Radiation pressure and absorption in the Chandra Deep Fields

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Introduction: radiation pressure

Balance radiation pressure – gravitational force

Eddington luminosity: $$L_E = \frac{4\pi G m_p c M_{BH}}{\sigma_T}$$

Eddington ratio: $$\lambda = \frac{L}{L_E}$$

Eddington limit: $$\lambda = 1$$

σ_T is defined for Thomson scattering, but what about dust?

Model

Eddington luminosity $$L_E = \frac{4\pi G m_p c M_{BH}}{\sigma_T} \rightarrow \frac{4\pi G m_p c M_{BH}}{\sigma_D}$$

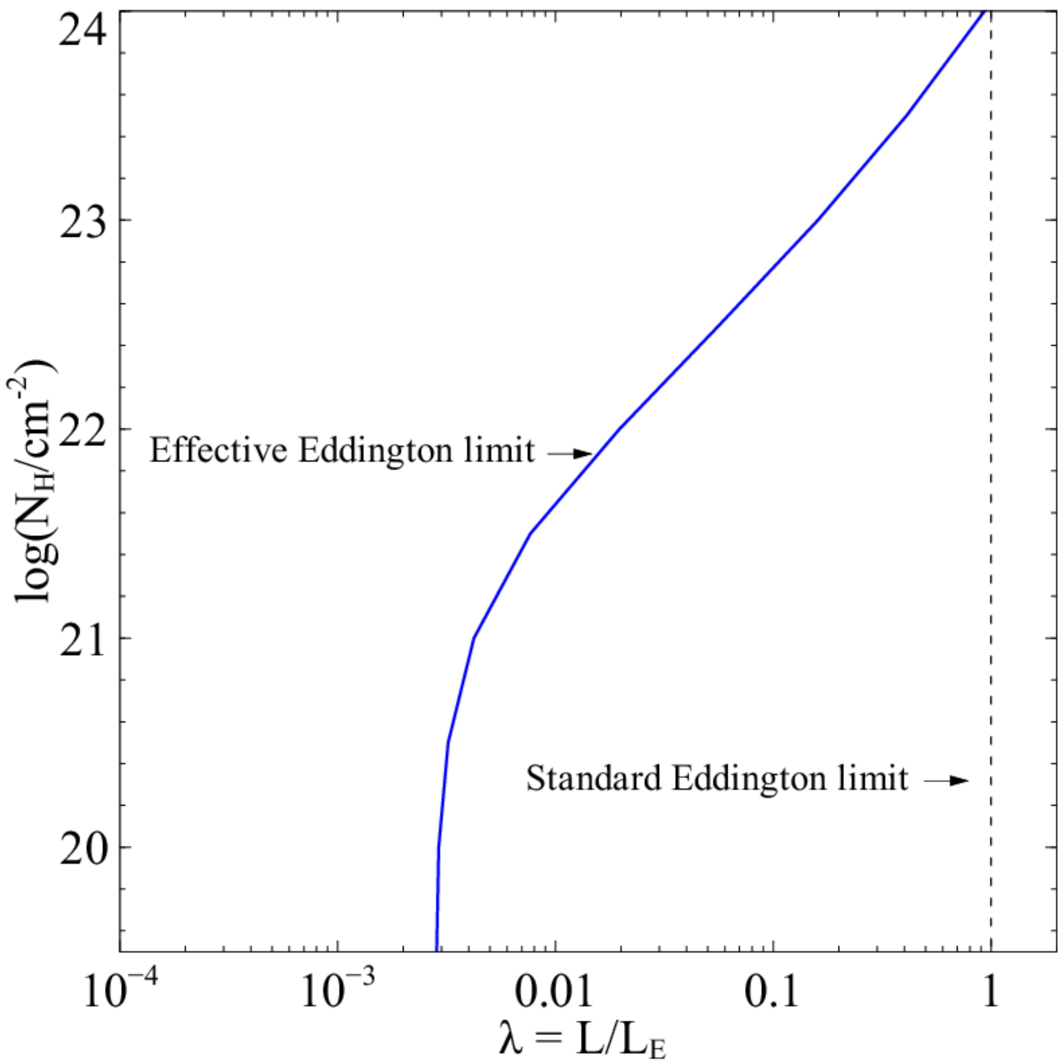
Boost factor $$A(N_H) = \frac{\sigma_D}{\sigma_T}$$ (~1 - 500)

