

X-ray spectral steepness in AGN: accretion rate is not the whole story

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X-ray steepness (Γ) $\longleftrightarrow$ accretion rate ($\lambda_{\text{Edd}} = L_{\text{bol}}/L_{\text{Edd}}$)

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Are X-ray steep AGN “necessarily” highly accretors?

From theory?

Yes!

(Done+12, Sobolewska+09
Done+17, Madau+24,
Pacucci+24)

From observations?

Strong maybe!

(Shemmer+06, Shemmer+08,
Risaliti+09, Brightman+13,
Trakhtenbrot+17, Laurenti+22)

From observations?

Yes, for small and
well-characterized samples
(Shemmer+06,
Shemmer+08, Risaliti+09,
Brightman+13)

Not so much, for larger
samples, highly accreting
(super-Eddington, SE),
higher redshifts
Trakhtenbrot+17,
Nardini+19, Laurenti+22)

A couple of issues

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Soft excess (SE, steeper Γ +
additional correlation? Chen+25)

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Single epoch (SE) calibration
Bolometric correction

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Non simultaneous

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and high- λ_{Edd} sources! Actually, let's have two!

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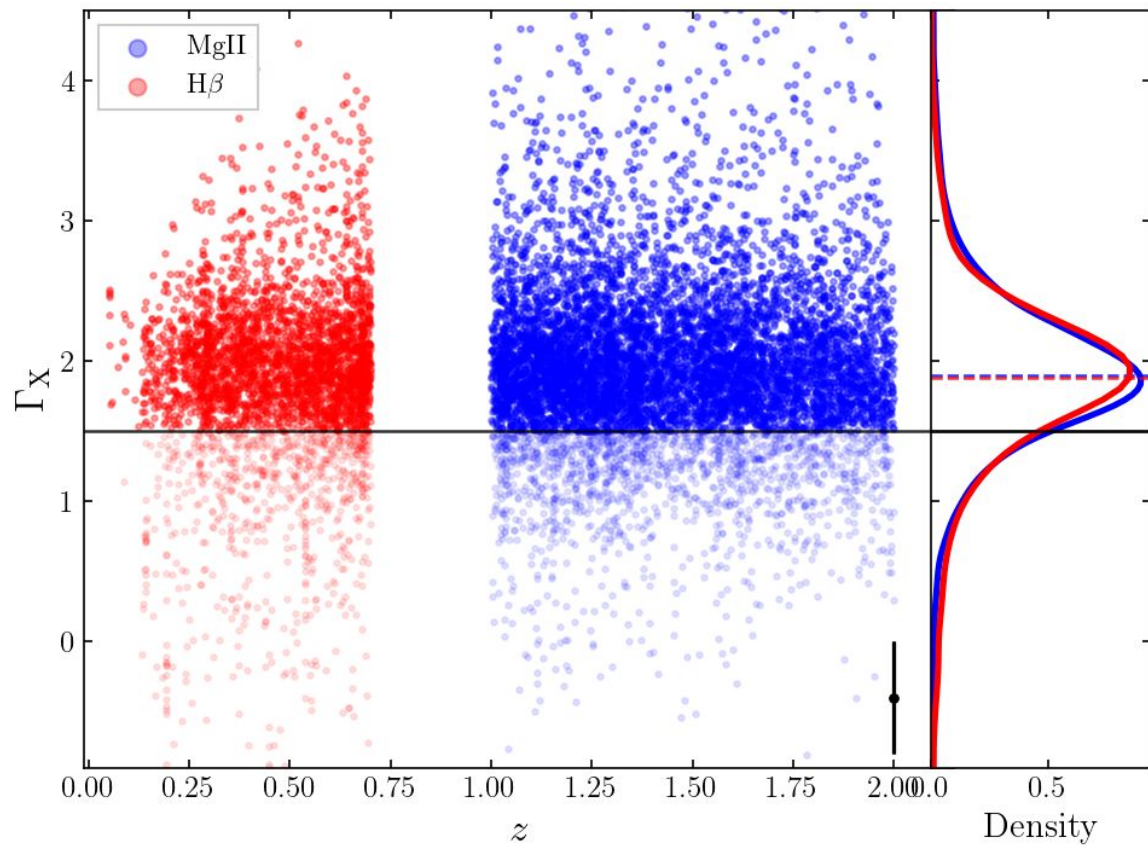
SDSSDR16Q (Lyke+20, Wu&Shen22) X **5XMM** (Webb+26)
41,765

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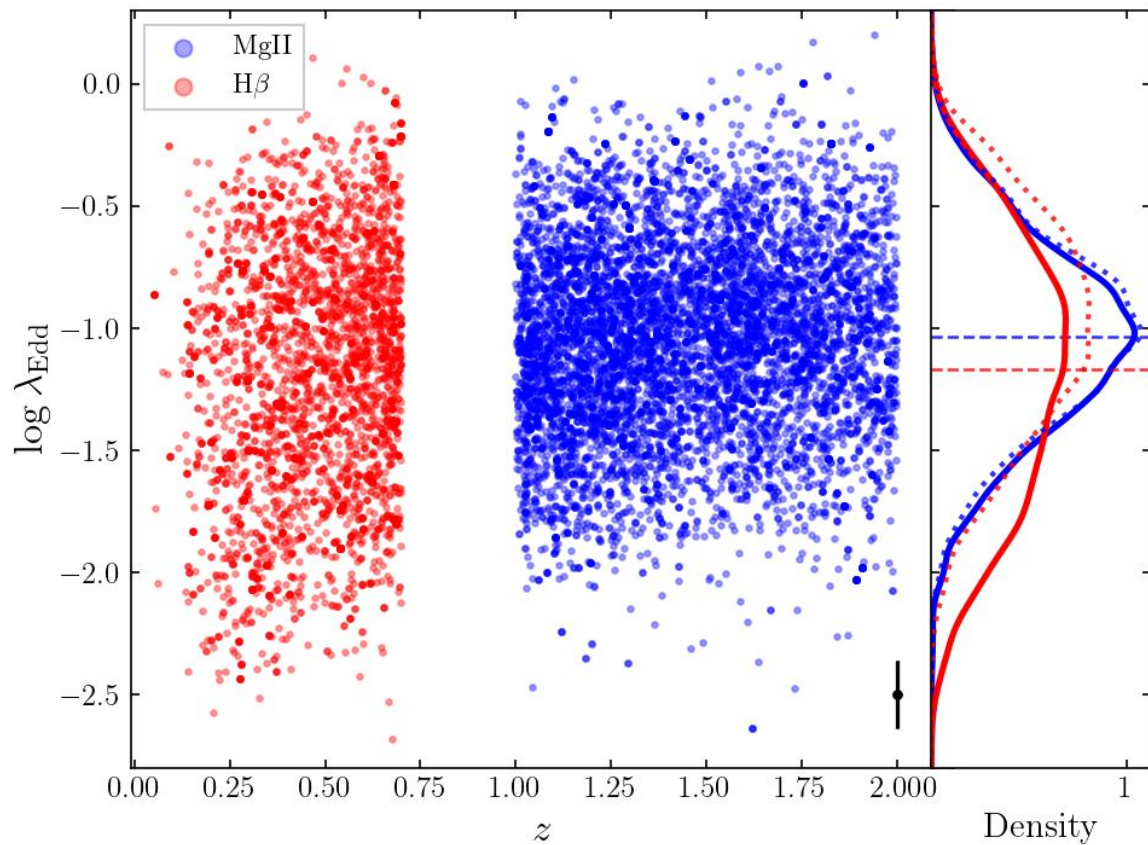
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Basic quality cuts	41,105
Radio quiet, non-BAL	39,068
X-ray S/N	18,284
$\Gamma > 1.5$	14,801
Redshift cut	9,482
Hβ BH masses	2,695
Mg II BH masses	6,787

