The central engine of Active Galactic Nuclei: an observational (*and personal*) perspective

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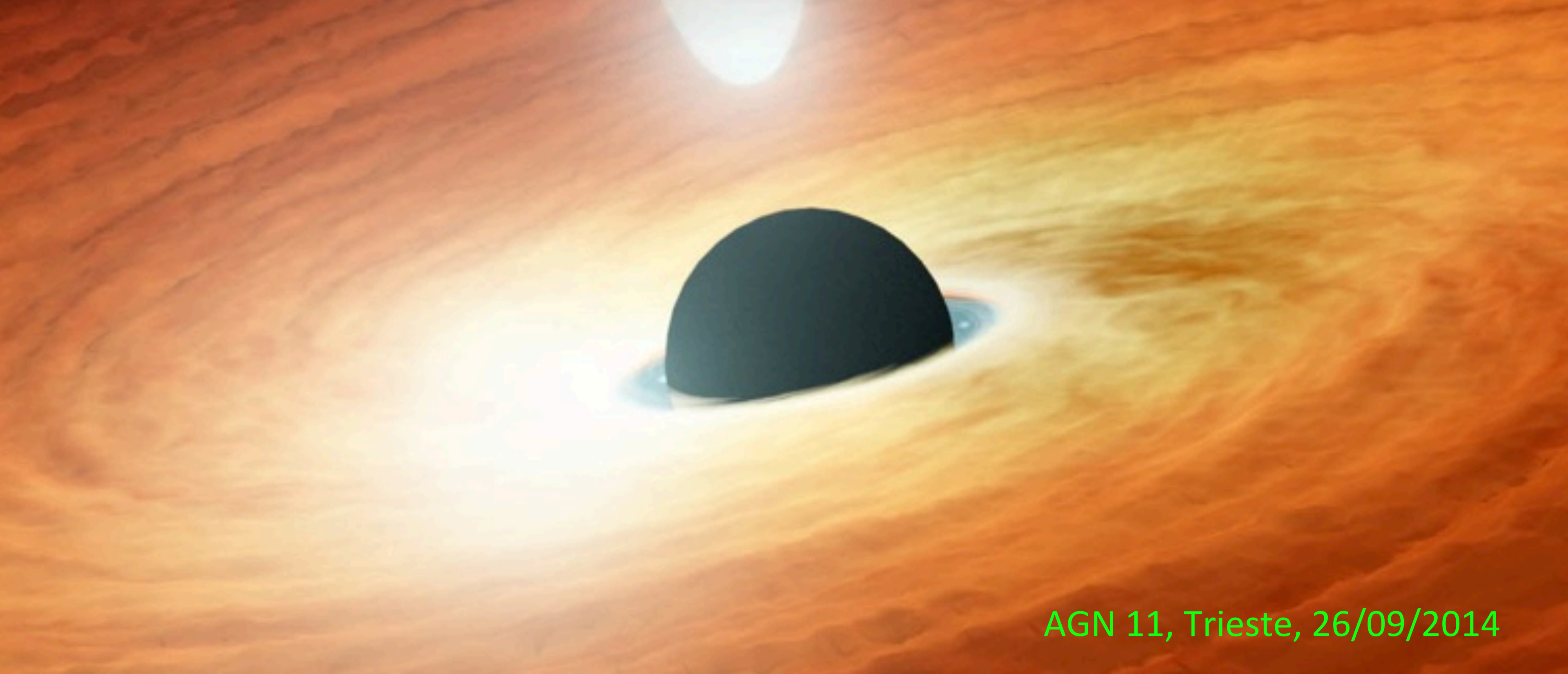


AGN 11, Trieste, 26/09/2014

OUTLINE

- **1. Accretion Disk:**

Direct observational evidence of SS-like accretion disks?

- **2. Black hole: mass and spin**

New perspectives of reverberation mapping

Spin measurements from X-ray spectroscopy

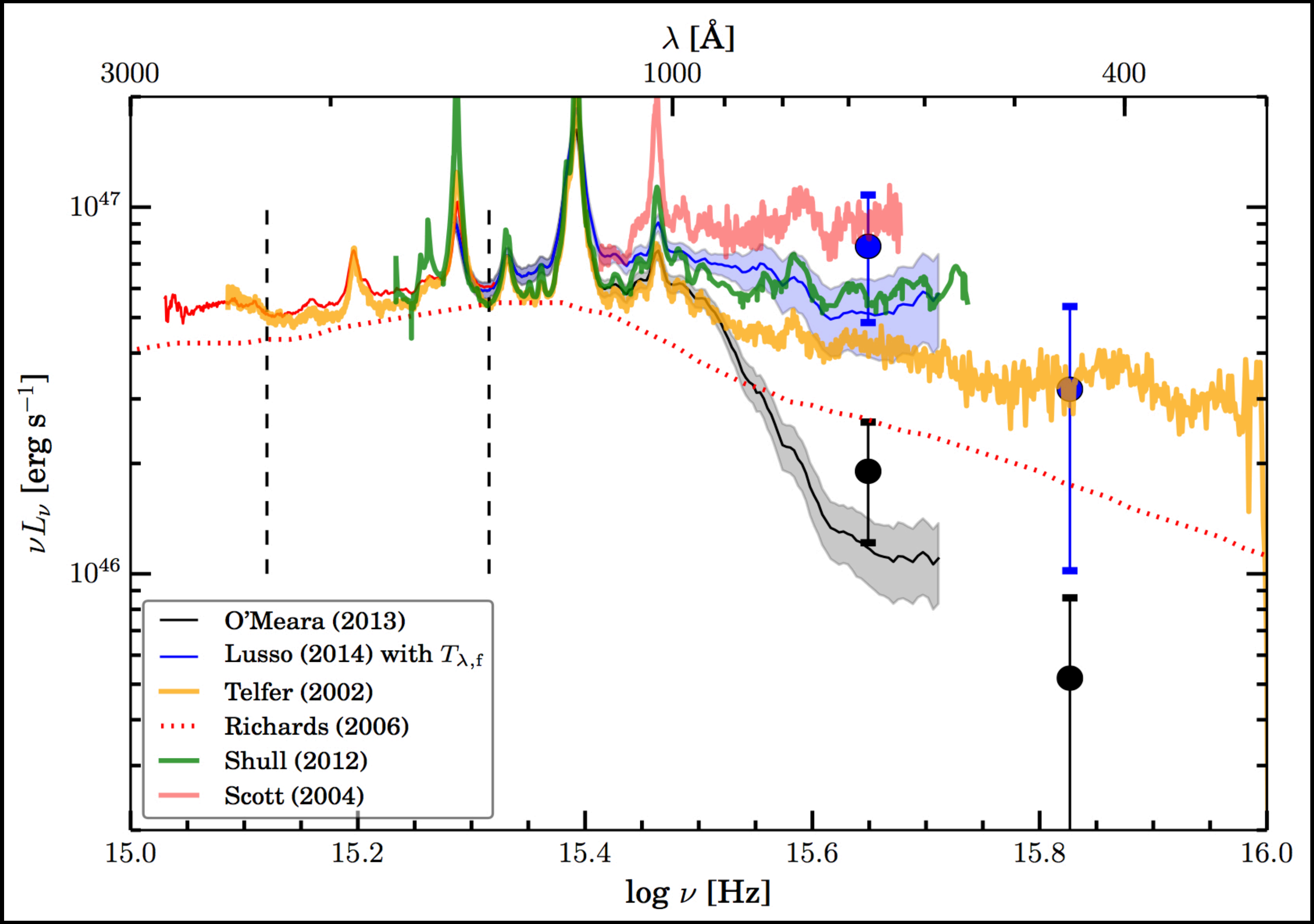
- **3. X-ray emission:**

constraining the physical properties of the X-ray source

- **4. X-ray/UV relation**

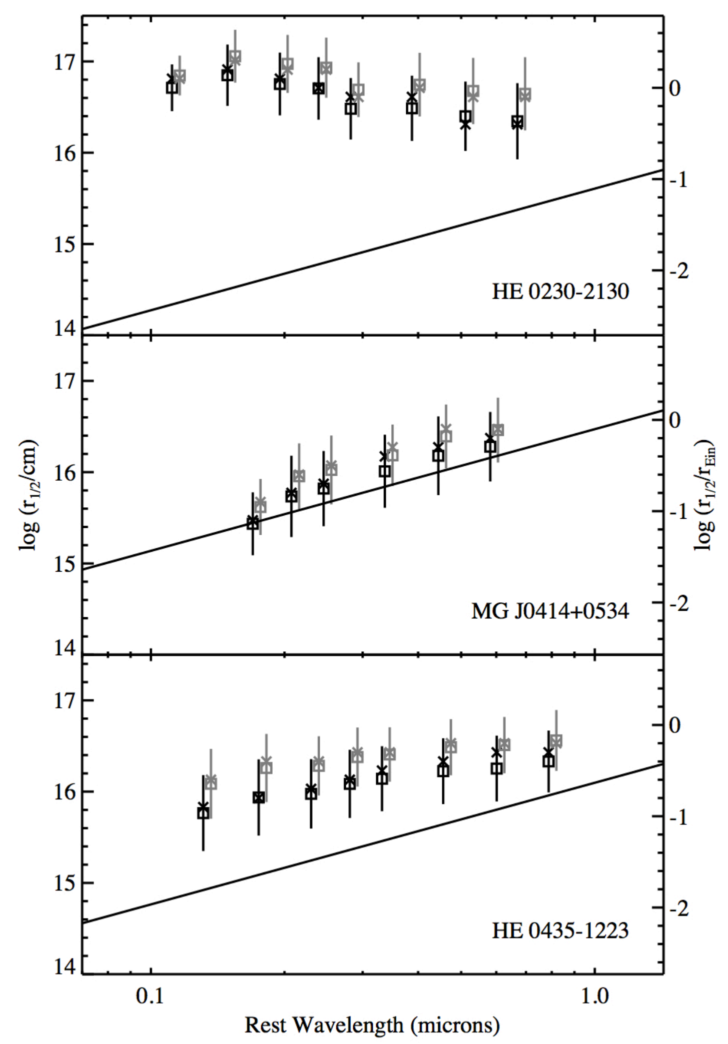
dependence on luminosity, X-ray weak objects