Effective Eddington ratio $$\lambda_{eff} = A\lambda$$

Limit at which radiation pressure can expel the dusty gas:

$$\lambda_{eff} = 1 \Rightarrow \lambda = \frac{1}{A}$$

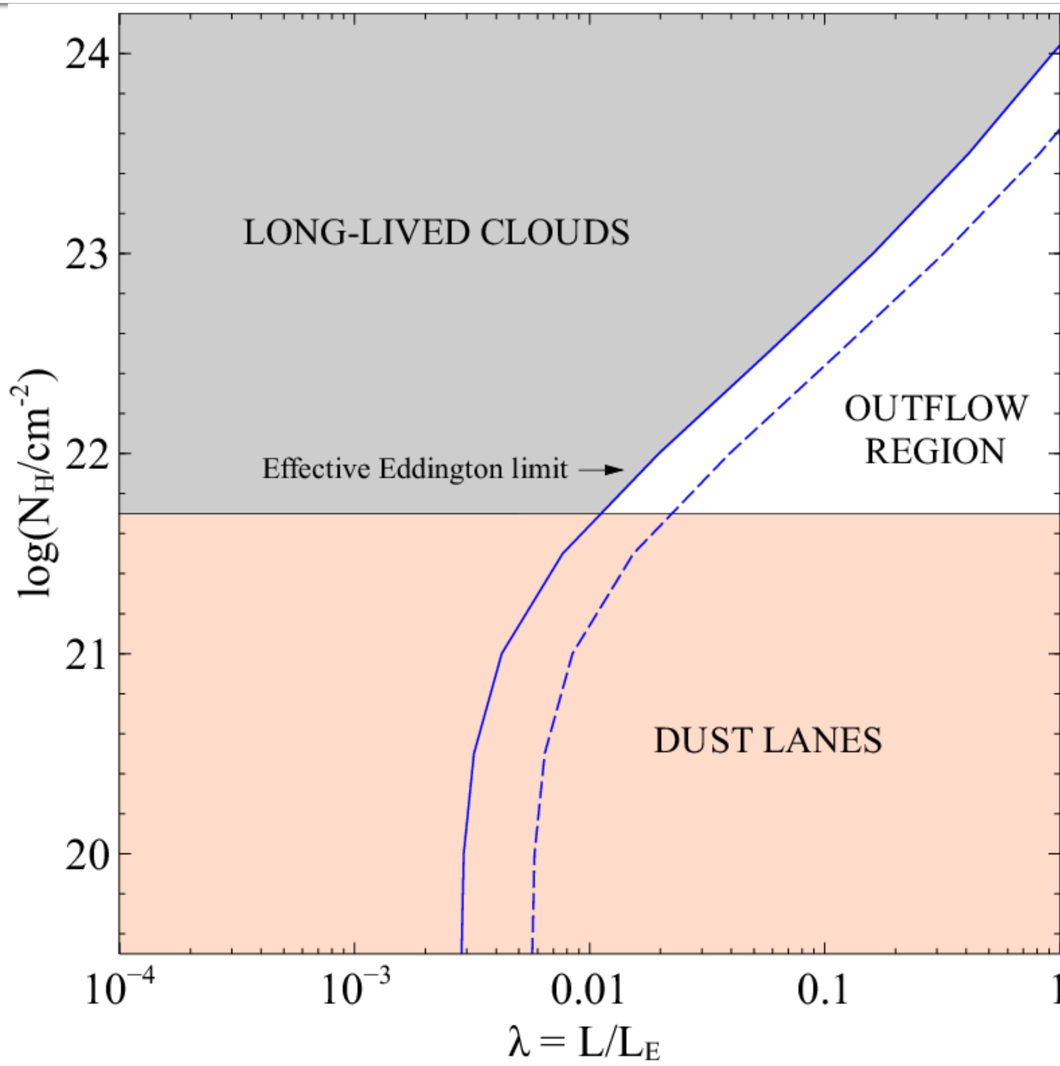
Model



Calculations using CLOUDY

Fabian et al 06, 08, 09

Model



Fabian et al 06, 08, 09

Observations

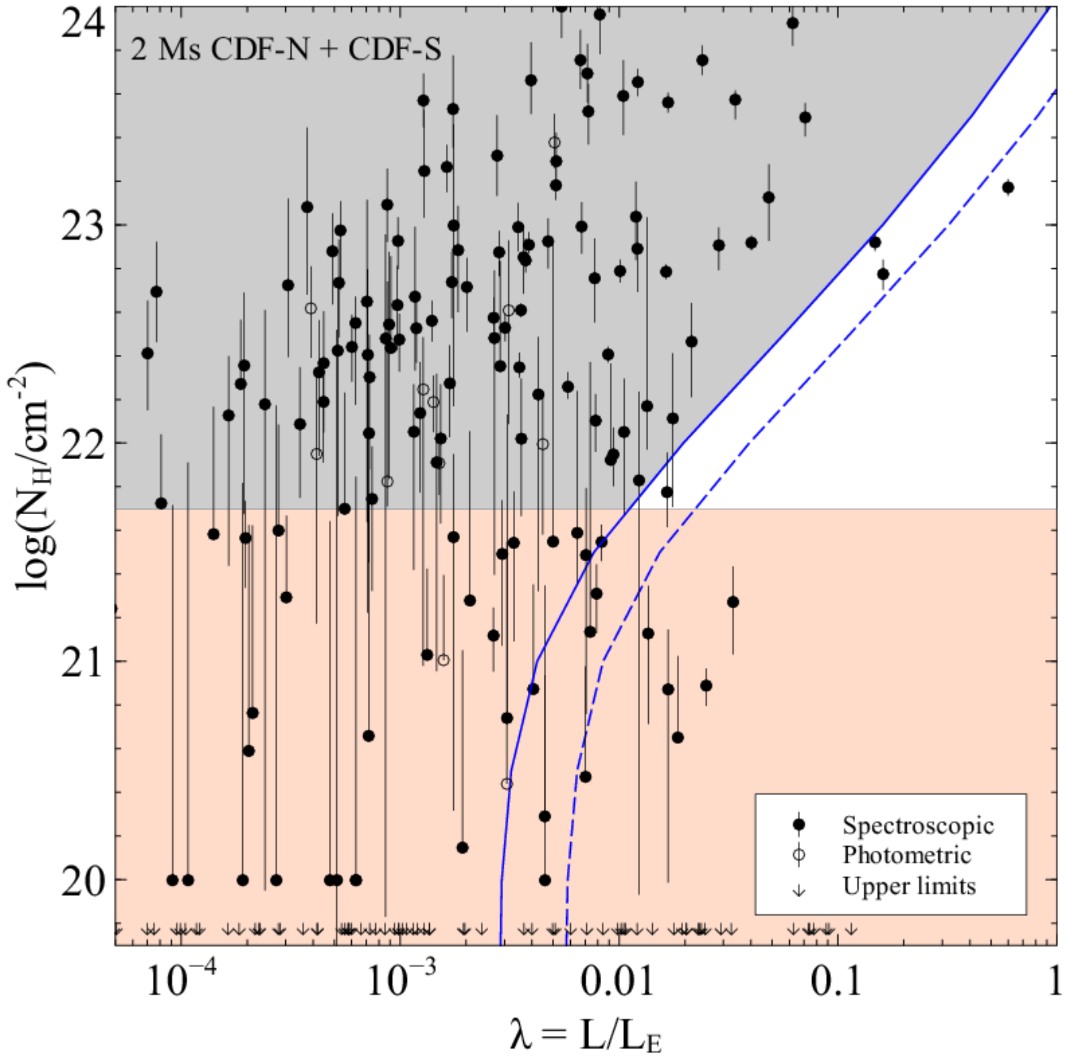
AGN from the deep X-ray surveys:
2 Ms *Chandra* Deep Field North and South (0.5 - 10) keV

965 objects in total – how to get the AGN?
$L_X > 10^{41}$ erg/s

Properties needed: M_{BH} ; L_{bol} ; N_H ; z

Spectral fitting (L_{bol} ; N_H)
Infrared follow-up: K-band magnitudes
Black Hole – Galaxy scaling relations (M_{BH} - M_K)

