RUHR-UNIVERSITÄT BOCHUM

RUB

PHOTOMETRIC REVERBERATION MAPPING OF 3C120

BBH & Dual AGN: Workshop in Memory of David S. De Young

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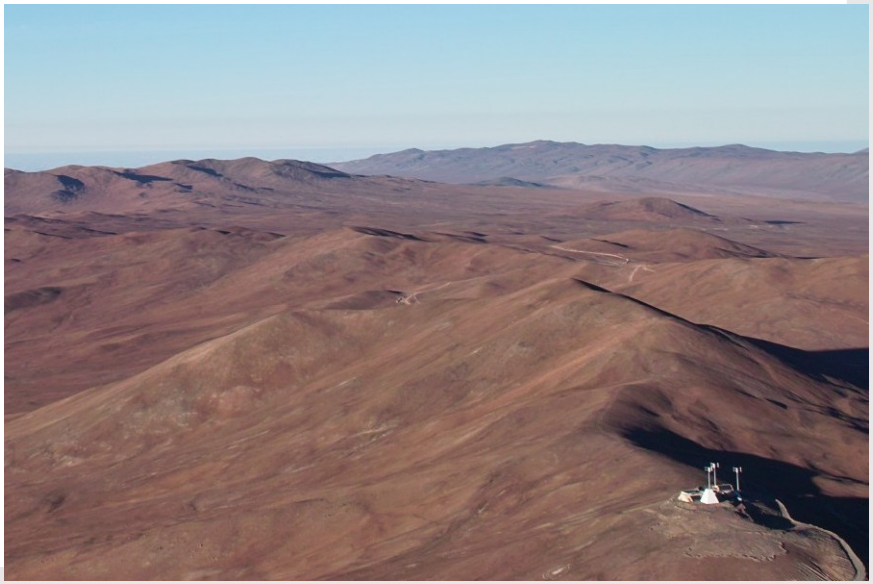
Robotic 6” telescope