Accretion disks: WEAK observational evidence of S-S disks



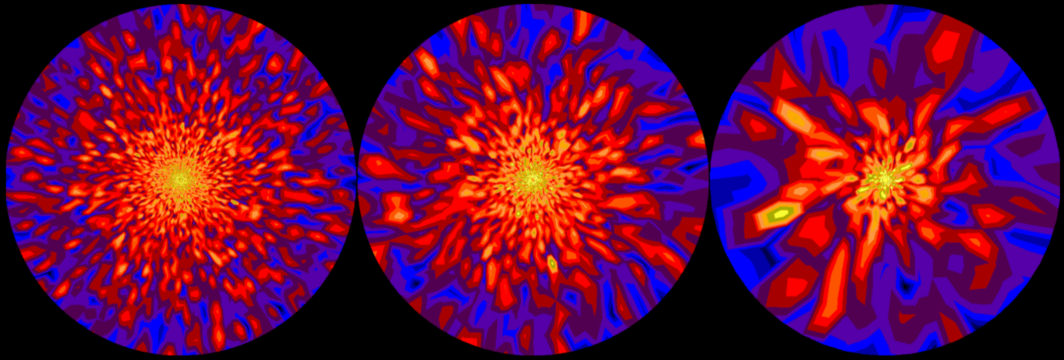
Lusso et al. 2014, subm.

Accretion disks: WEAK observational evidence of S-S disks



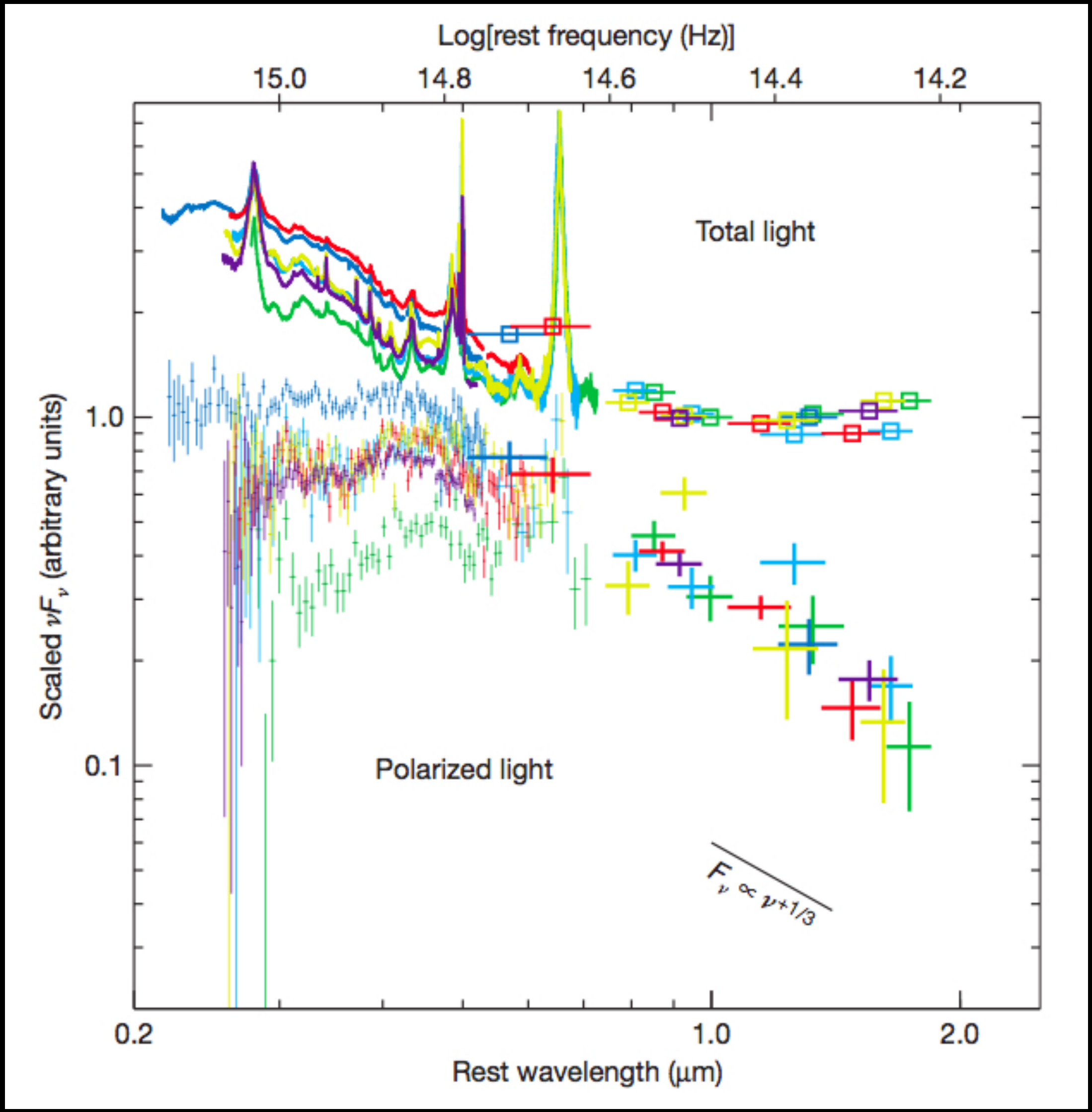
Results from microlensing:
Accretion disk systematically larger than expected by a factor ~4-10.
(Blackburne et al. 2011, Dai et al. 2010…)

Variability due to local temperature fluctuations



Dexter & Agol 2011

Accretion disks: WEAK observational evidence of S-S disks

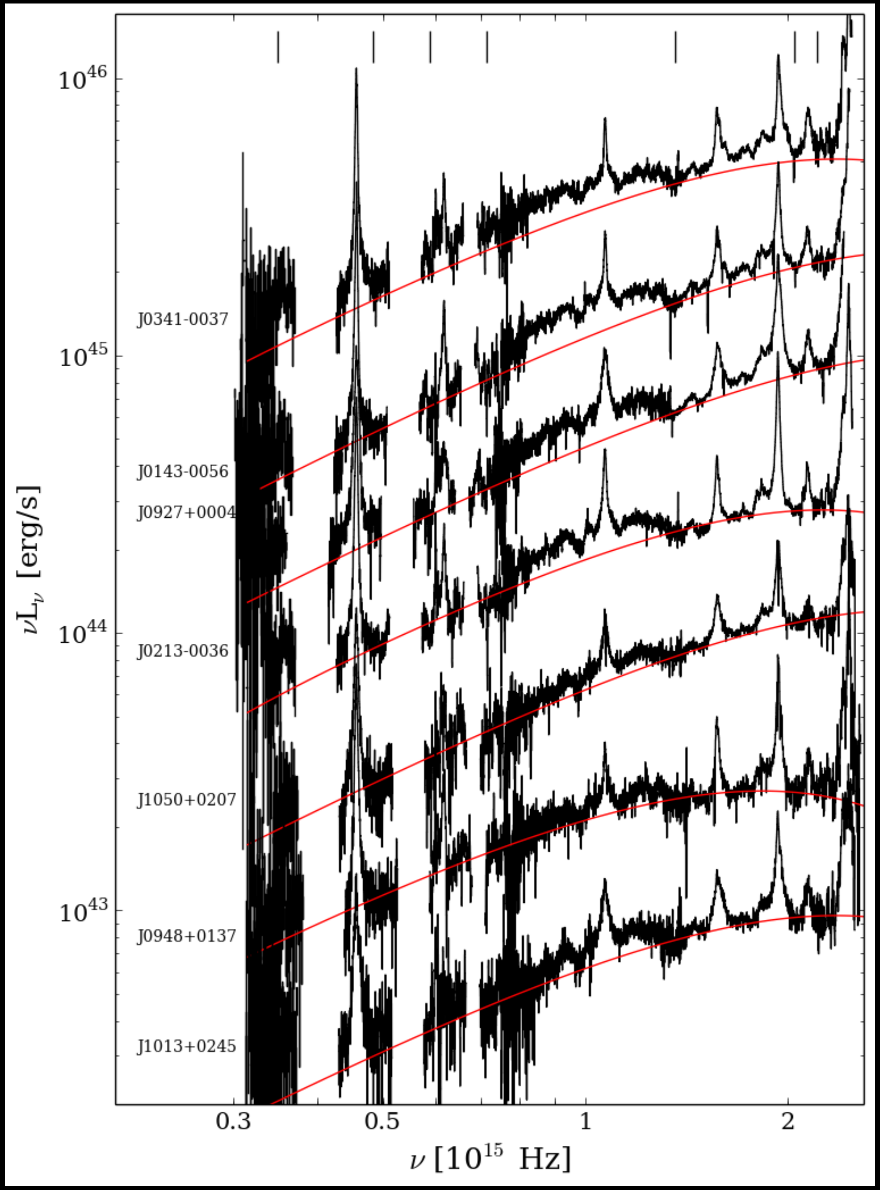


kishimoto et al. 2008

Expected signatures of a standard thin disks ($F_\nu \sim \nu^{-1/3}$) usually not seen in quasar spectra

BUT: in some cases observed in polarized light

Accretion disks: WEAK observational evidence of S-S disks



Recently:

Wide band X-shooter spectra: good fit with thin disk models

(Courtesy of H. Netzer, Capellupo et al. 2014, subm.)

