Quasars as high redshift standard candles

The L_X-L_{UV} relation at high redshift

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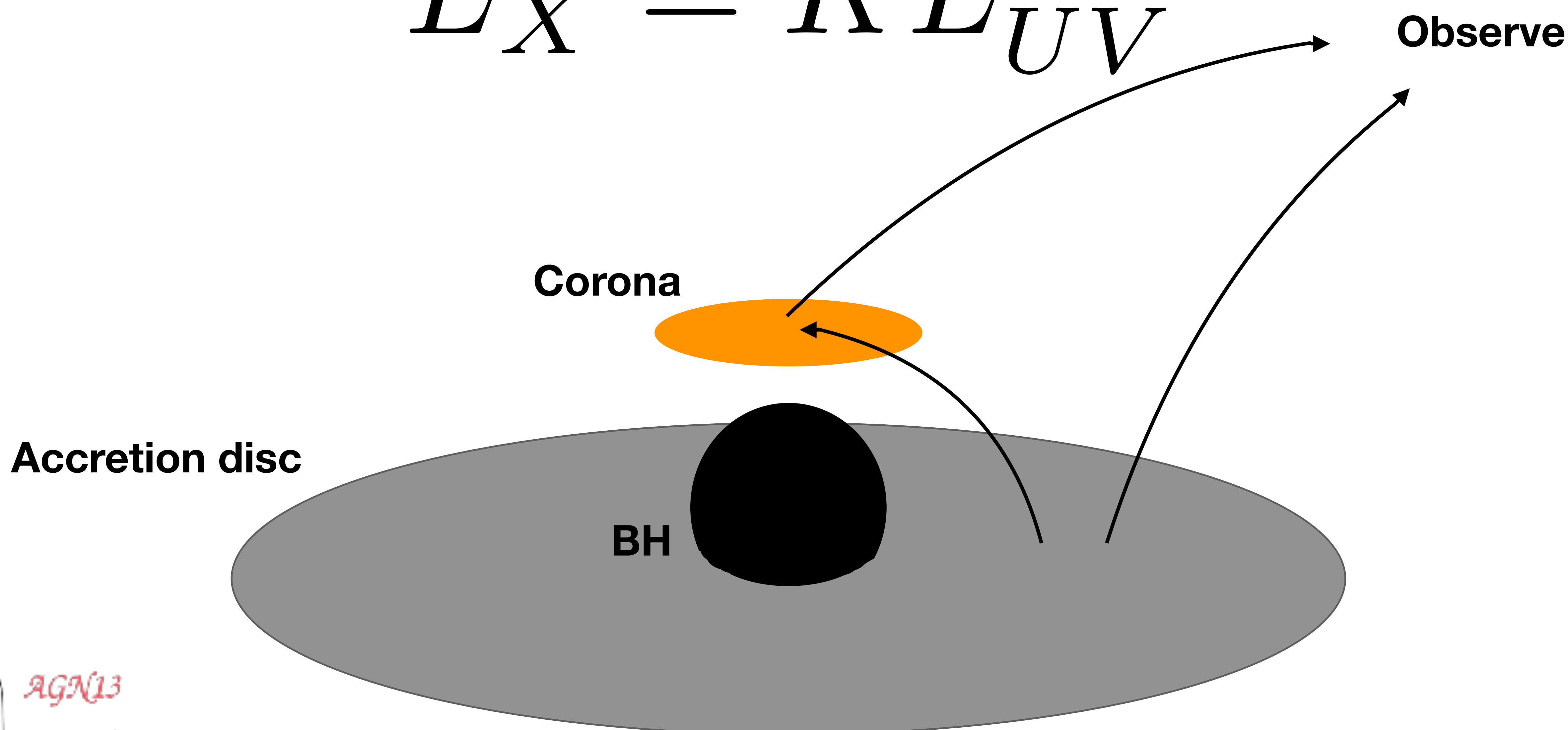
The L_X-L_{UV} relation: why?