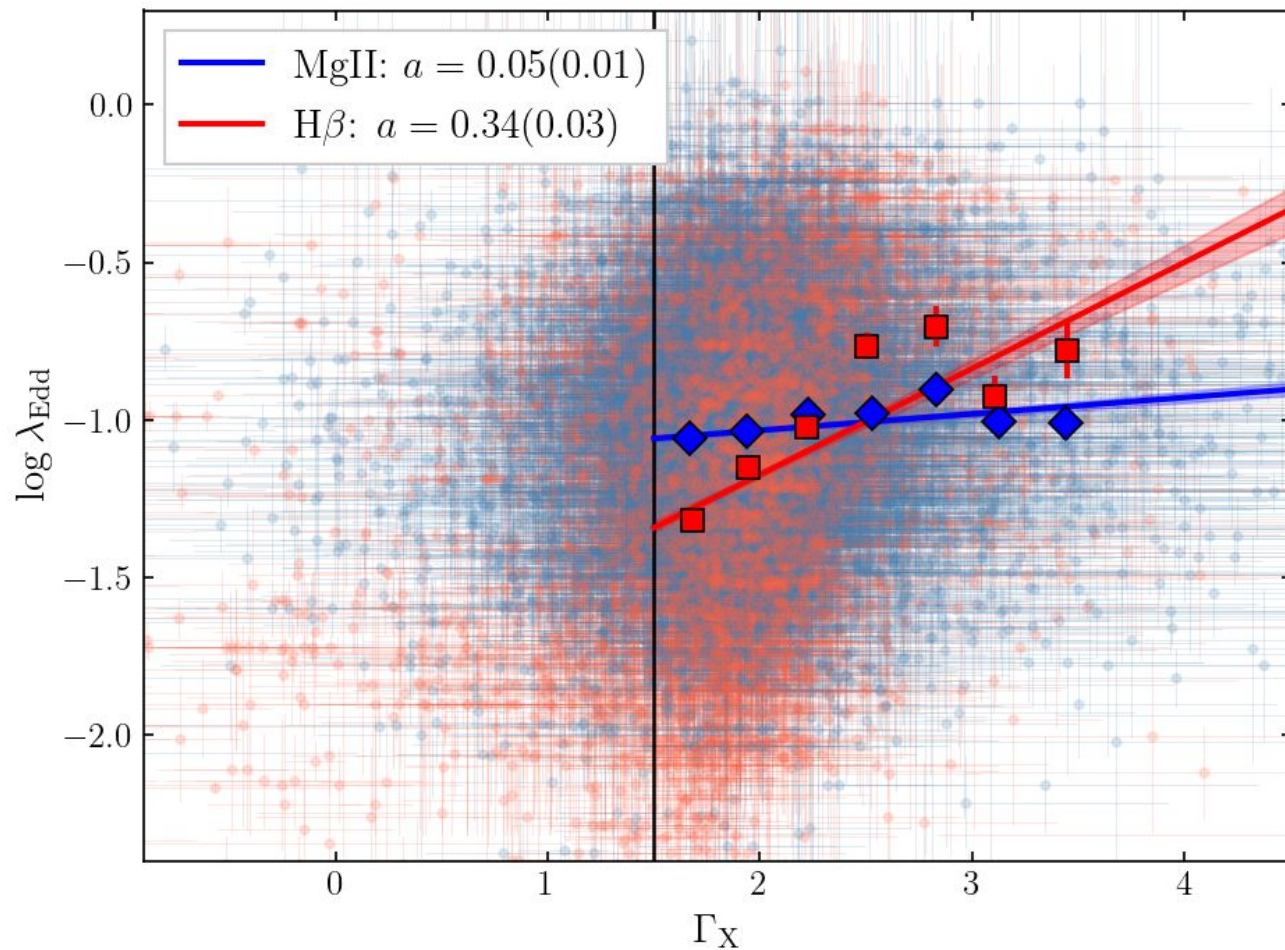
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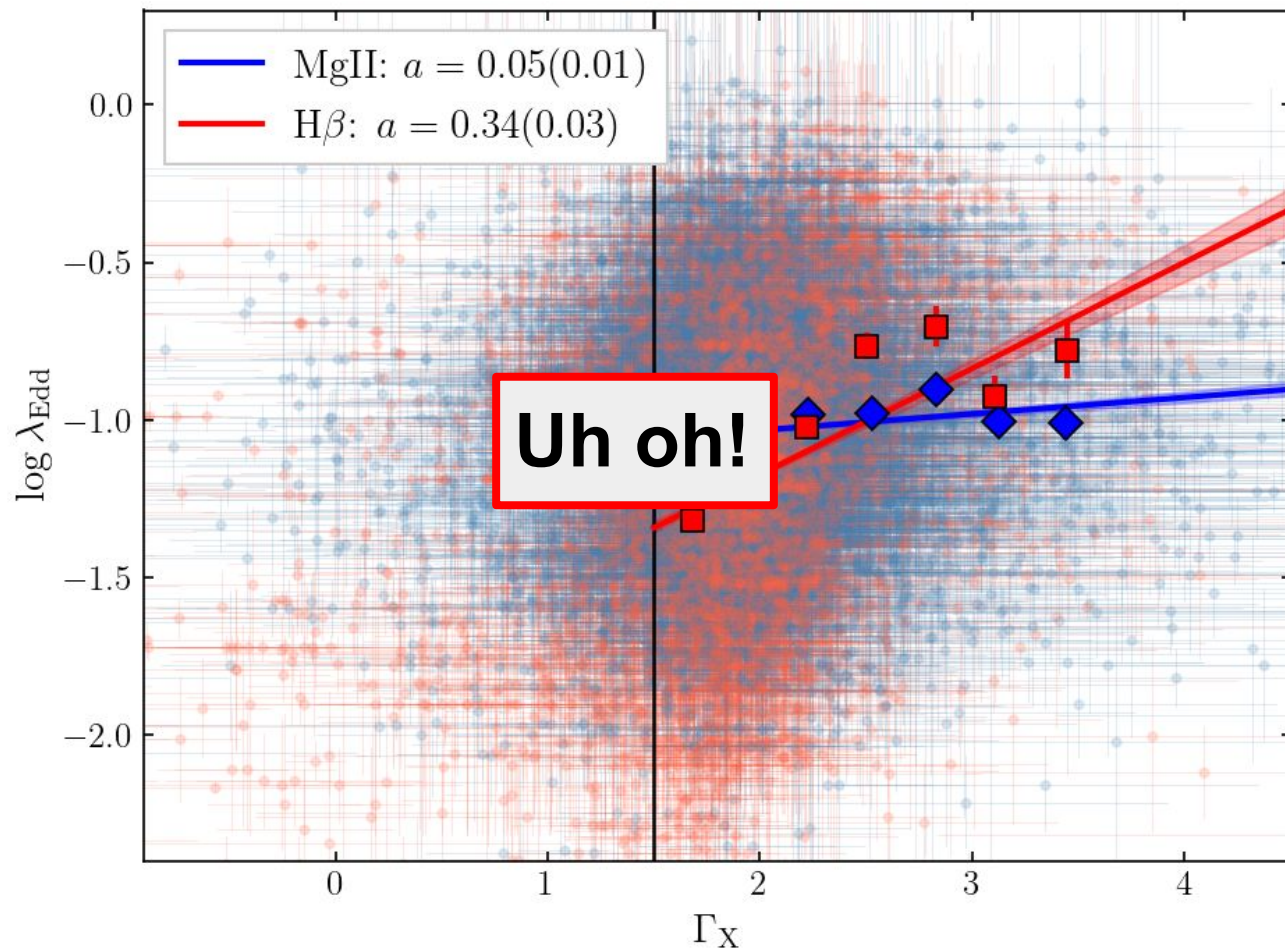