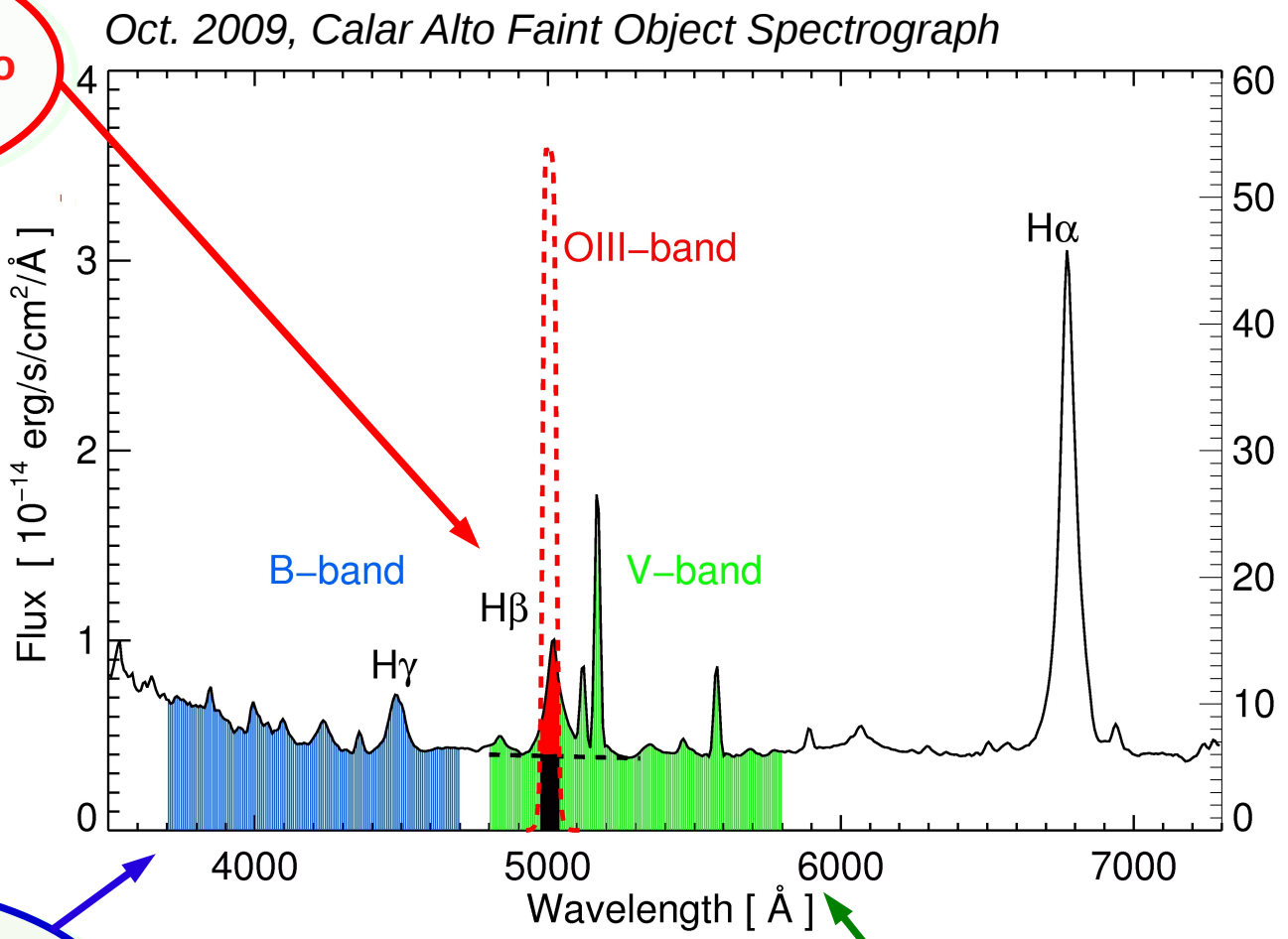


Observatory of the RUB, Cerro Armazones

Principle of Photometric Reverberation Mapping

3C120 (z=0.0331)
Emission line falls into NB (5007+-30)Å

- The NB catches 50% continuum
- Line not centered

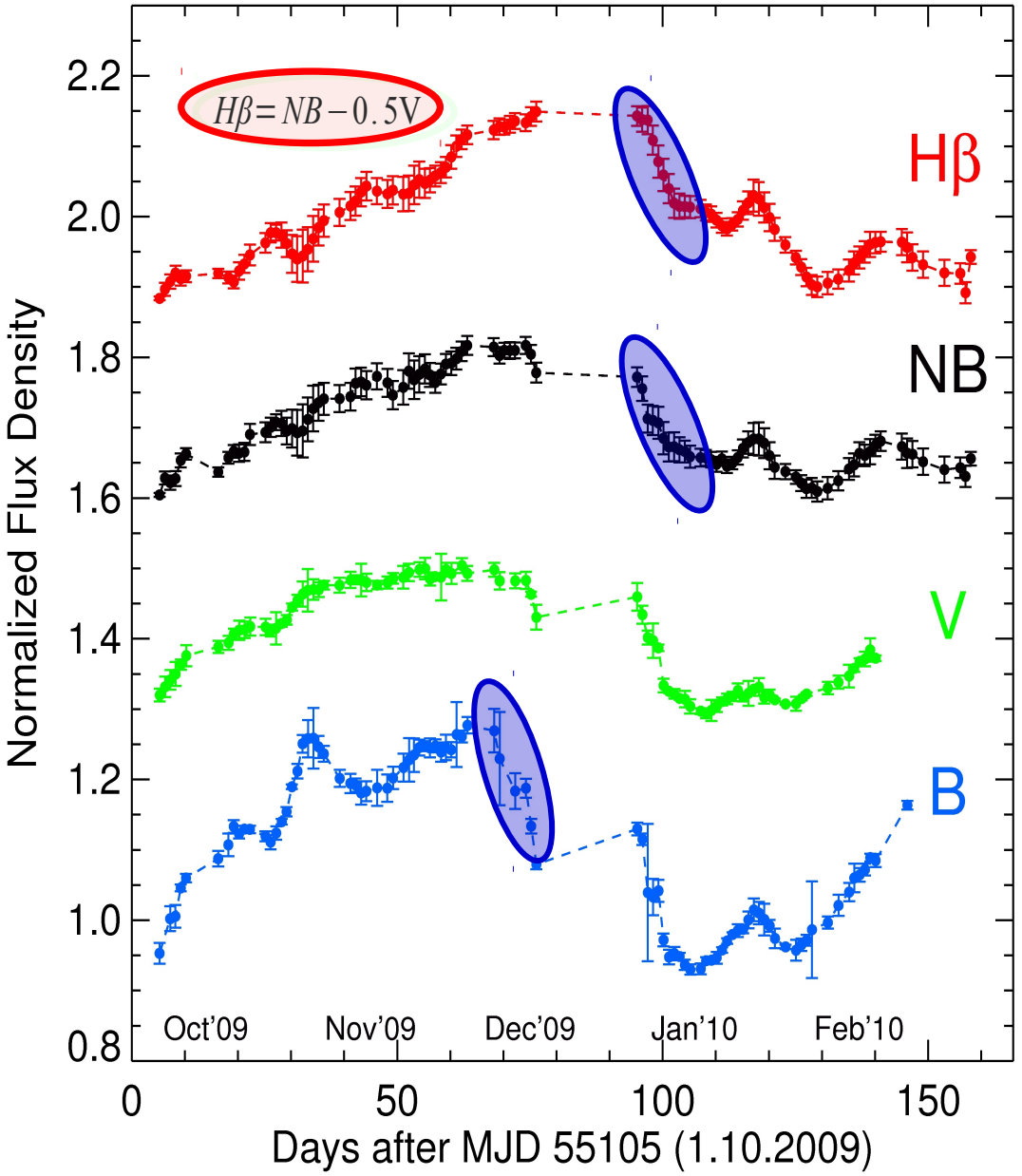