1. Where does it come from?

$$L_X = K L_{UV}^{\gamma}$$



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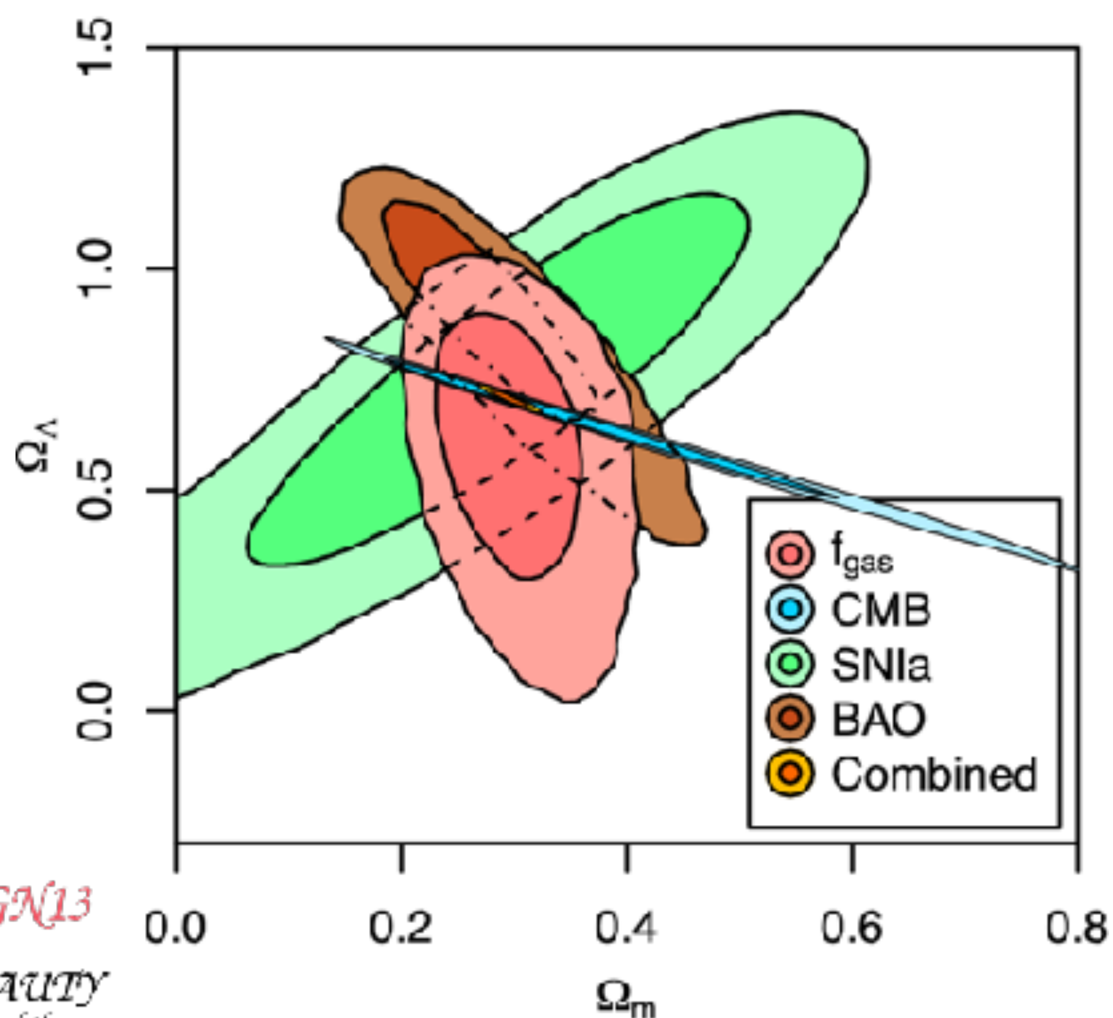
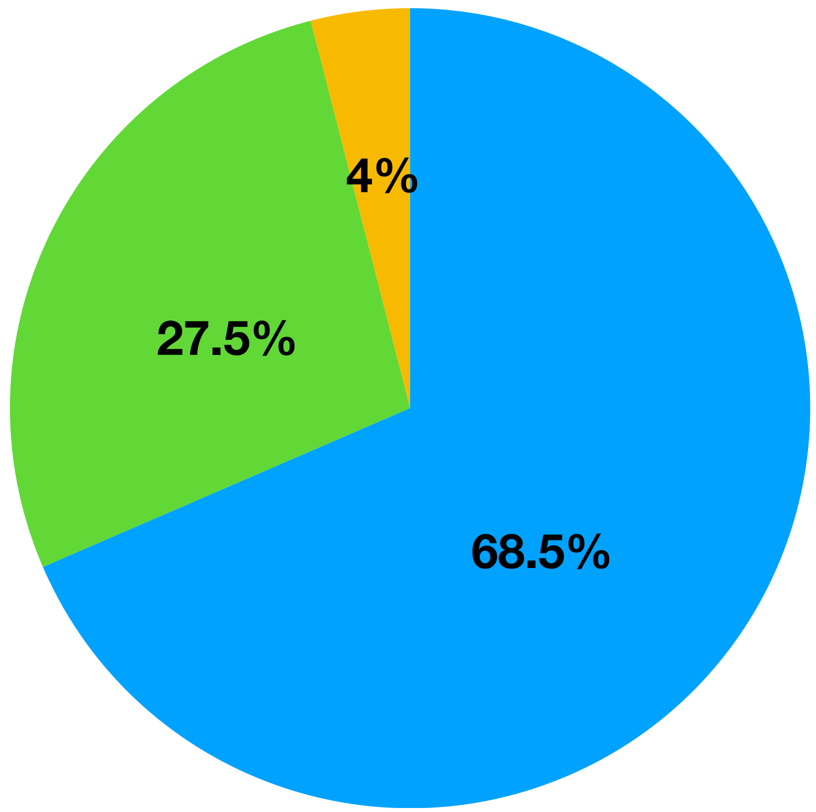
The L_X-L_{UV} relation: why?