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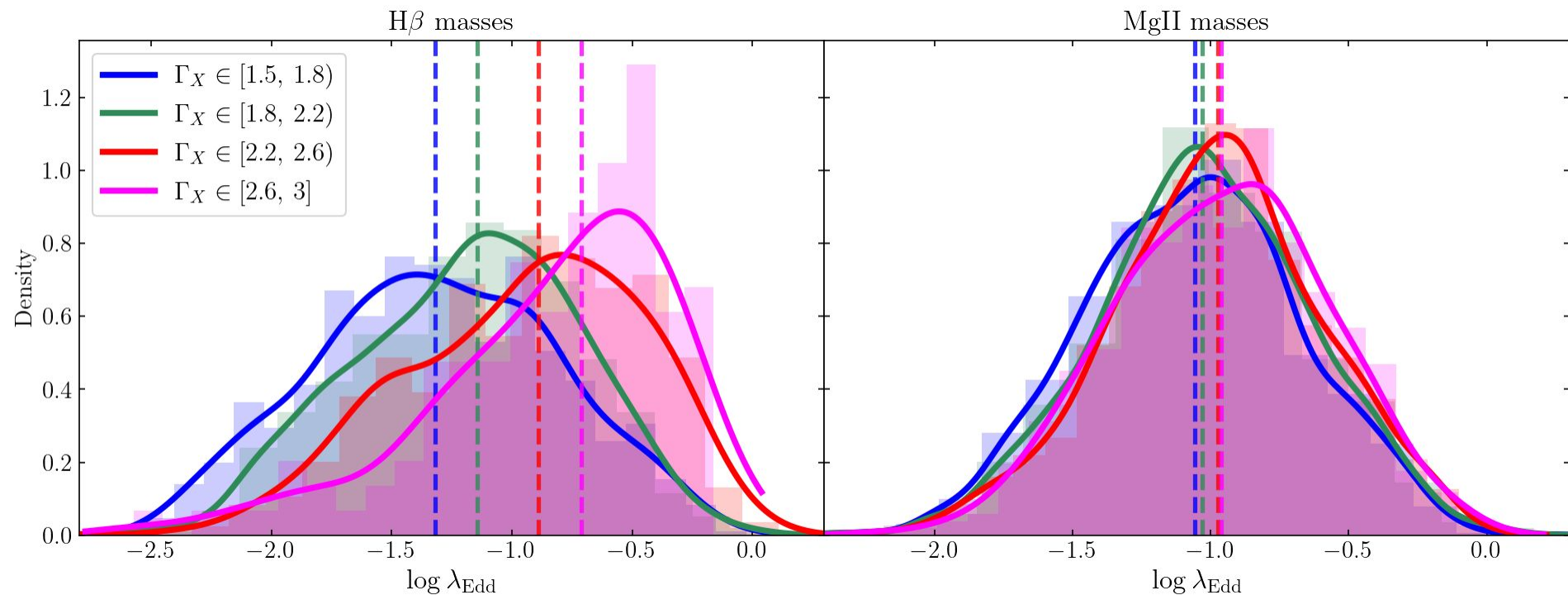
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