Detection of faint broad emission lines in AGN2

The M_{BH}-σ_* relation of AGN2 and the unified model

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ABSTRACT. Type 2 active galactic nuclei (AGN) represent the majority of the AGN population. However, due to the difficulties in measuring their black hole (BH) masses, it is still unknown whether they follow the same BH mass-host galaxy scaling relations valid for quiescent galaxies and type 1 AGN. Here we present the locus of type 2 AGN having virial BH mass estimates in the $M_{BH} - \sigma\star$ plane. Our analysis shows that the BH masses of type 2 AGN are ~ 0.9 dex smaller than type 1 AGN at $\sigma\star$ ~ 185 km s^{-1}, regardless of the (early/late) AGN host galaxy morphology. Equivalently, type 2 AGN host galaxies have stellar velocity dispersions ~ 0.2 dex higher than type 1 AGN hosts at M_{BH} ~ 10^7 $M_\odot$.
This result disagrees with standard AGN unification scenarios in which AGN1 and AGN2 are the same objects observed along different viewing angles with respect to a toroidal clumpy absorbing material.

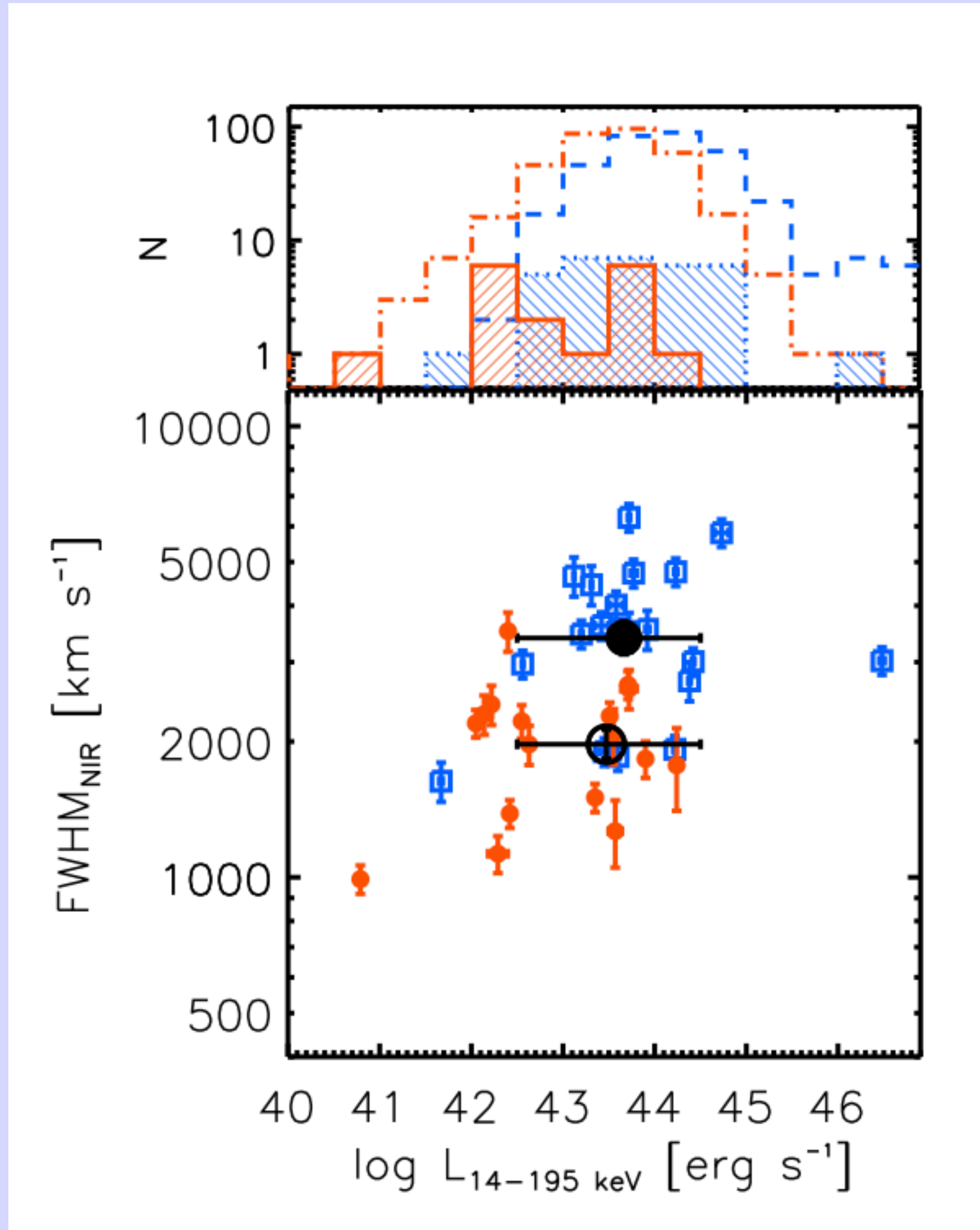

Fig. 1. *Top.* Distribution of L_X of the **AGN2** (red continuous line) and Reverberation Mapping **AGN1** control sample (blu dotted line). The red dot dashed and the blu dashed lines show the distribution of the **AGN2** and **AGN1** of the *Swift*/BAT 70-month catalogue. *Bottom.* Average FWHM of the BLR of the NIR lines (Paβ and HeI) of **AGN1** (blue open squares) and **AGN2** (red filled circles) as a function of the intrinsic 14-195 keV luminosity, L_X. The black filled (open) circle show the FWHM average value of the total **AGN1** (**AGN2**) sample in the 42.5< log(L_X/erg s^{-1}) <44.5 luminosity bin and has been plotted at the position of the average logL_X (Onori et al. 2017b).

In the luminosity range 42.5<logL_X<44.5, where the two distributions overlap, **AGN2 show on average significantly smaller FWHM than AGN1** (1970 km s^{-1} instead of 3400 km s^{-1}).

