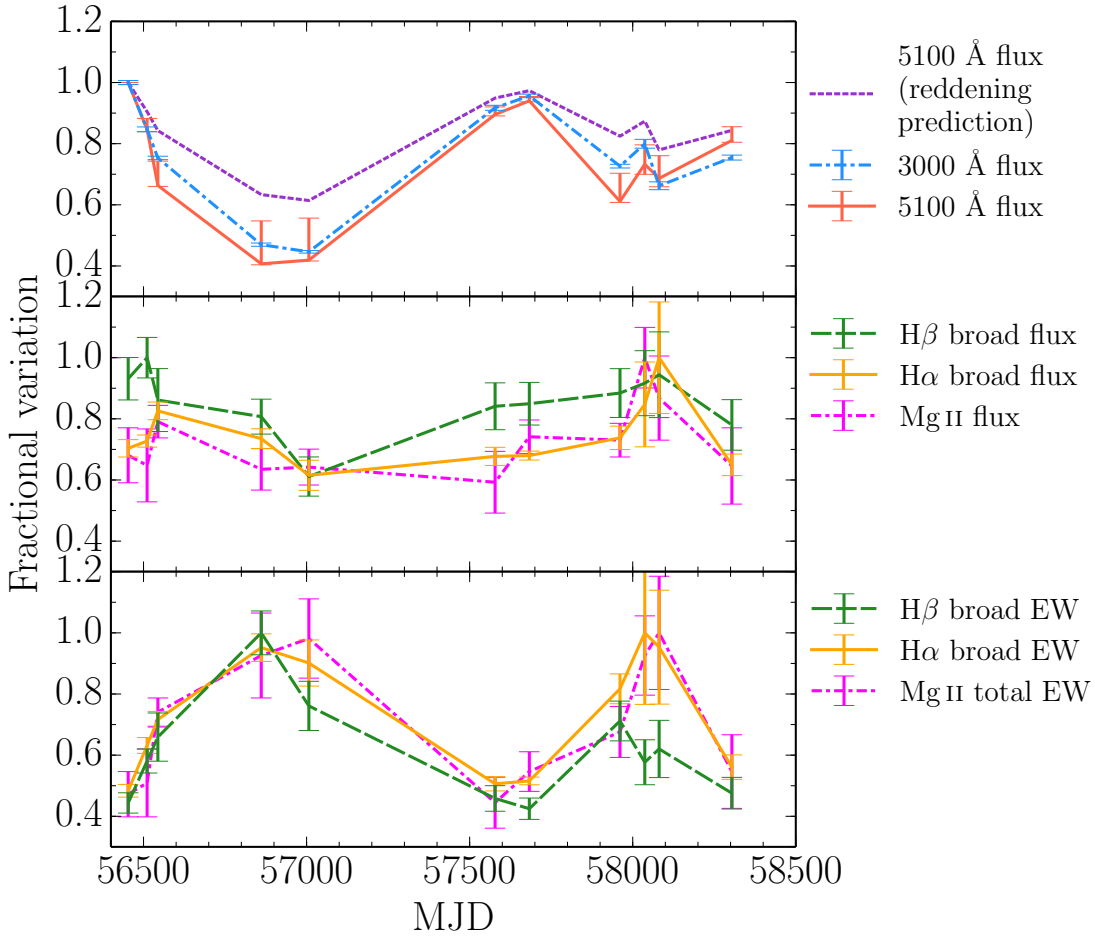