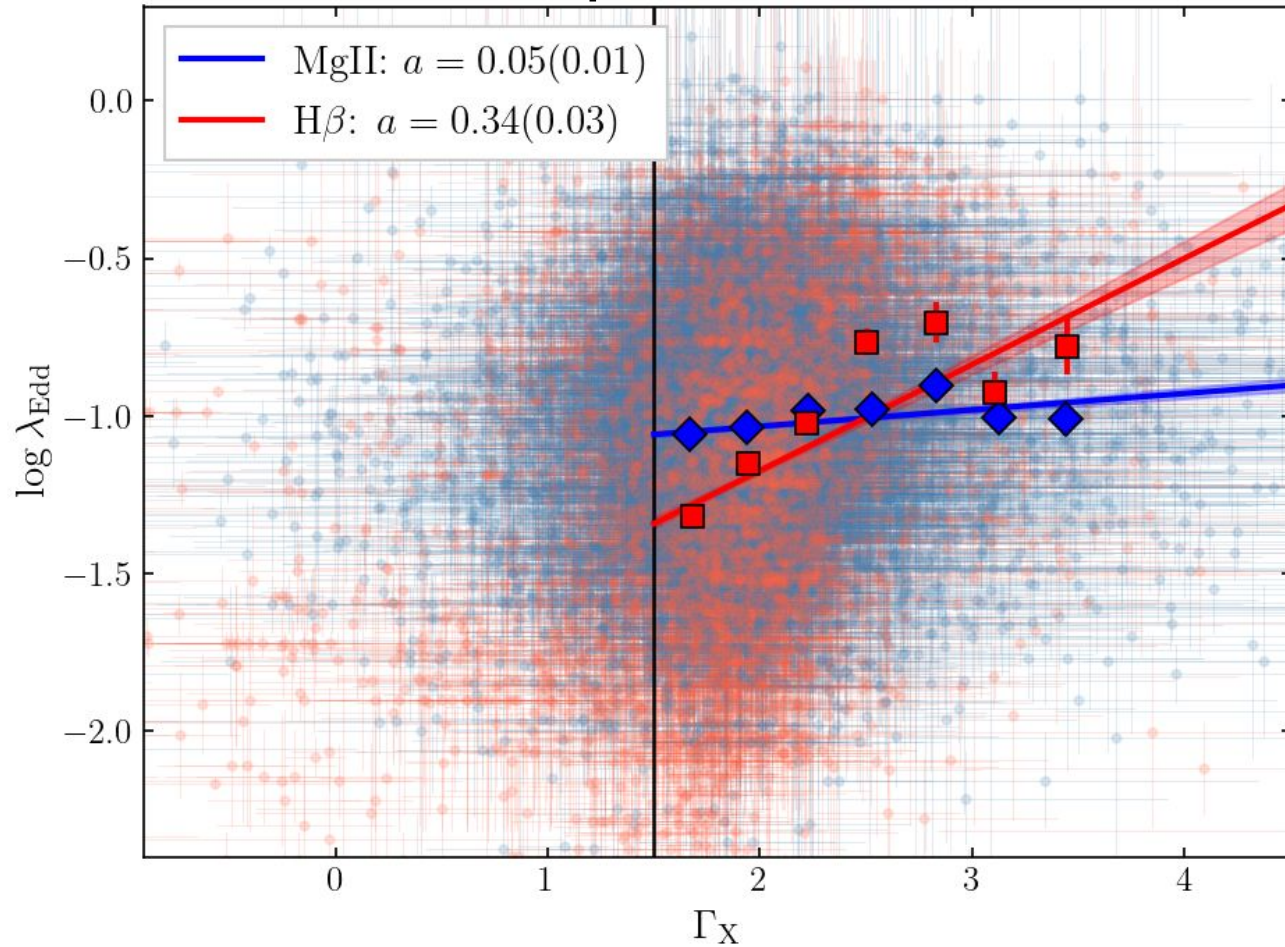
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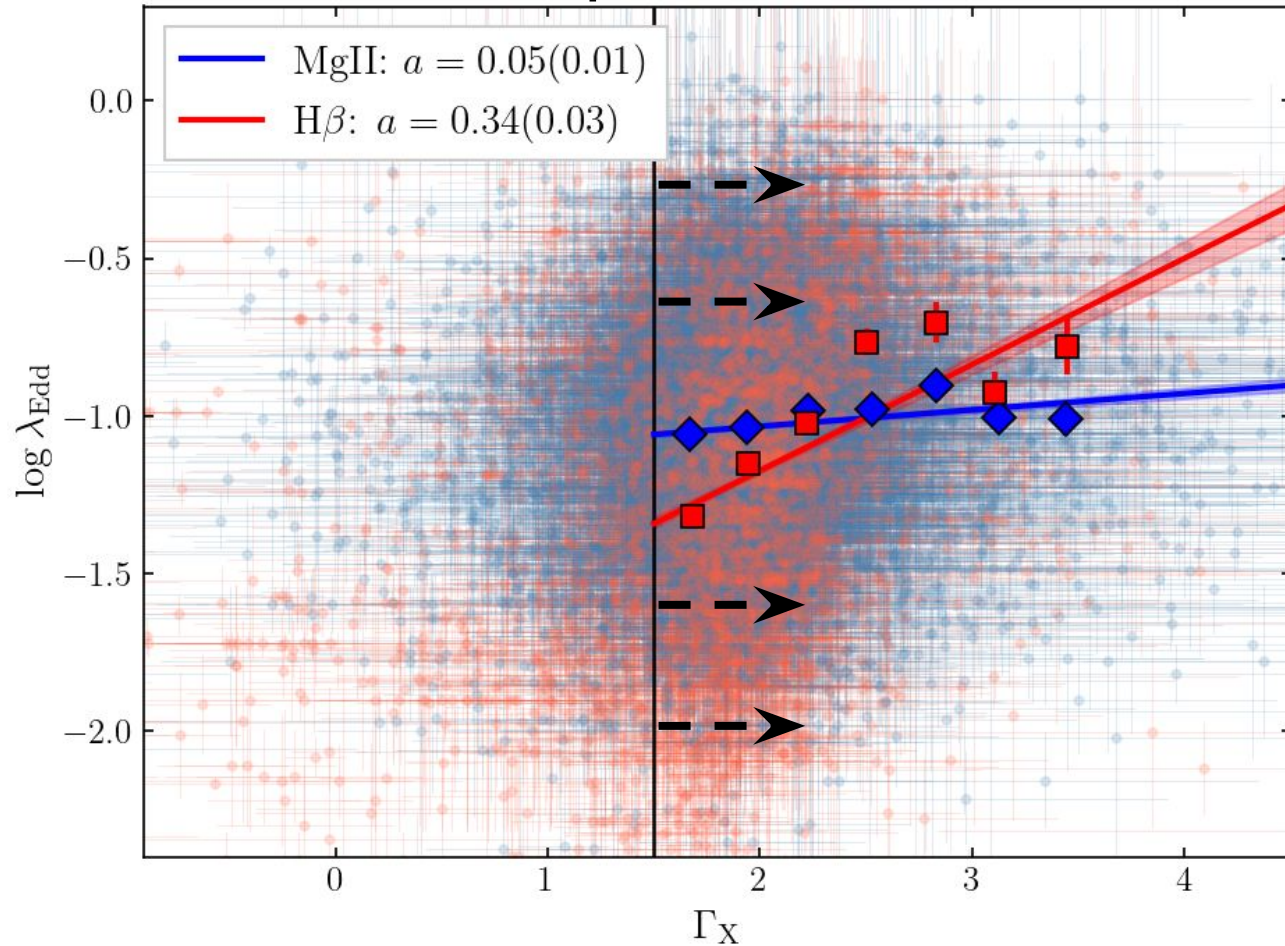