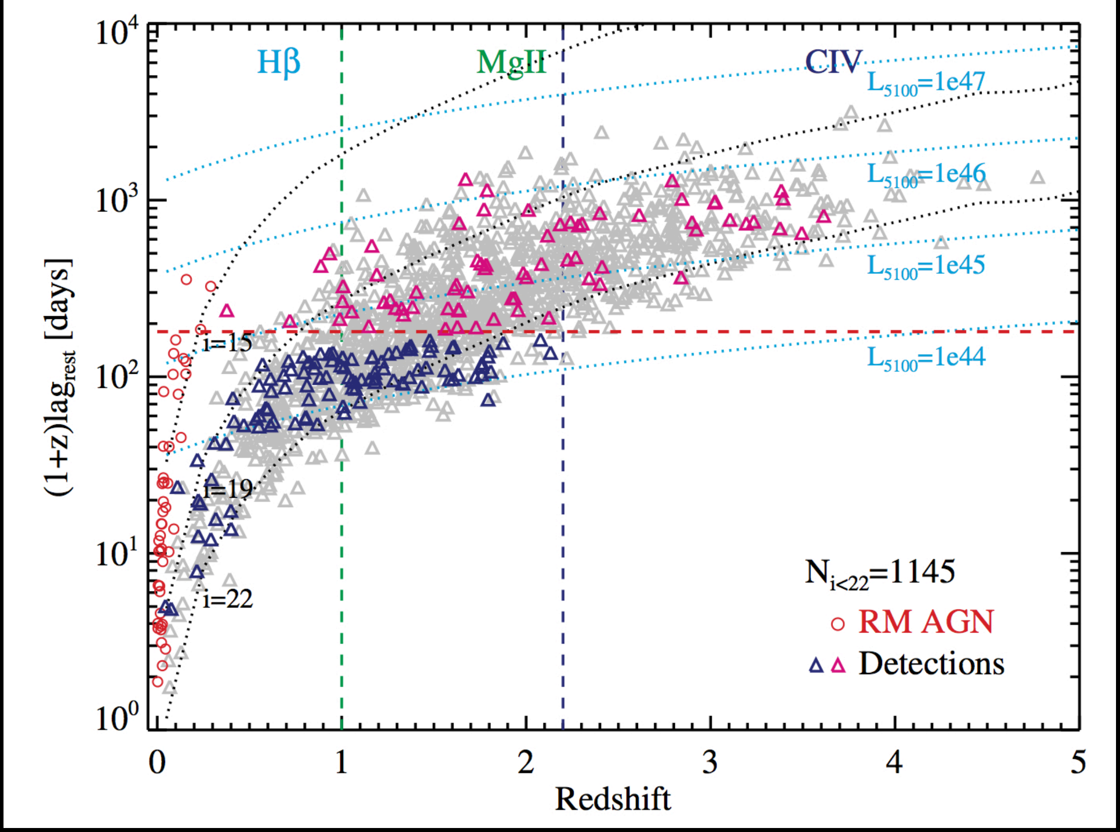
(Active) Black holes: MASS

Reverberation mapping:

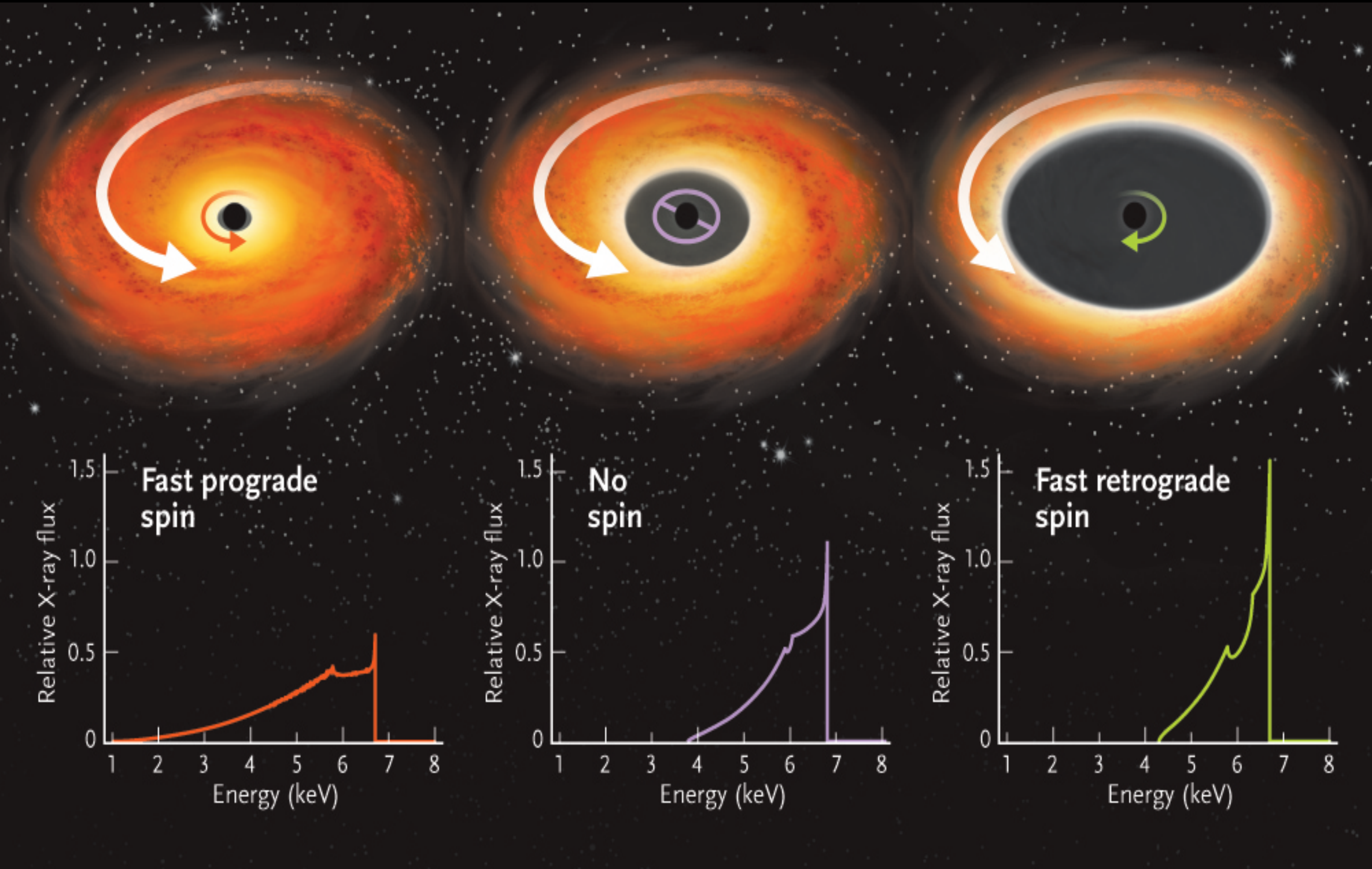
- "Standard" approach: intensive monitoring with small telescopes of ~50 local, bright sources: complete velocity – resolved results → detailed models of BLR structure

- New approach: multi-object spectroscopy of fainter objects (higher surface density) with bigger telescopes

(Shen et al. 2014)