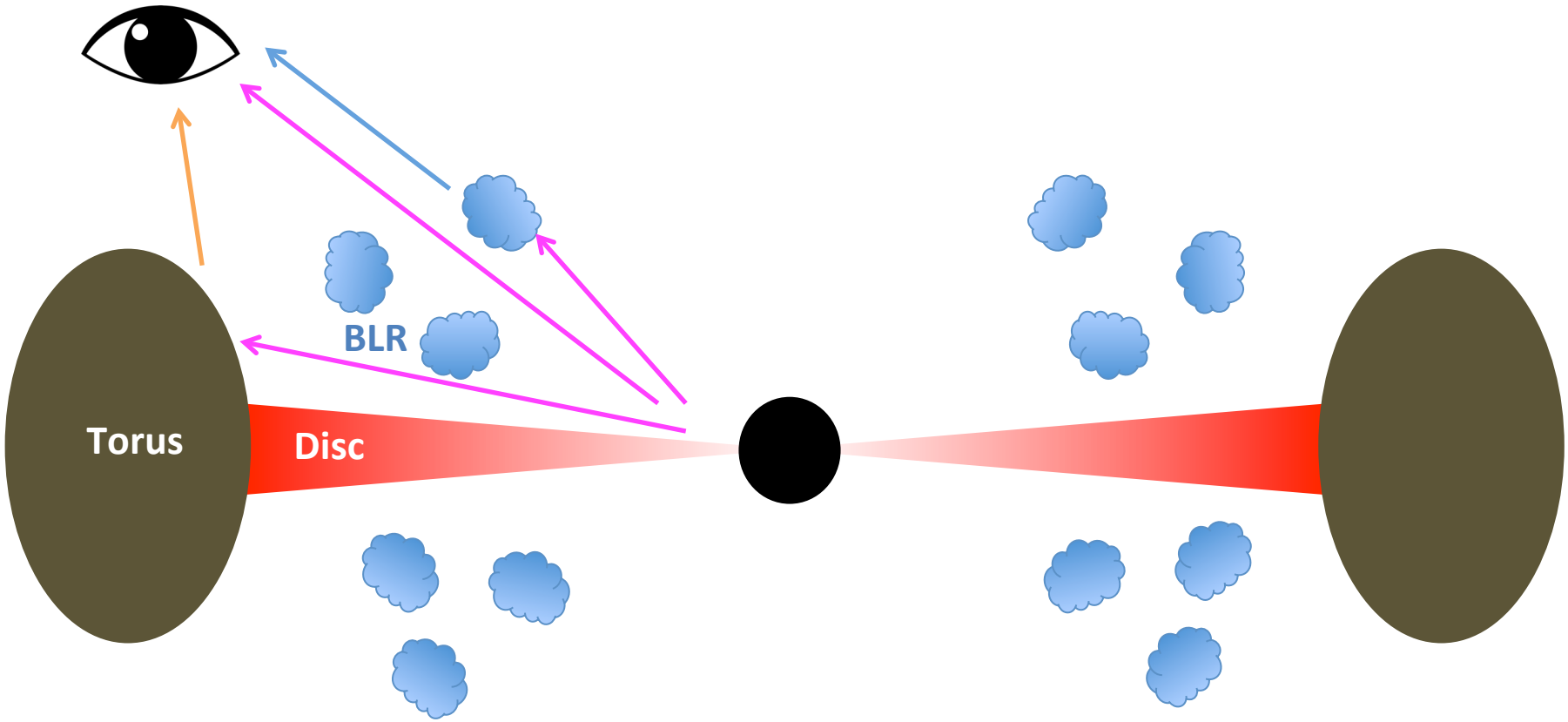




