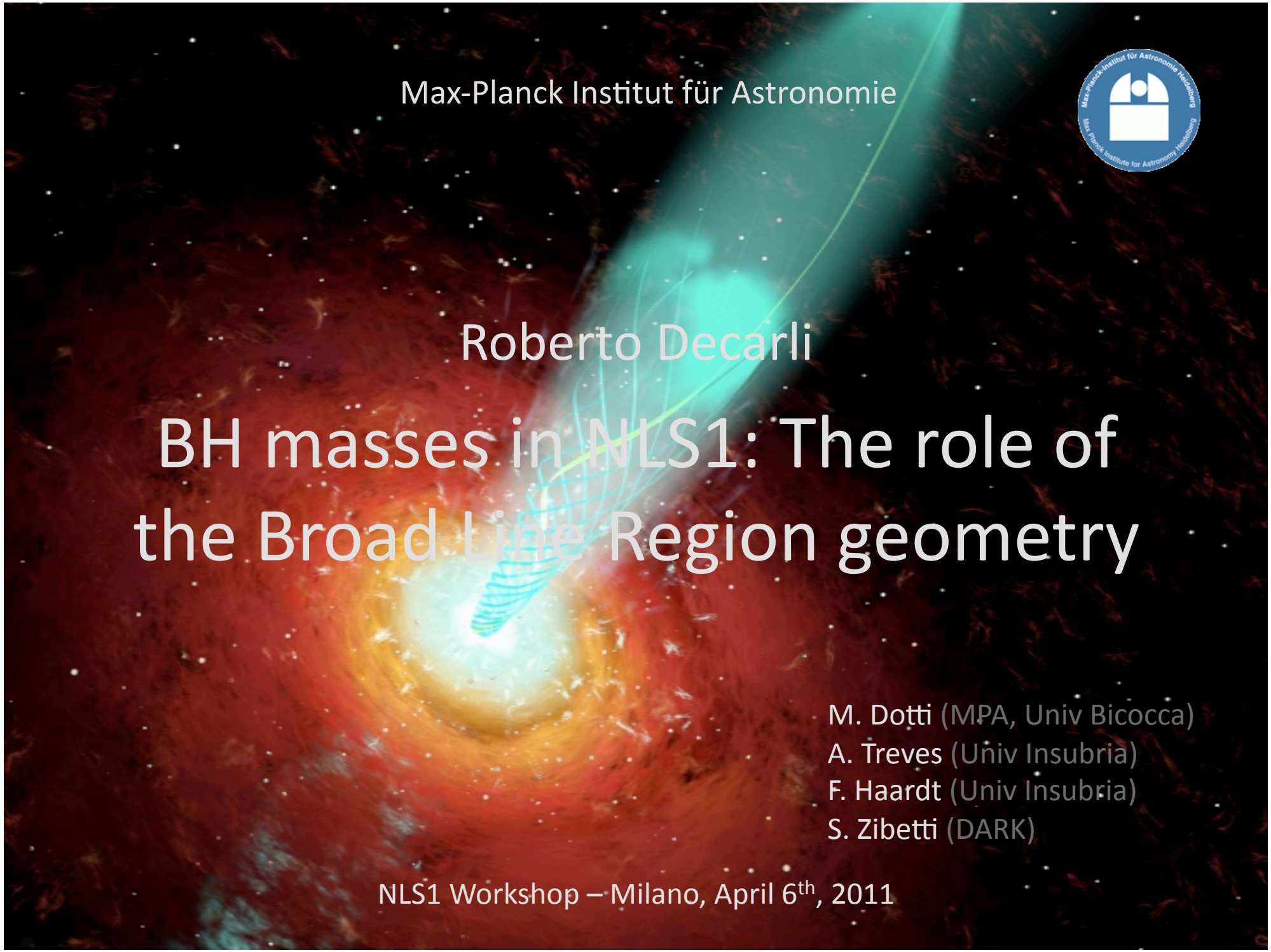


Max-Planck Institut für Astronomie

Roberto Decarli

BH masses in NLS1: The role of the Broad Line Region geometry

M. Dotti (MPA, Univ Bicocca)
A. Treves (Univ Insubria)
F. Haardt (Univ Insubria)
S. Zibetti (DARK)

NLS1 Workshop – Milano, April 6th, 2011

Black hole masses in

What w

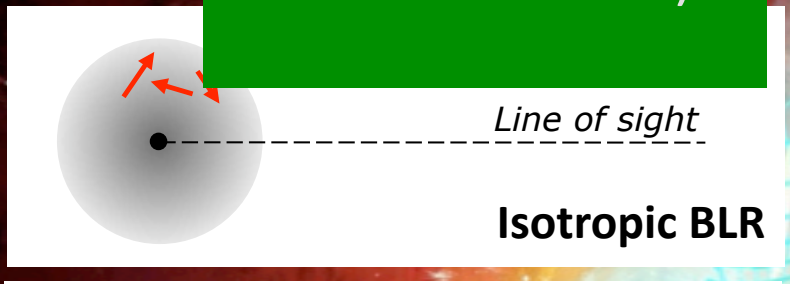
M_{BH}

From the host properties we estimate M_{BH} (hopefully, not such a bad idea)

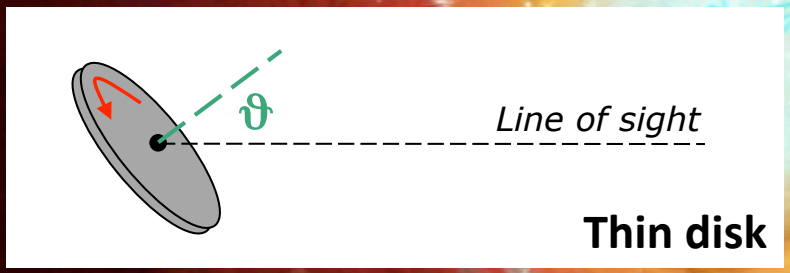
From spectra we infer L_{disk} and *FWHM*