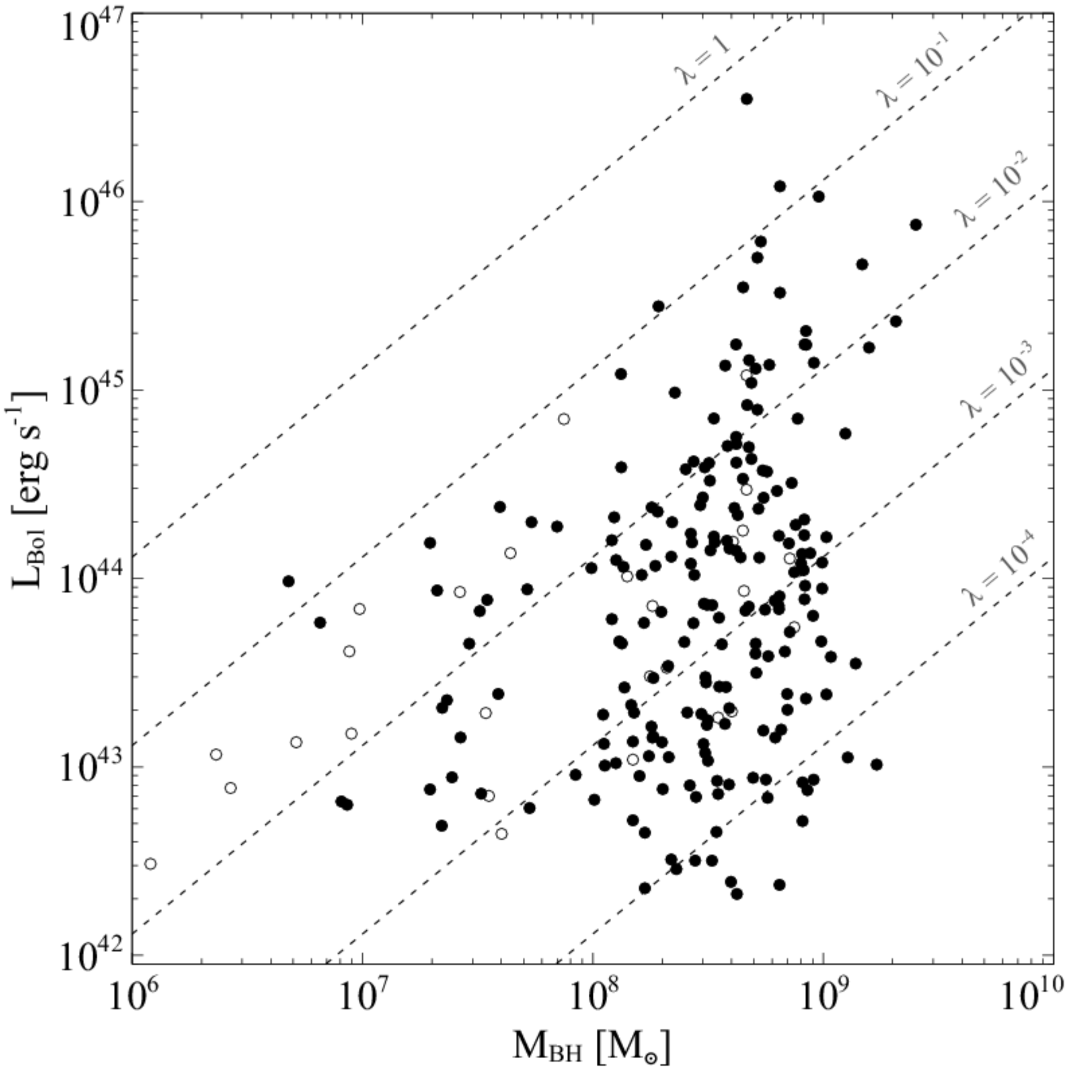
Observations: results