Intrinsic change scenario



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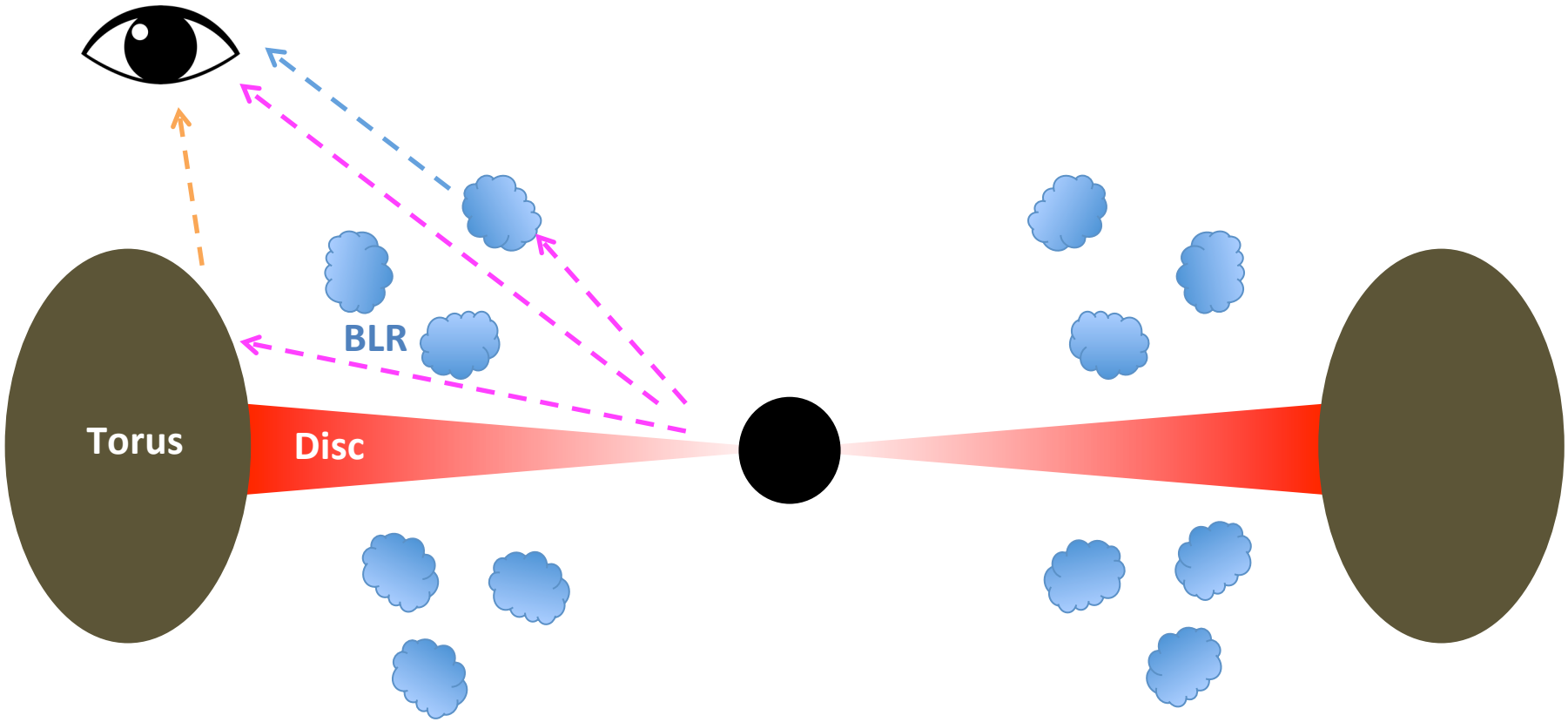