What w actually d

$$M_{BH} = \frac{(A L_{disk}^{a})(f\,FWHM)^{2}}{G}$$

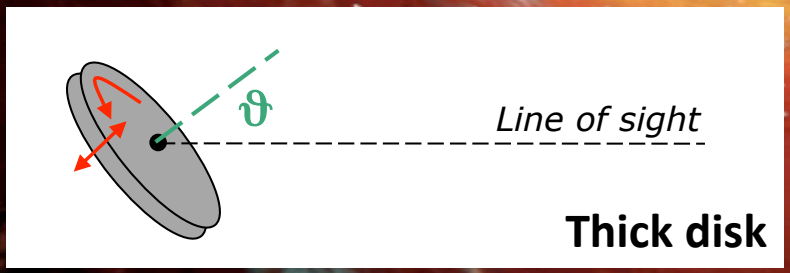


$f = \sqrt{3/4}$ Constant, < 1

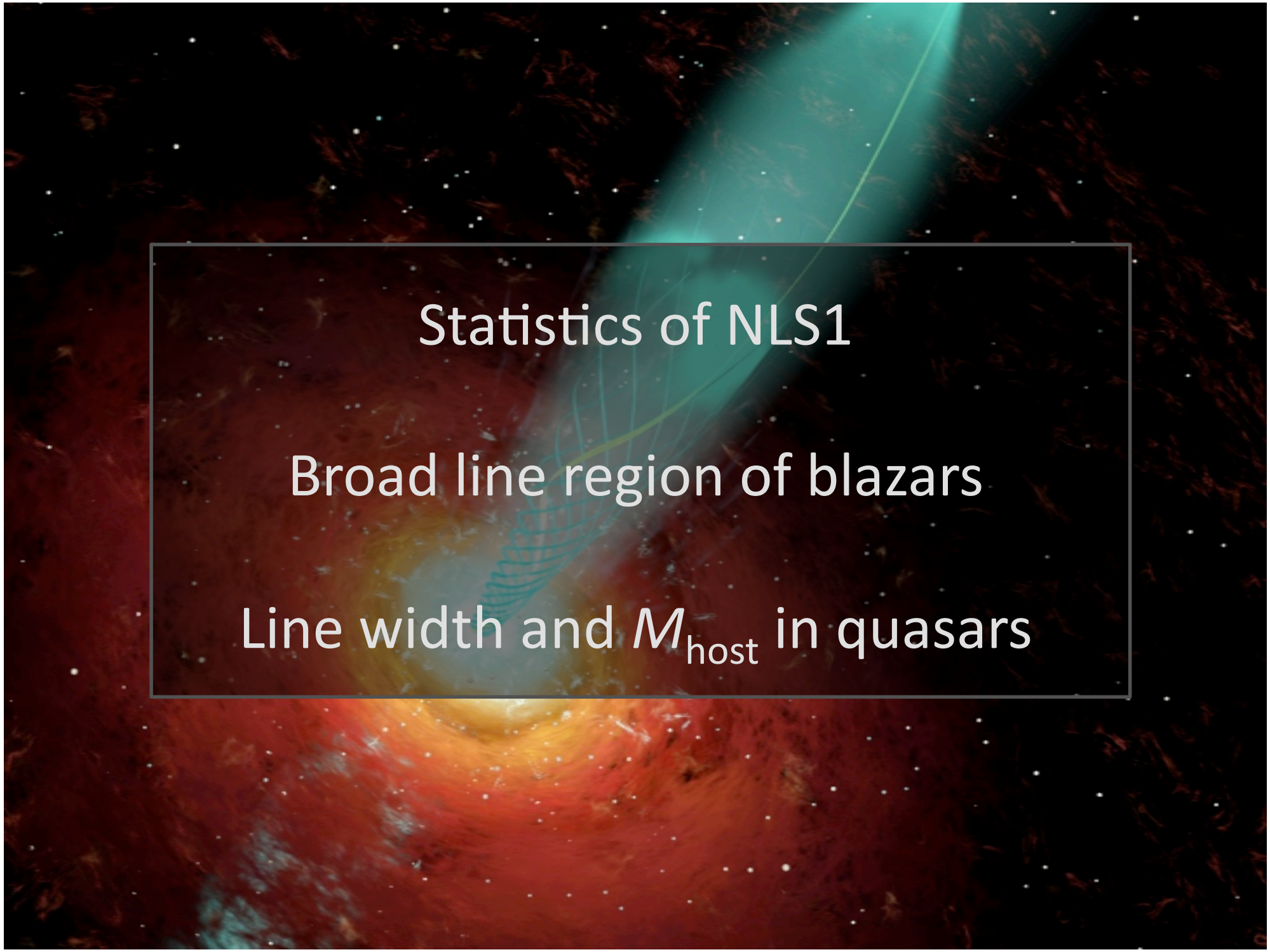


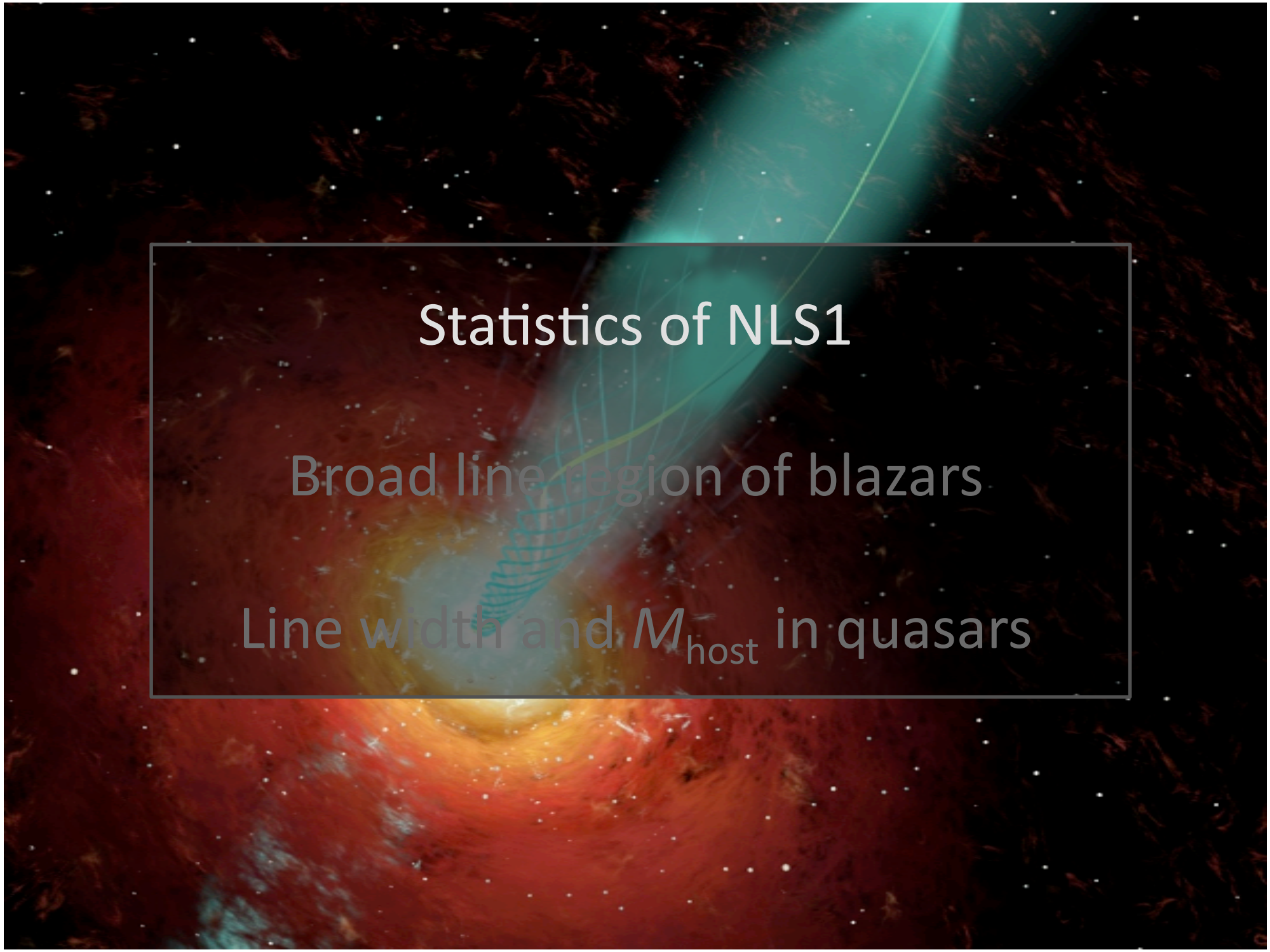
$$f = \frac{1}{2\sin\vartheta}$$ $0.5 < f < \infty$

See Martin Krause's talk!



$$f = \frac{1}{2\sqrt{\sin^{2}\vartheta + (H/R)^{2}}}$$ $0.5 < f < R / 2H$


Statistics of NLS1
Broad line region of blazars
Line width and M_{host} in quasars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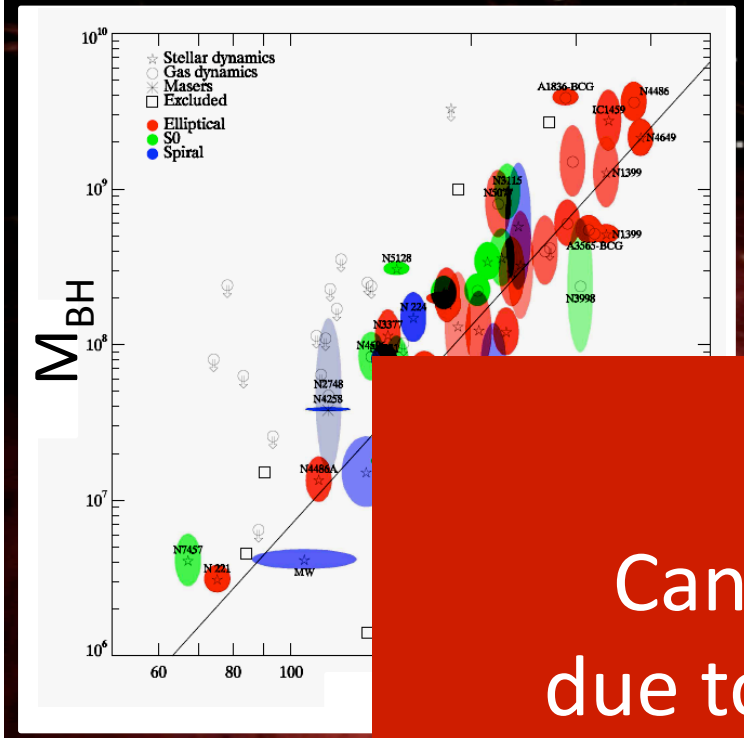
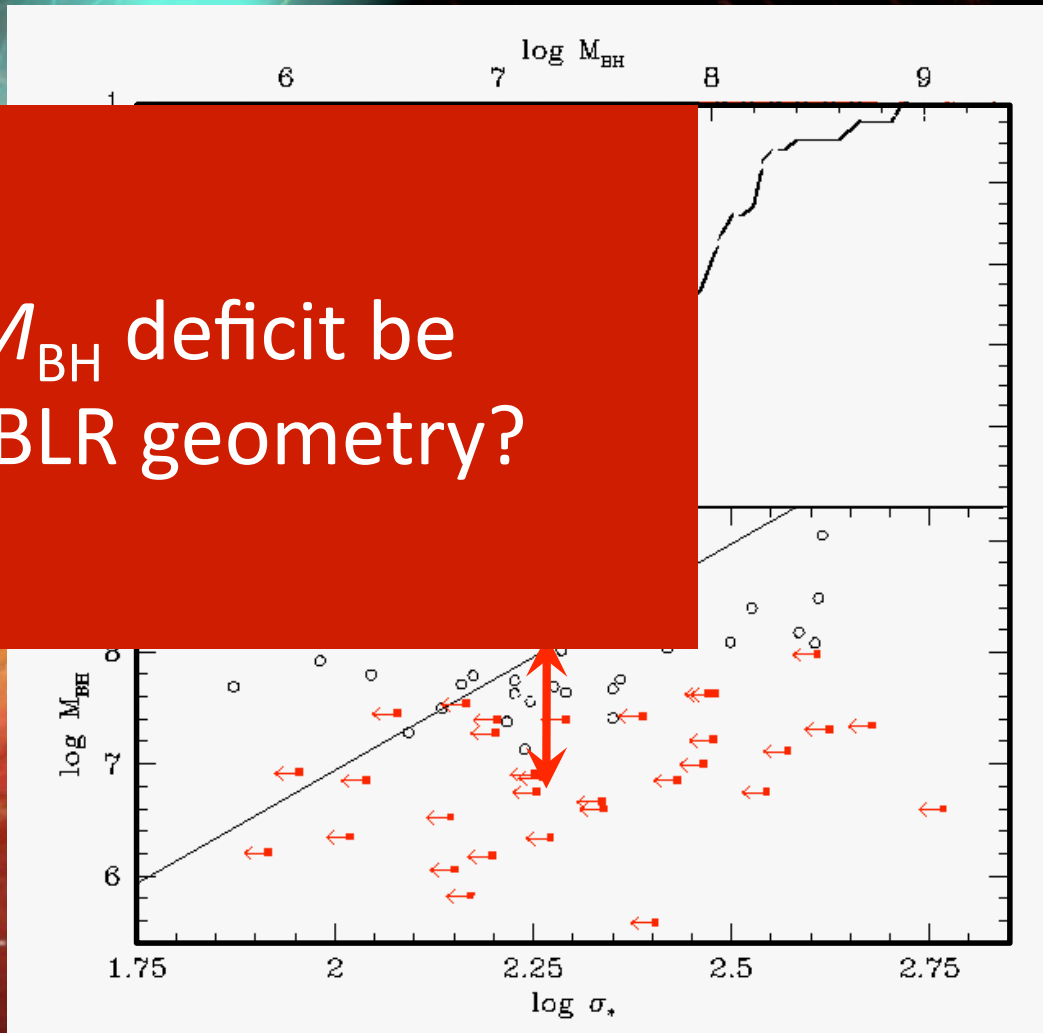
The "M_{BH} deficit" in NLS1

Black hole masses correlate with host galaxy σ_*, mass, luminosity



Gultekin et al. (2

Can the M_{BH} deficit be due to the BLR geometry?



Grupe & Ma

- Similar AGN Luminosity
- Similar host galaxy size
- Adopting $f = \sqrt{3}/2$, BH masses are 1 dex smaller!
- Consequently, L/L_{Edd} are higher

Decarli et al. (2008)

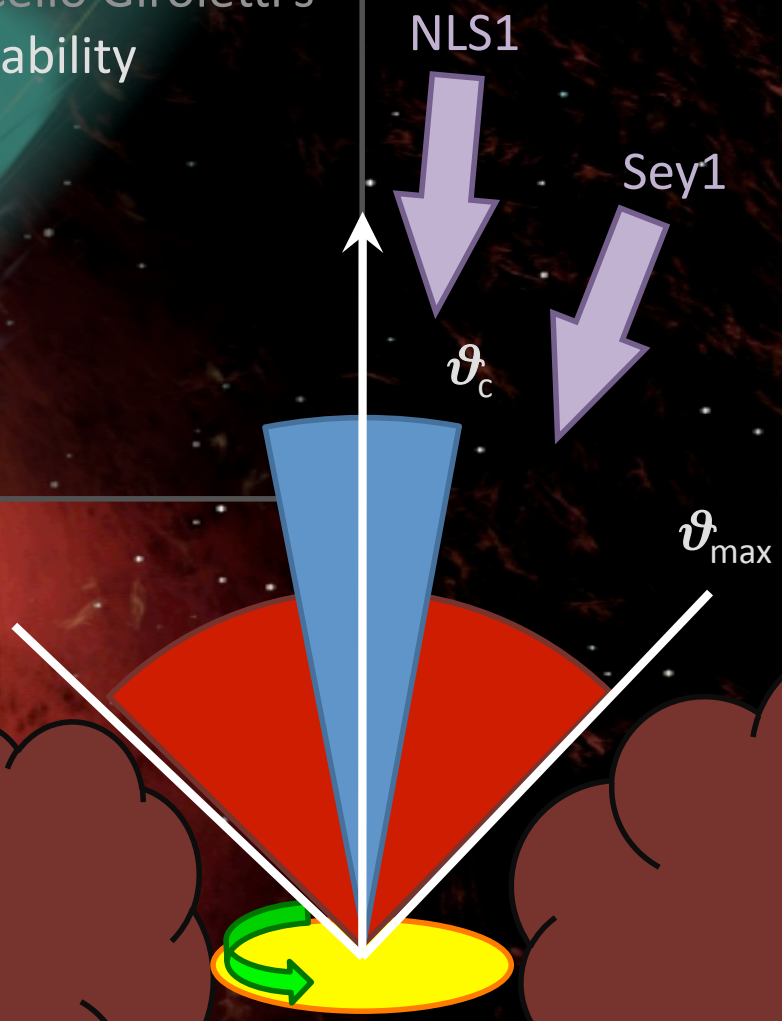
Clues from NLS1 statistics

See also T. Fischer's poster and M. Crenshaw's talk!