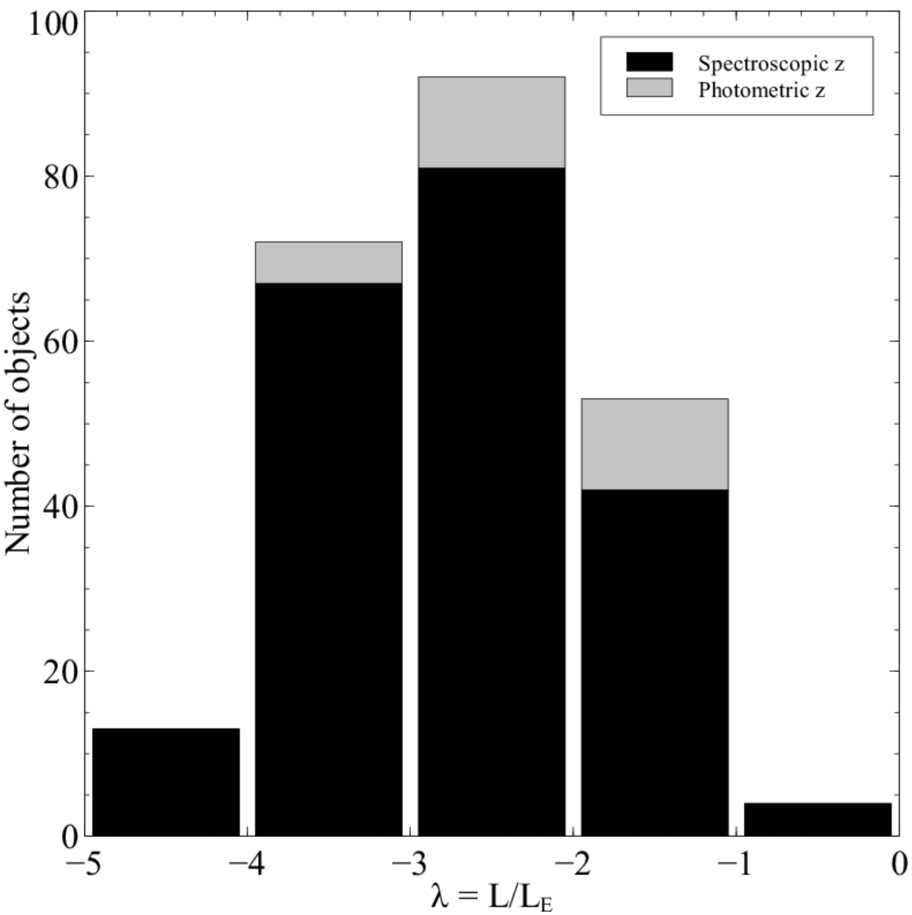
234 AGN in both fields with :