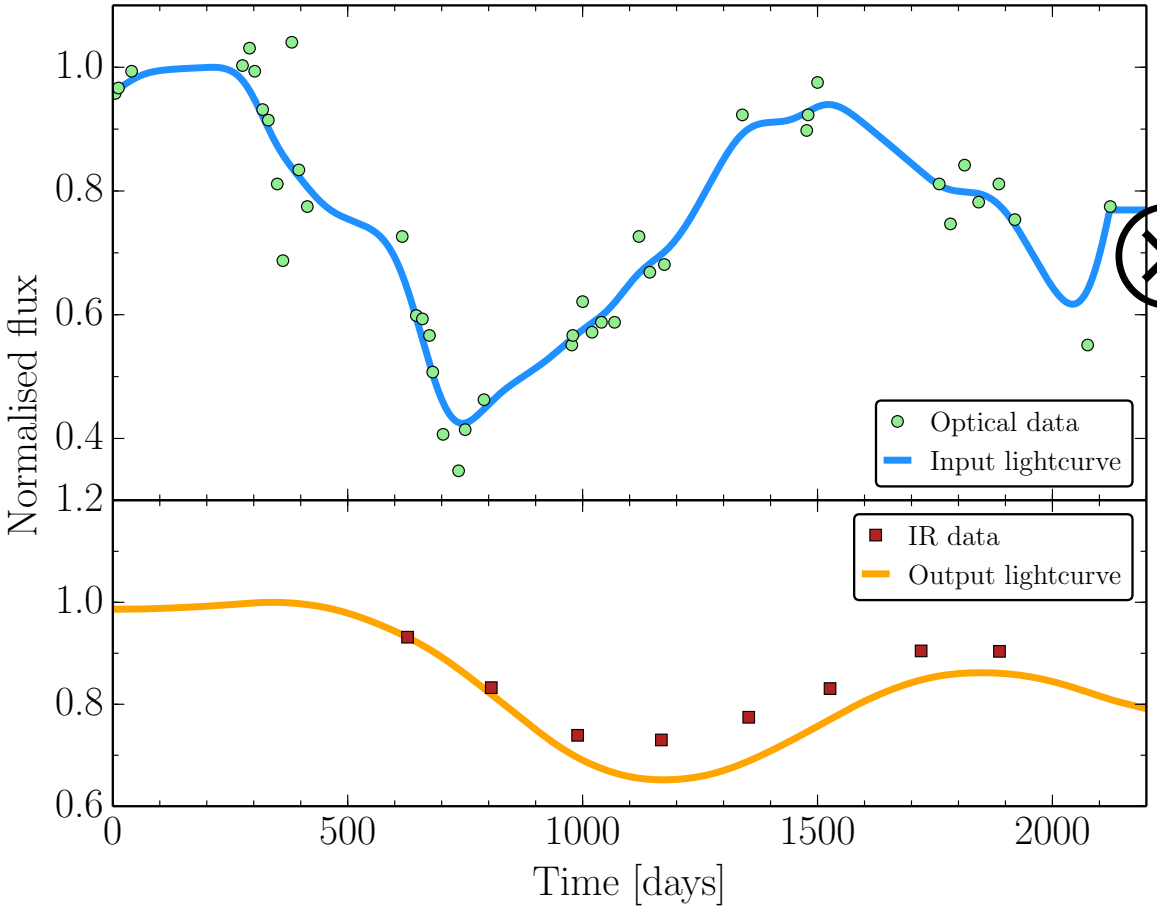
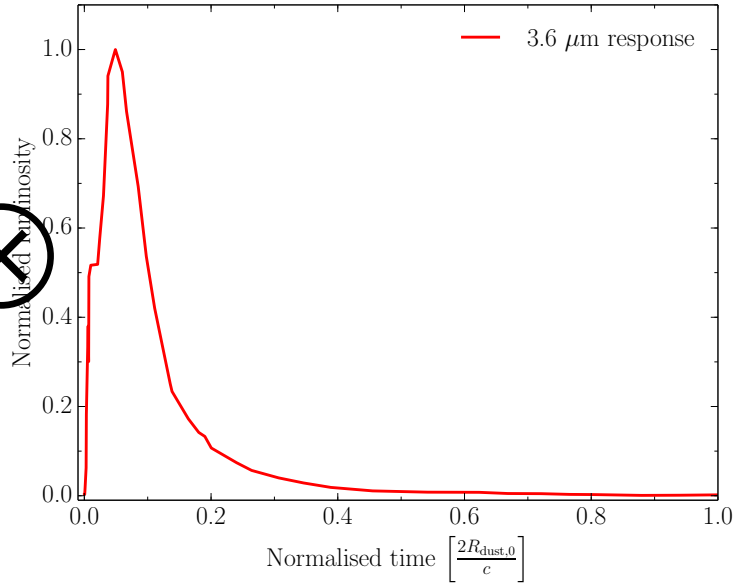