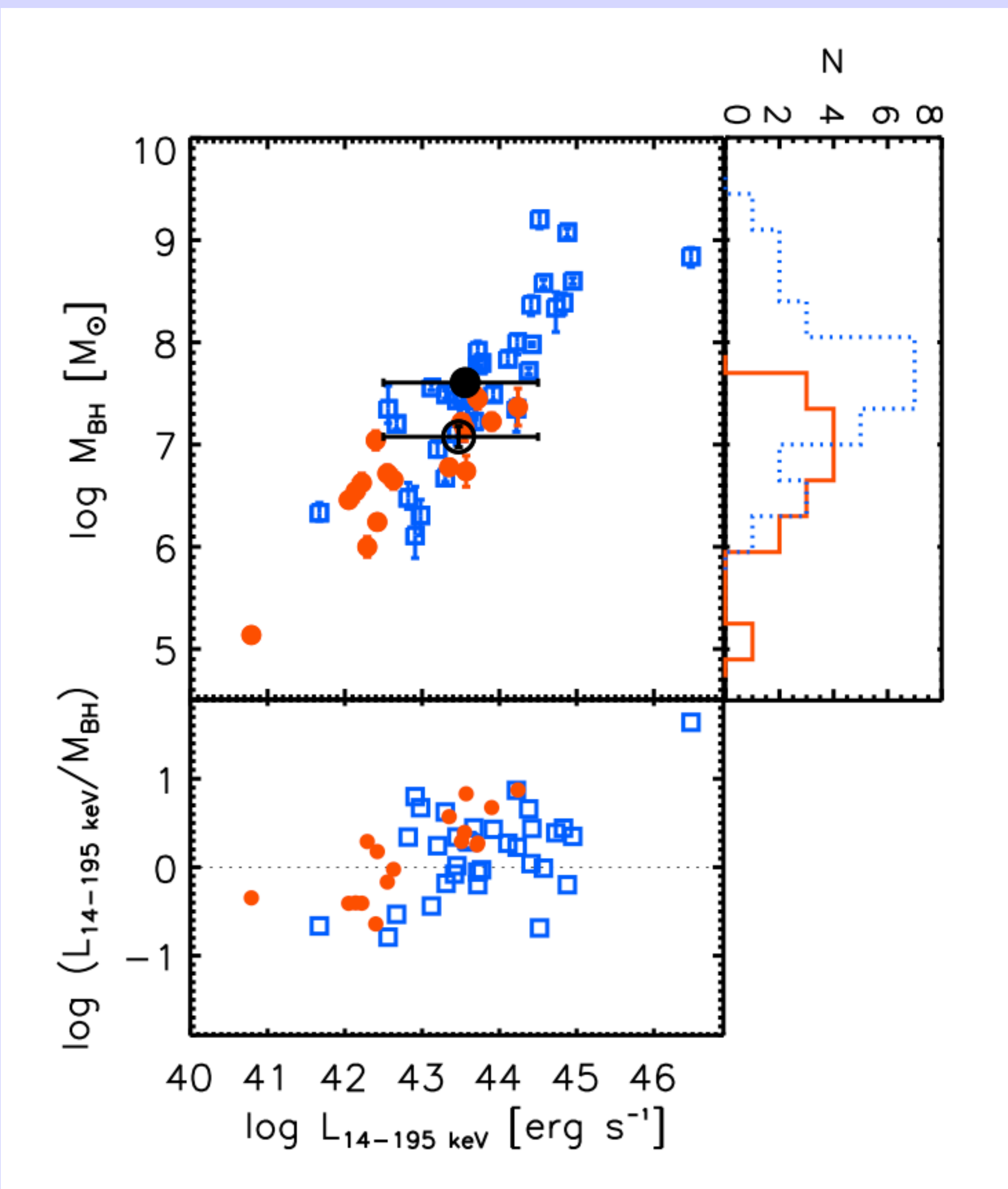

Fig. 2. *Center*. Black hole masses of **AGN1** (blue open squares) and **AGN2** (red filled circles) as a function of L_X. The black filled (open) circle shows the M_{BH} average value of the total **AGN1** (**AGN2**) sample in the 42.5< log(L_X/erg s^{-1}) <44.5 luminosity bin and has been plotted at the position of the average logL_X. The right panel shows the projected distributions of M_{BH} of the **AGN1** (blu dotted line) and **AGN2** (red continuous line) samples. *Bottom*: Ratio between L_X and M_{BH} (plus a constant) of the **AGN1** (blue open squares) and **AGN2** (red filled circles) as a function of L_X (Onori et al. 2017b).

In order to compute the BH masses of the AGN2 we used the following relation calibrated by Ricci et al. (2017a):

