Extended continuum emission in quasars and its impact on time-delay lightcurves

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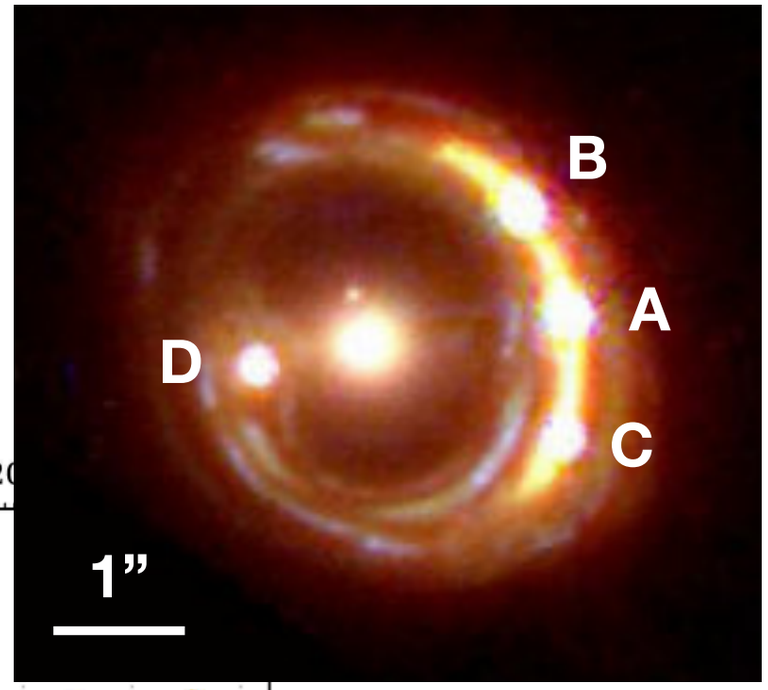
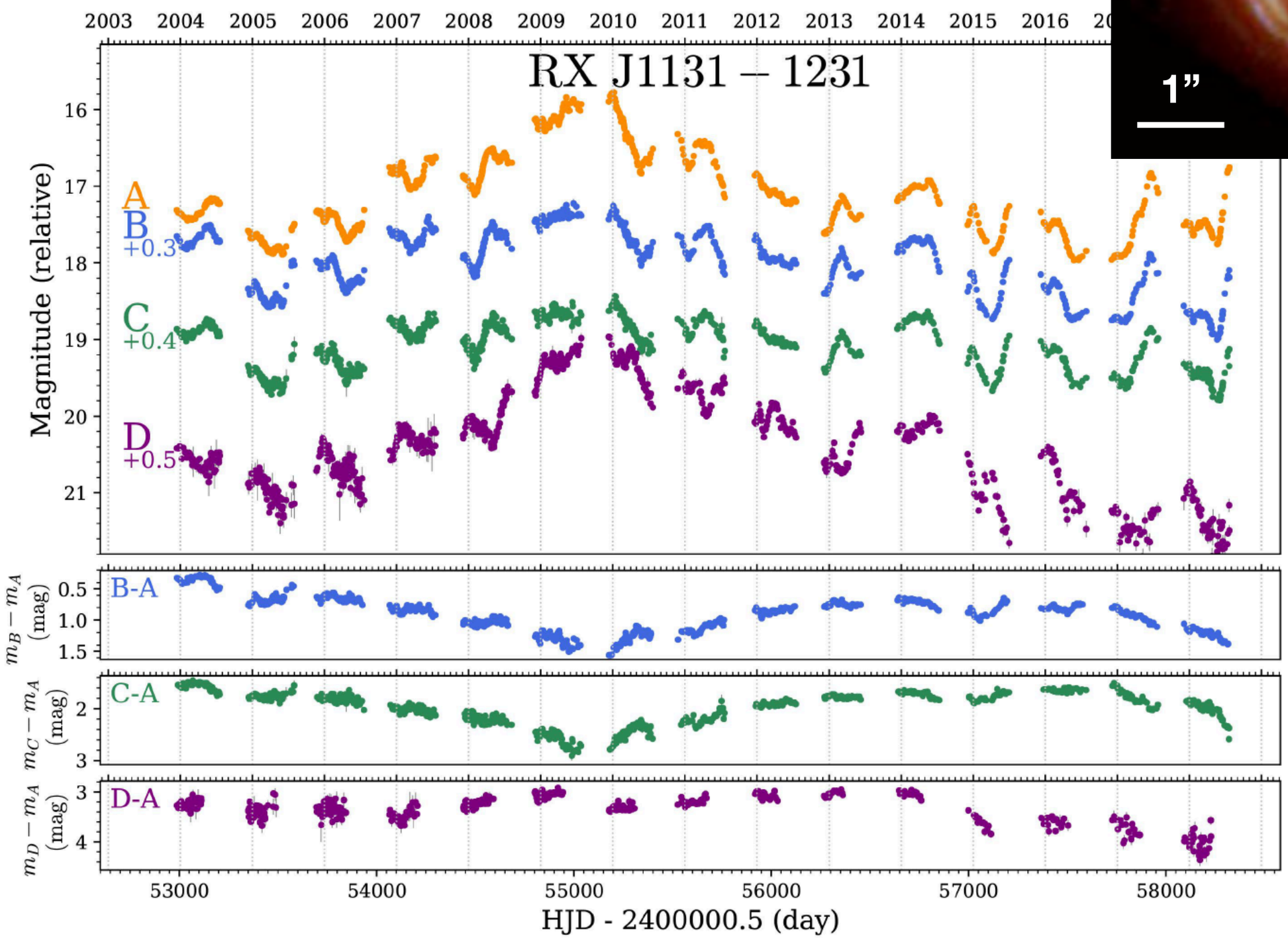
T. Anguita (U. Andrès Bello)

Time Domain Cosmology with Strong Gravitational Lensing
Online meeting – January 2021