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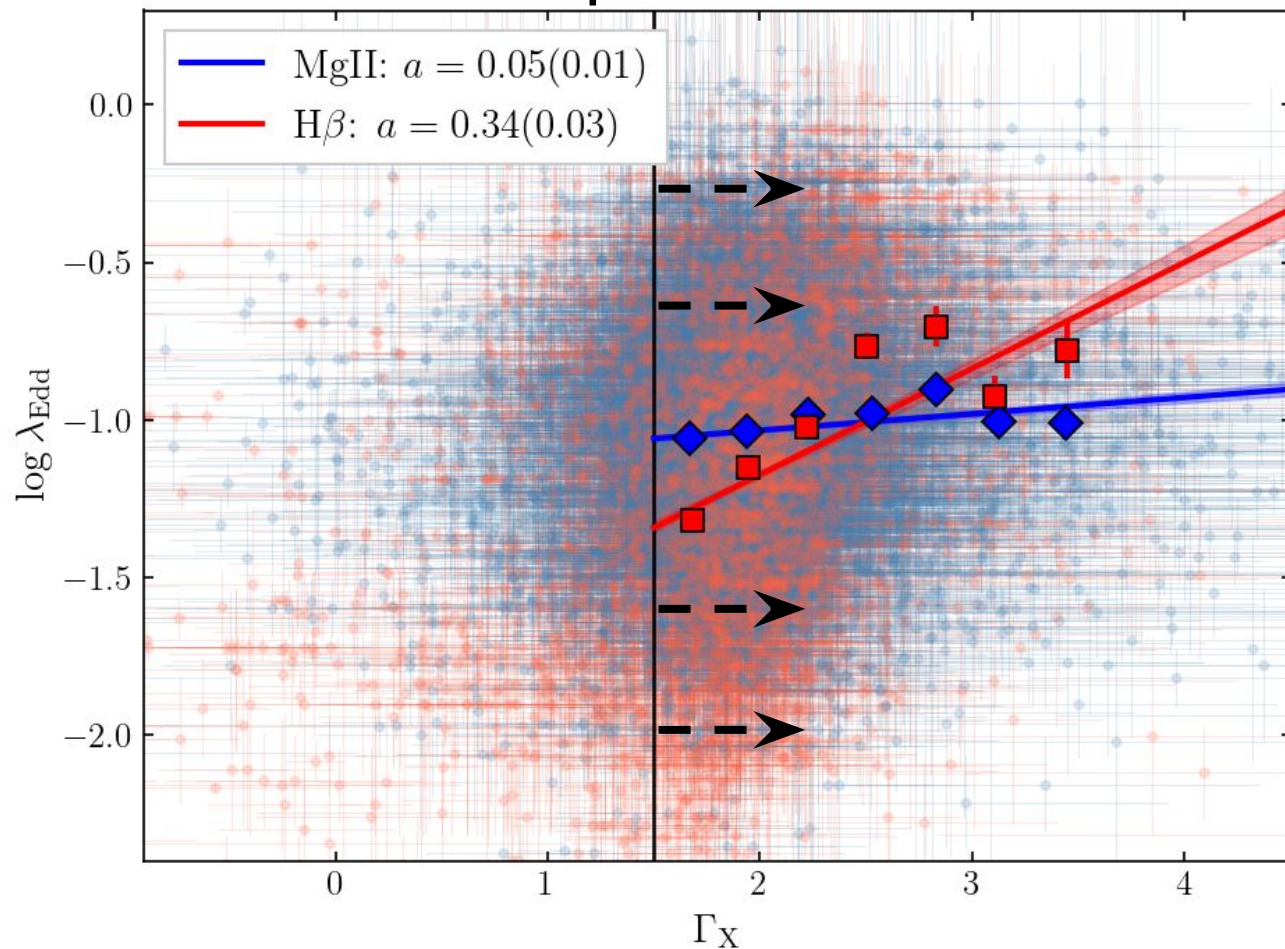
Is it the photoelectric absorption?