Continuous trends from "normal" Sey1 to NLS1
Blazar-like properties of some NLS1 nuclei: CSS radio emission (Dawei Xu's talk), polarization (Marcello Giroletti's talk), GeV emission (Luigi Foschini's talk), variability (various Tuesday talks)…

Do NLS1 have flat BLR seen pole-on?

NLS1 are ~ 15% of the "normal" Seyfert 1
15% of the solid angle => $\vartheta_c \approx 18$ deg



$$f = \frac{1}{2\sqrt{\sin^2\vartheta + (H/R)^2}}$$

$\vartheta < \vartheta_c$: $< f > = 2.5 - 3.8$

$\vartheta_c < \vartheta < \vartheta_{max}$: $< f > = 1.0$

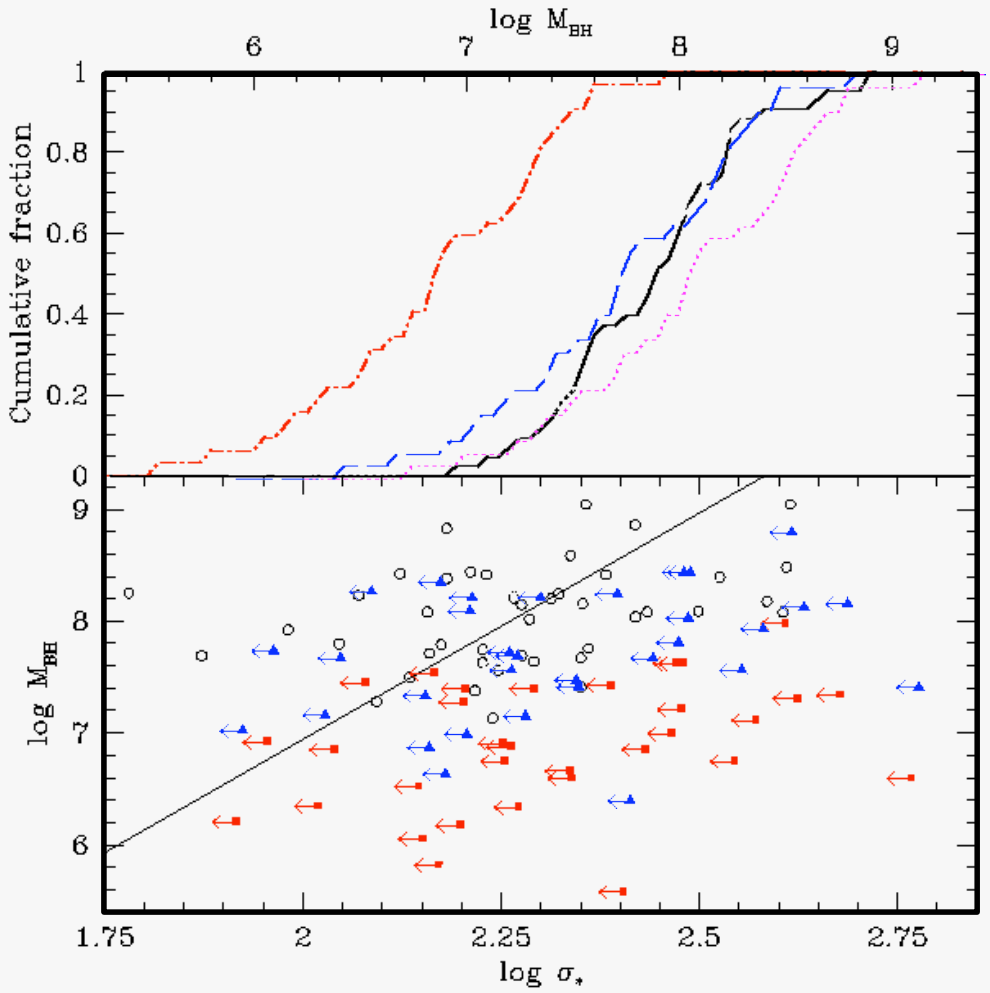
A cosmic conspiracy?

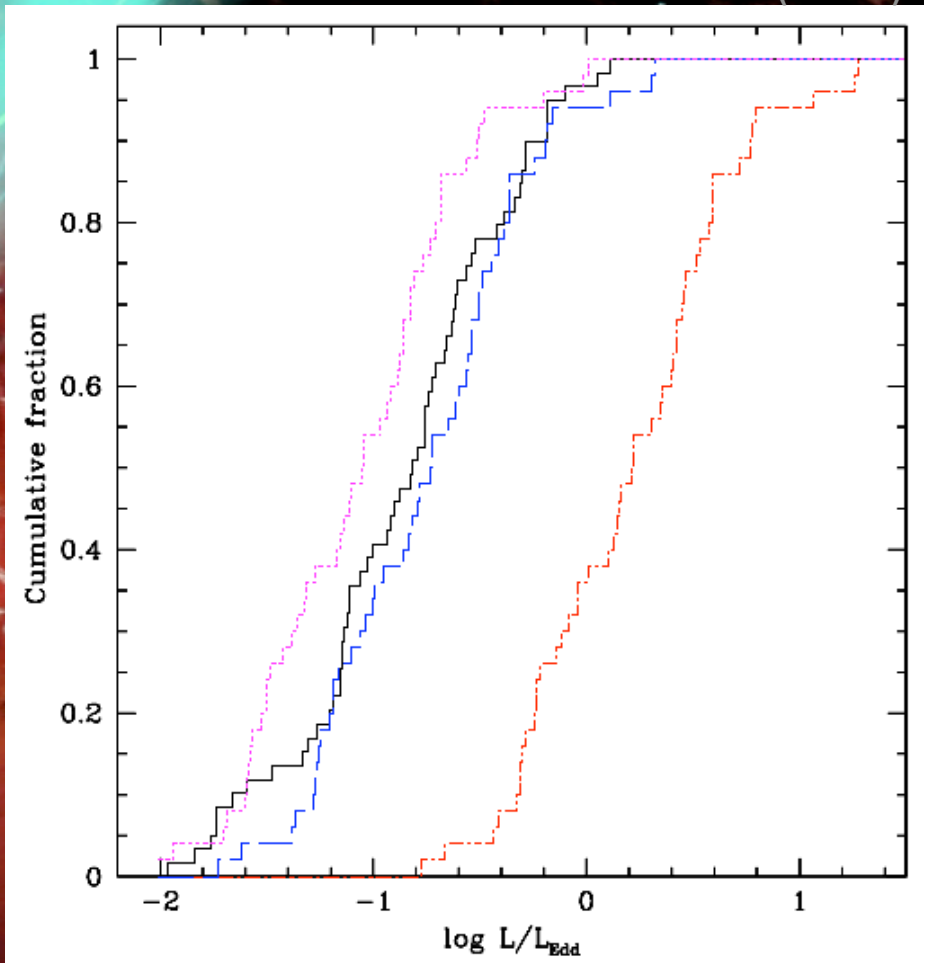
Once corrected for the new geometrical factor:

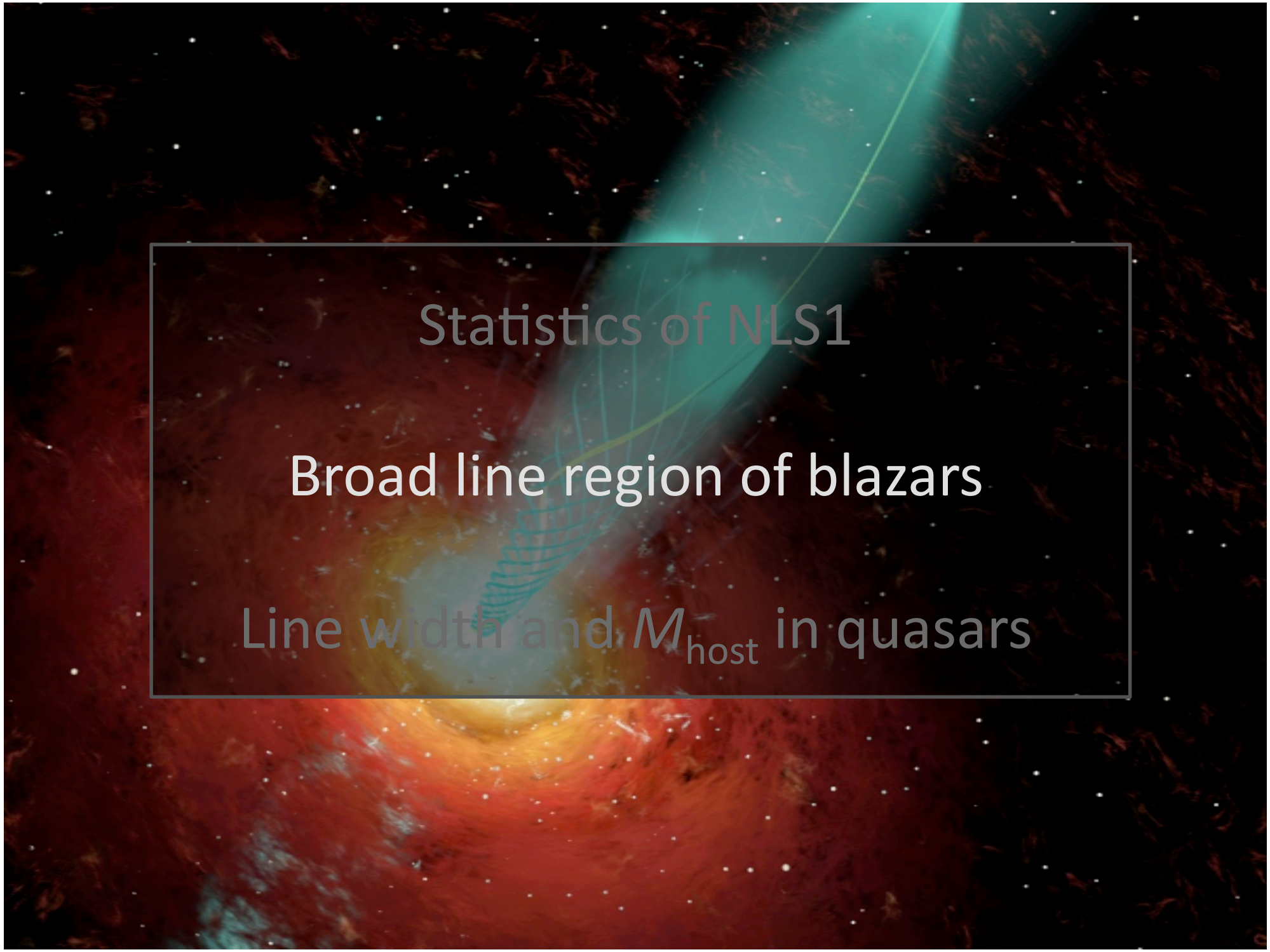
M_{BH} are consistent with the M_{BH} - σ_*