A surprise hidden in long light-curves

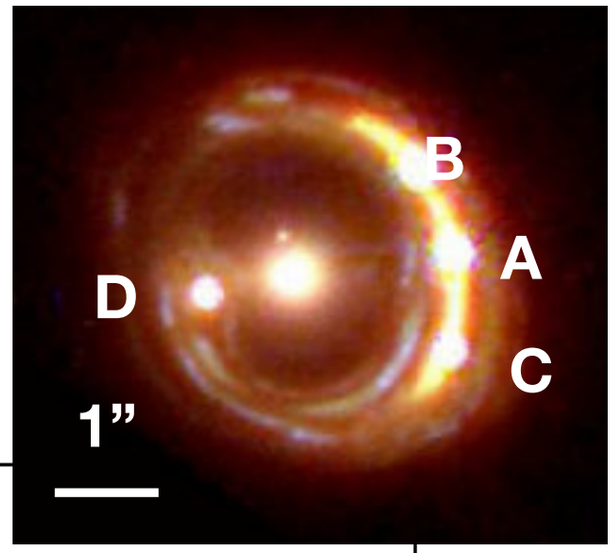
COSMOGrail

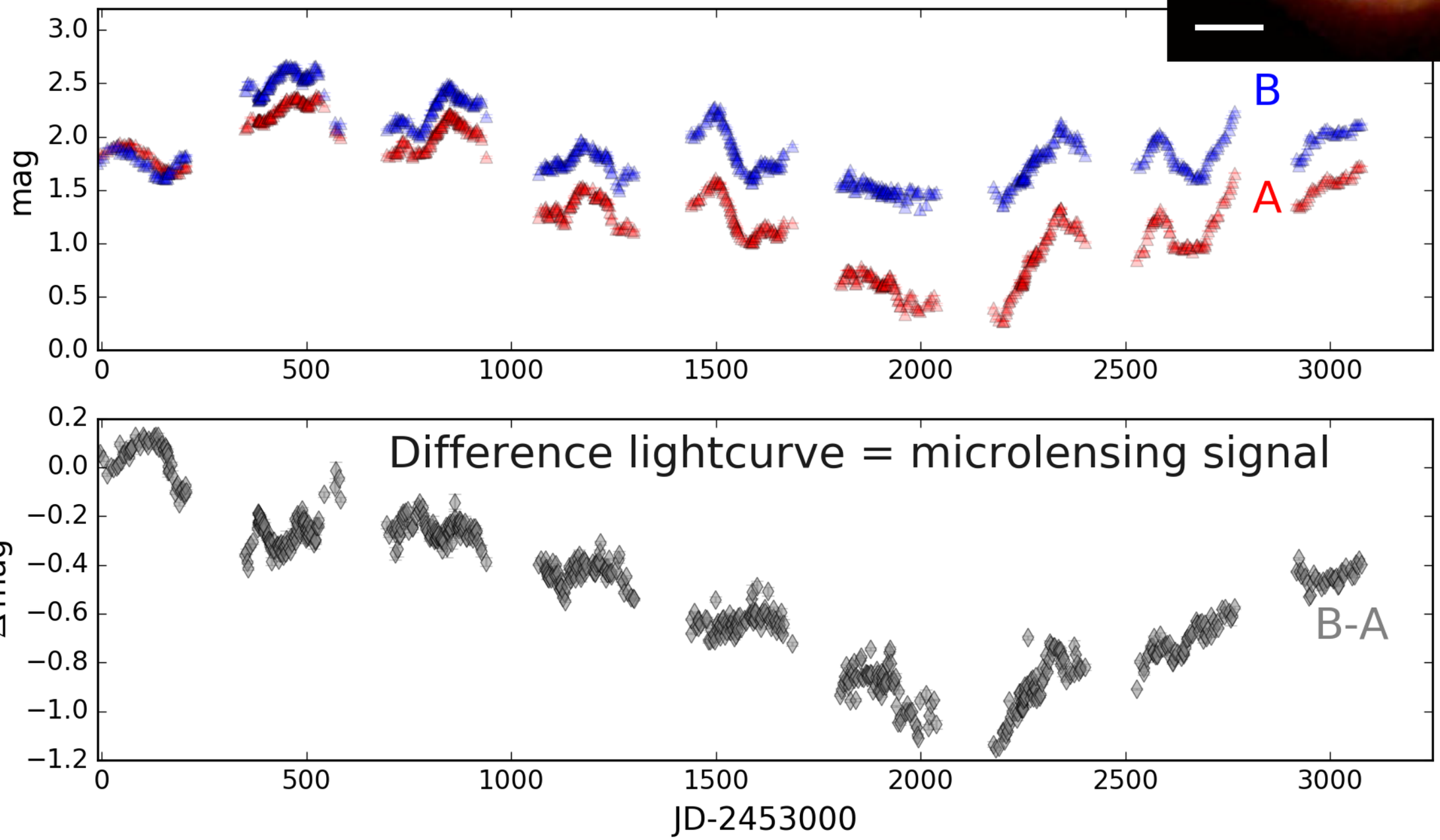




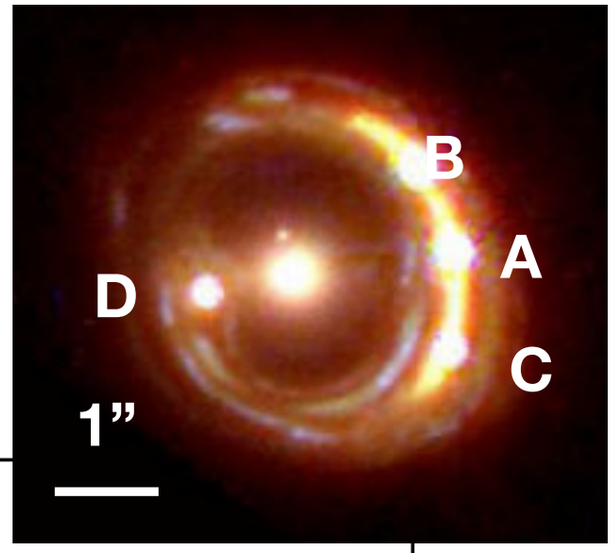
COSMOGRAIL XIX
Millon et al. 2020, A&A, 640, A105
arXiv:2002.05736