Dimming / brightening of central source affects reprocessed emission of the broad line region and torus. Delayed response of reprocessed light because of increased travel time.

Intrinsic change scenario

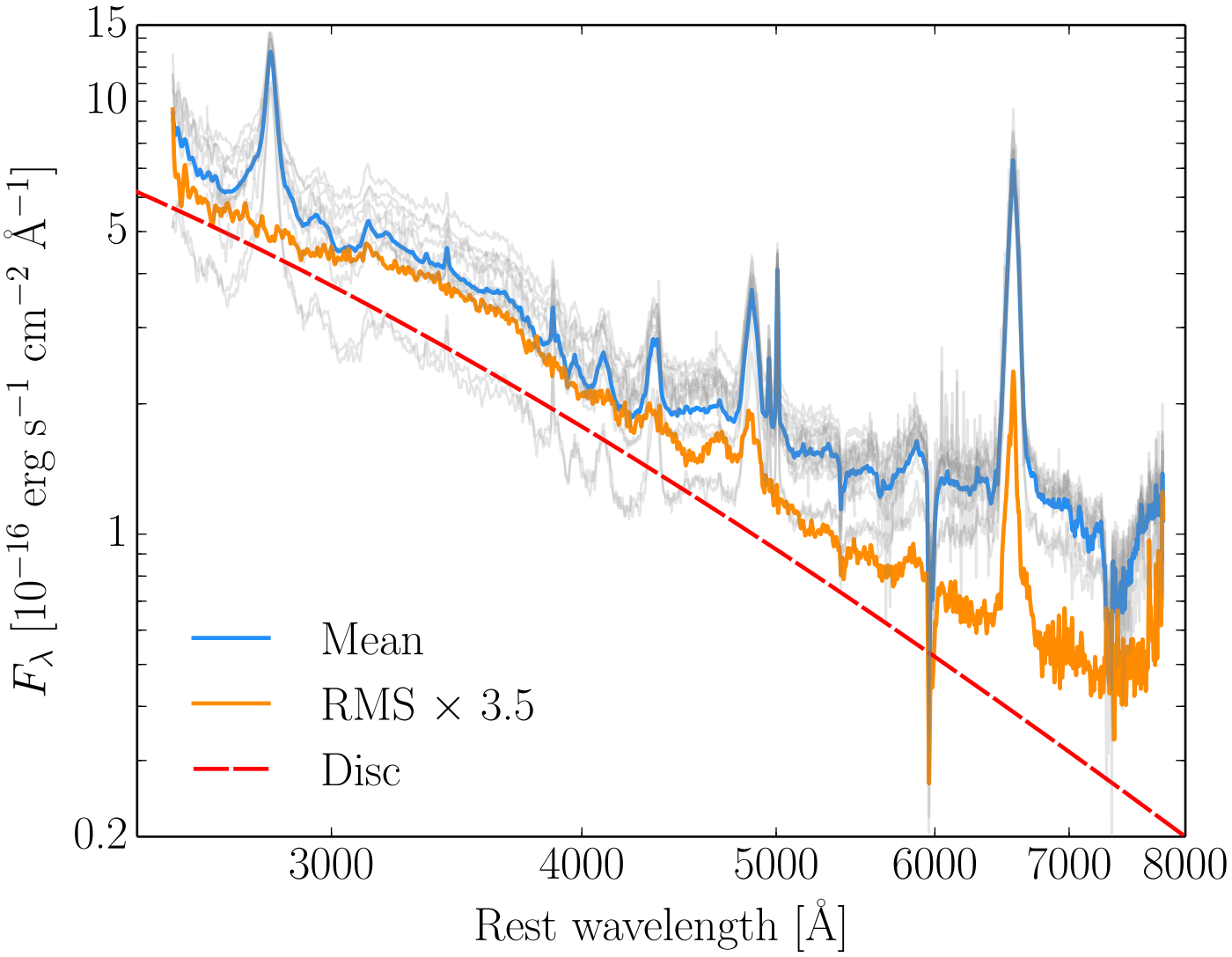




Almeyda et al. (2017) ApJ, 843, 3

$R_{dust,rev}$ ≈ 150 light days
IR delay ≈ 335 light days
response calculated for:
$R_{dust,0}$ = 250 light days
R_{out} / R_{in} = 10