L/L_{Edd} are also consistent with those of normal Seyfert 1

Decarli et al. (2008)



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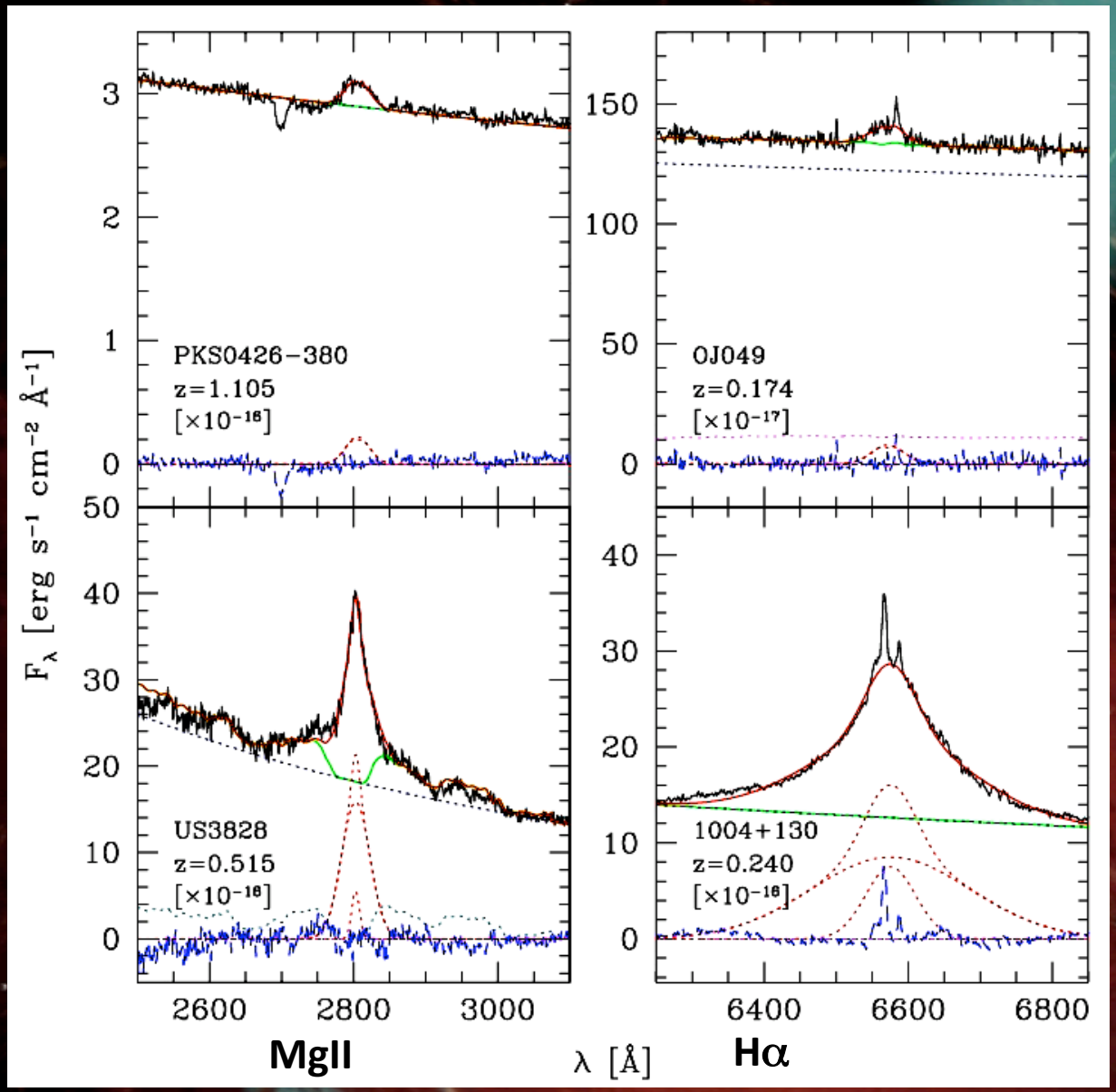
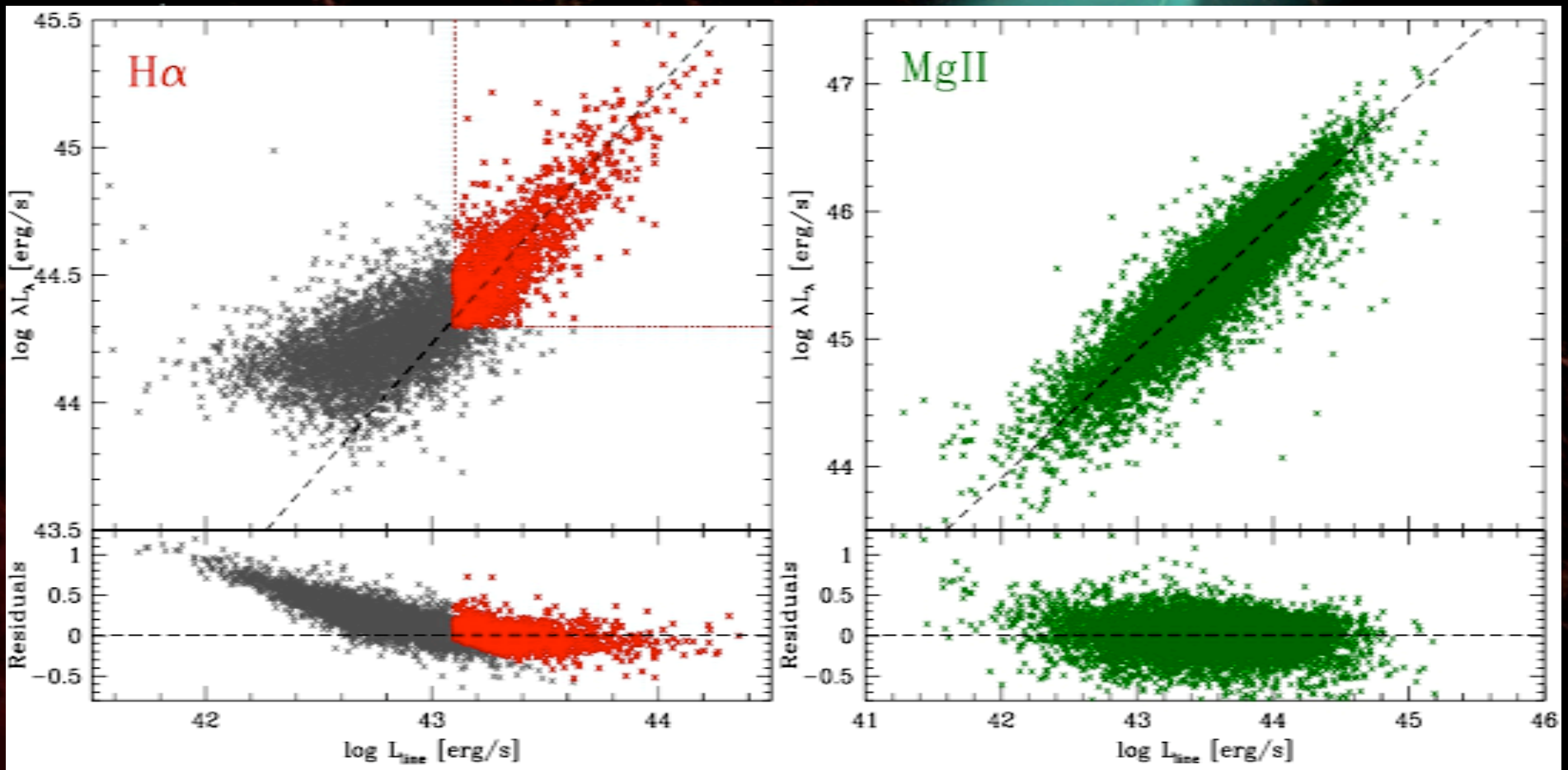
The realm of small inclination angles



$$f = \frac{1}{2\sqrt{\sin^2\vartheta + (H/R)^2}}$$

Jet pointing towards us, i.e., small ϑ

We select BL Lac, Blazars and quasars with detected broad lines and resolved host galaxies