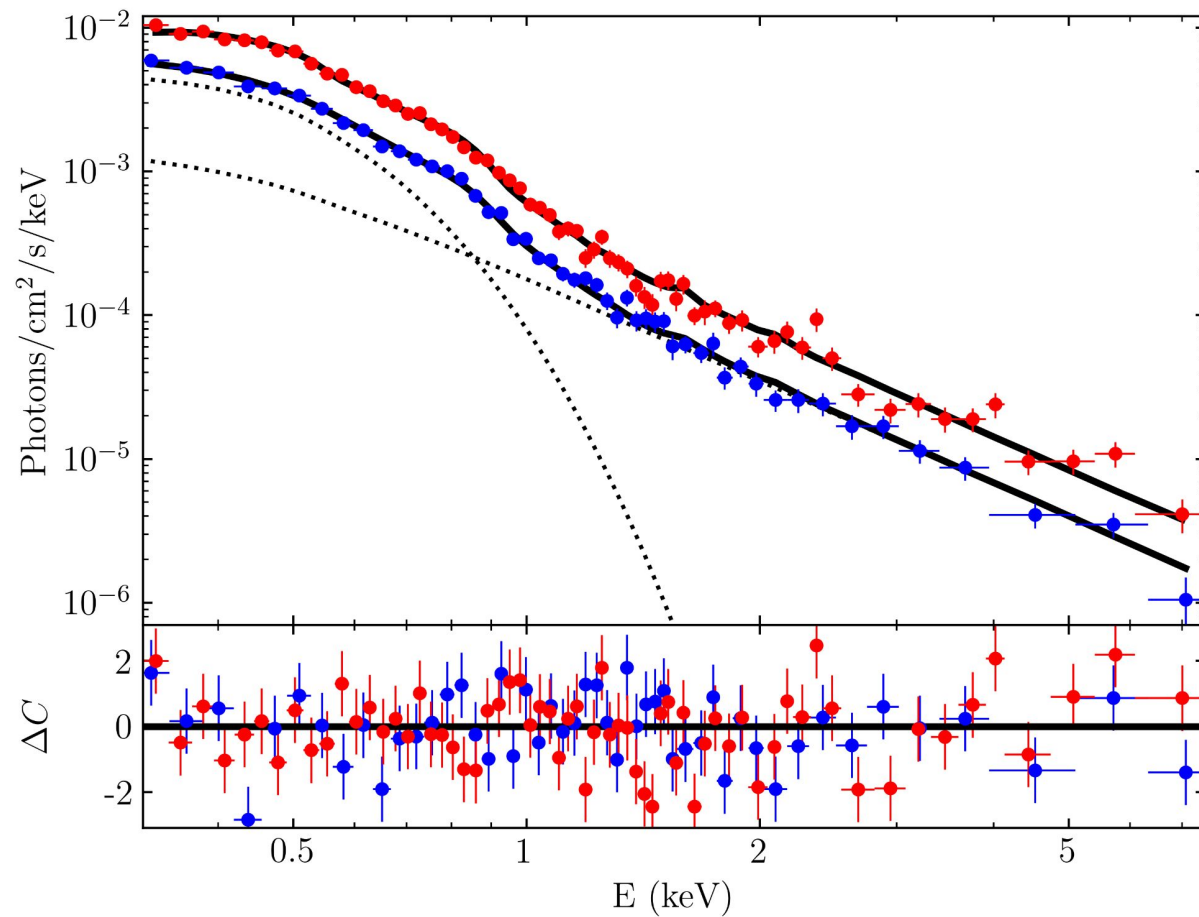
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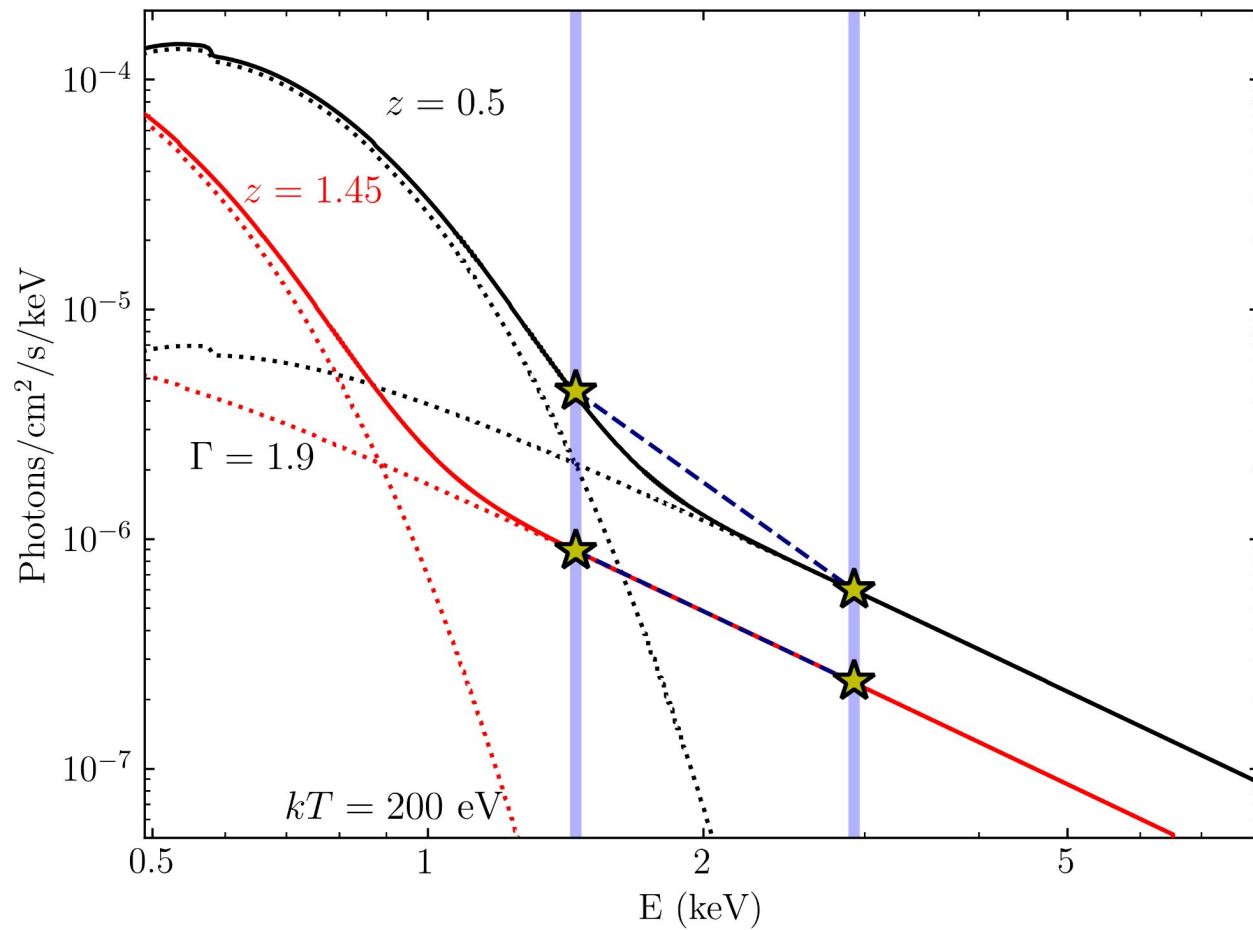
Is it the photoelectric absorption? **No.**