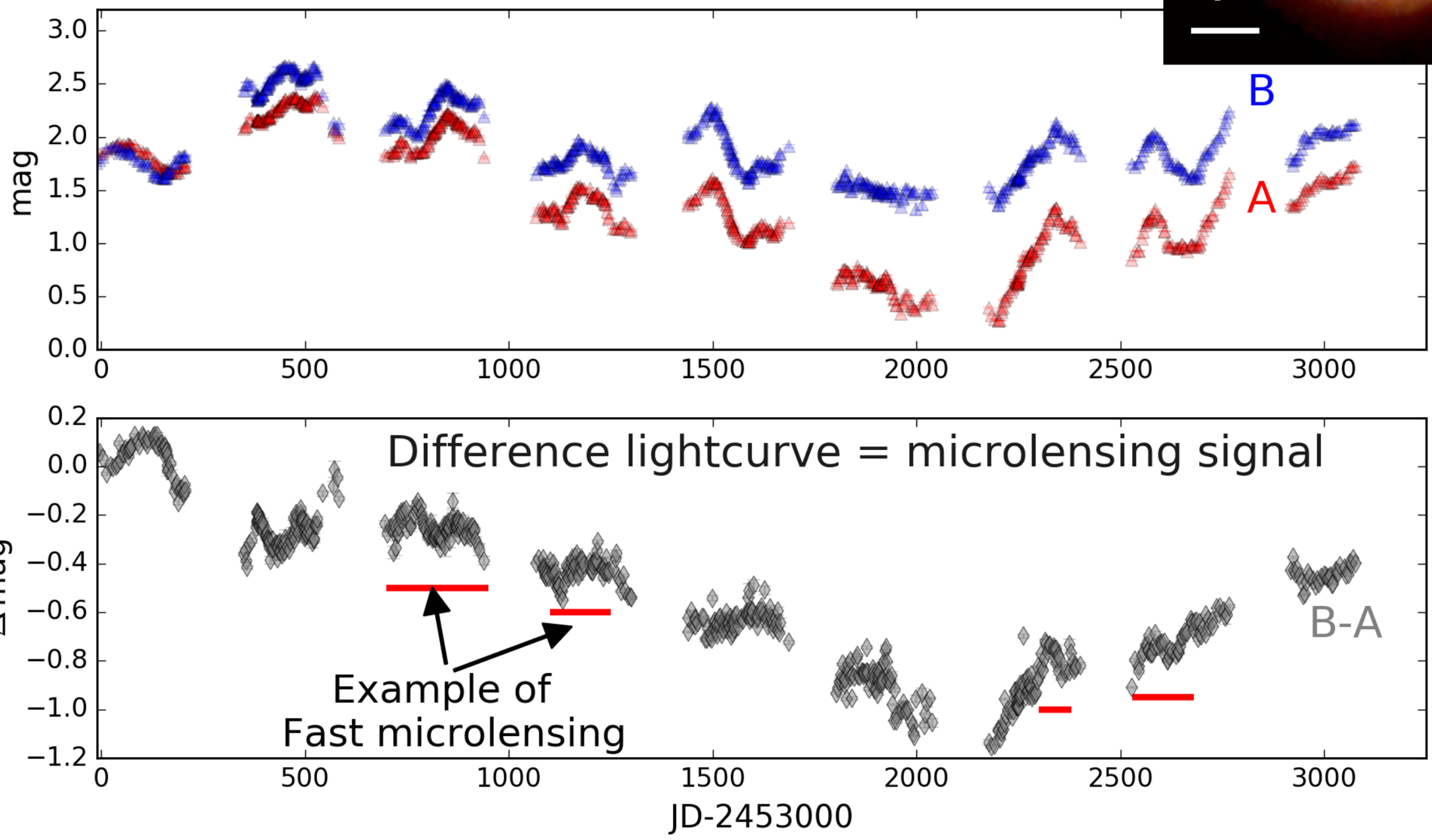
A surprise hidden in long light-curves



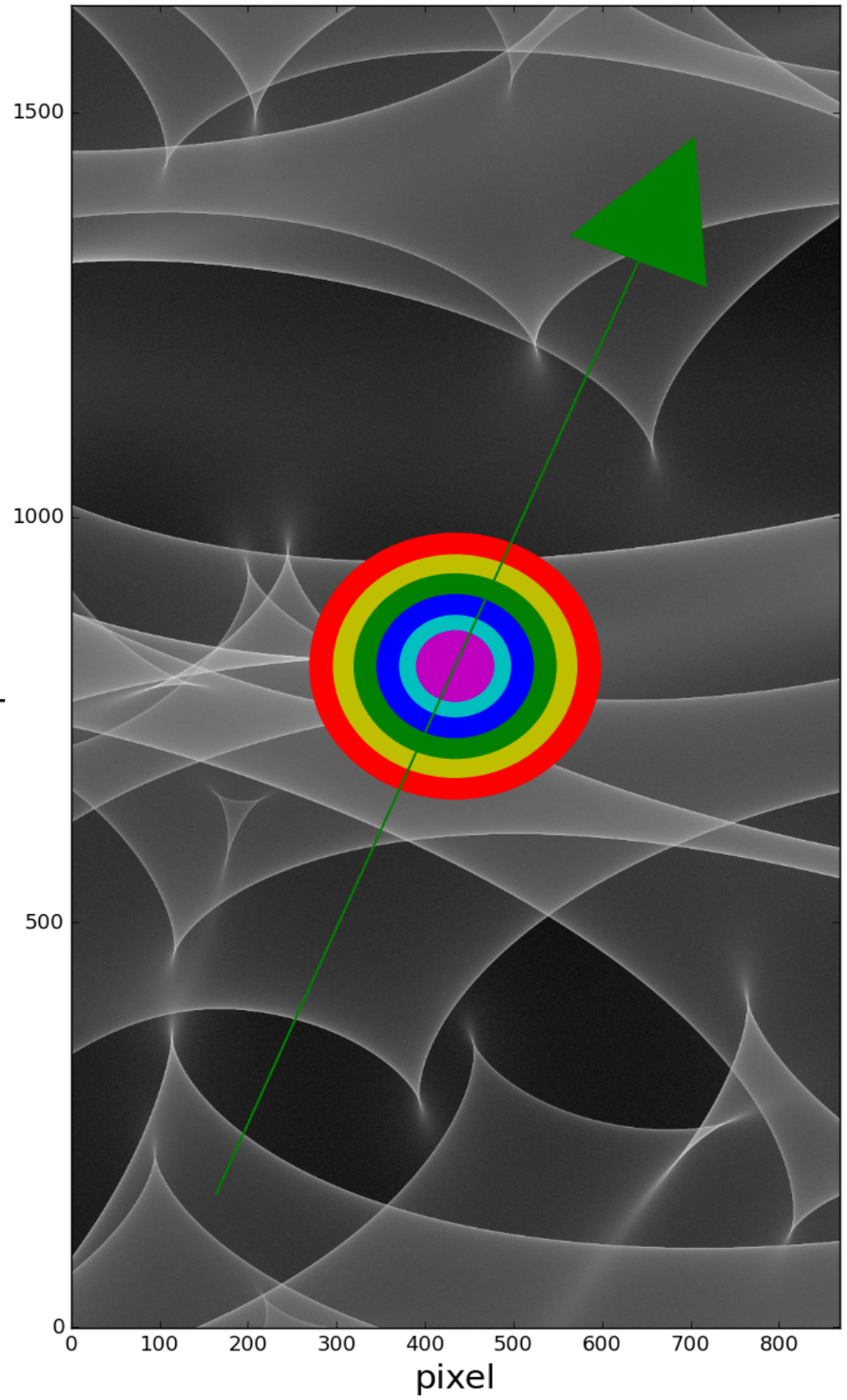


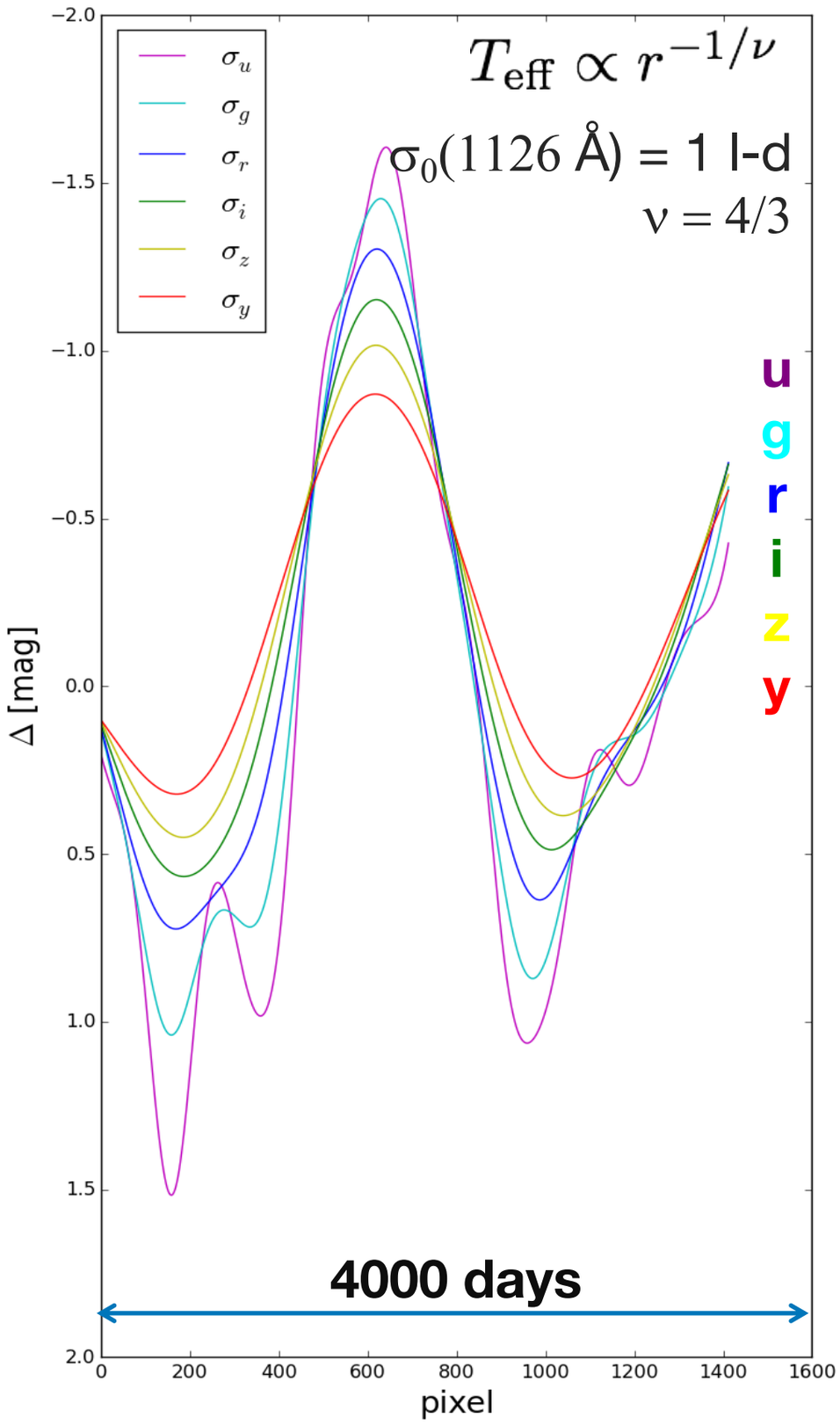
Microlensing lightcurves are not smooth





Microlensing predicted for a smooth continuum AD