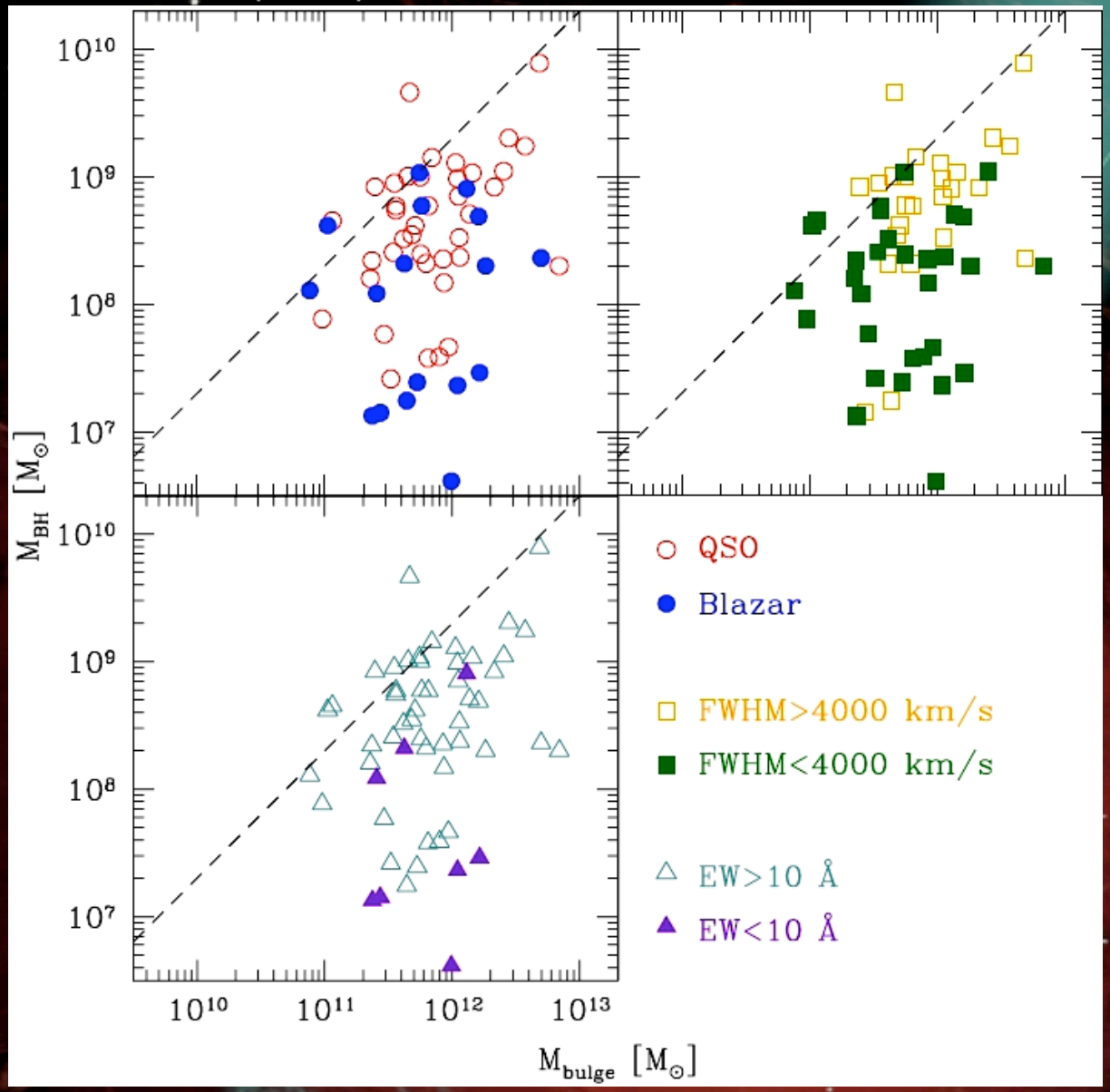
$$\left\langle \log \frac{\lambda L_\lambda(5100\ Ang)}{L_{line}(H\alpha)} \right\rangle = 1.23 \pm 0.14$$

$$\left\langle \log \frac{\lambda L_\lambda(3000\ Ang)}{L_{line}(MgII)} \right\rangle = 1.91 \pm 0.26$$

see also Vestergaard & Peterson (2006)

M_{BH}, f, FWHM & EW

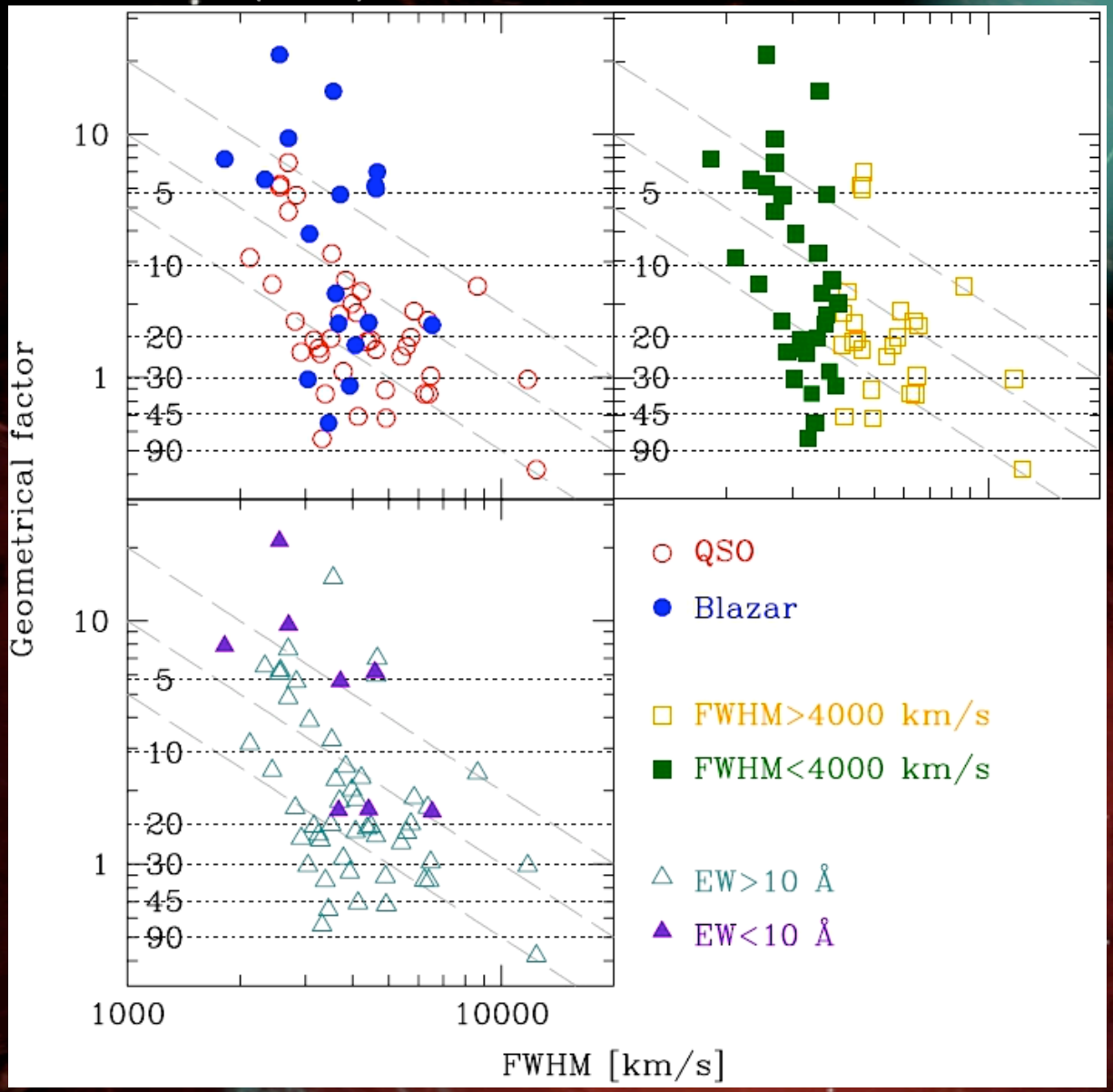
Decarli et al. (2011)



- Virial M_{BH} in blazars are systematically smaller than in QSOs

M_{BH}, f, FWHM & EW

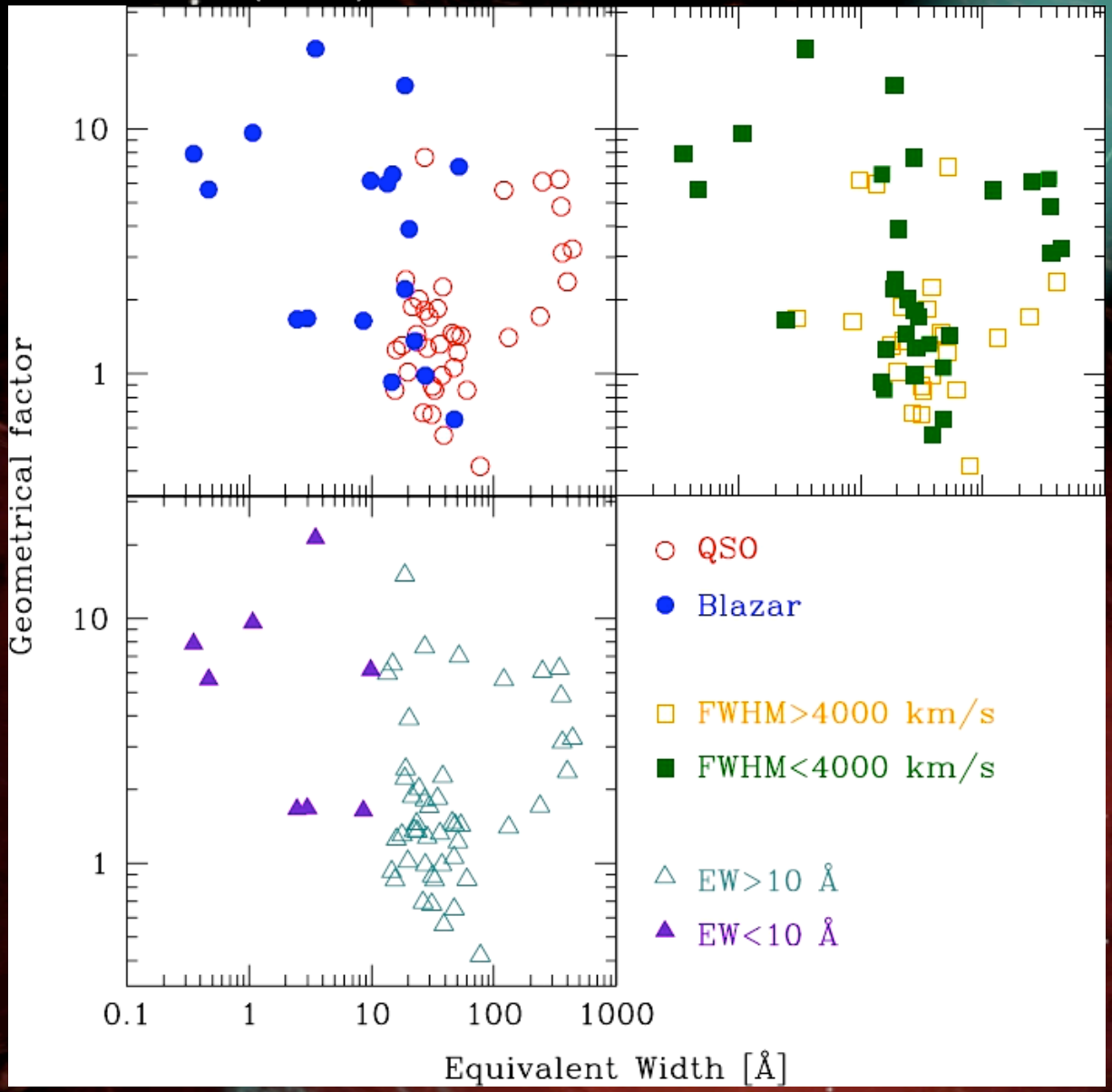
Decarli et al. (2011)



- Virial M_{BH} in blazars are systematically smaller than in QSOs
- f is anti-correlated to the FWHM
- Blazars (and BL Lac objs in particular) have systematically higher f and smaller FWHM than QSOs