B-Band (4330+-500)Å to trace the AGN continuum variations

V-Band observations to estimate continuum in NB

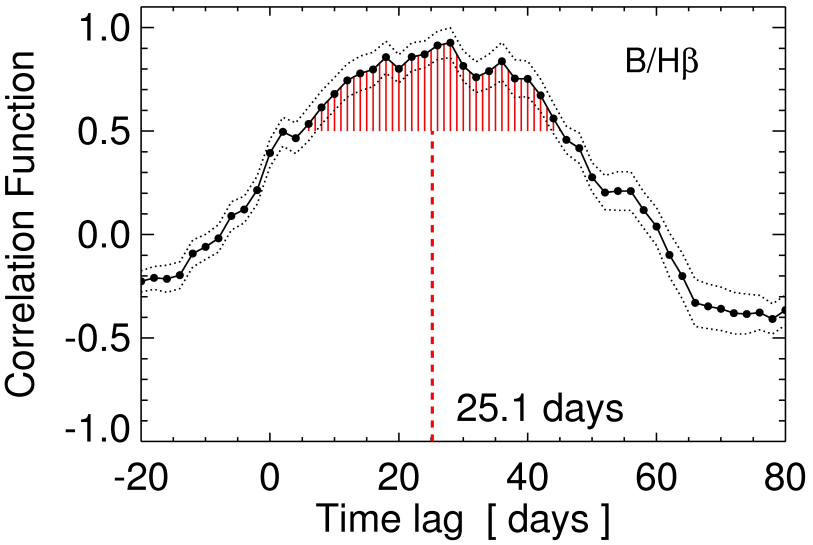
Light curves and BLR size

Lightcurves of 3C120

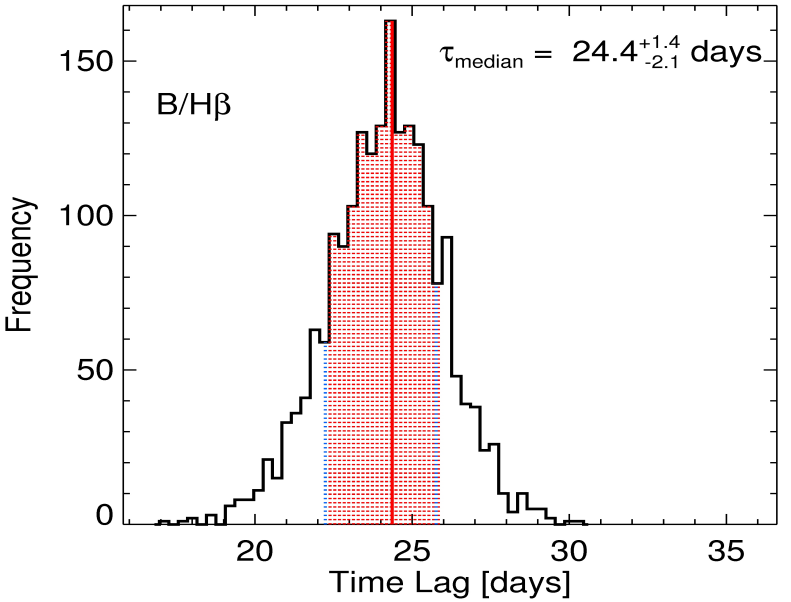


Discrete Correlation Function (DCF, Edelson & Krolik 1988)