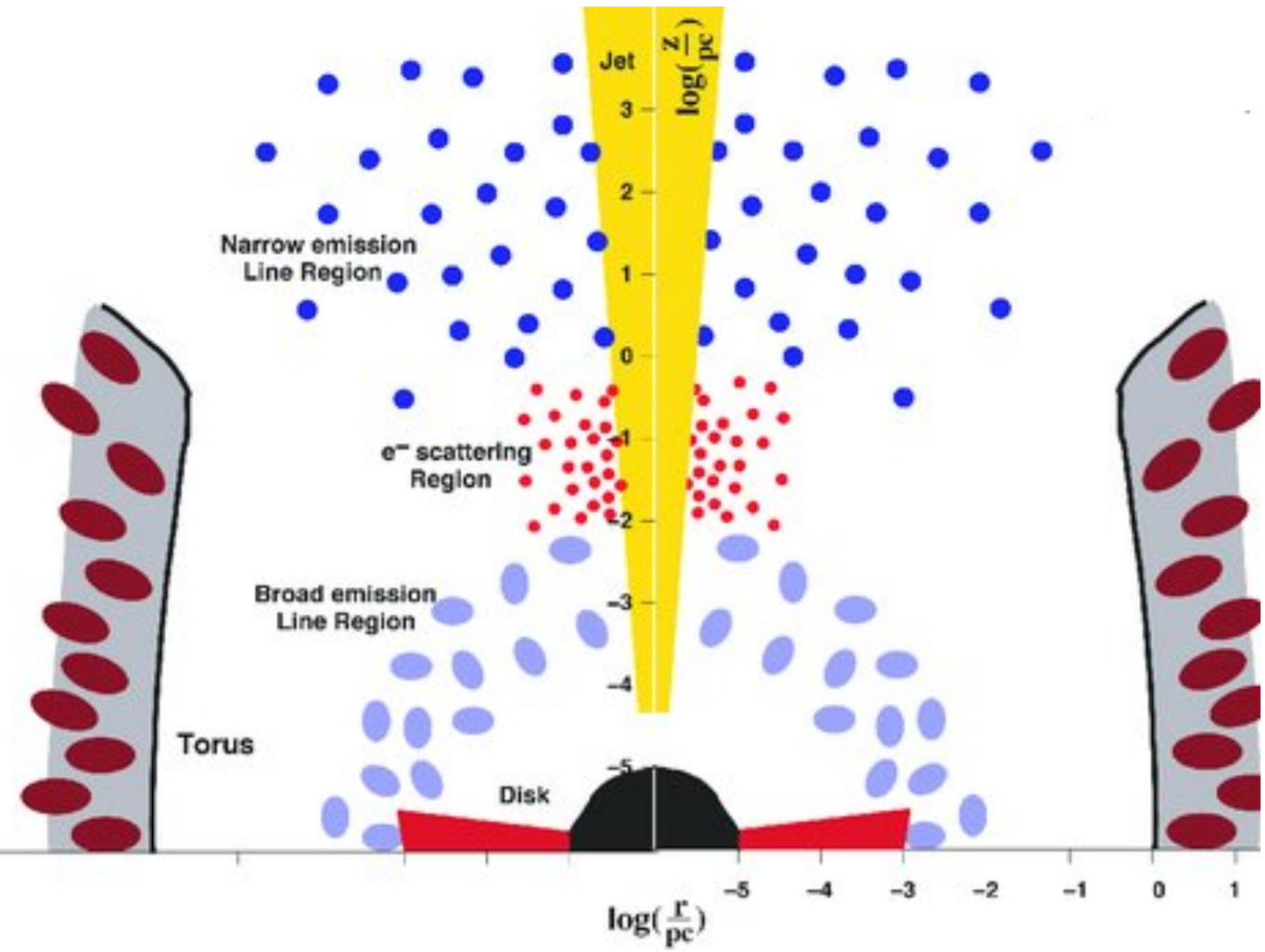




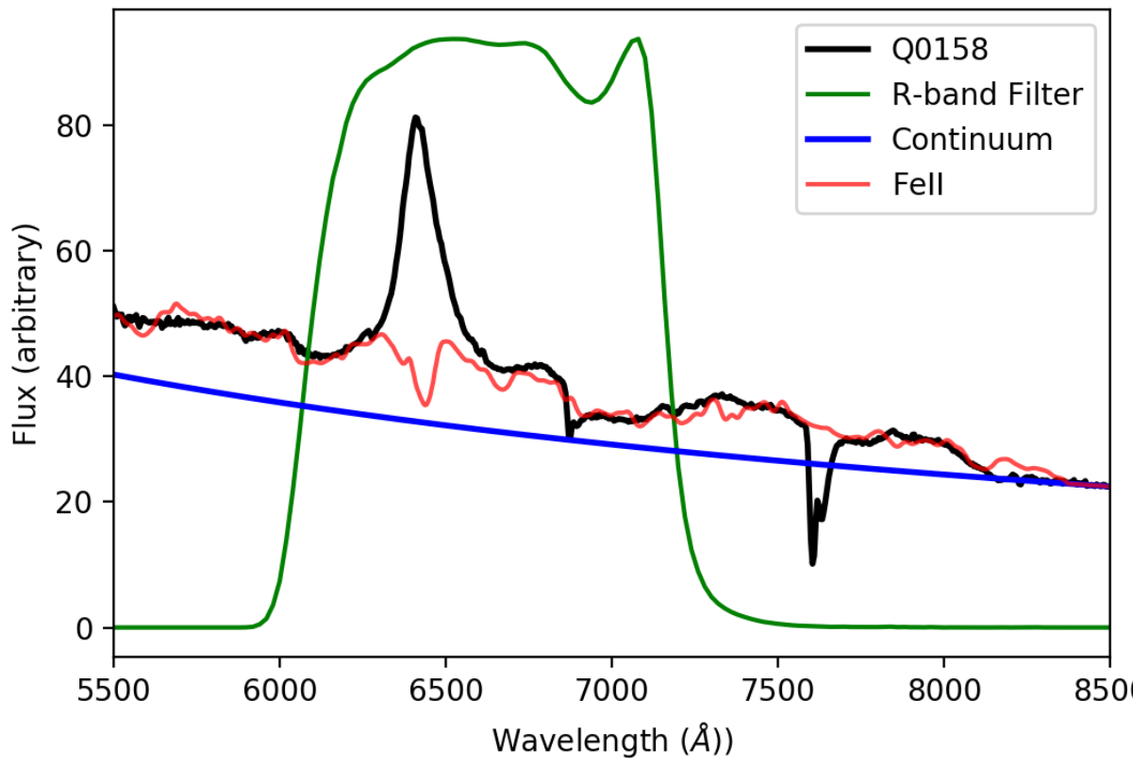
Courtesy: T. Anguita

The BLR as a natural source of extended flux

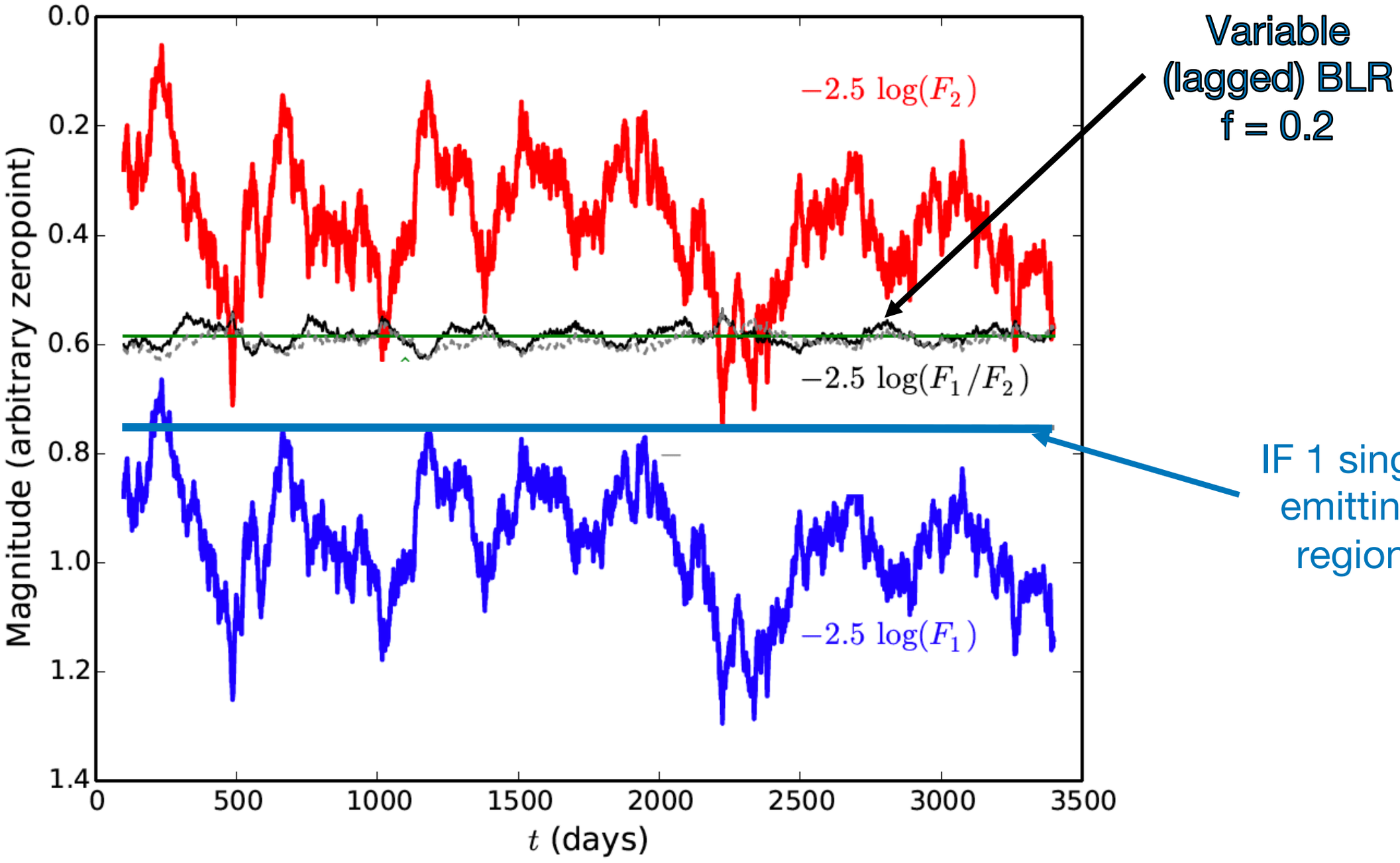
Sketch of an AGN