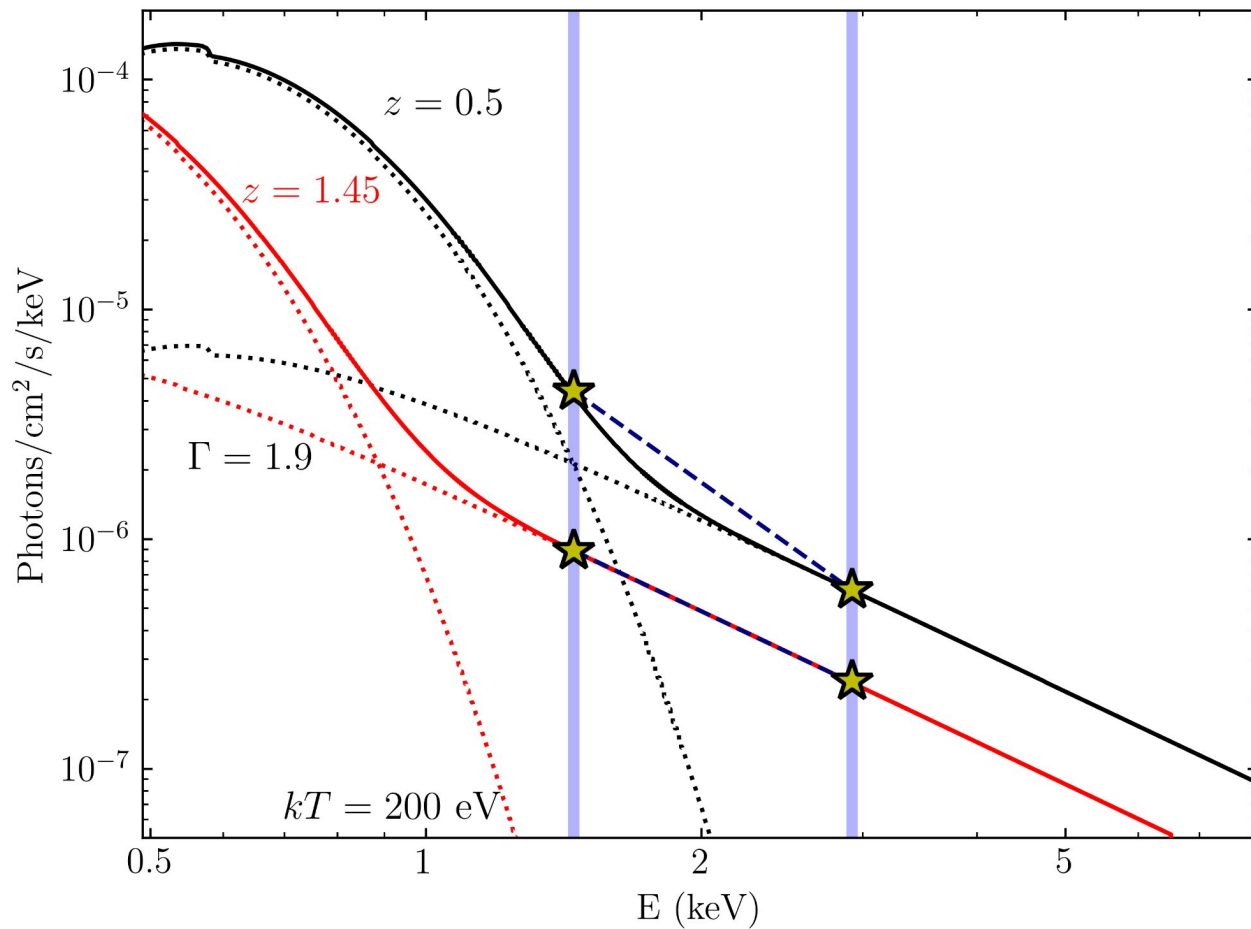
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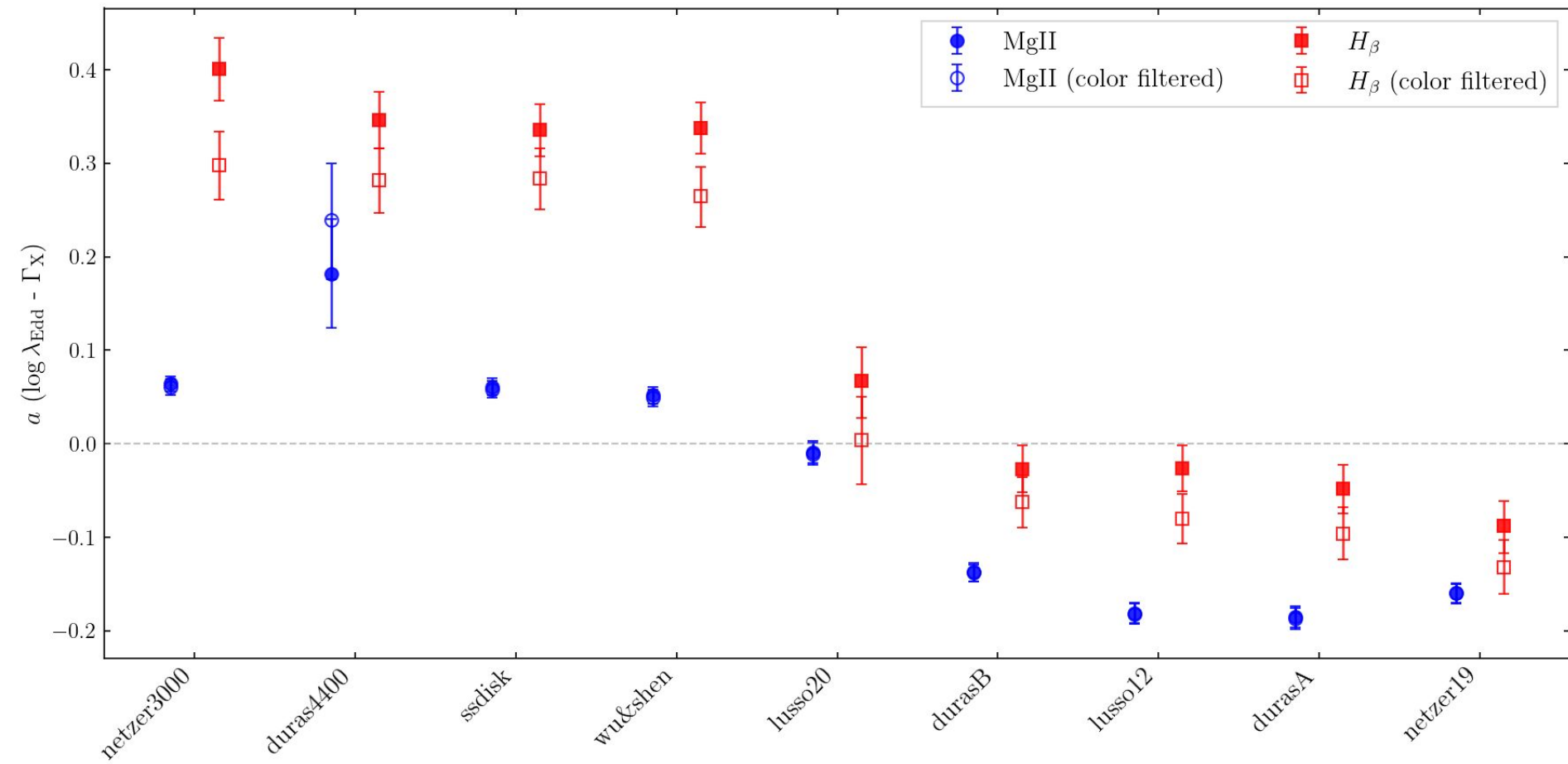