1. Constraints on the unknown physical mechanism

2. Quasars as Standard Candles





$\Omega_\Lambda = 0.685 \pm 0.013$

$\Omega_m = 0.315 \pm 0.013$ Planck (2015)

$\Omega_b = 0.040 \pm 0.005$ Komatsu et al. (2011)

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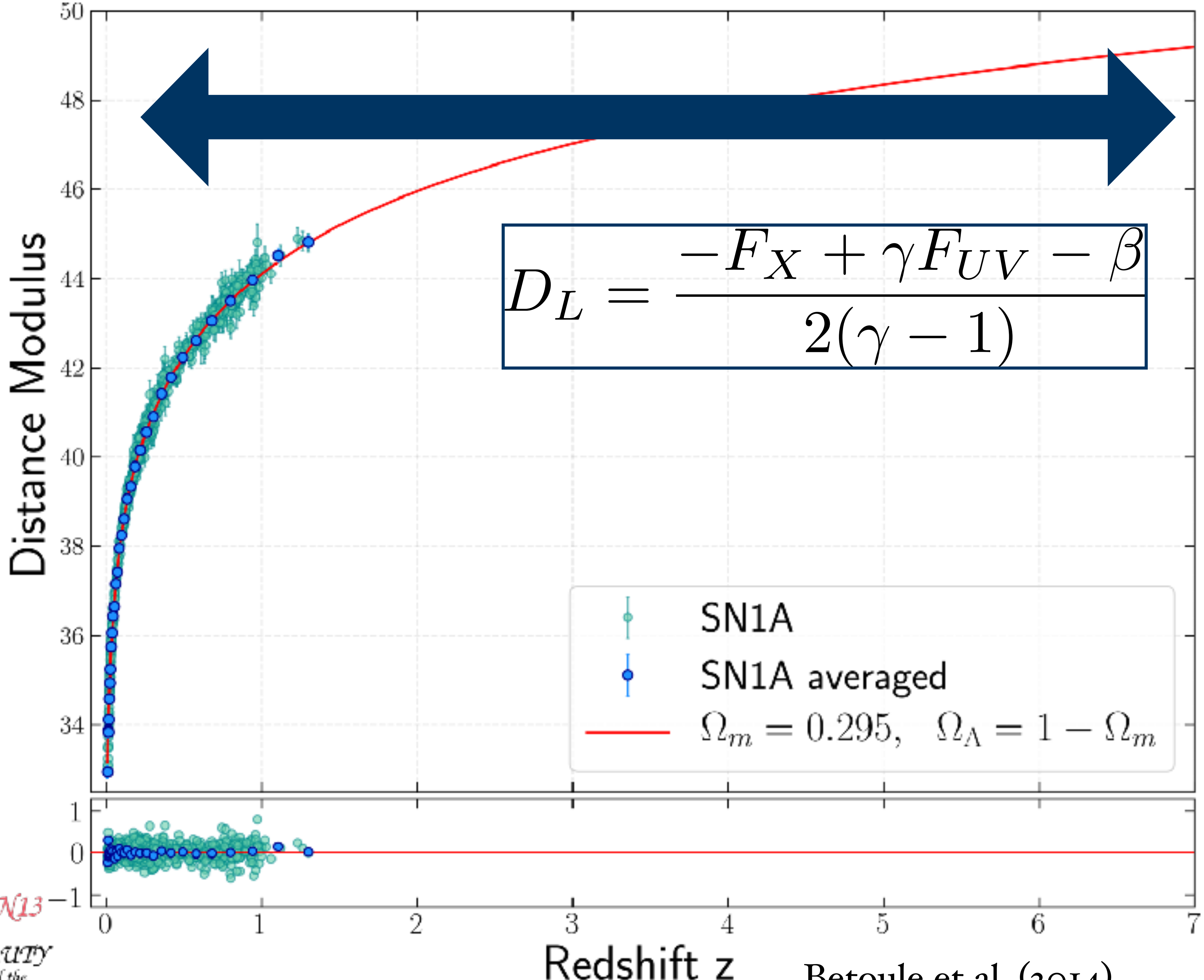
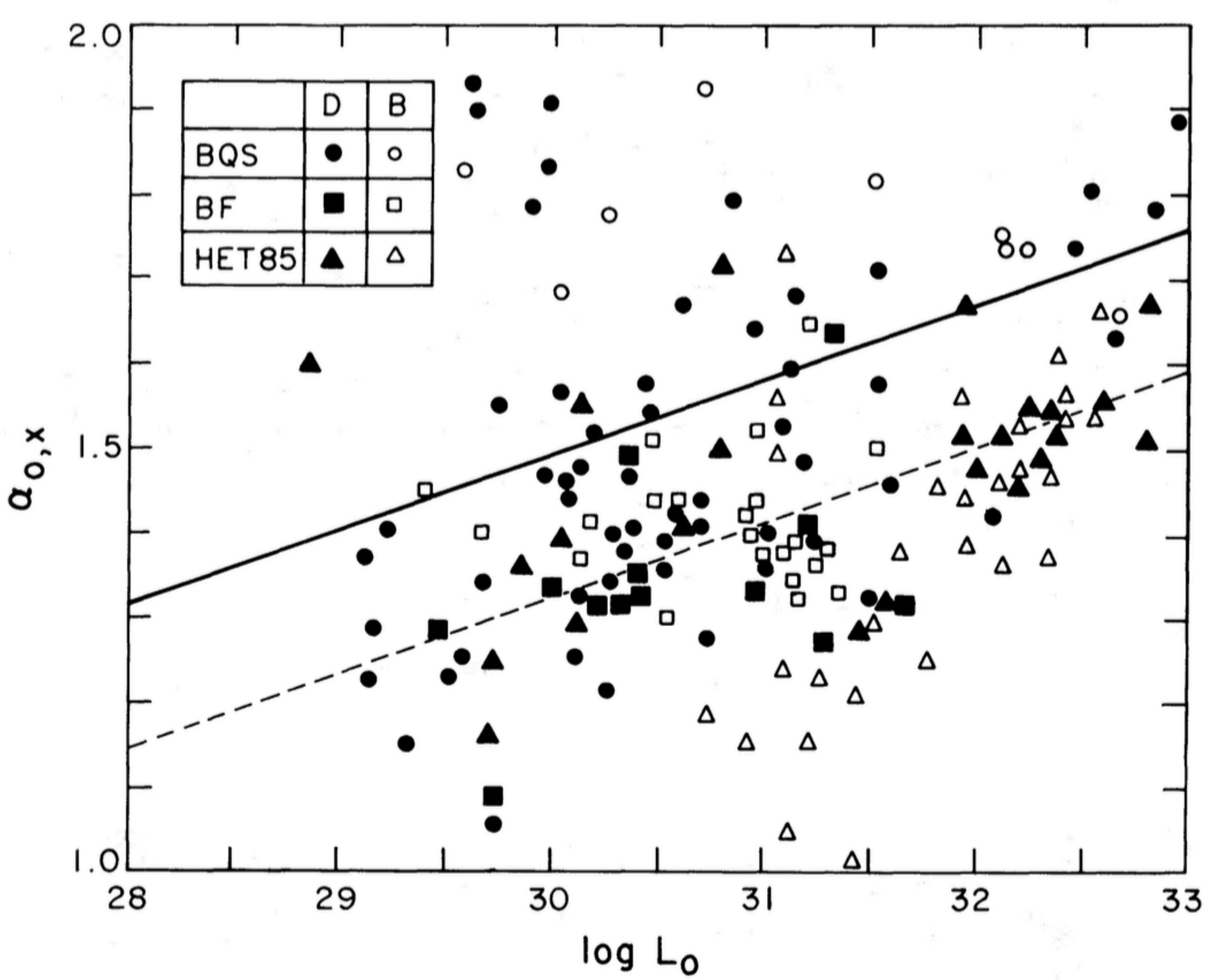
Hubble Diagram of SN1A