M_{BH}, f, FWHM & EW

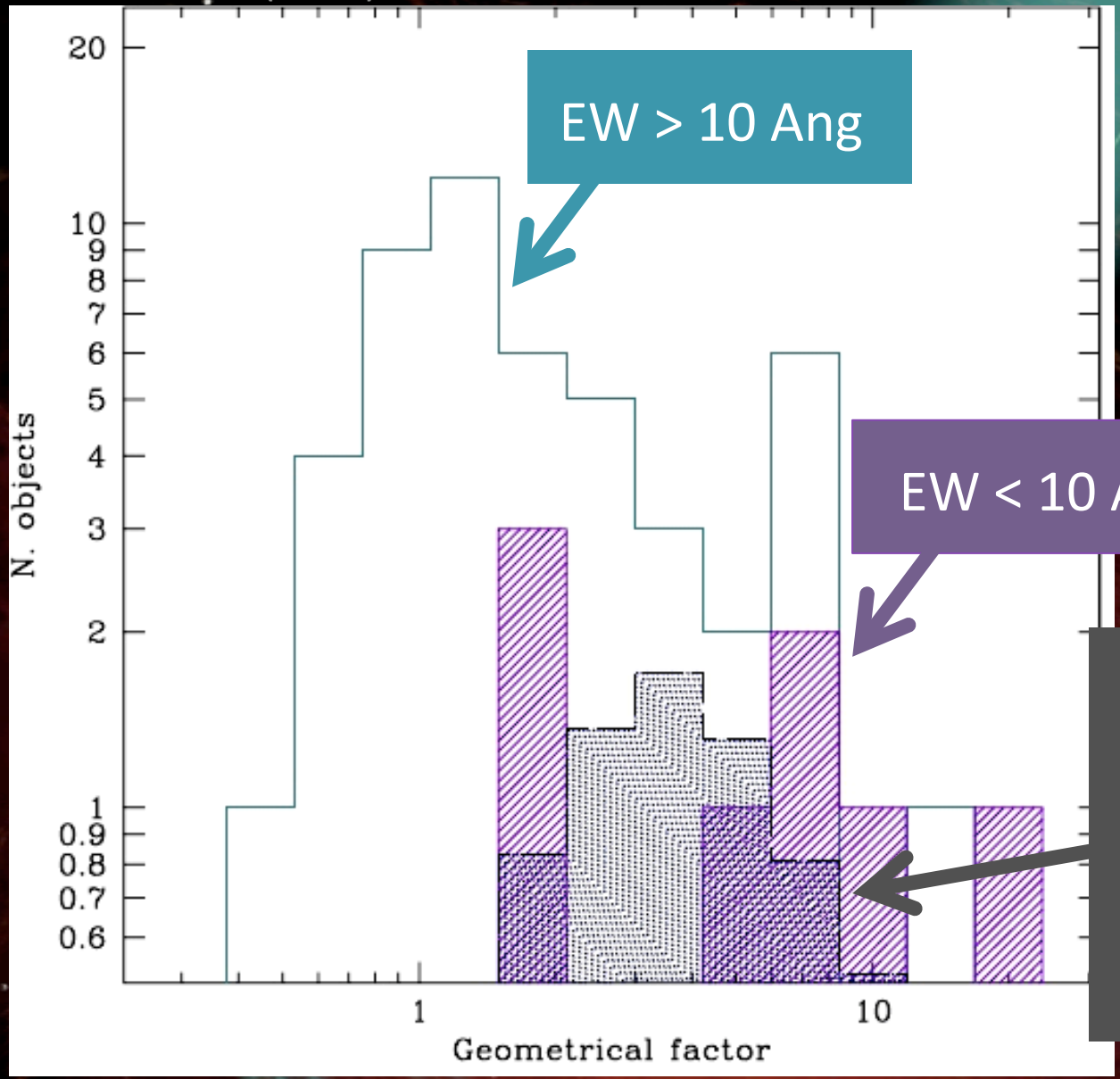
Decarli et al. (2011)



- Virial M_{BH} in blazars are systematically smaller than in QSOs
- f is anti-correlated to the FWHM
- Blazars (and BL Lac objs in particular) have systematically higher f and smaller FWHM than QSOs
- f also depends on the line EW

M_{BH}, f, FWHM & EW

Decarli et al. (2011)

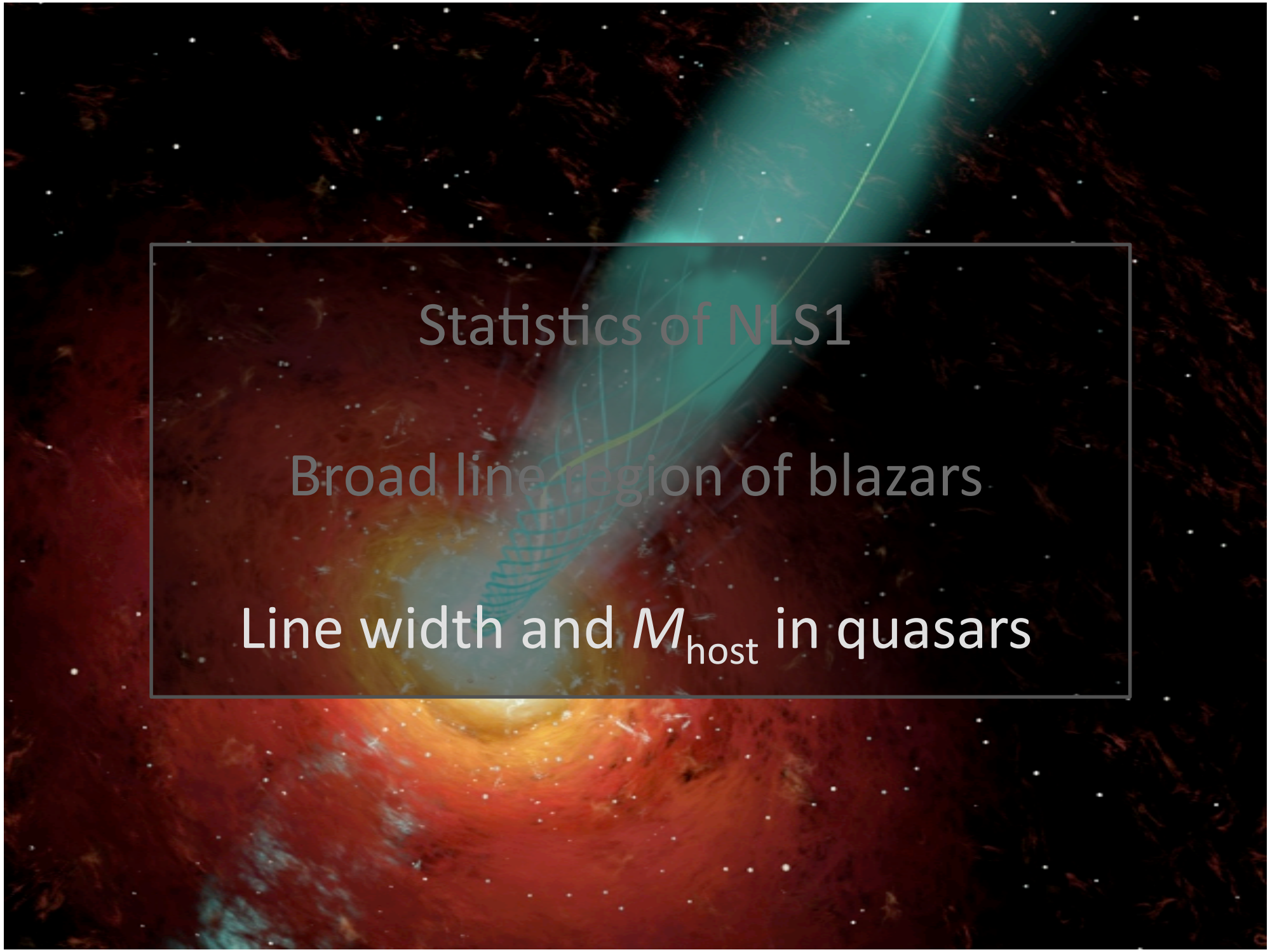


Expected distr. for:
ϑ < 10 deg
σ_ϑ = 10 deg
H/R = 0

- Virial M_{BH} in blazars are systematically smaller than in QSOs
- f is anti-correlated to the FWHM

zars (and BL Lac objs in particular)
tically
smaller
QSOs

ds on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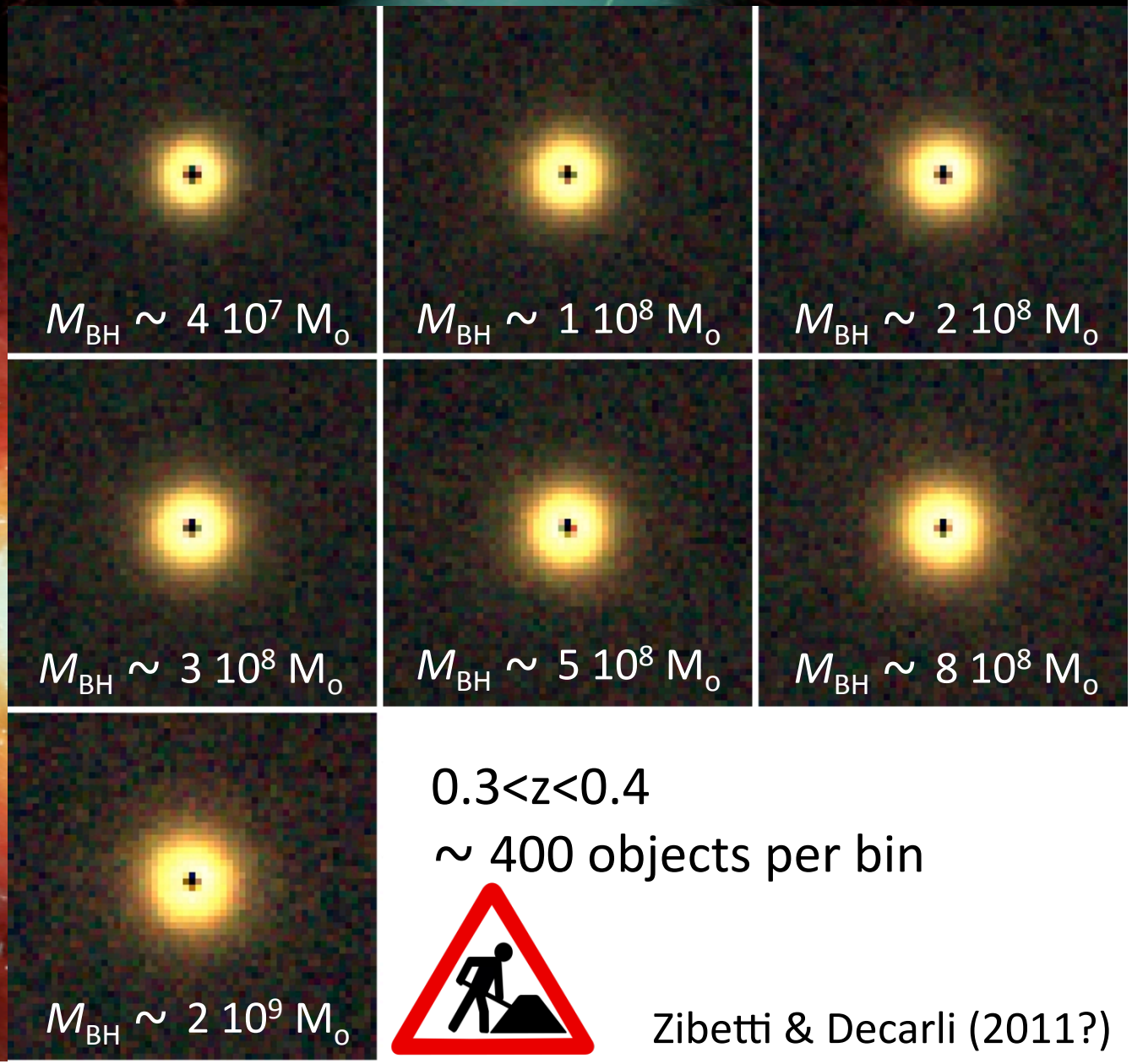
Quasar host from stacking of SDSS images