Synthetic Hβ = NB – 0.5 V

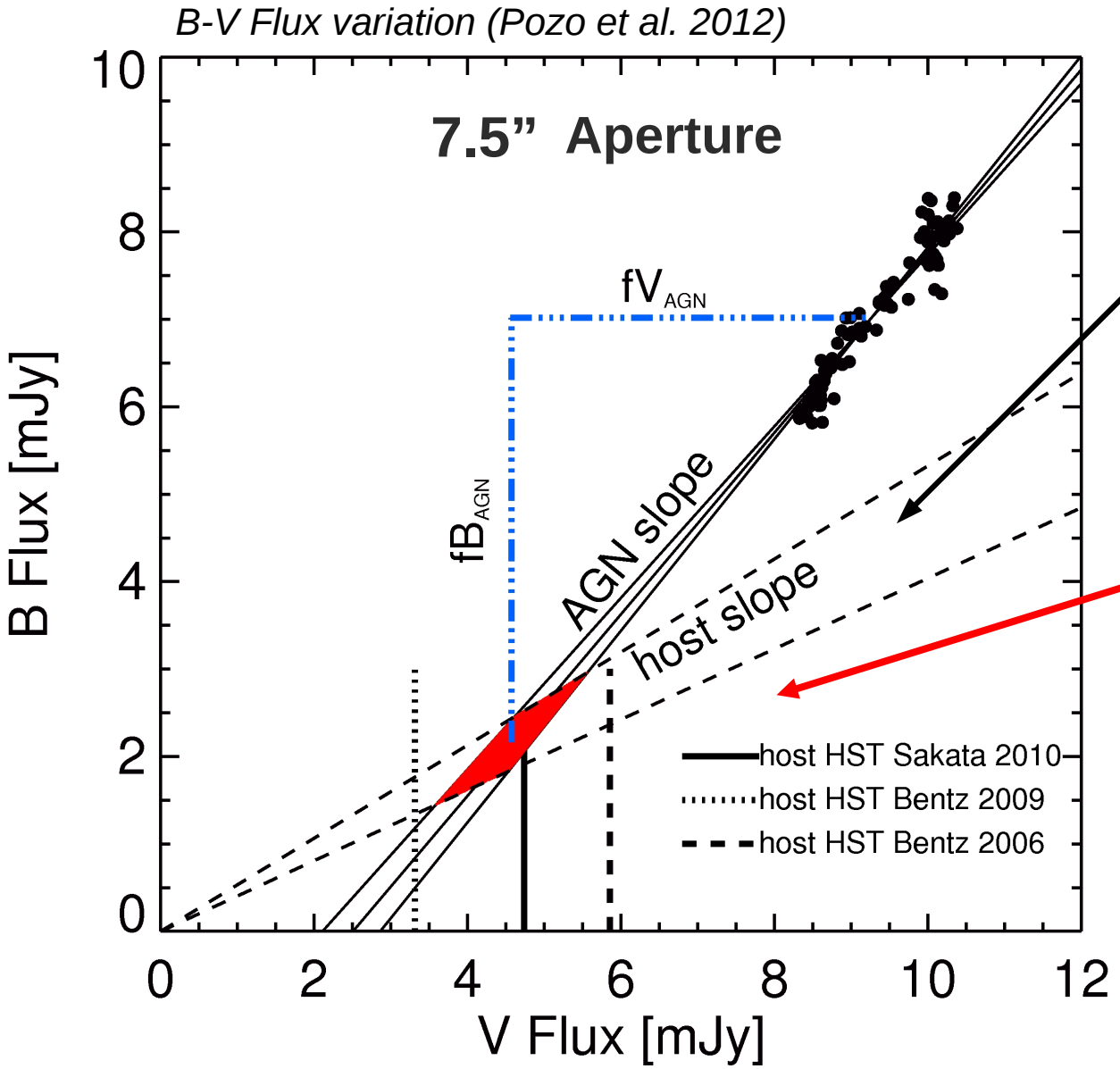


Flux Randomization / Random Subset (FR /RSS, Peterson 1998)



Host subtracted AGN luminosity

The varying total fluxes follow a linear gradient!
(Choloniewski 1981, Winkler et al. 1992)



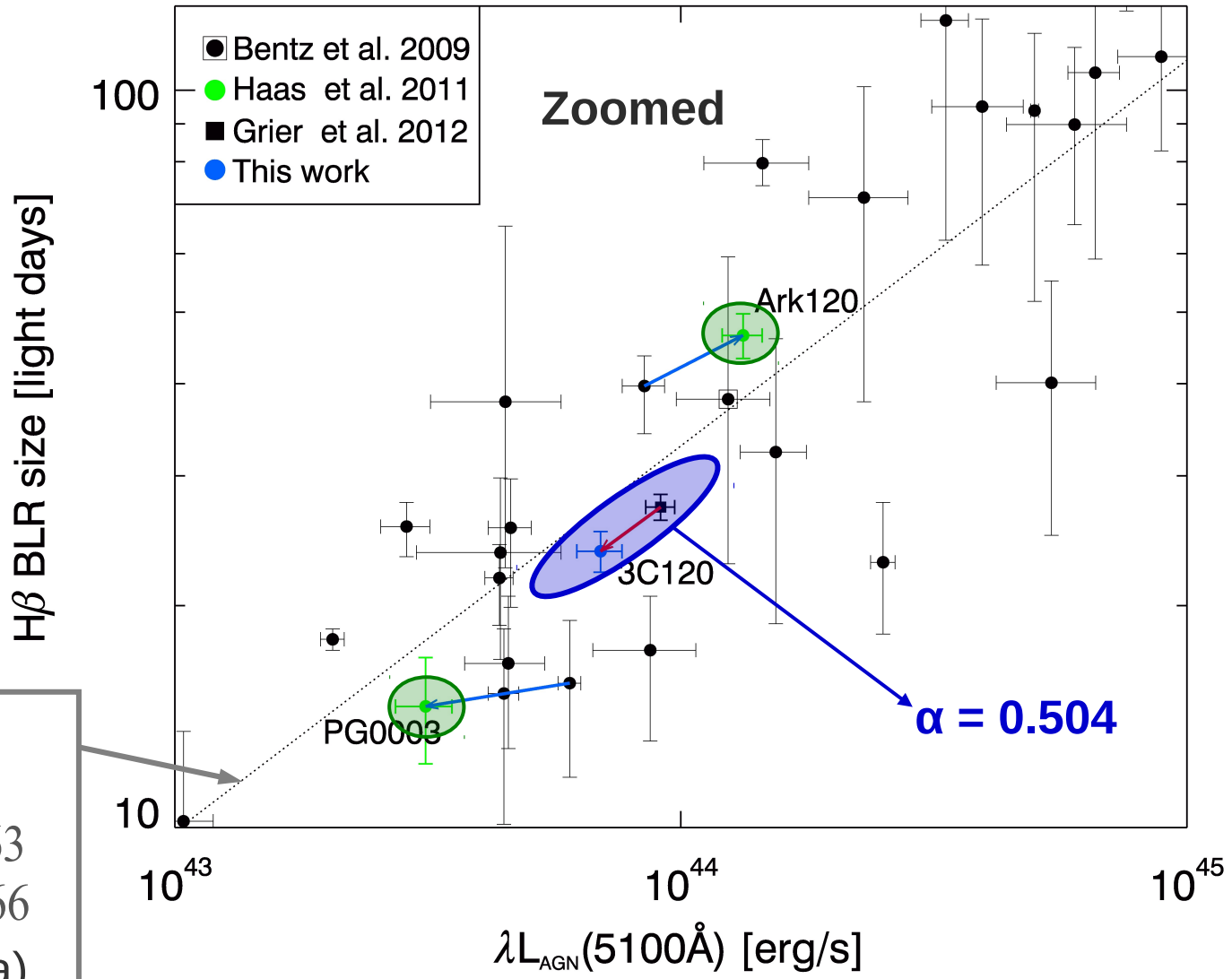
Host-galaxy slope
(Sakata et al. 2010)

$$0.4 < \Gamma_{BV}^{host} < 0.53$$

Our host flux is consistent with Sakata et al. and Bentz et al.