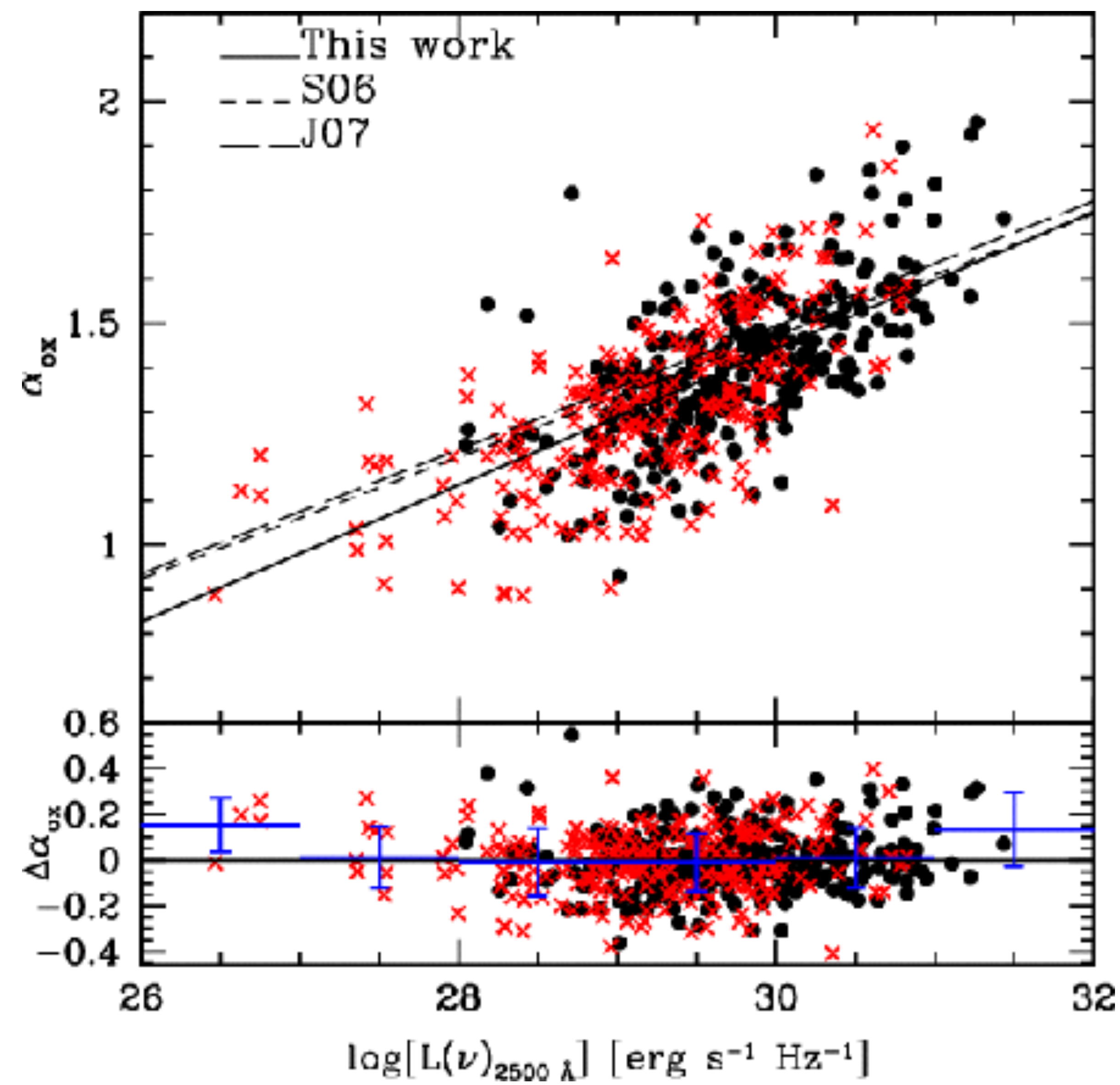


Betoule et al. (2014)

The L_X-L_{UV} relation



Avni and Tananbaum (1986)



Lusso et al. (2010)