Is it the soft excess? **Likely!**

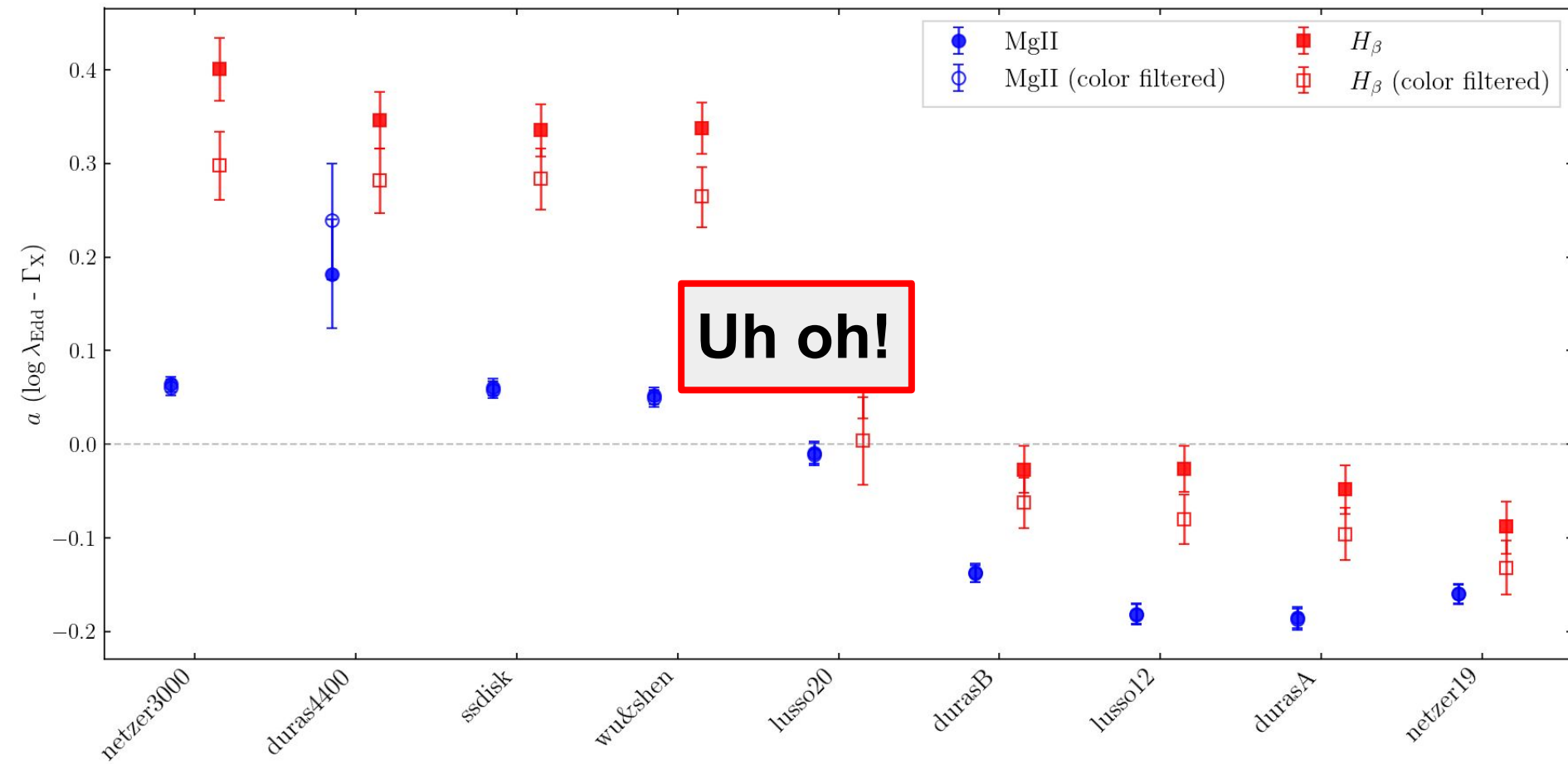


But what about the accretion rate?

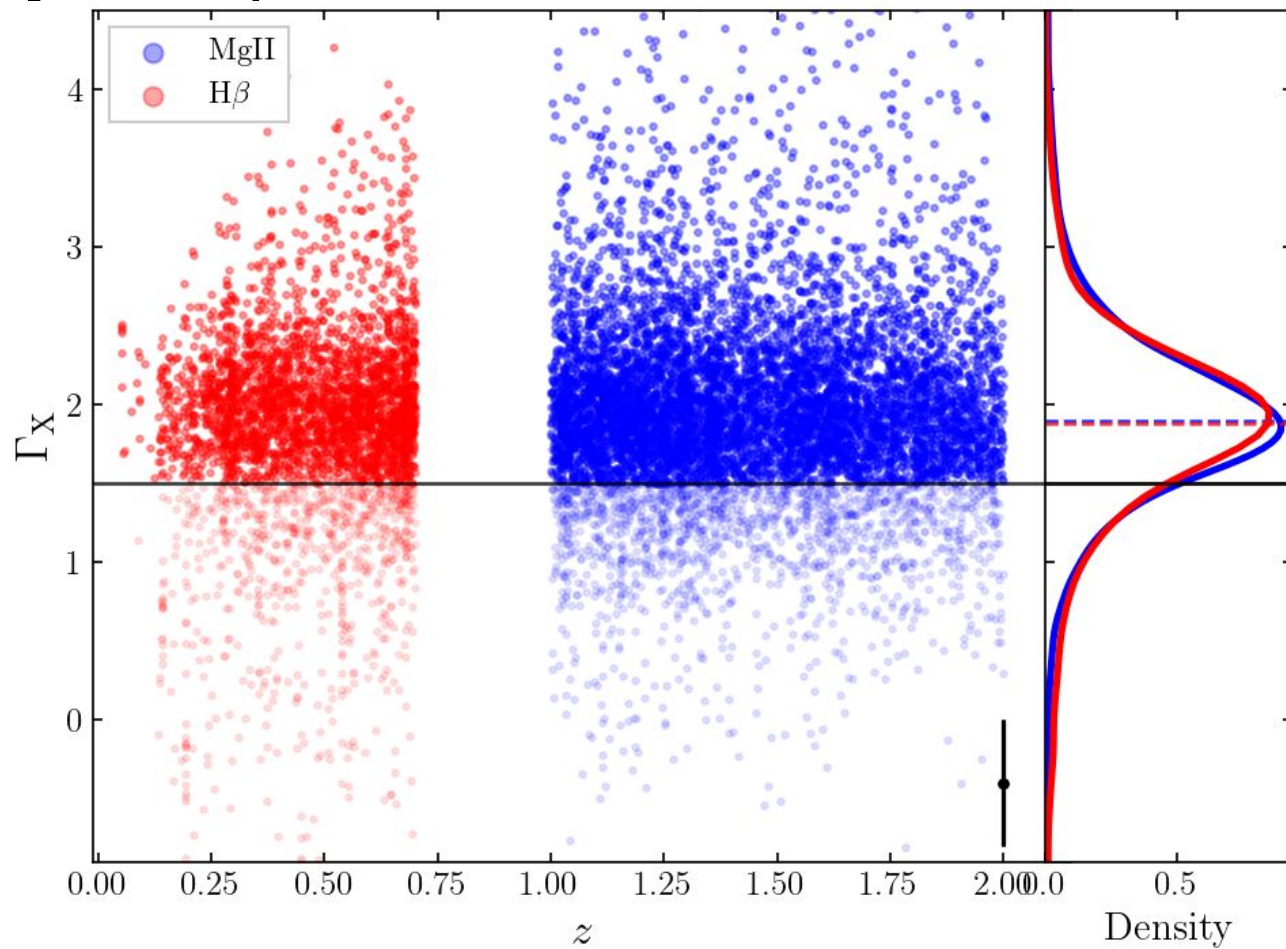
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Cherry on top!



$$\sigma\Gamma \sim 0.5$$
$$\langle\Delta\Gamma\rangle\sim 0.2$$

Final considerations:

- Significant correlation for H β sources, much weaker correlation for MgII sources
- Correlation for H β sources driven by soft excess rather than powerlaw
- Relation strongly dependent on the choice of bolometric correction
- Similar spread in Γ for both subsamples => additional variable?

Sexten Center for Astrophysics
8-12 March 2027

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