We study quasar host galaxies from stacked SDSS images in *griz*

~ 45,000 quasars at 0.3<z<1.3

1 TB of processed data

Stacked quasar images, stacked stars, net images, galfit fits



0.3<z<0.4

~ 400 objects per bin

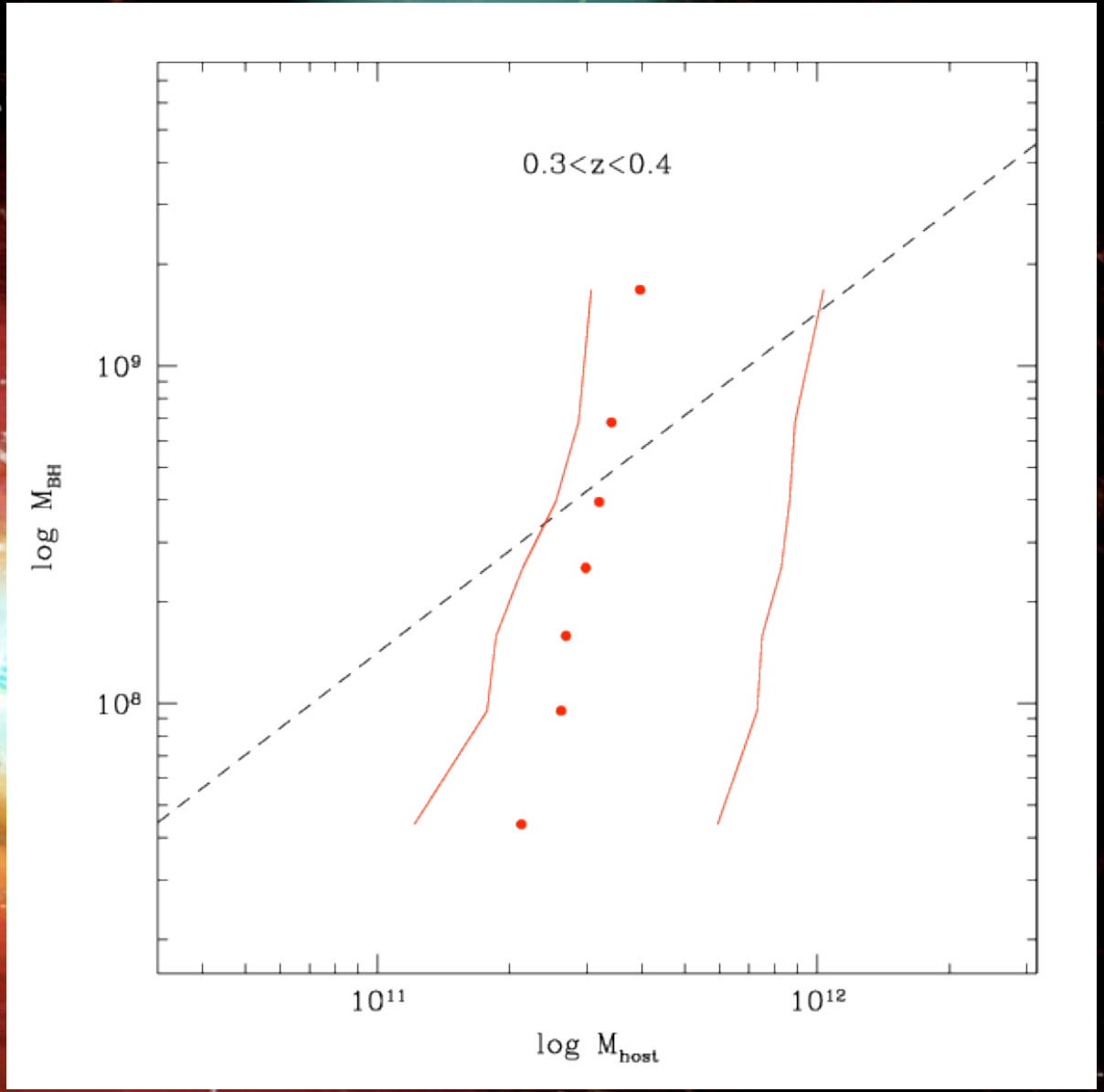
Zibetti & Decarli (2011?)

The M_{BH}/M_{host} relation at z>0

- The virial BH masses are only mildly correlated to the host galaxies!

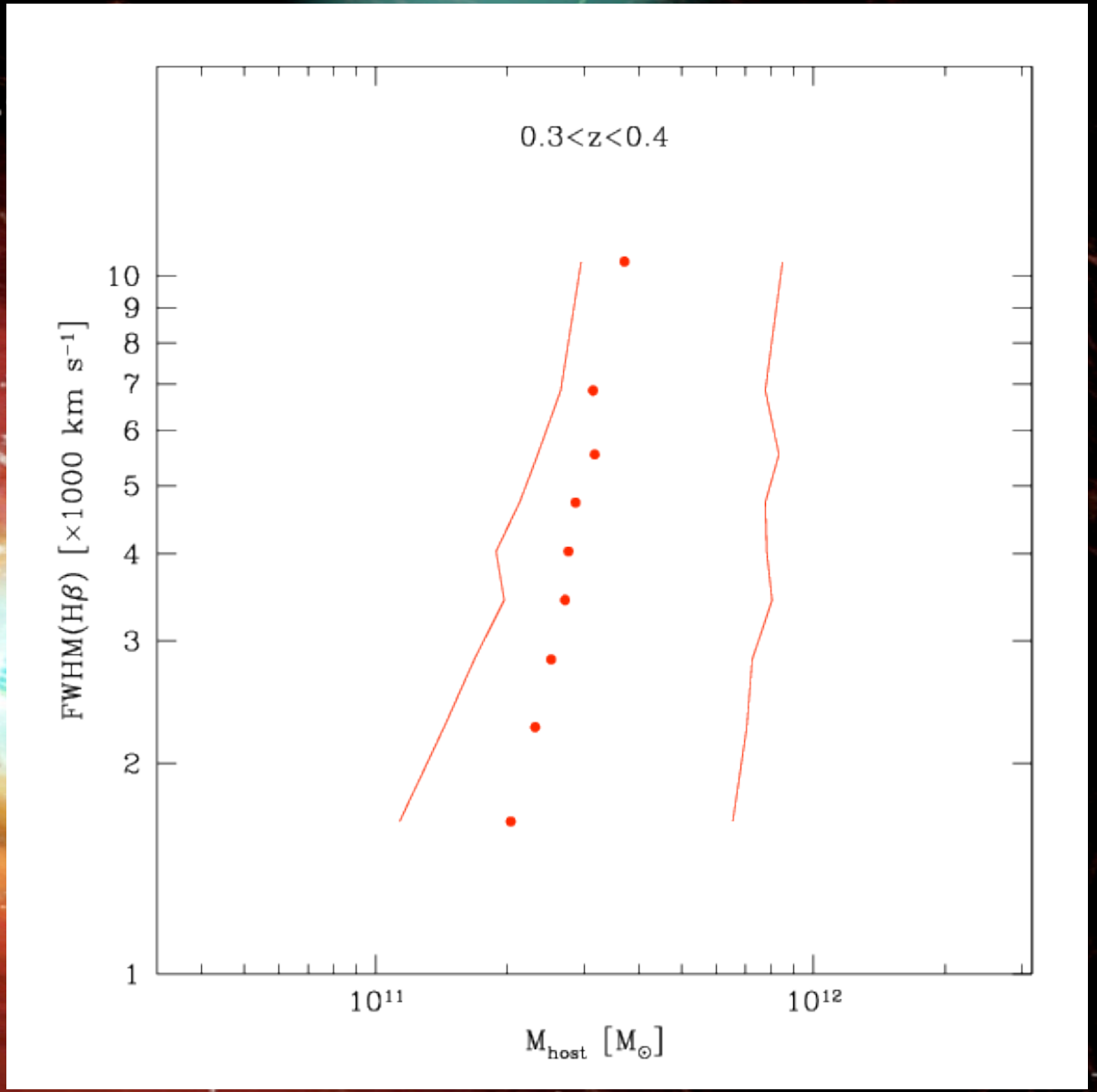
- But the relation *SHOULD* be in place at 0.3<z<0.4…

- What breaks the M_{BH}/M_{host} relation?