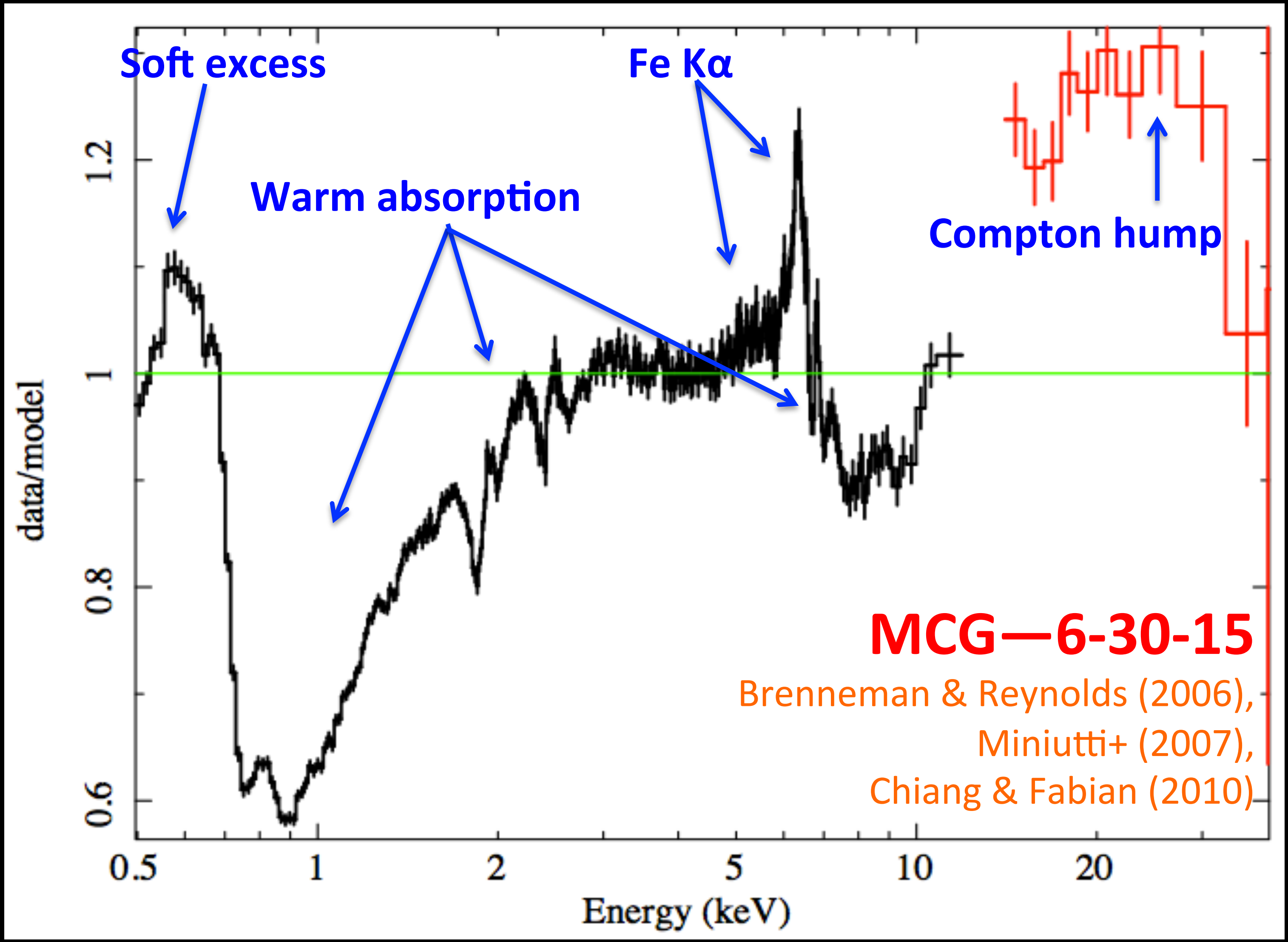


(Active) Black holes: SPIN



(Active) Black holes: SPIN

Caveat: Spectral Complexity

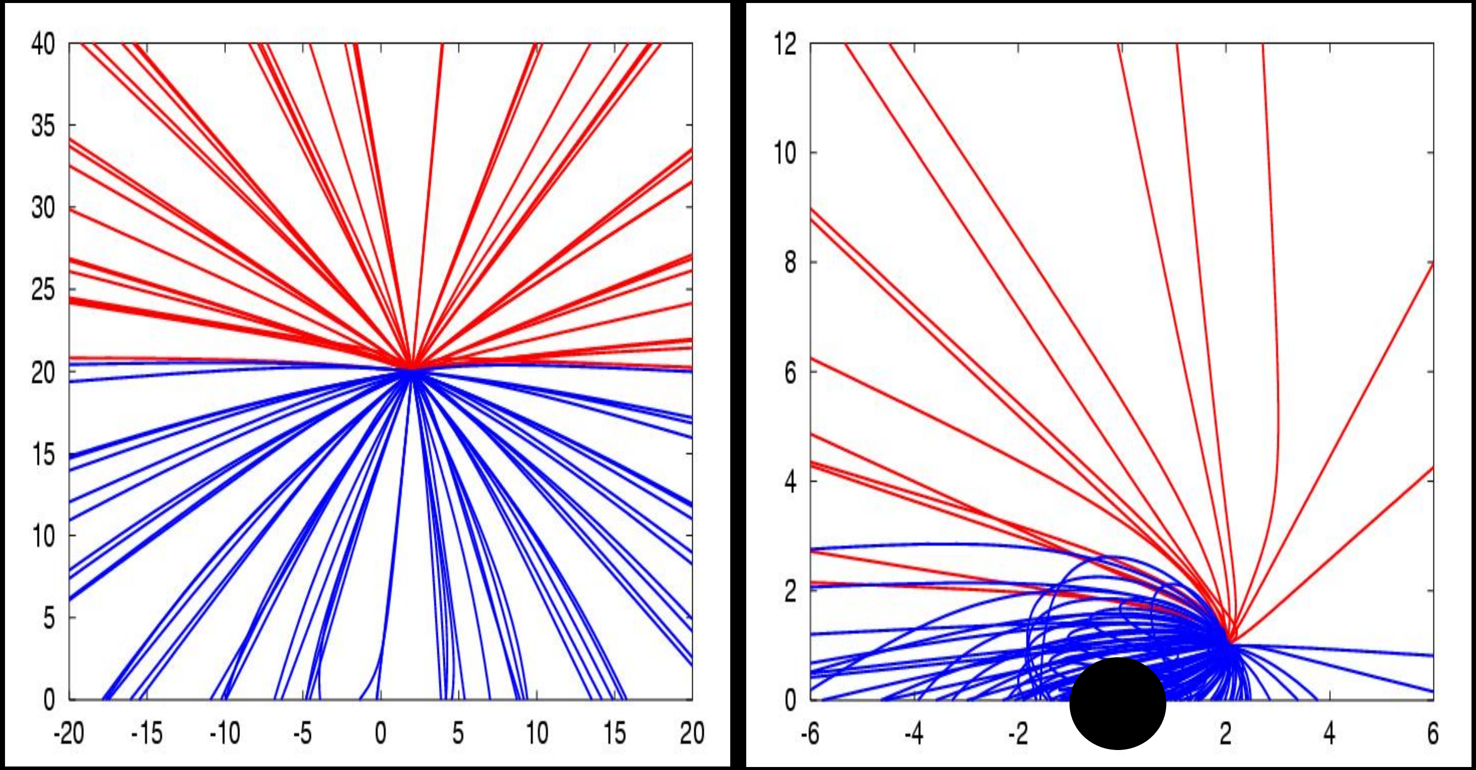


Major issues: how to model soft excess, separate absorption and reflection components?

(Active) Black holes: SPIN

Extension to high energies crucial for two reasons:

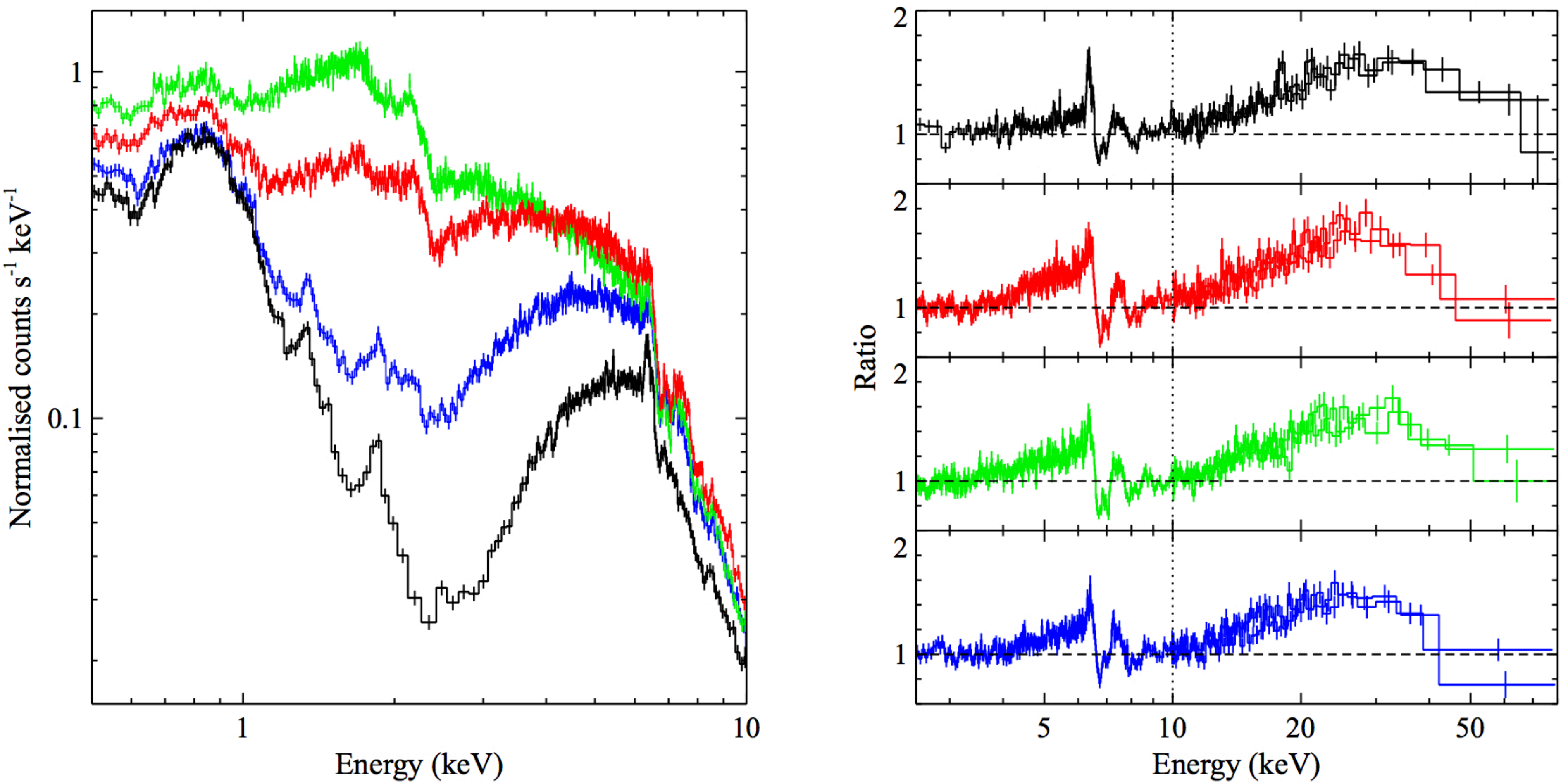
1) Unambiguous determination of the continuum level
2) Detection of hard X-ray excess due to beamed reflection