$$\log\left(\frac{M_{BH}}{M_\odot}\right) = 7.75 + 2\log\left(\frac{FWHM_{NIR}}{10^4\ \mathrm{km\ s^{-1}}}\right) + 0.5\log\left(\frac{L_{14-195\ \mathrm{keV}}}{10^{42}\ \mathrm{erg\ s^{-1}}}\right) \quad (1)$$

As expected from the analysis of the FWHM distributions, it results that in the 42.5<log(L_X/erg s^{-1})<44.5 luminosity bin **the average M_{BH} of the AGN2 sample (log(M_{BH}/$M_\odot$) = 7.08 ± 0.10) is ~0.5 dex smaller than measured in the AGN1** sample (log(M_{BH}/$M_\odot$) = 7.61 ± 0.01).

The **BH masses of AGN2 are ~ 0.9 dex smaller than AGN1 at $\sigma\star$ ~ 185 km s^{-1}**, regardless of the (early/late) AGN host galaxy morphology. Equivalently, AGN2 host galaxies have stellar velocity dispersions ~ 0.2 dex higher than AGN1 hosts at M_{BH} ~ 10^7 $M_\odot$.
This result disagrees with standard AGN unification scenarios in which AGN1 and AGN2 are the same objects observed along different viewing angles with respect to a toroidal absorbing material.