Example of emission spectrum



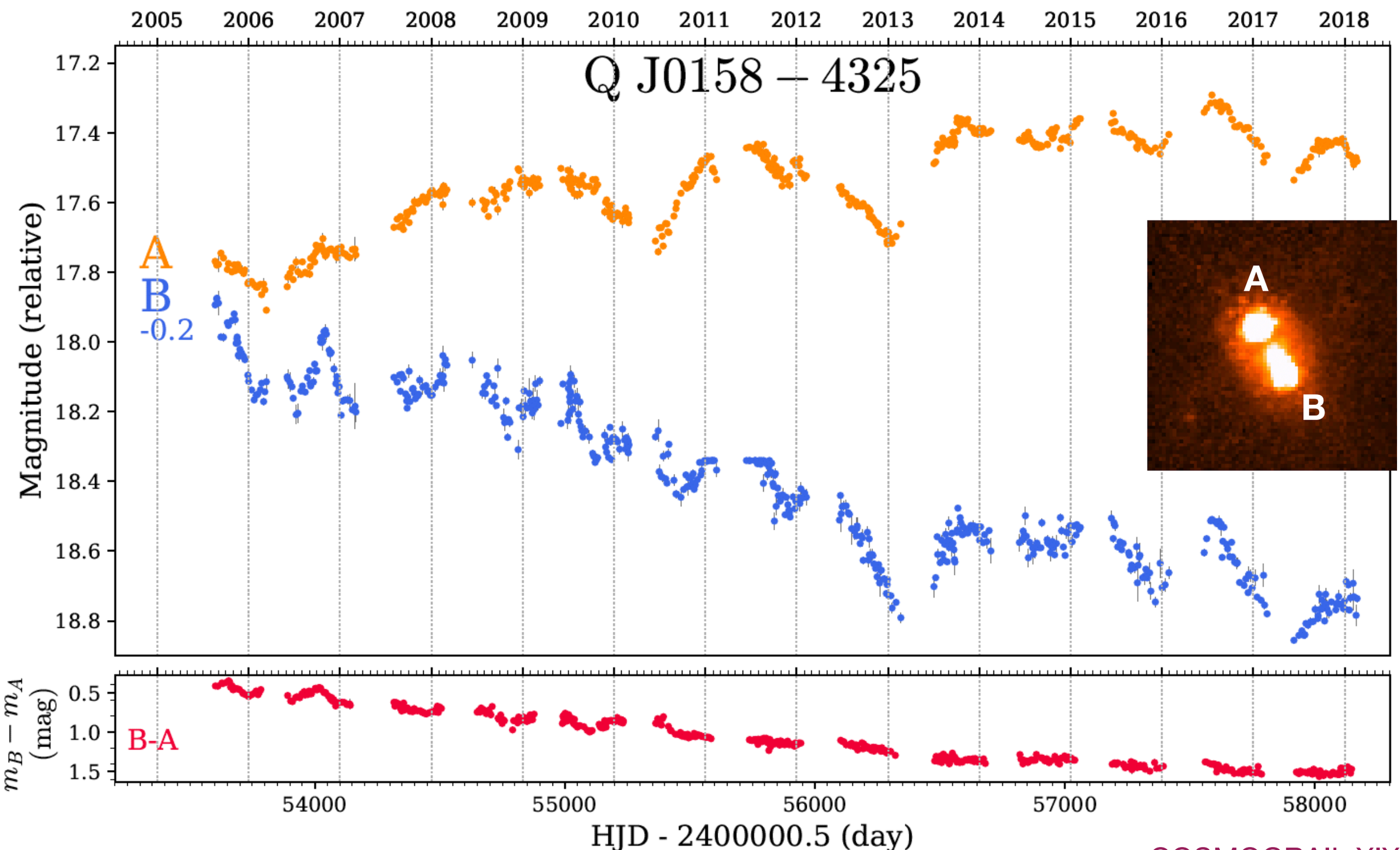
Two sources of emission: compact + extended



Lightcurve flickering happens with a lagged (e.g. BLR) or constant ***extended flux*** emission but rather low amplitude