Miniutti & Fabian 2004, Fabian 2012, Dauser et al. 2014

(Active) Black holes: SPIN

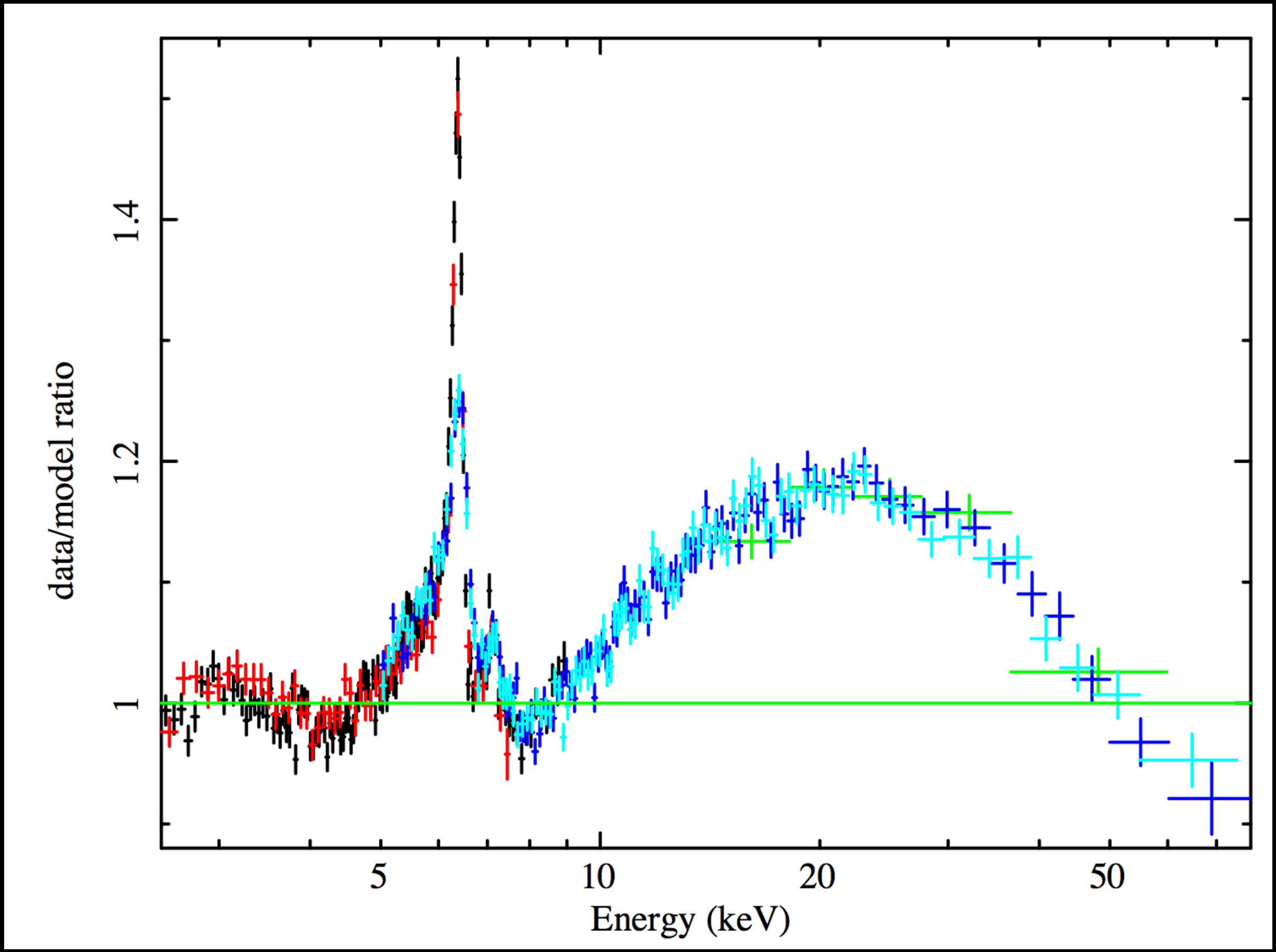
NGC 1365



Walton et al., 2014

(Active) Black holes: SPIN

NGC 4151



Keck et al. 2014, in prep.

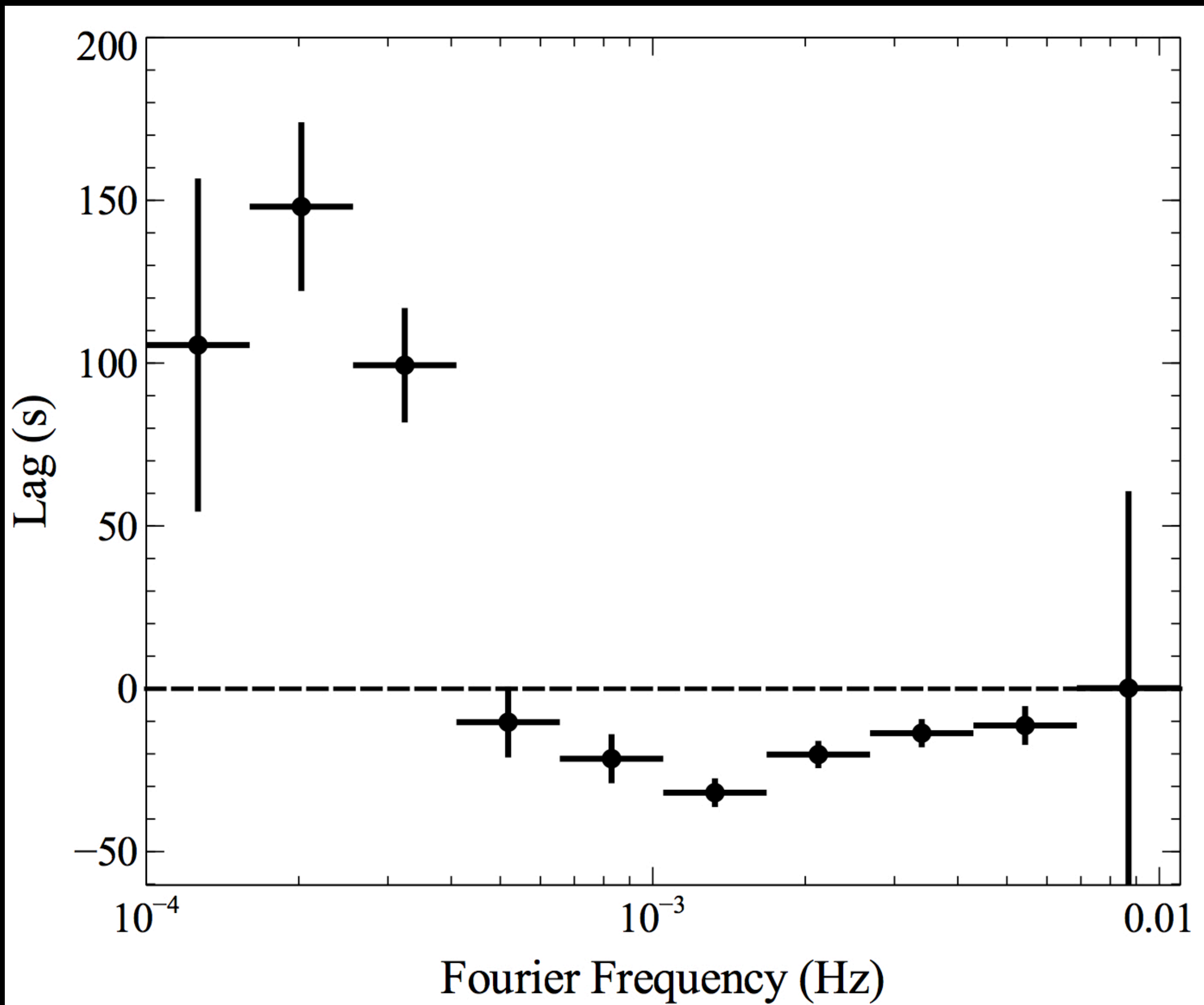
(Active) Black holes: SPIN

My conclusion: spin measurements are robust in a few cases, where a very high reflection component implies nearly maximally rotating black holes.