Mean and RMS optical spectra



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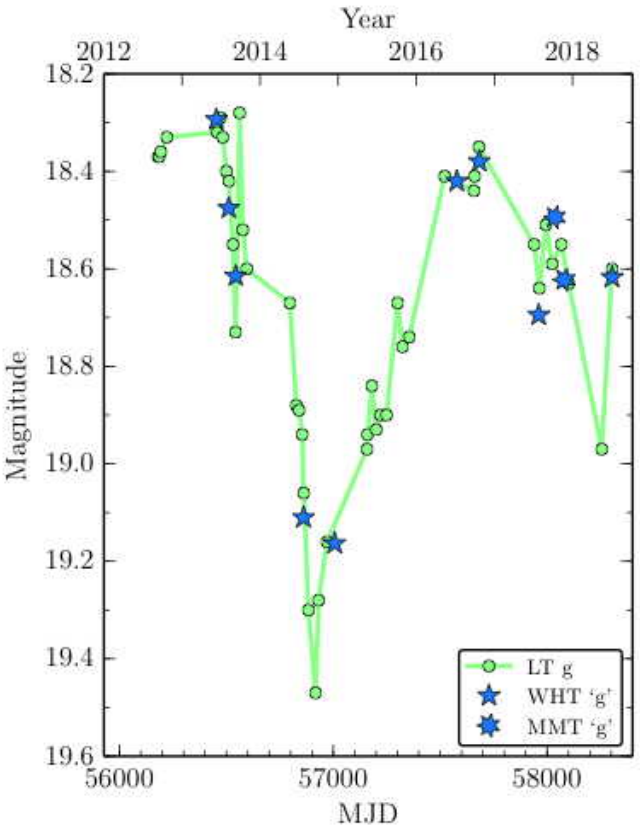


Accretion disc variability timescales:

t_{dynamic}	α	$R^{3/2}\, M^{-1/2}$	≈ 10 days
t_{thermal}	=	$t_{\text{dynamic}} / \alpha$	≈ 3 months
t_{viscous}	=	$t_{\text{thermal}}\, (H/R)^{-2}$	≈ 1 Gyr
t_{observed}			≈ 3 years

Intrinsic change scenario

Variable obscuration:

✗ Timescale – cloud crossing

✗ Continuum colour change

✗ Line EW changes

✗ Infrared variability

Variable accretion disc:

✓ Timescale – IR lag

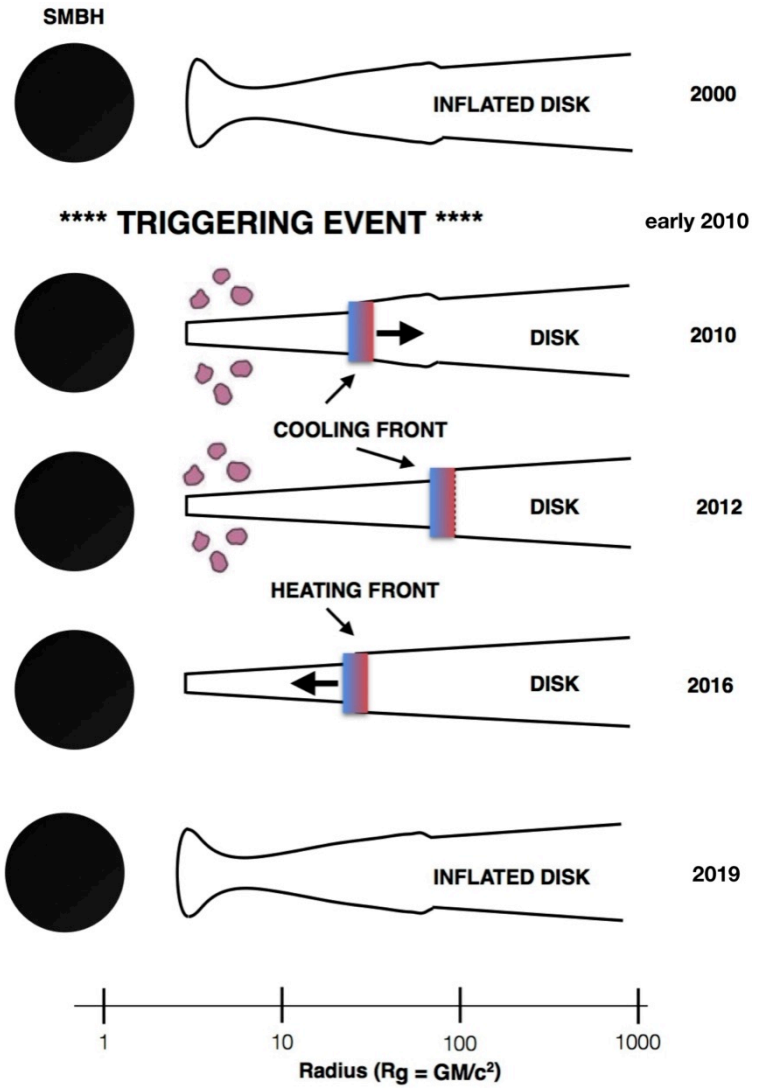
✓ Continuum colour change

✓ Line EW changes

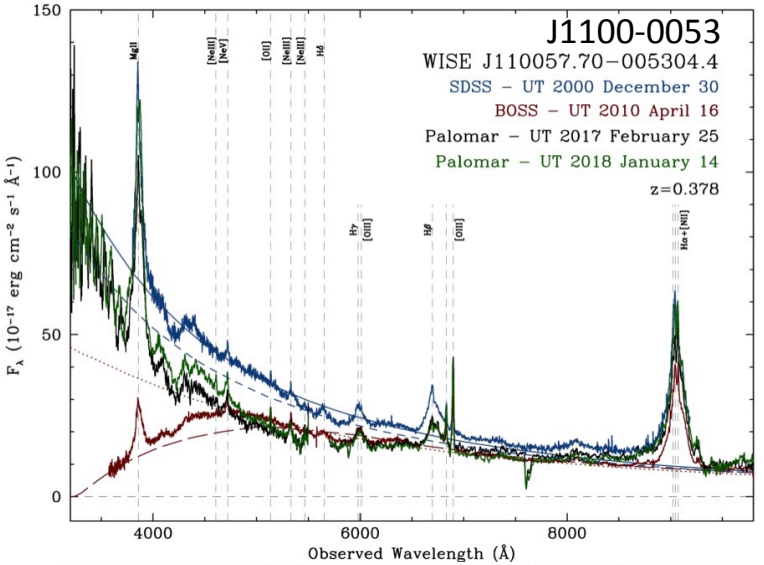
✓ Infrared variability

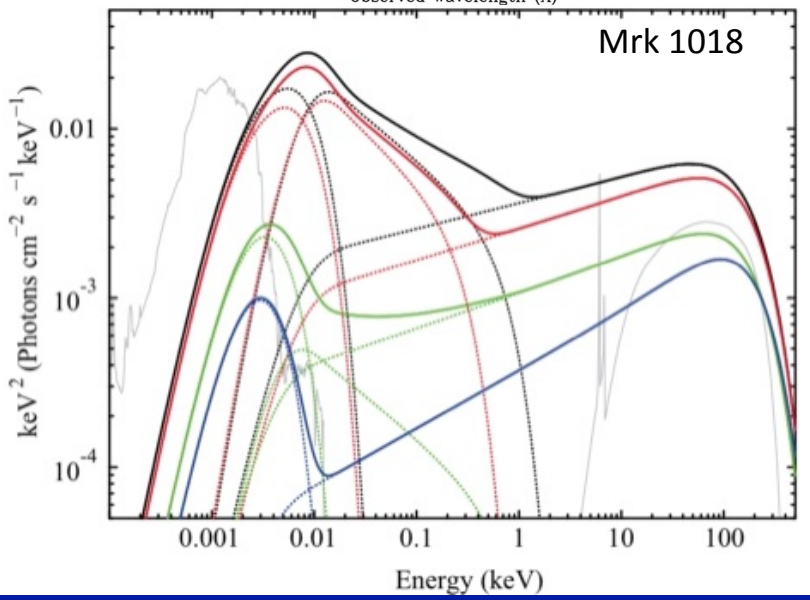
✗ Timescale - viscous

Intrinsic change scenario



Ross et al. (2018) MNRAS, **480**, 4468





Noda & Done (2018) MNRAS, **480**, 3898

Conclusions

- Source dimmed by factor ~3 and rebrightened over ~3 yrs.
- Changes in continuum colours and Balmer decrement inconsistent with reddening.
- RMS spectrum shows that the variable component is 'disc-shaped'. Mg II appears not to vary.
- Shape of infrared lightcurve consistent with hot dust reverberating with nuclear optical/UV flux.
- Rapid, large-amplitude change in accretion disc luminosity likely occurred. We need new models to explain this!
- Give me a job.