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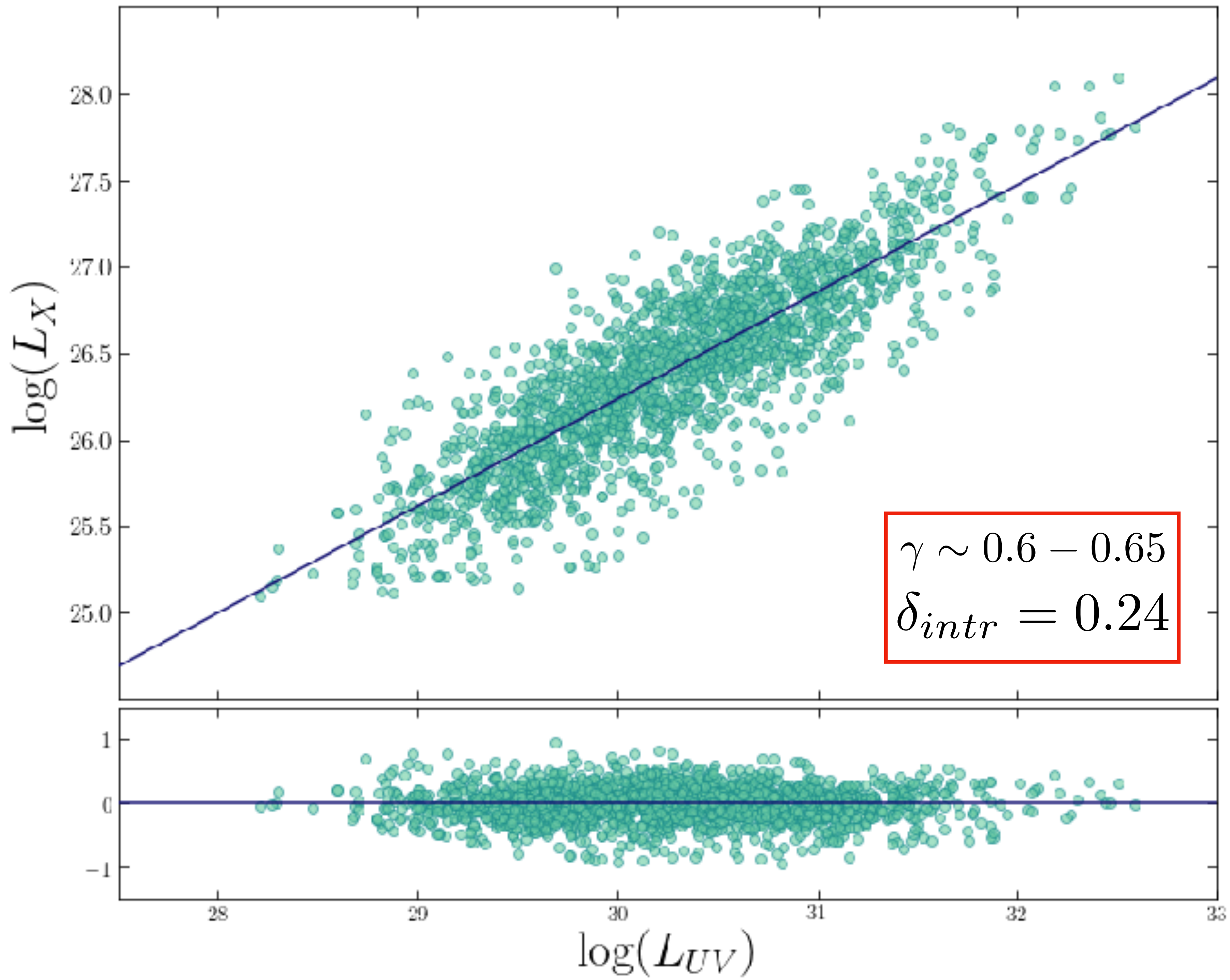
$\delta_{intr} \sim 0.35\text{-}0.40$ *dex*