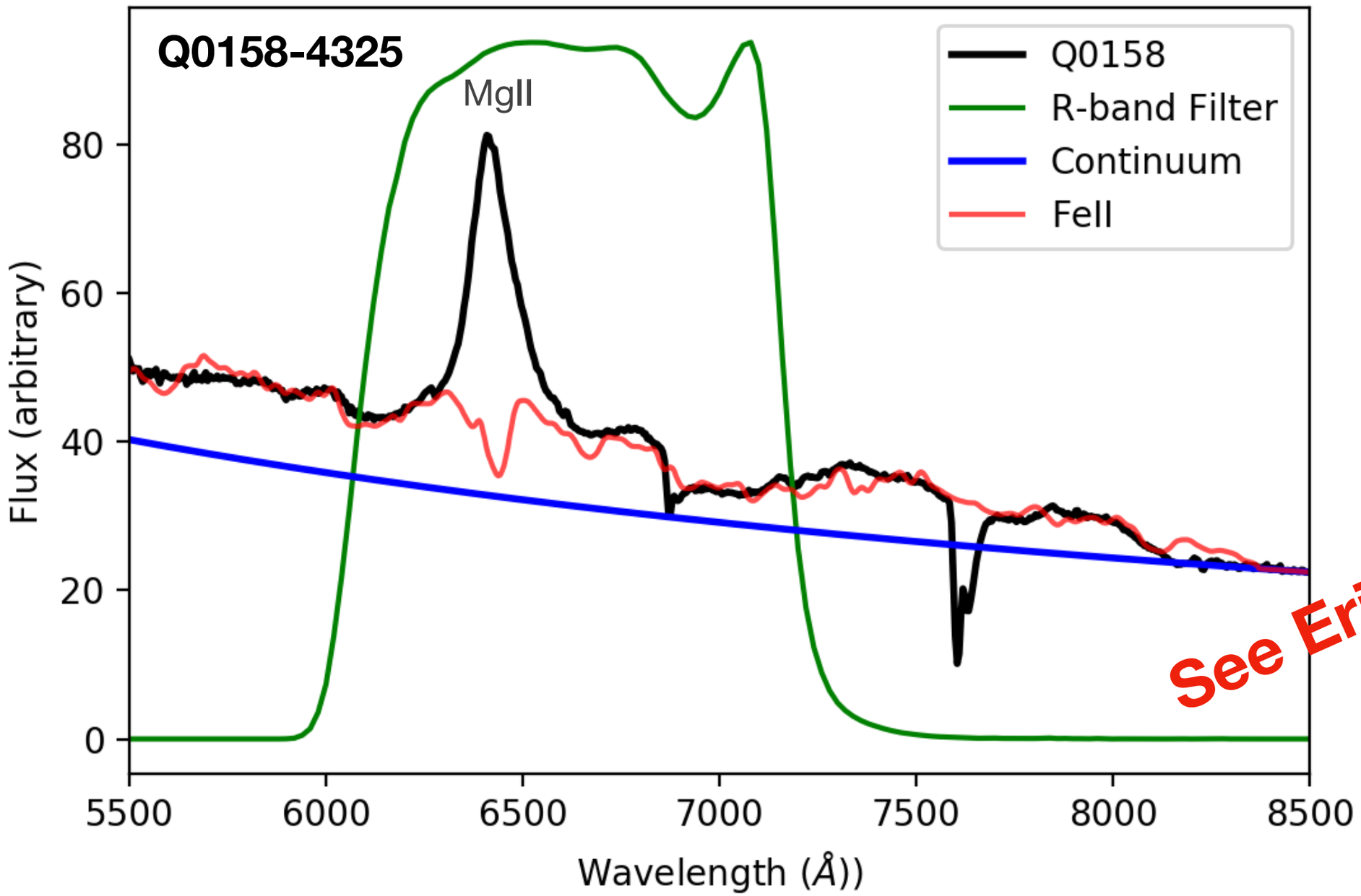
Sluse and Tewes 2014, A&A, 571, A60

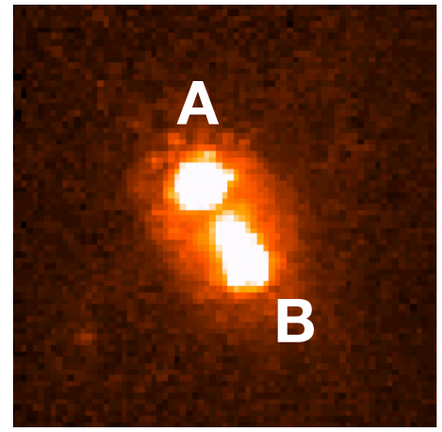
Visible in *MANY* COSMOGRAIL lightcurves