All other cases still ambiguous

(Active) Black holes: SPIN

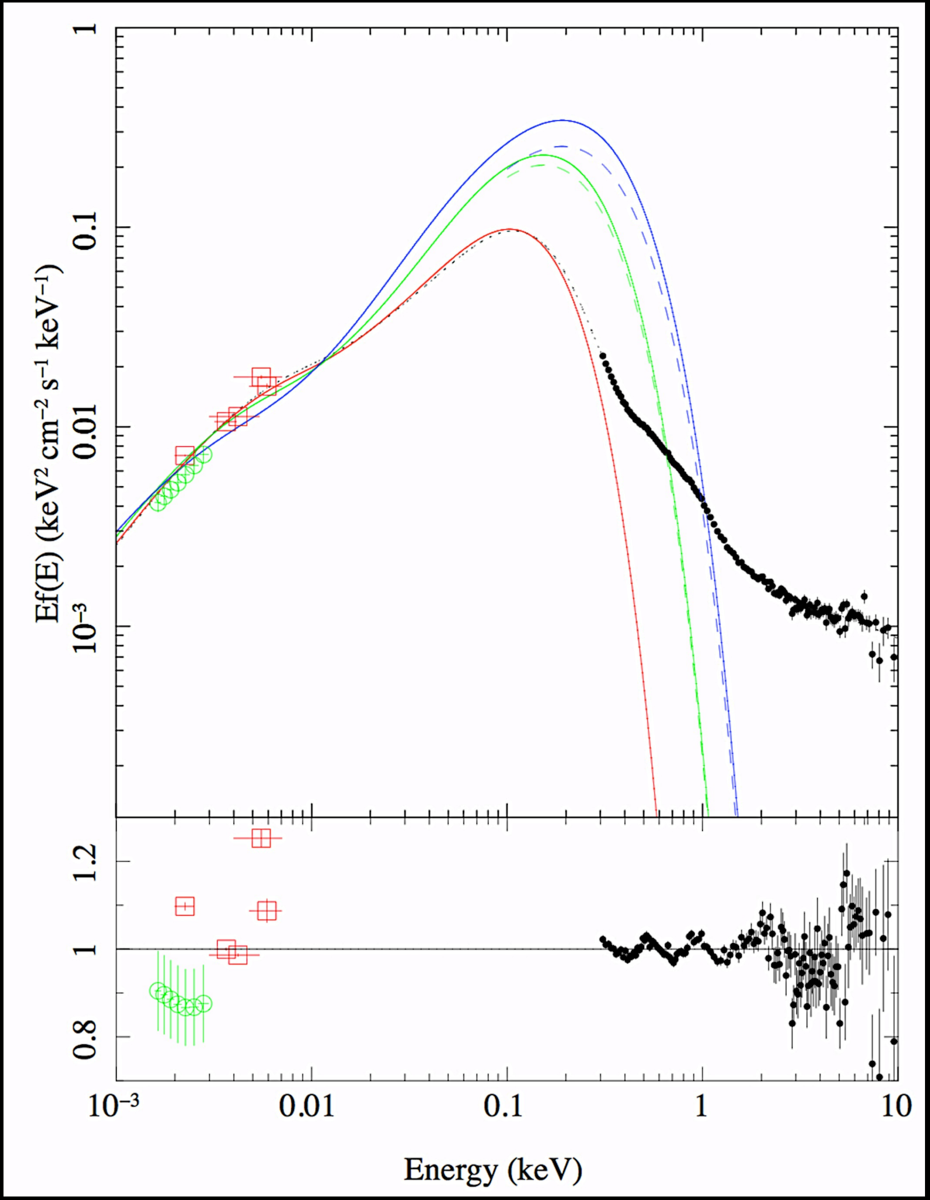
Other methods: TIME LAGS



Kara et al. 2013

(Active) Black holes: SPIN

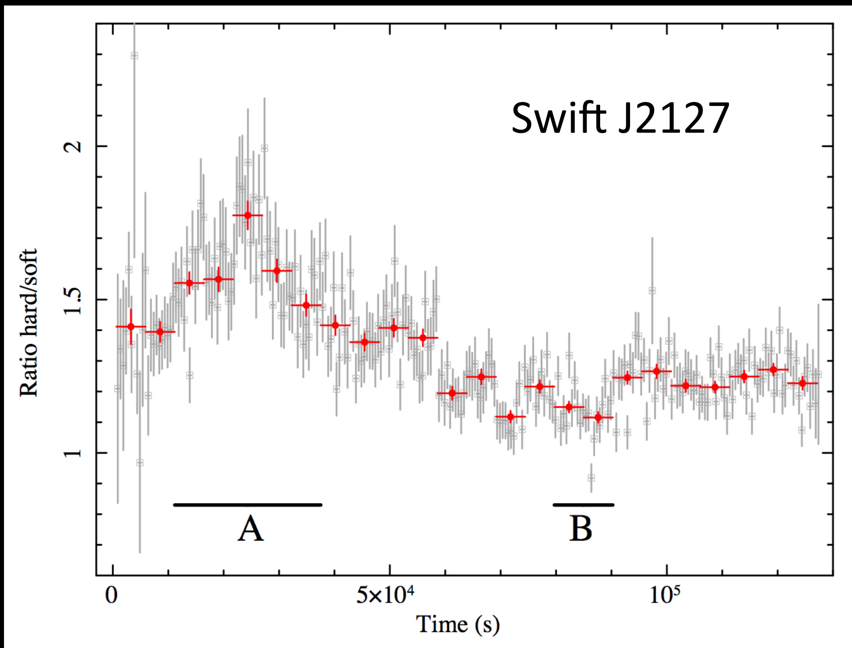
Other methods: tail of disk emission in high L_{EDD}, low mass objects



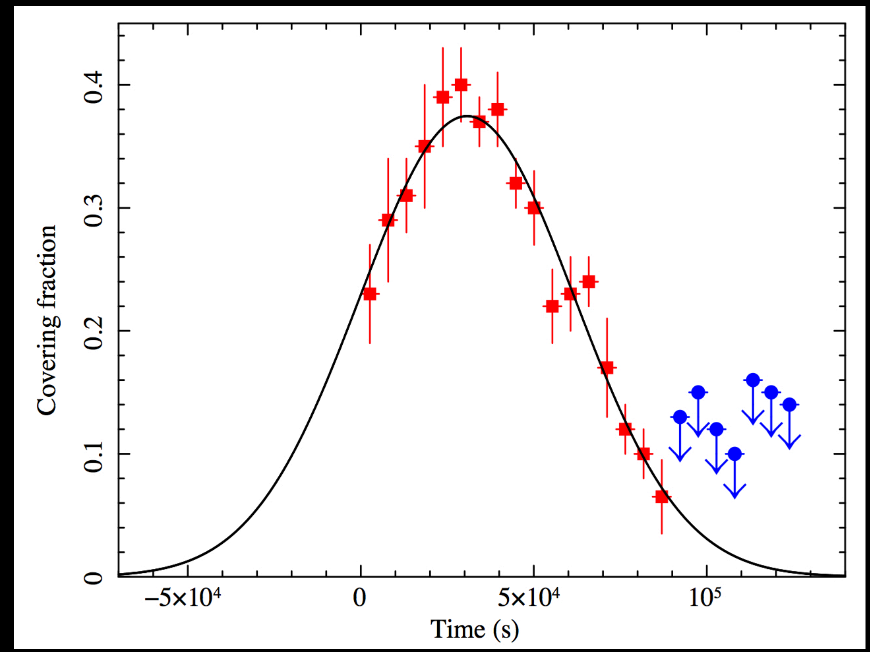
Done et al. 2013

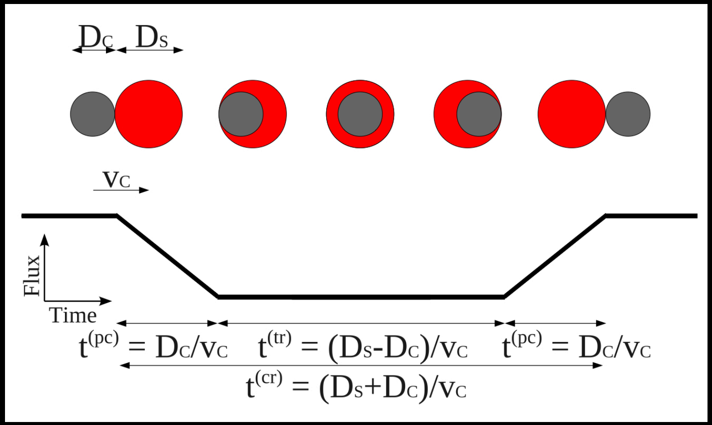
The X-ray source: size and physical properties

Size: a few R_G, from microlensing and X-ray occultations



→





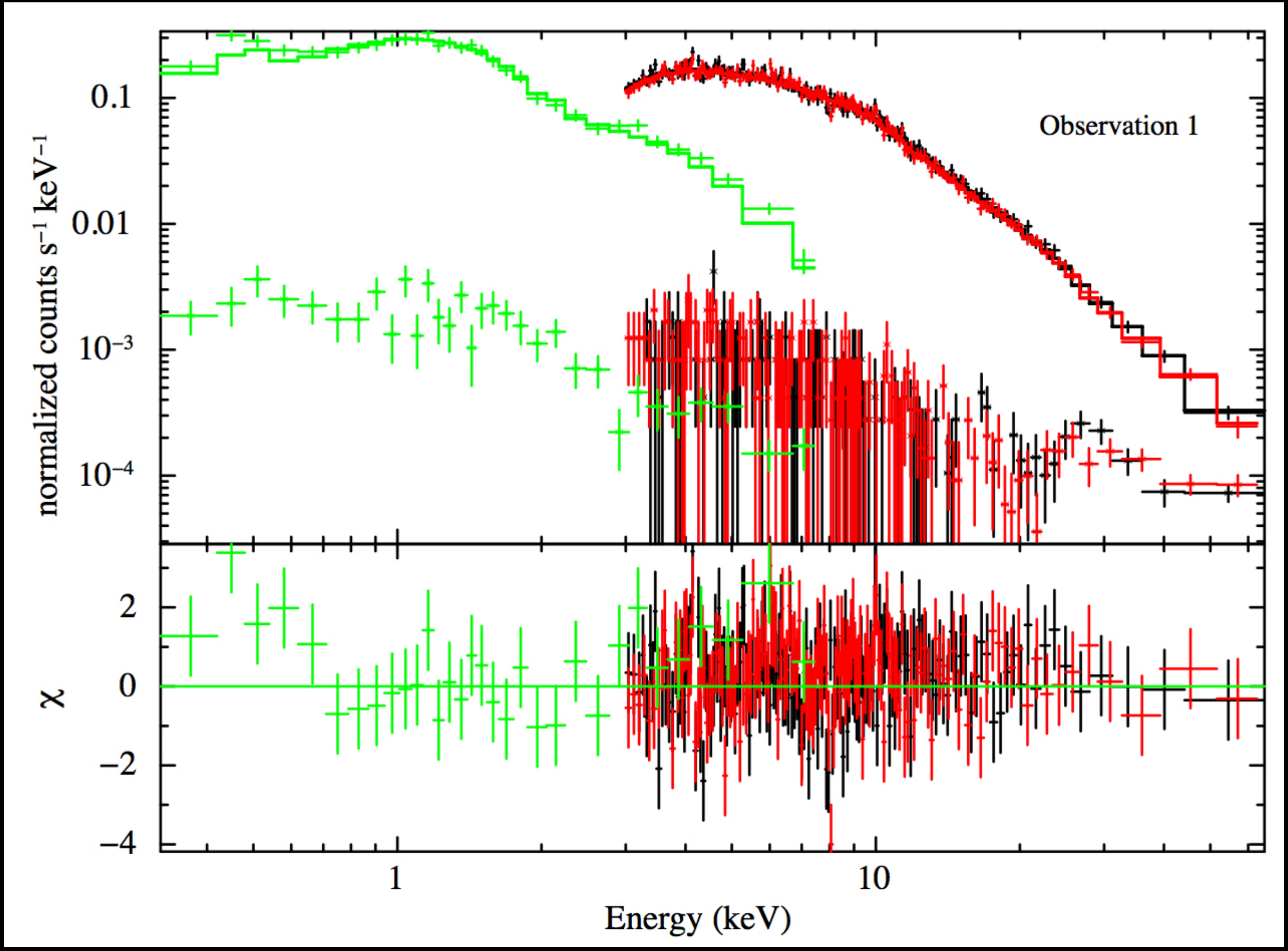
→ Eclipse by a BLR cloud, size of the X-ray source: < 10 R_G