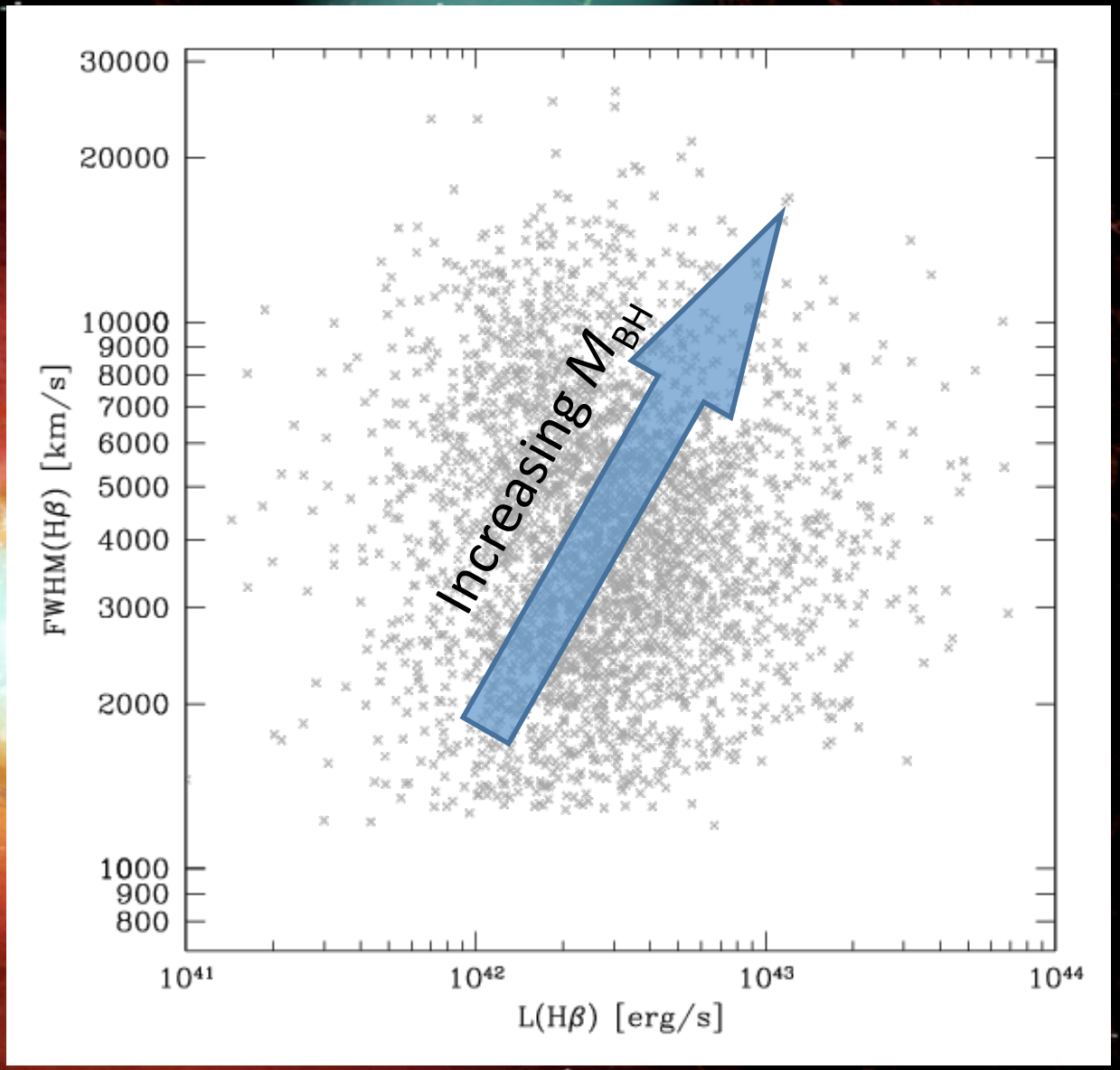


FWHM vs M_{host}

- Increasing the FWHM by a factor 7, M_{host} changes by a factor < 2!
- Is FWHM by itself a ***poor*** tracer of M_{BH}?
- Orientation?

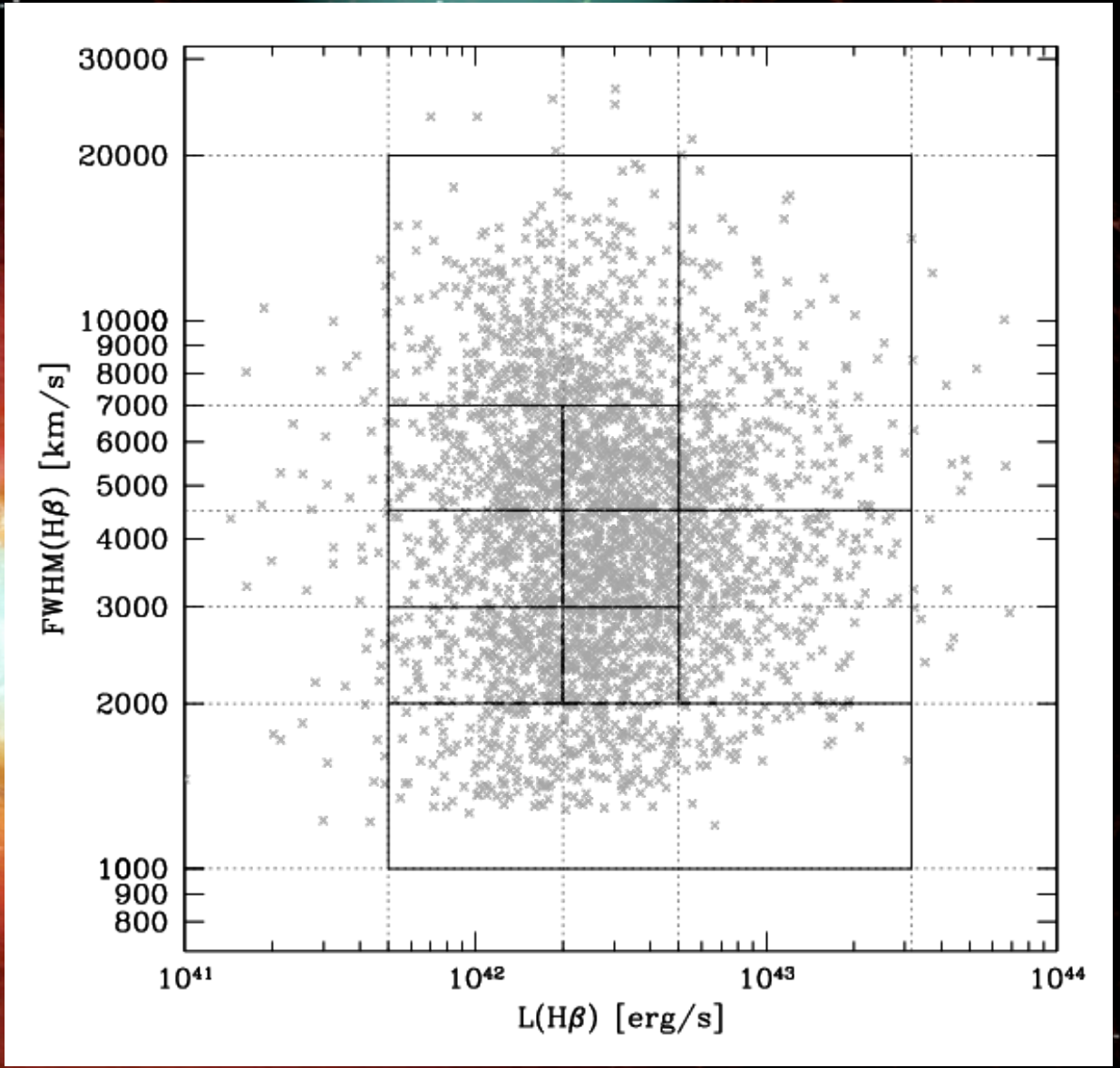


FWHM vs Luminosity vs L_{host}



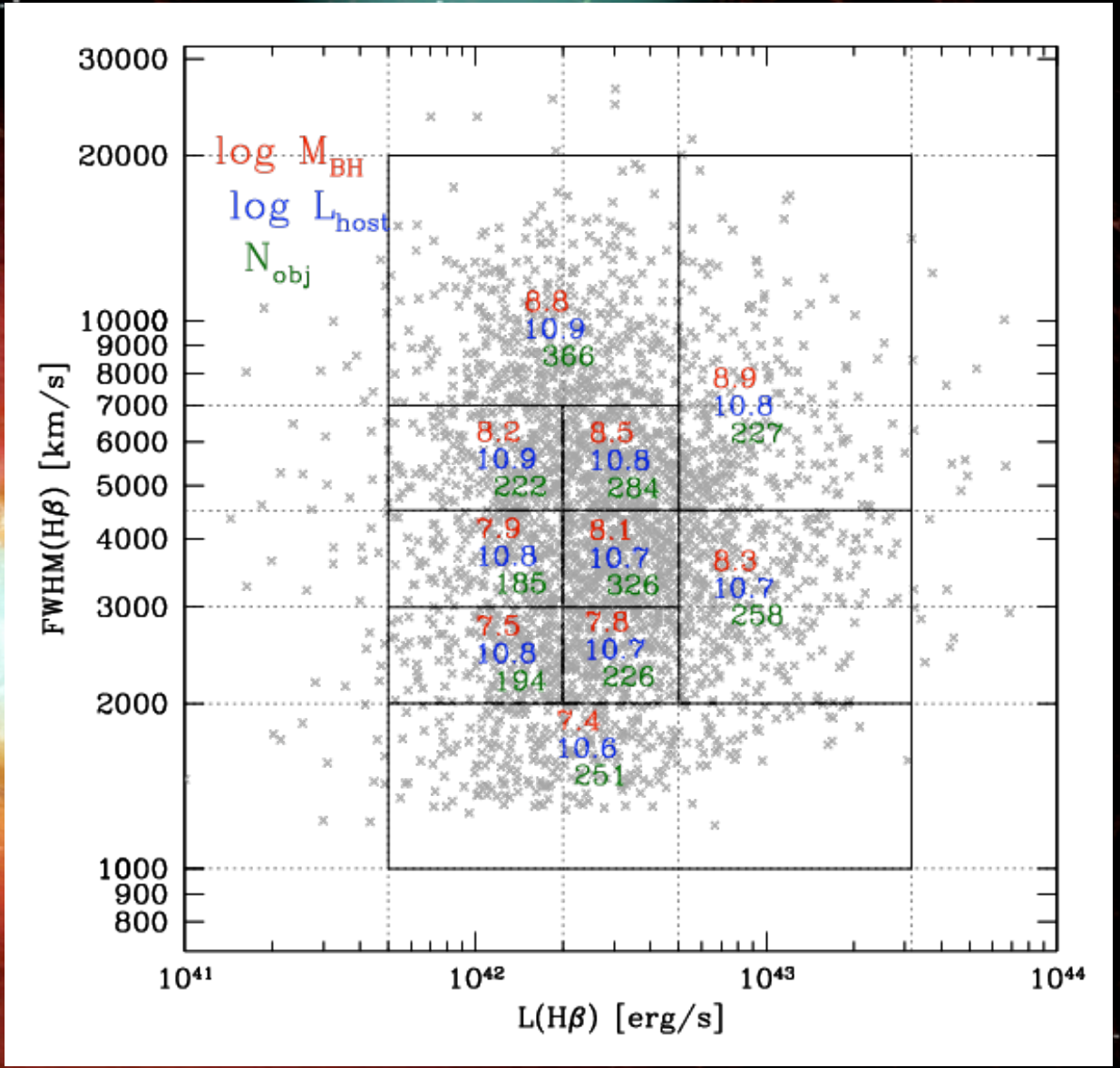
FWHM vs Luminosity vs L_{host}

We bin in blocks of similar FWHM and line luminosity



FWHM vs Luminosity vs L_{host}

- We bin in blocks of similar FWHM and line luminosity
- The virial grows towards the top-right corner
- The stacked host luminosity is almost constant



Conclusions

A geometrical factor $f > 1$ is expected for disk-like BLR

This could affect the virial mass estimates in pole-on systems, in particular yielding:

- the "M_{BH} deficit" and the unusually high L/L_{Edd} in NLS1
- the deviation from the M_{BH}/M_{host} relation in blazars
- the lack of correlation between FWHM and L_{host} in low-z quasars from stacking

CAVEATS:

1) All these are purely *demographic* approaches
2) We *assumed* the M_{BH}–host galaxy relations to be valid for all the AGN
3) We don't have any prediction on X-ray, radio, host galaxy SF (see Sani and Orban de Xivry's talks), etc