COSMOGRAIL XIX
Millon et al. 2020,
A&A, 640, A105

The BLR as a natural source of extended flux

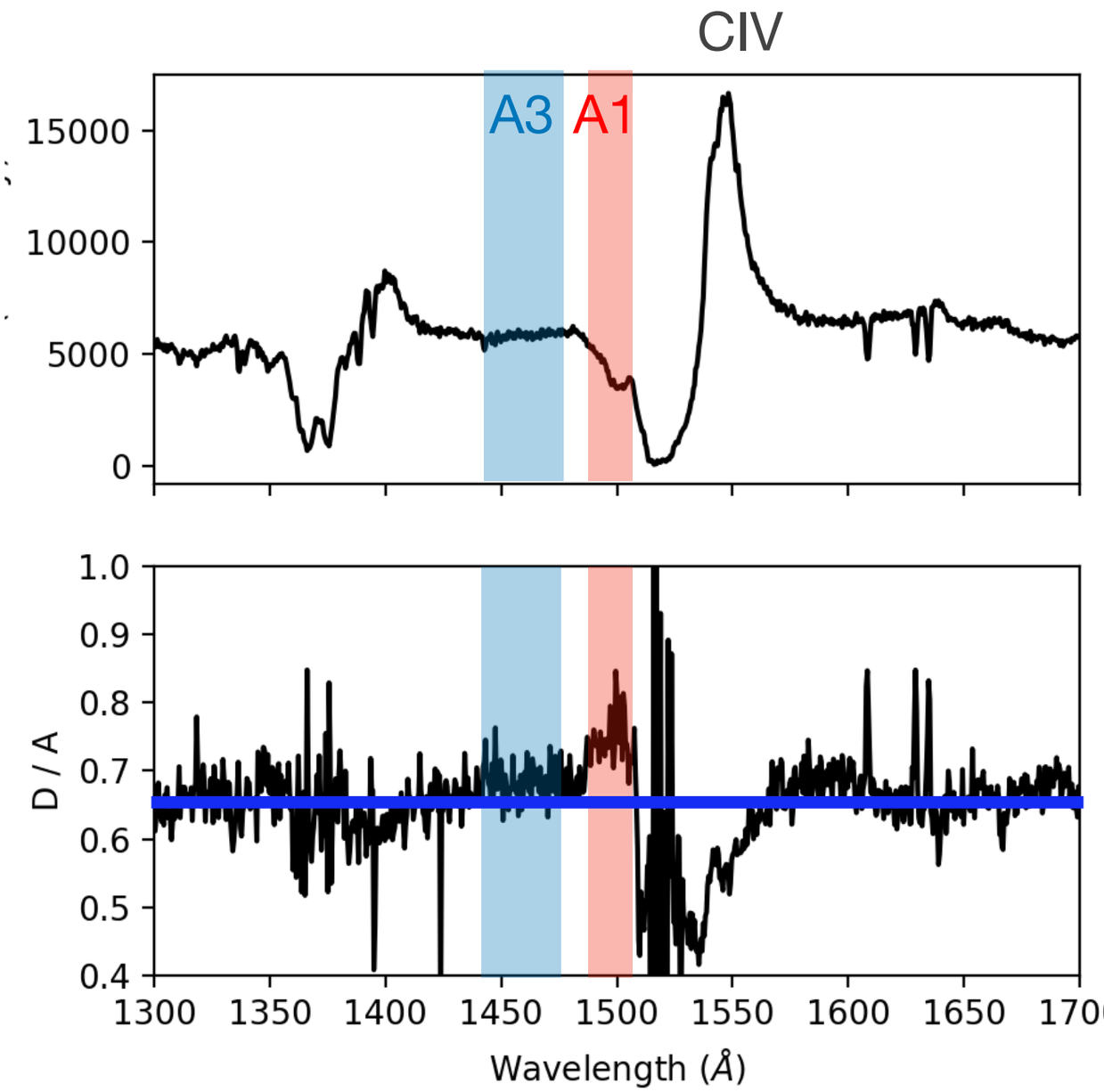




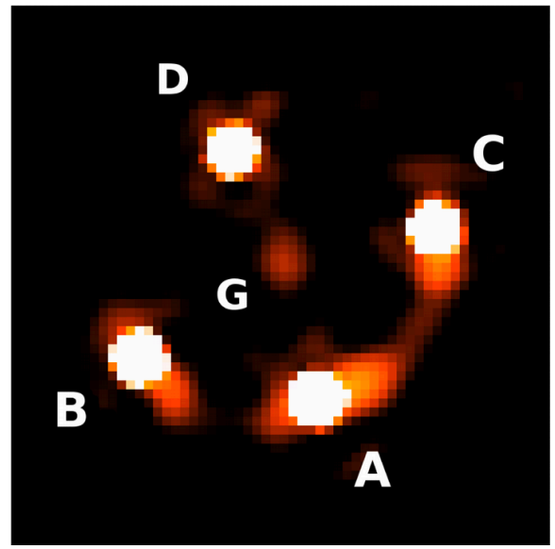
See Eric Paic's talk

For Q0158-4325, the **B**road **L**ine **R**egion (MgII + FeII) are *main contributors* to **non-microlensed/less microlensed** (extended) flux (*30% of flux in R-band* !)

Anything else ? Extended *continuum*



H1413+117



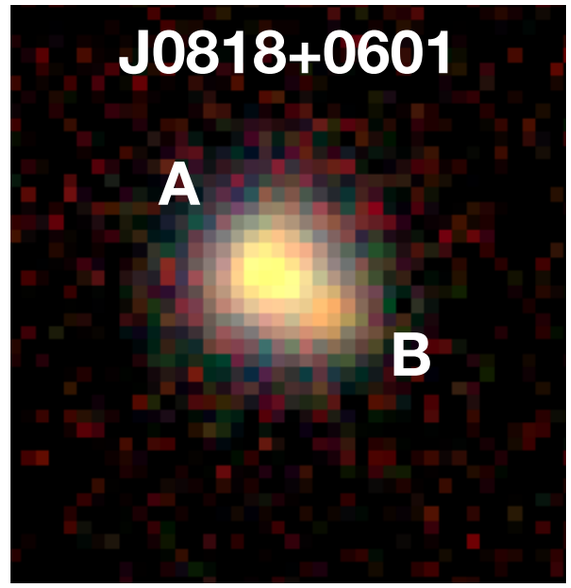
The absorbing region A1 covers a region that is less microlensed than A3. This is evidence for an extended continuum on top of a compact microlensed continuum

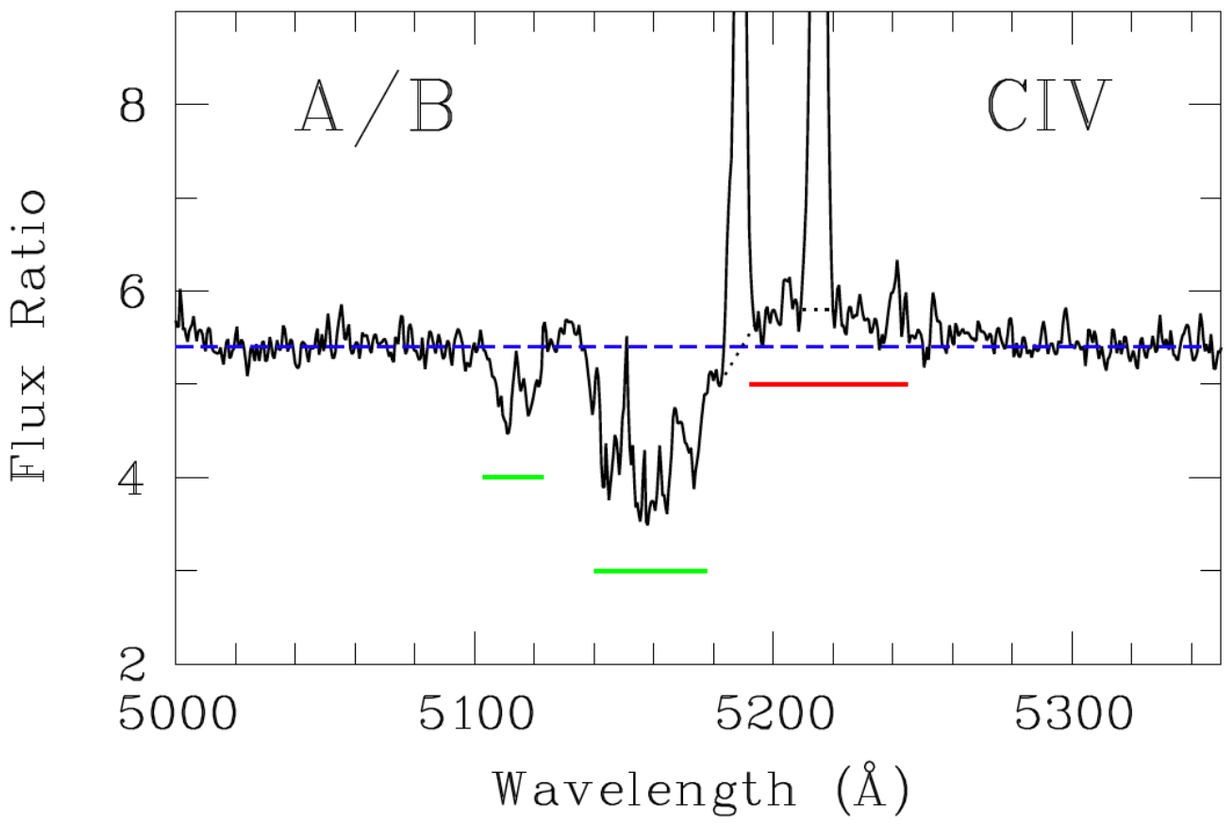
At least **30%** of the continuum flux is extended in this system !

Spectropolarimetry (not shown) also unveil a different **P** and θ in A & B, supporting total flux results

Sluse et al 2015, A&A, 582, A109 1508.05394
Hutsemékers et al. 2015, A&A, 584, A61 1510.06047

Further evidence for an extended *continuum*





MmD and spectral ratios support existence of a compact + a diffuse extended continuum

Spectropolarimetry (not shown) also unveil a different P and θ in A & B, supporting total flux results

Hutsemékers, DS, Kumar, 2020, A&A, 633, A101 - arXiv:1912.04336

Conclusions

- Microlensing signal in **long** lightcurves is more complex than expected (flickering on time-scales smaller than expected)

- A *natural* explanation for the signal observed in COSMOGRAIL lightcurves is that it is an imprint of the ***structure*** of the AGN:

  - Broad Line Region (likely in Q0158-4325) – See **Eric Paic's** talk

  - Extended continuum may sometimes be significant (cf spectropolarimetry)

- ***Alternative explanations exist*:** Accretion disc temperature fluctuations on small scales, (very)-low mass end of the DM mass spectrum, primordial BHs, …