Sanfrutos et al. 2013

The X-ray source: size and physical properties

Coronal properties: temperature

3C 382



(Ballantyne et al. 2014)

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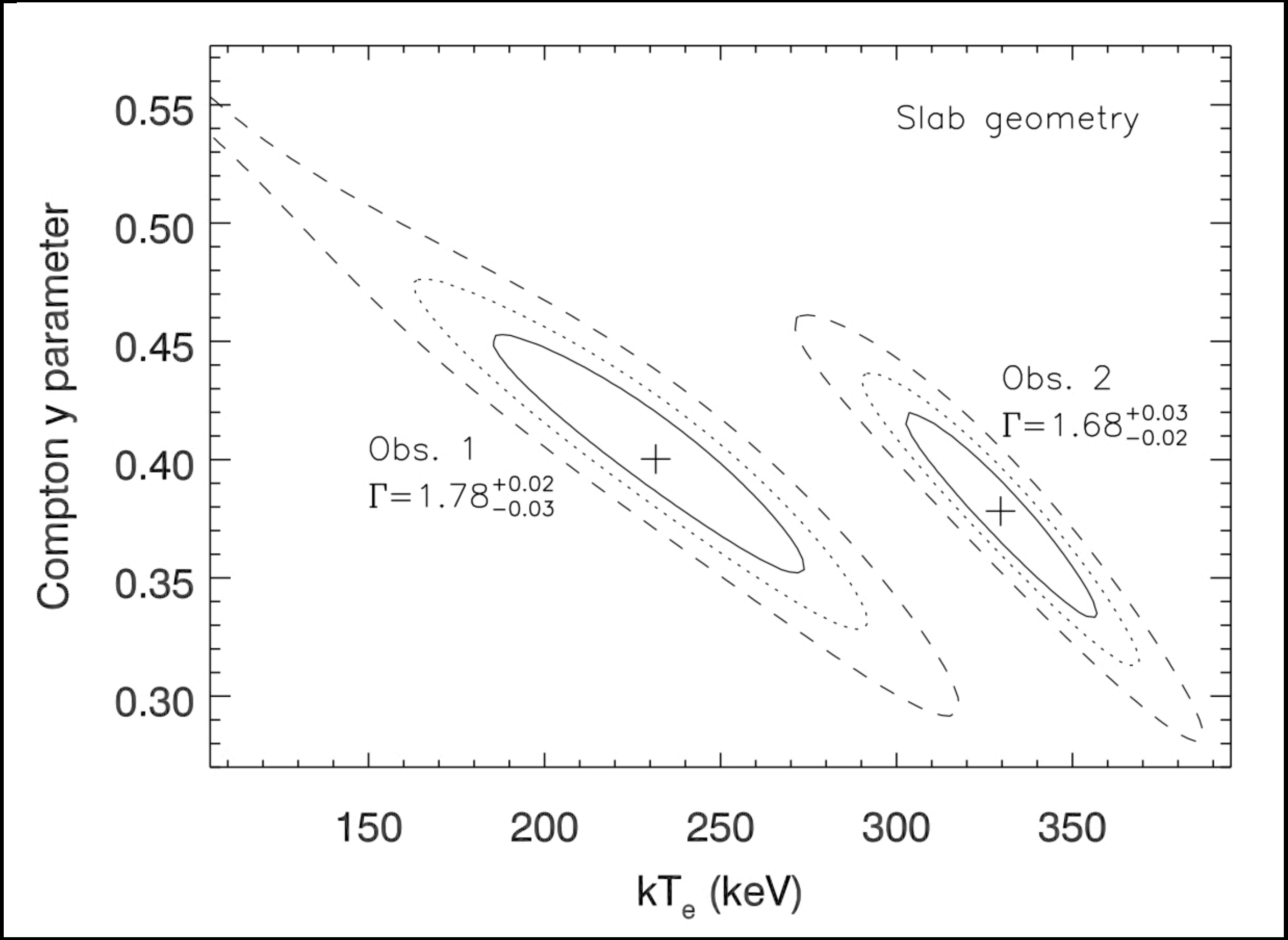
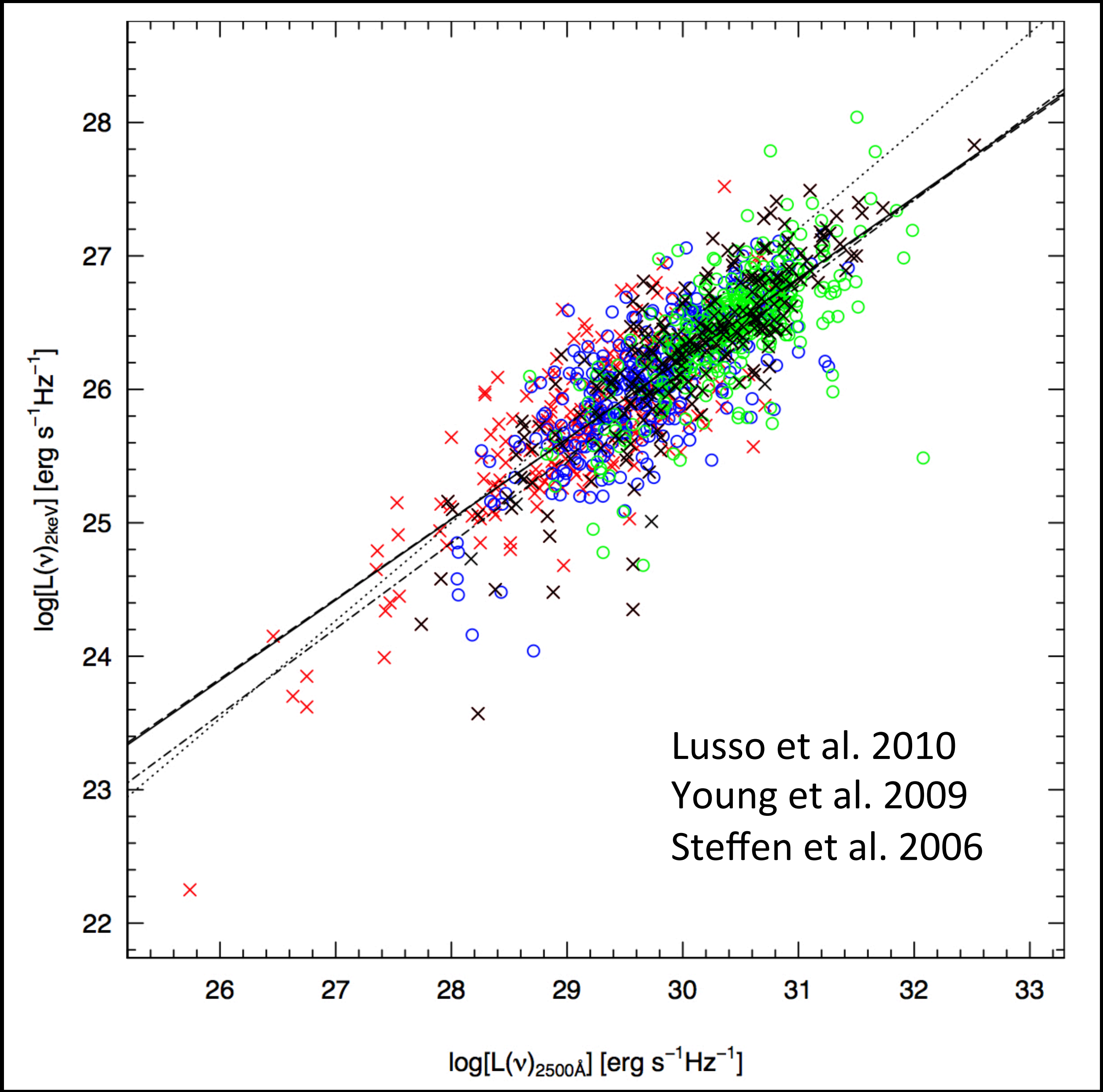