The L_X-L_{UV} relation

- SDSS DR7
  (Shen et al. 2011)
- 3XMM-DR5
- No BAL sources
- Radio Quiet
- $1.6 < \Gamma_X < 2.8$
- 2153 sources
- $0.065 < z < 4.925$



Lusso and Risaliti (2016)

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The sample

- SDSS DR7 (Shen et al. 2011) & DR12 (for $z<5.3$)
- No BAL sources
- Radio Quiet

Accurate selection

- Archival ***Chandra*** and ***XMM-Newton*** observations

Accurate X-ray analysis

- No X-ray flux upper limit
- $4.0 < z < 7.08$

Evolution with redshift?

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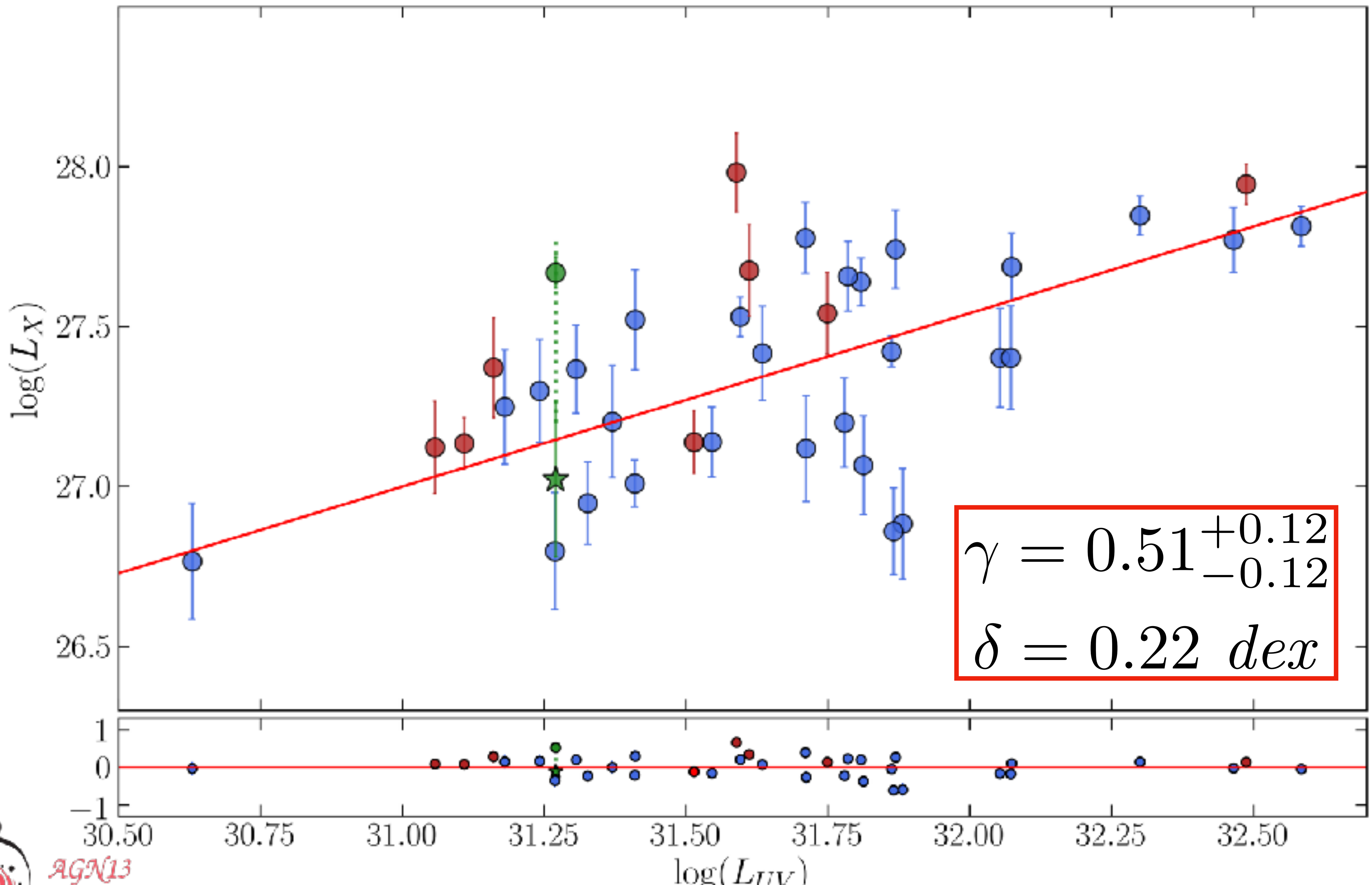
More details in: Salvestrini et al. in prep.