$$L_{5100\,A} = 6.94 \pm 0.71 \cdot 10^{43}\, erg\, s^{-1}$$

The Radius – Luminosity Relationship



$$R_{BLR} \propto L^{\alpha}$$

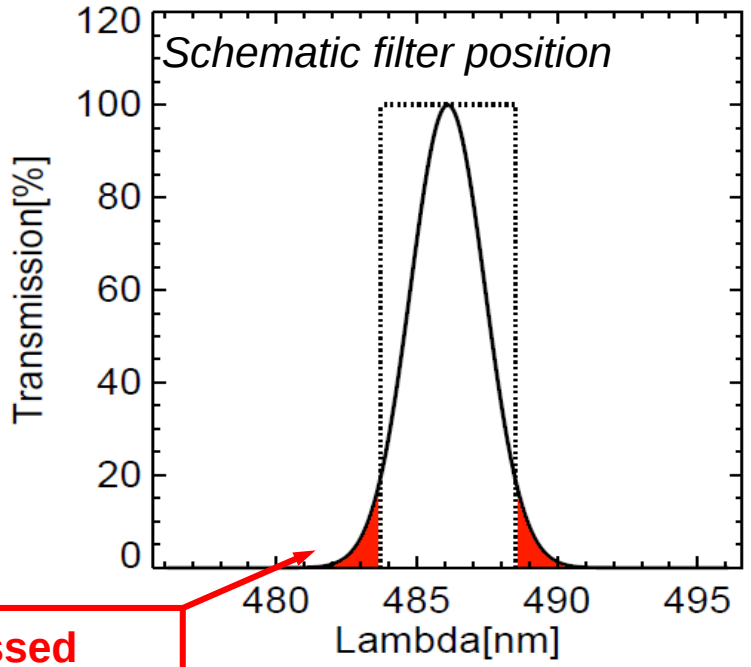
$$\alpha = 0.519^{+0.063}_{-0.066}$$

Bentz et al. (2009a)

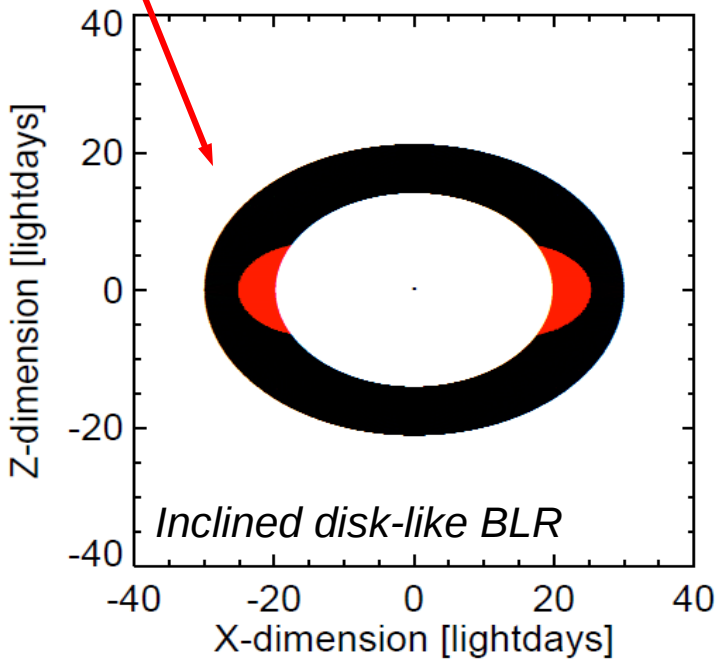
During the brightness changes, 3C120 moves parallel to the theoretically expected slope. (Pozo et al. 2012 A&A).