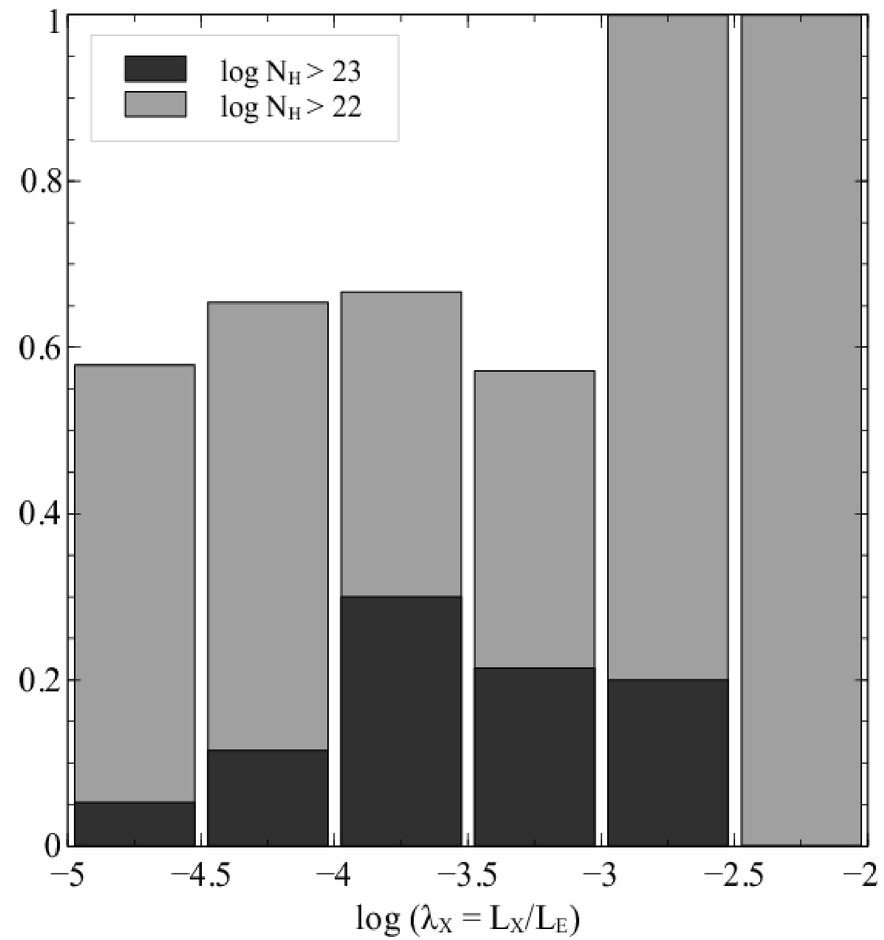
- measured K band mag
- z < 1

AGN properties



AGN properties

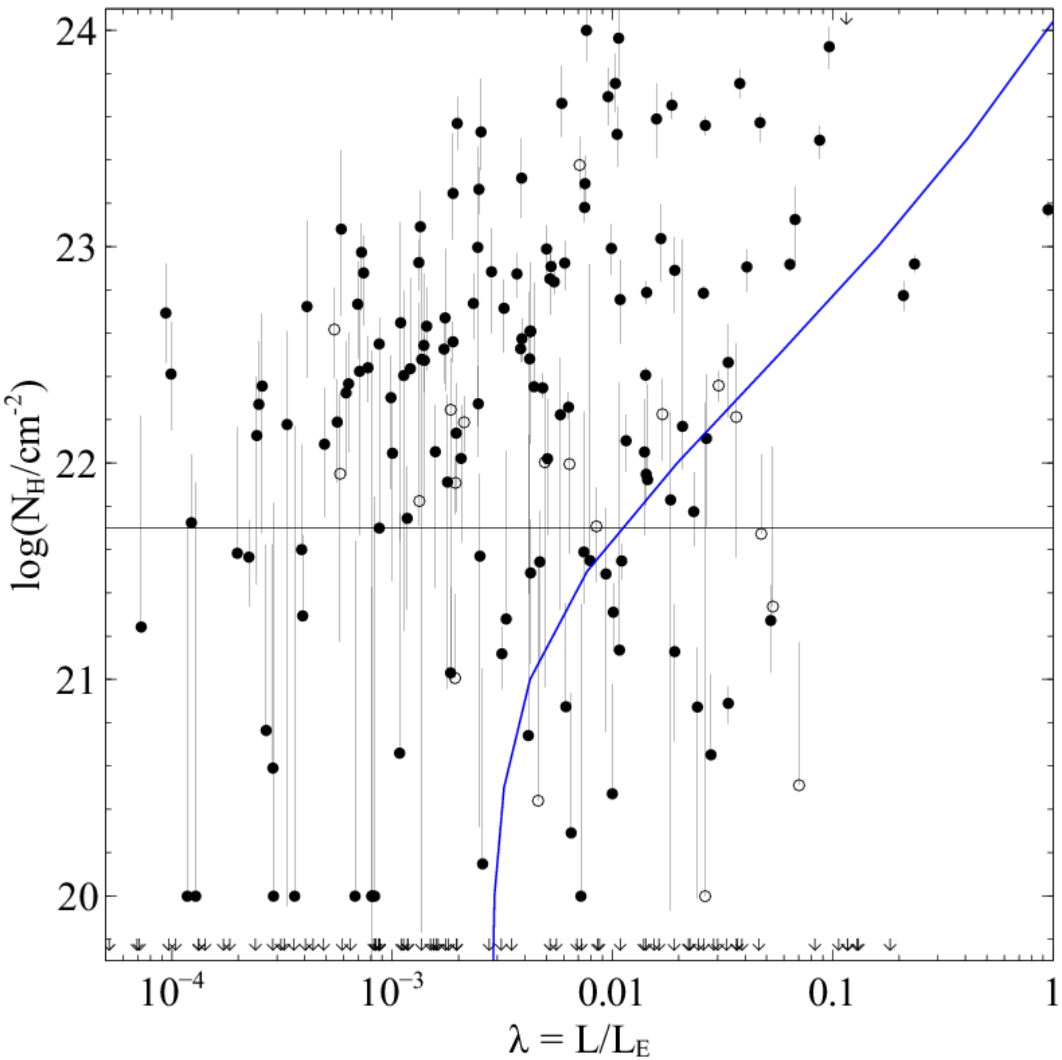




Wide distribution:
agreement with Babić et al 07

Large fraction of obscured sources

AGN properties

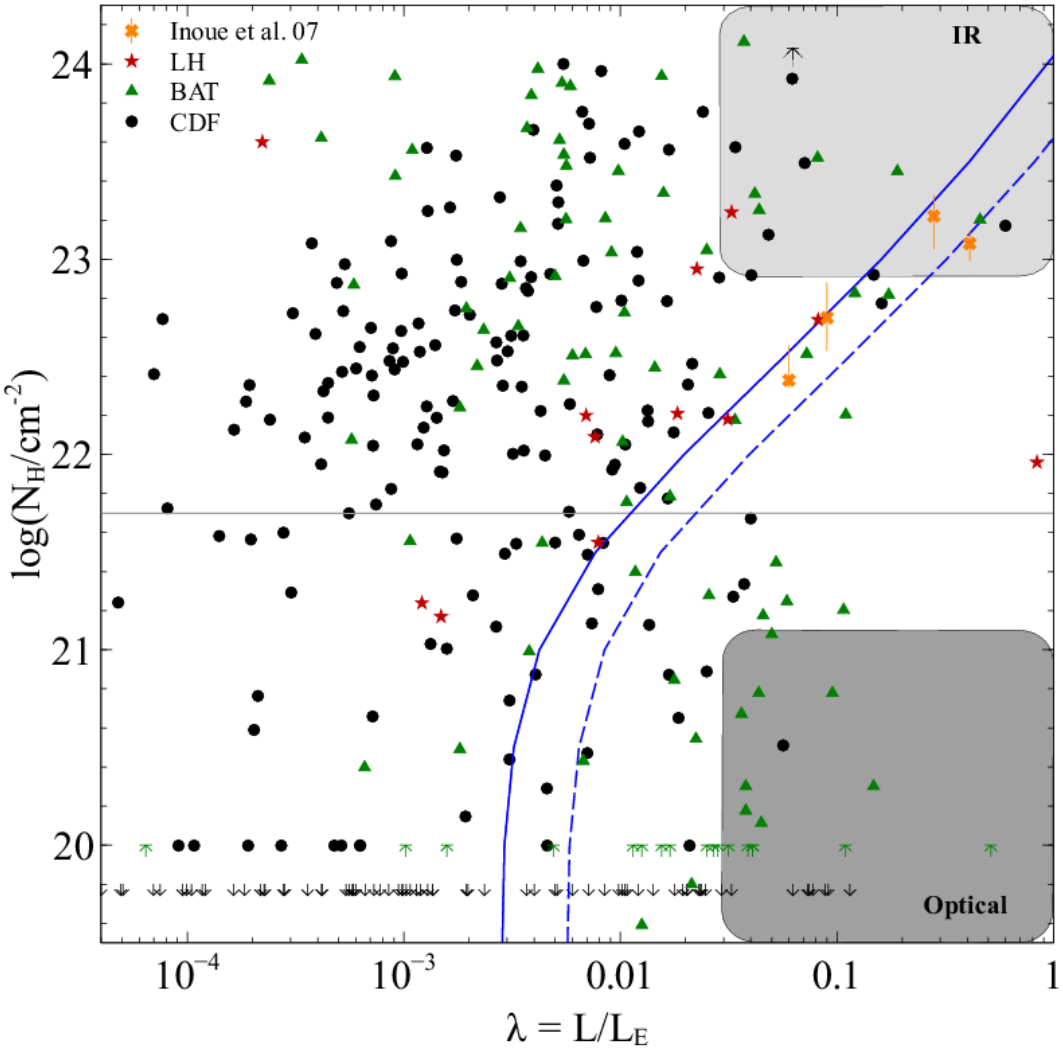


- (M_{BH} - M_K) redshift evolution

(Merloni et al 2010 relation)

- At z = 1, masses are lower by a factor of 1.6

AGN properties



- Search for outflows: good spectroscopic candidates

- Evolution with redshift?

Raimundo et al 10

Fabian et al 08, 09

Conclusions

- AGN in our sample have typically low Eddington ratios and high hydrogen column densities

- They avoid the area where we would expect outflows
  - Spend most of their time obscured

- Prediction of primary candidates for spectroscopic studies

- Radiation pressure is important to understand central engine/obscuration interaction and population properties