$$\log(L_X) = \gamma \log(L_{UV}) + \beta$$



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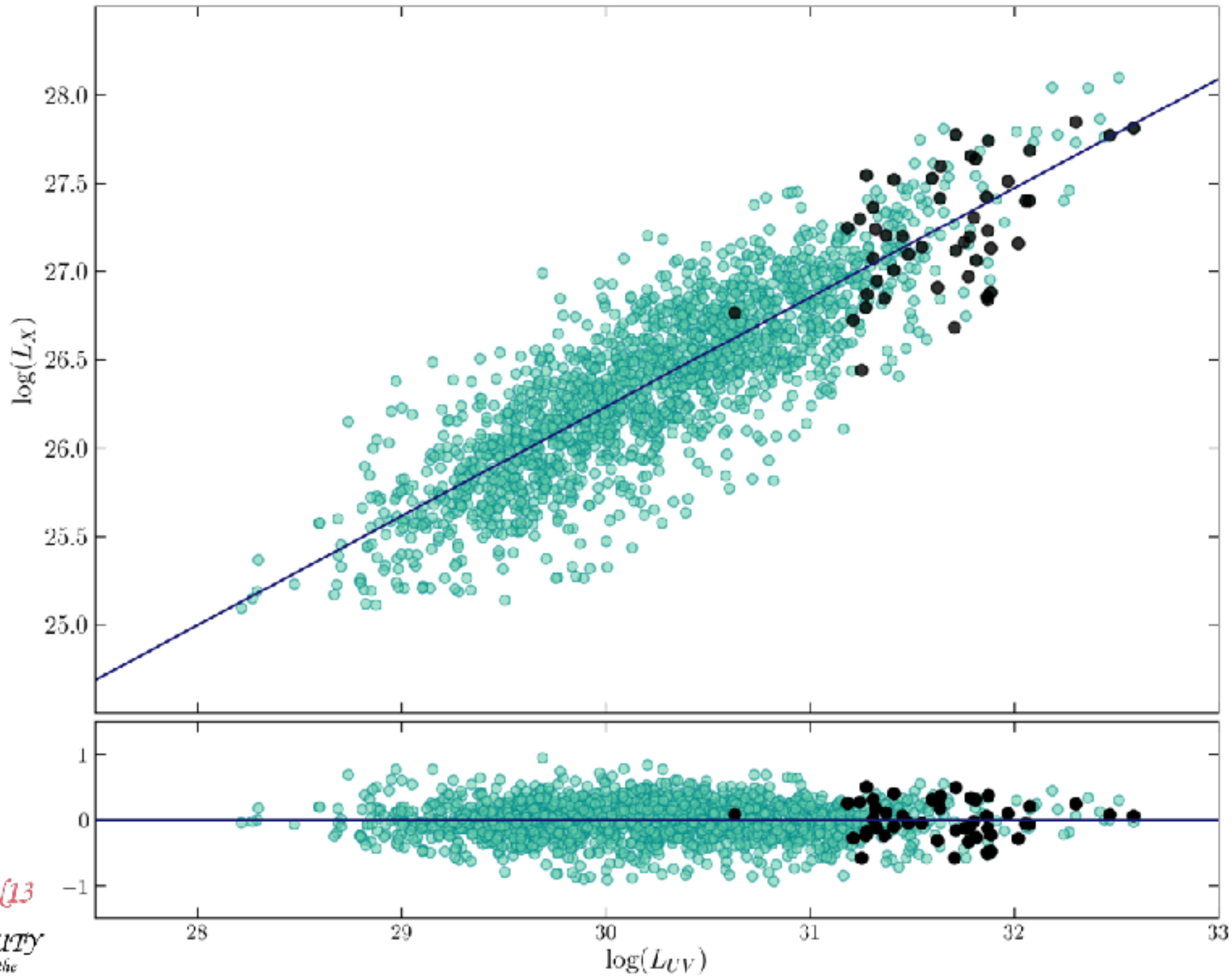
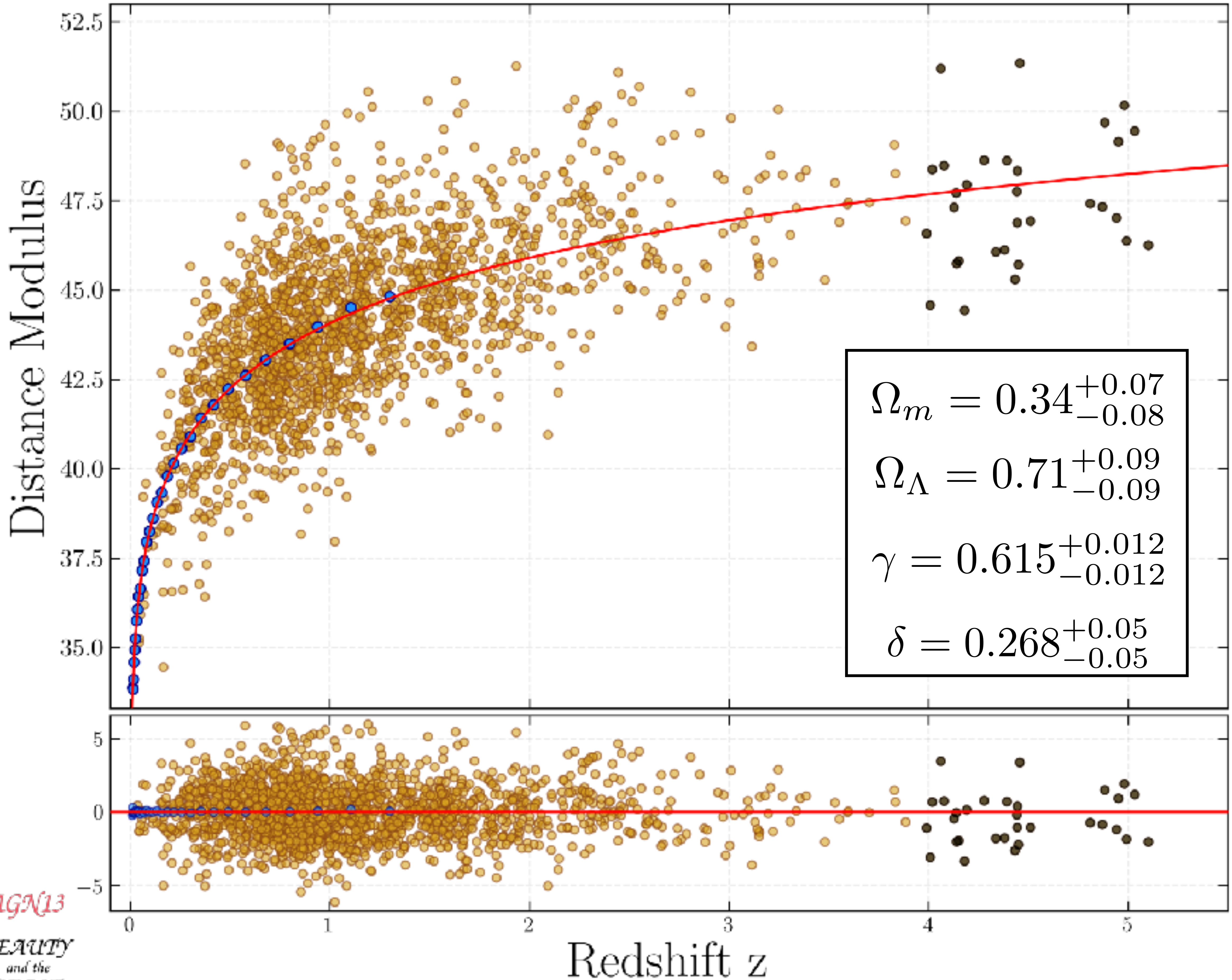
Consistency with lower redshift results





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Conclusions

1. **L_{UV} - L_X relation**
   - Accurate sample selection
   - More reliable flux estimates

     → **Lower intrinsic dispersion**
   - **No evidence of evolution with redshift**
2. **Hubble Diagram of quasars**
   - Test of the ΛCDM model
   - Test on possible extensions to standard model

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Thank you!