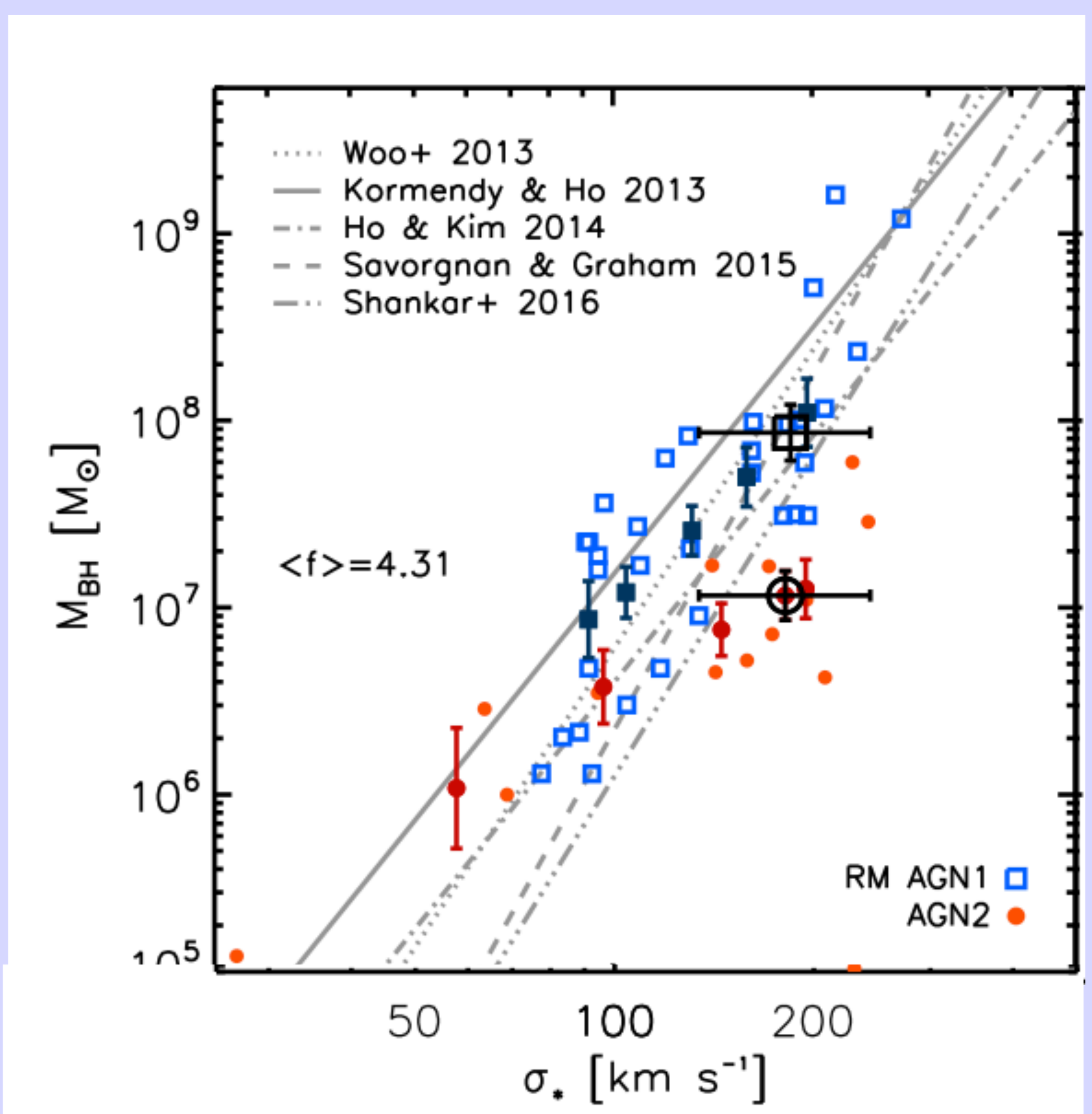

Fig. 3. The $M_{BH} - \sigma\star$ plane for local samples of RM AGN1 (blue open squares) and AGN2 (red filled circles), together with average M_{BH} of the RM AGN1 (dark blue) and AGN2 (dark red), computed in (not independent) bins of stellar velocity dispersion. The black open square (circle) shows the M_{BH} average value of the RM AGN1 (AGN2) sample in the 135 < $\sigma\star$ < 250 km s^{-1} stellar velocity bin and has been plotted at the position of the average $\sigma\star$ (Ricci et al. 2017b).

Related papers
Onori F., La Franca F., Ricci F. et al., 2017a, MNRAS, 464, 1783
Ricci F., La Franca F., Onori F., Bianchi S., 2017a, A&A, 598, A51
Onori F., Ricci F., La Franca F. et al., 2017b, MNRAS Letters, 468, L97
Ricci F., La Franca F. et al., 2017b, MNRAS Letters on line, arXiv:1706.06110