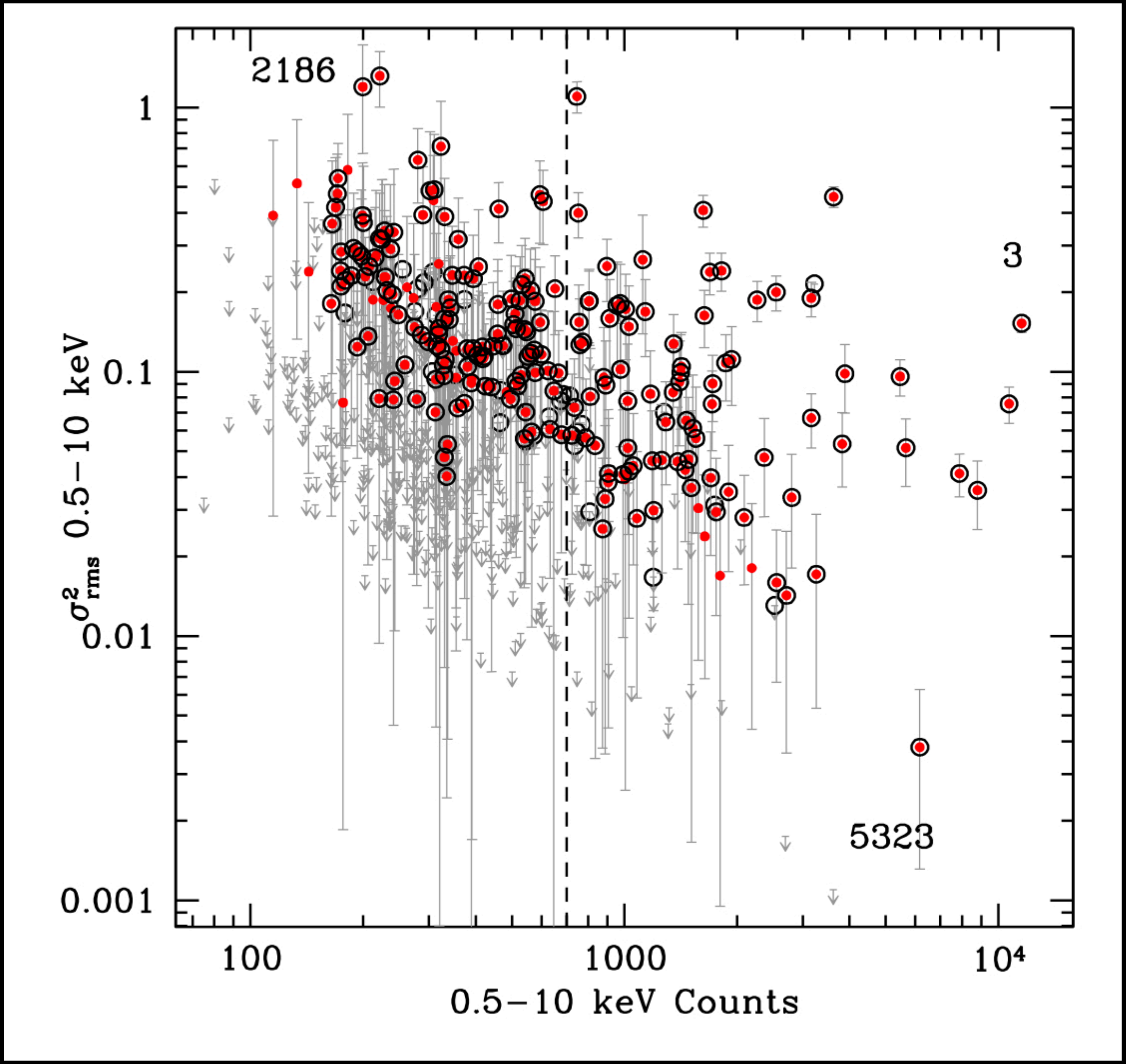
(Ballantyne et al. 2014)

The relation between X-ray and UV emission



The relation between X-ray and UV emission

Effects of variability



X-ray variability of COSMOS quasars

Lanzuisi et al. 2014

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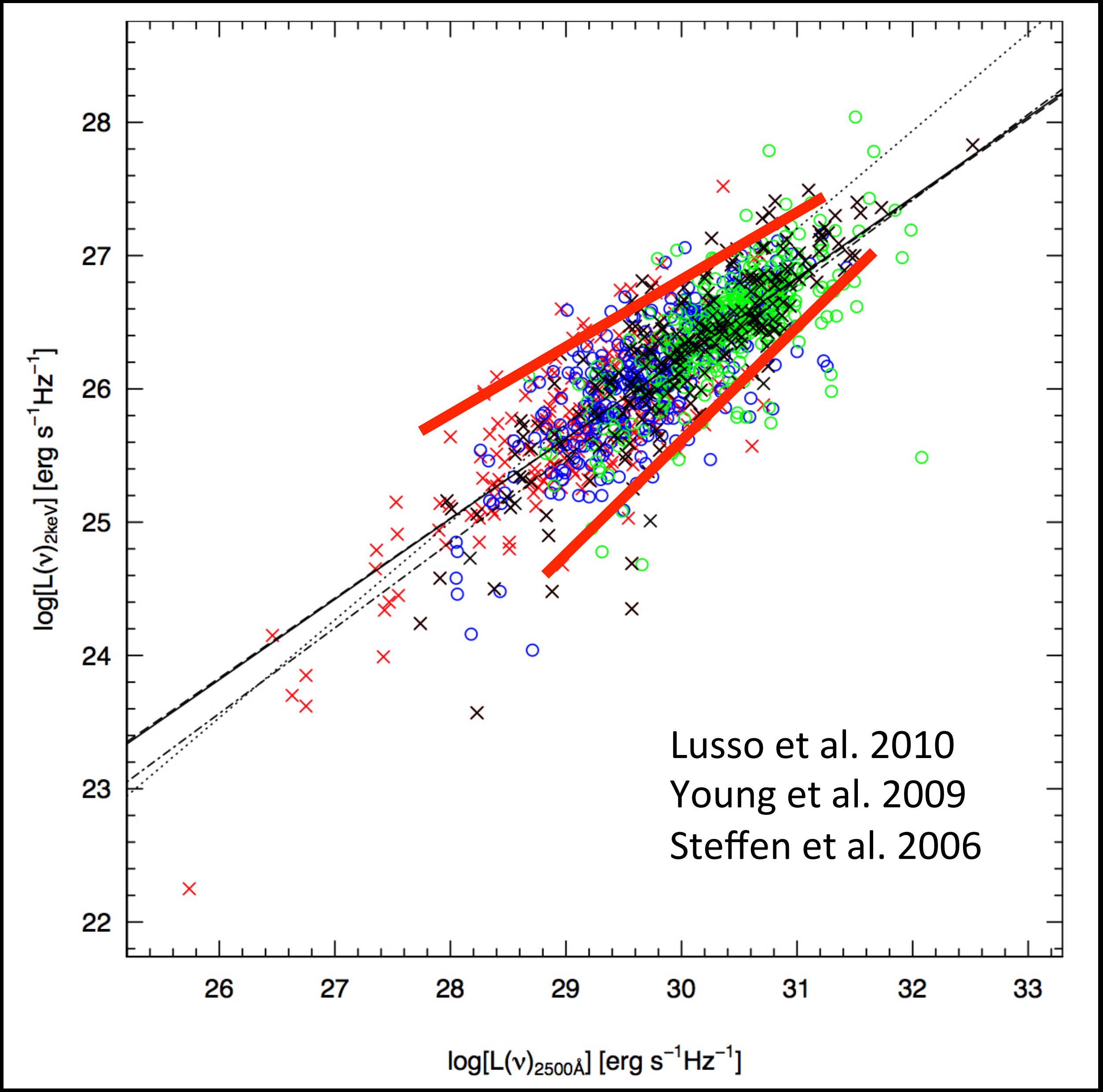

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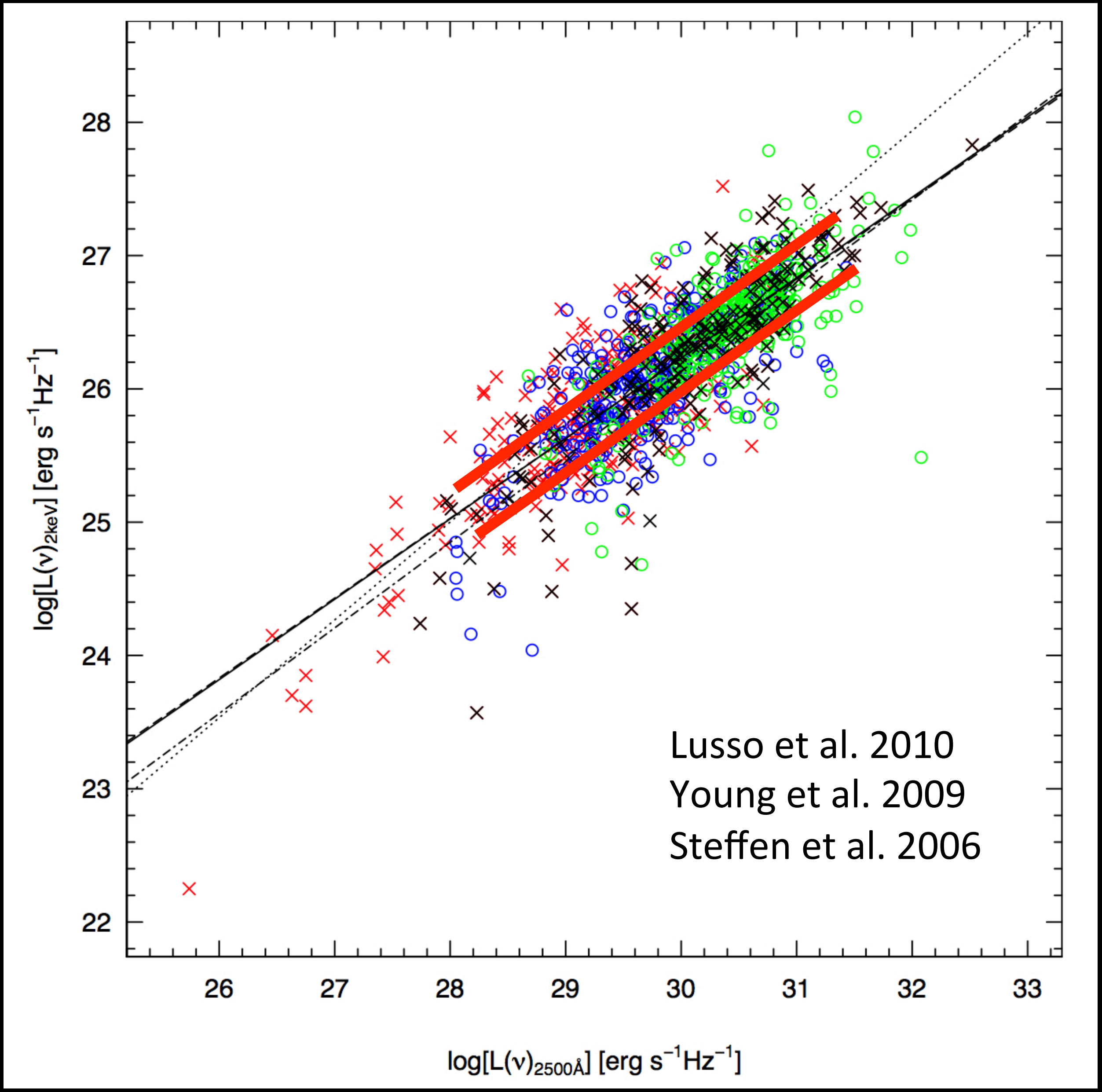

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