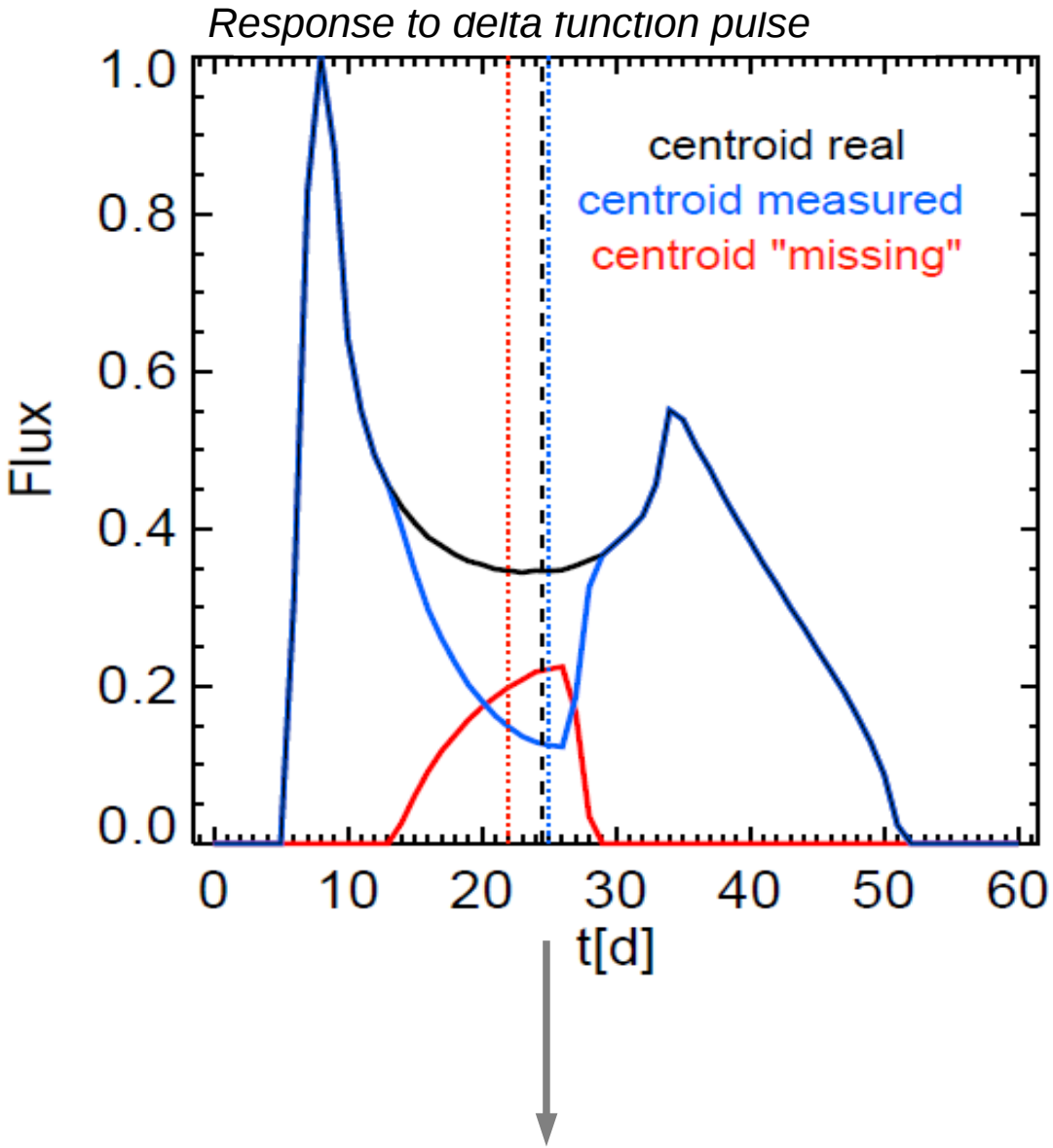
R-L relationship to determine quasar distances? (Haas et al. 2011; Watson et al. 2011)