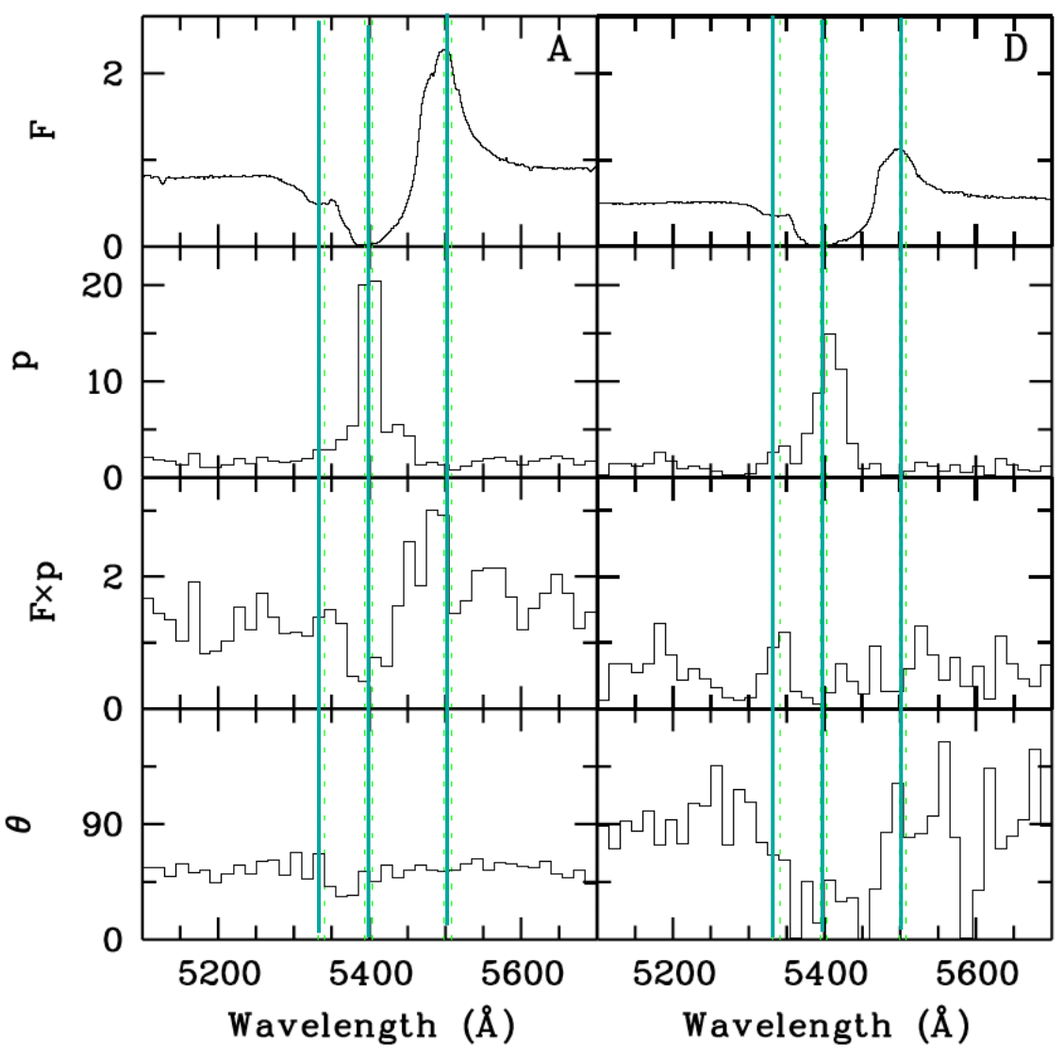
Need for **spectroscopic monitoring** data to disentangle these scenarios and learn more about AGN structure / "exotic" physics

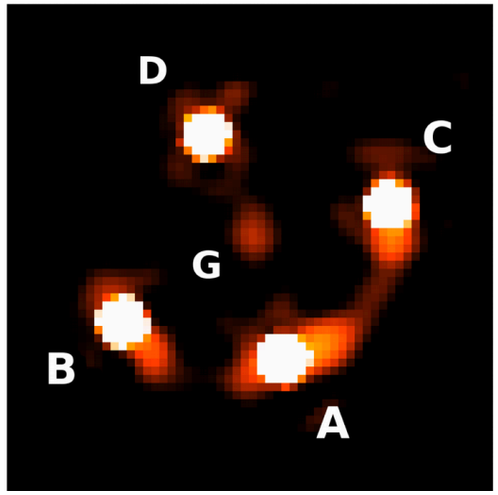
One man's noise is another man's signal …

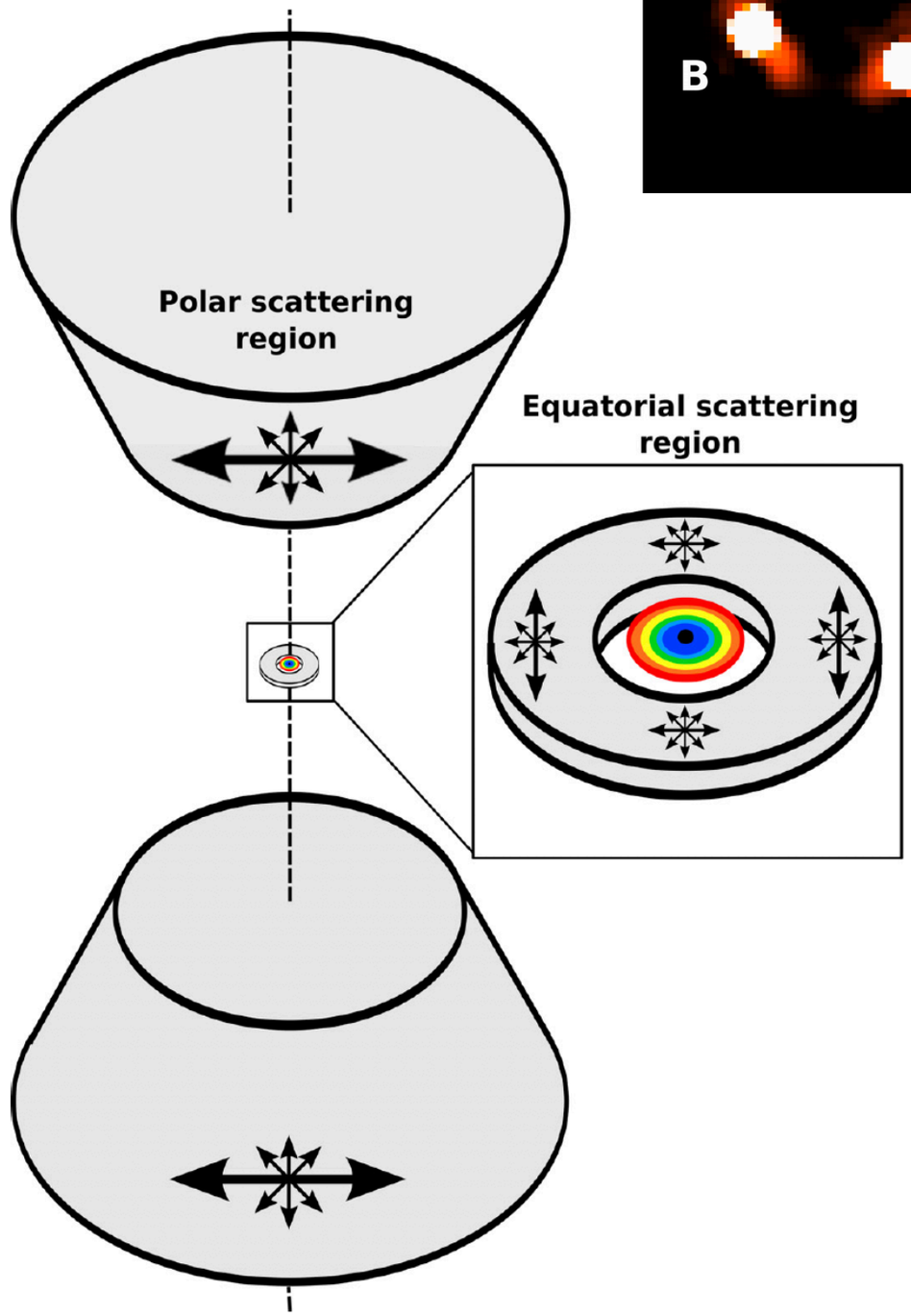
dsluse@uliege.be

Supplementary slide

Spetropolarimetry of H1413+114







Difference in **P** and θ between A & D supports 2 components scattering:

- Equatorial compact w. $R < R_{BLR}$
- Polar extended w. $R >>$

Sluse et al 2015, A&A, 582, A109 1508.05394
Hutsemékers et al. 2015, A&A, 584, A61 1510.06047