Effect of incomplete line coverage – line centered case



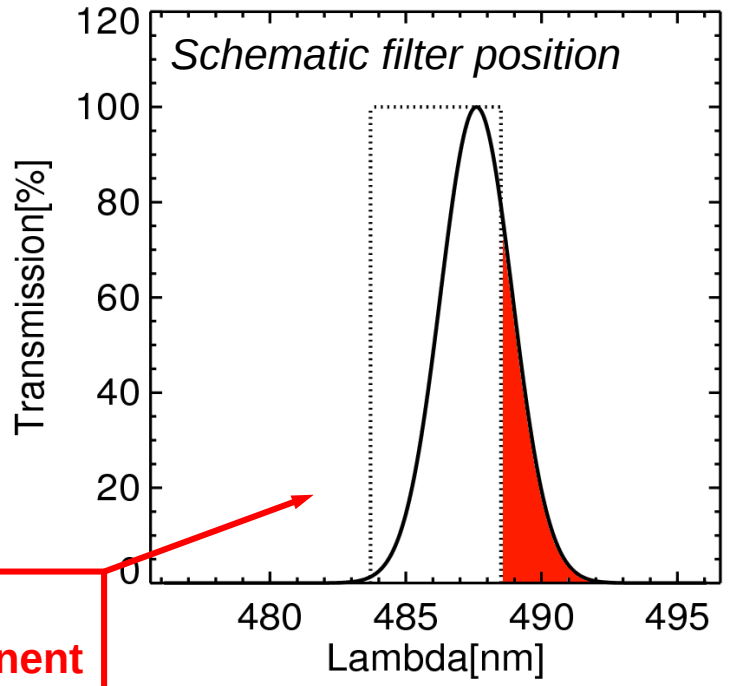
Missed component



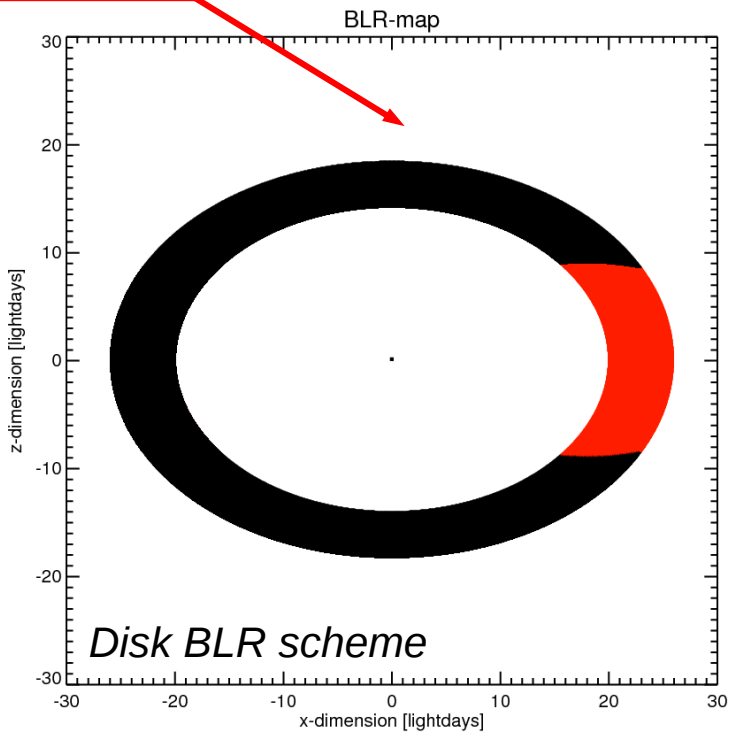


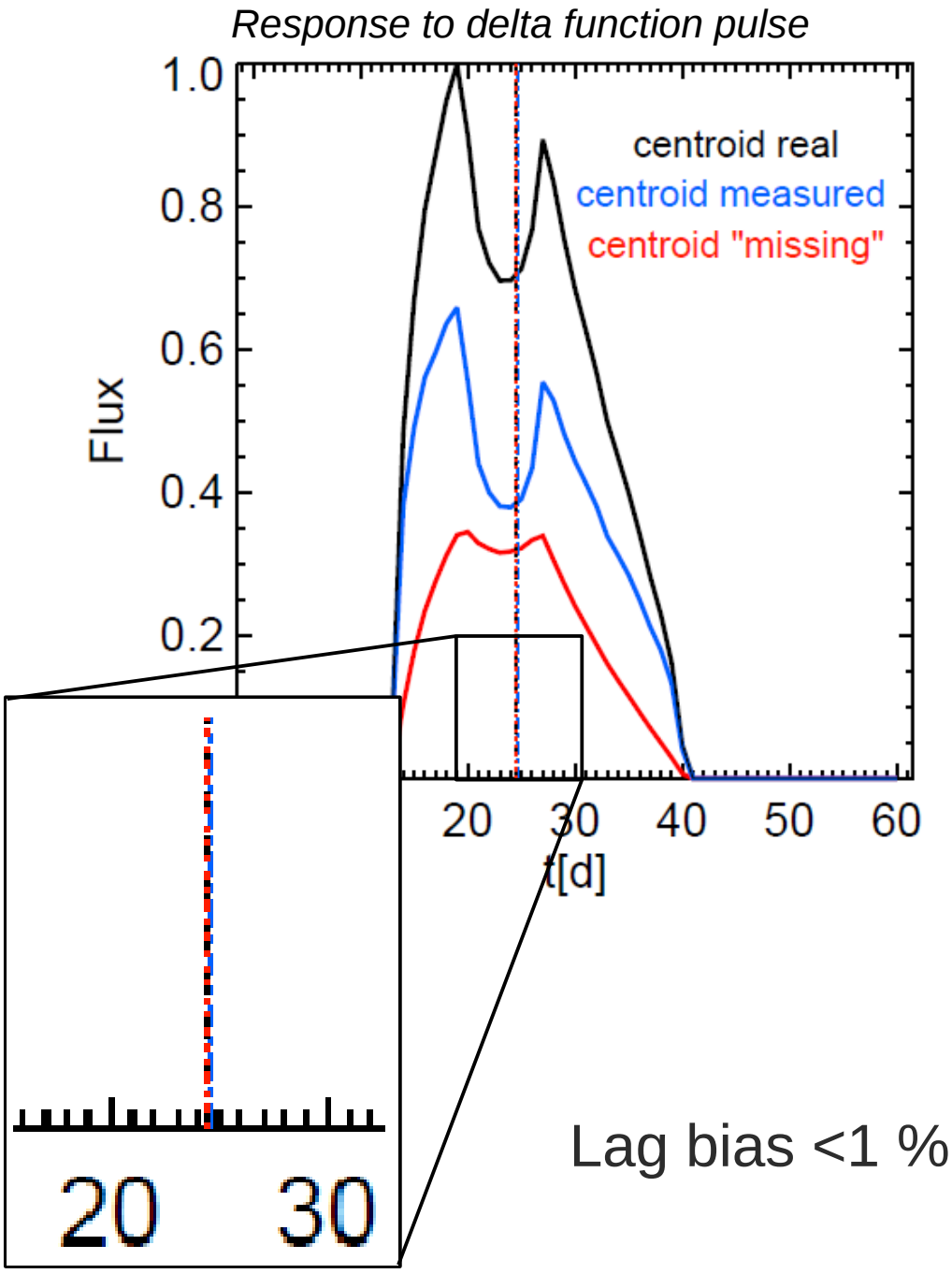
Lag bias < 2%

Effect of incomplete line coverage – asymmetric 3C120 case



Missed component

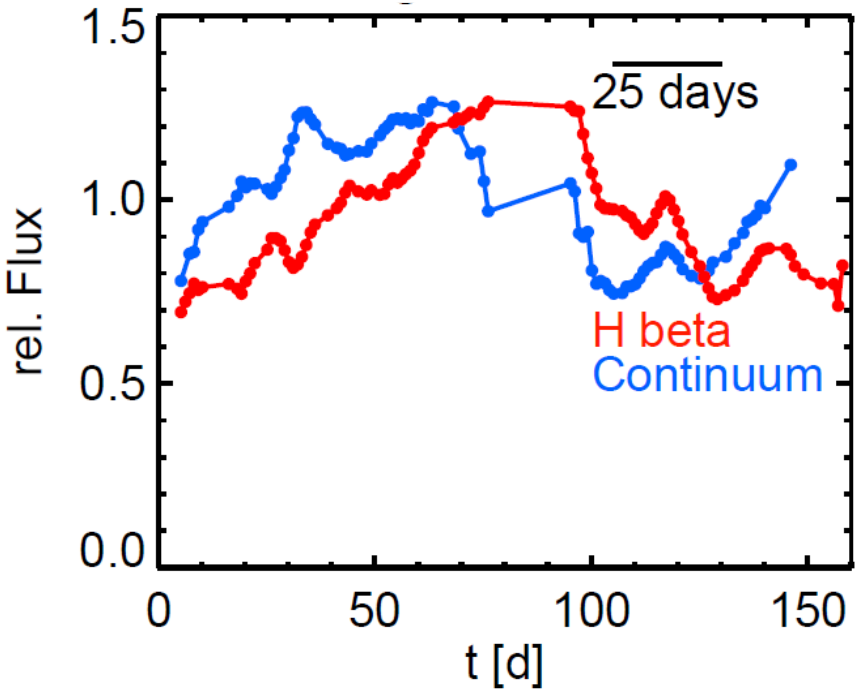




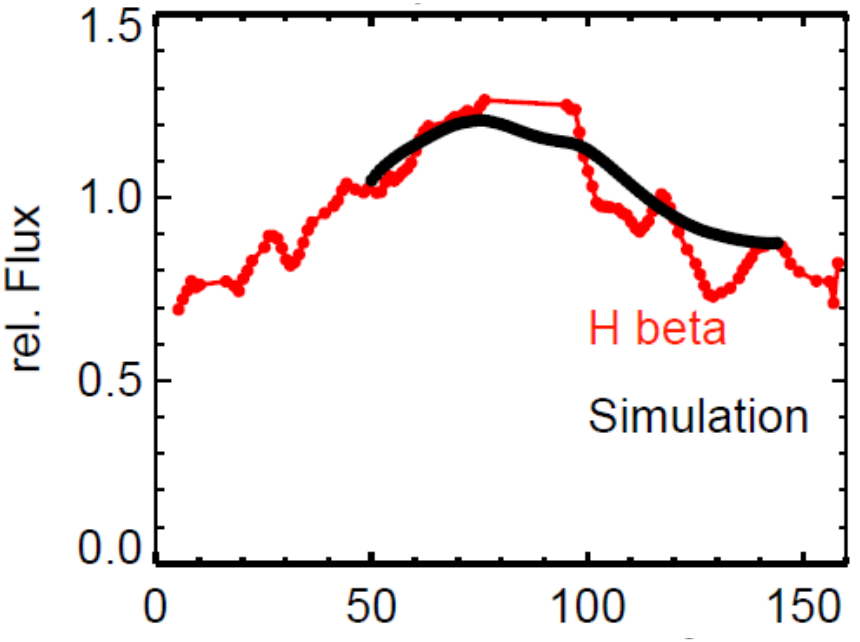
Lag bias <1 %

Modelling the BLR geometry of 3C120

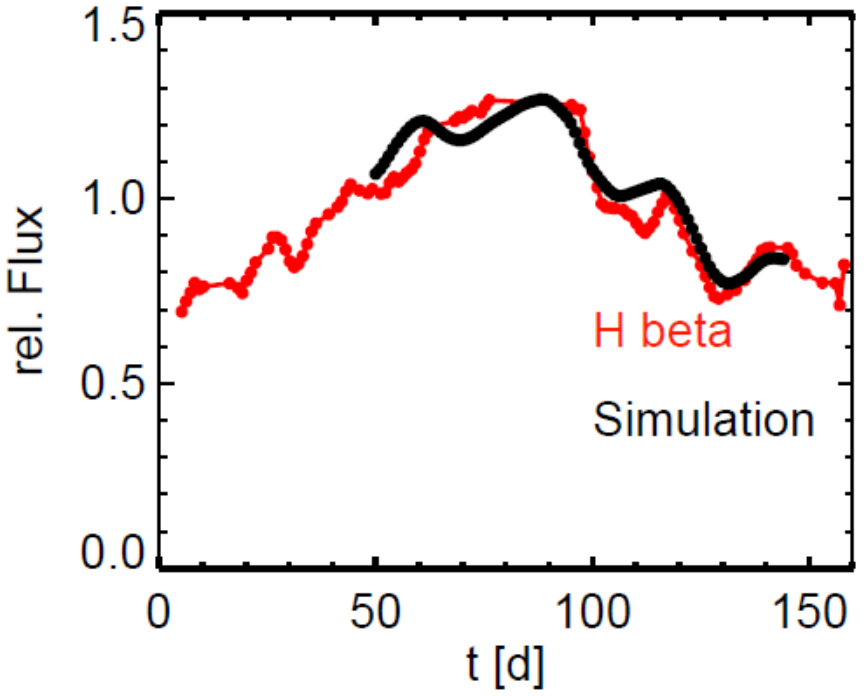
Measured lightcurves



Best spherical model



Best disk model, i = *10°*



- Pronounced variability pattern
- Model echo of continuum
  - Sphere : echo too smooth
  - Disk-like : best fit, i=(10 +/- 5)°

Summary and Outlook

- Photometric Reverberation Mapping:
  - BLR size and AGN luminosity
  - Very efficient with small telescopes

- Effect of incomplete line-coverage by the narrow-band:
  - Symmetric: Lag bias <2%
  - Asymmetric: Lag bias <1%

- BLR of 3C 120:

  Evidence for disk-like BLR

- Outlook:

  Tighten the R – L relationship