The $M_{\text{BH}} - M_{\text{Bulge}}$ relation for low-z AGN: preliminary analysis of a sample from SDSS-DR4 data

D. Bettoni, R. Falomo
INAF - Osservatorio astronomico di Padova

M. Salvato
California Institute of Technology
Estimating black hole masses

• Dynamical measurement
• BLR line widths plus region size
  – reverberation mapping
  – $M_{\text{BH}} - L_{\text{rad}}$ relation
• X-ray Fe line
• $M_{\text{BH}} - \sigma$ relation
  – direct measurement
  – through fundamental plane
Investigate the Black Hole mass distribution of a large and homogeneous datasets of low-redshift AGN.

We plan to use $L_{5000}$ and $H_\beta$ to derive $M_{BH}$

We will try to answer the following question: Can we use SDSS images to measure $M_{Bulge}$ for AGN? And derive $M_{BH}$ from $M_{Bulge}$?
400 AGN black hole masses

• Collected ~200 from literature
• Estimated ~200 using host galaxy properties
• Measured bolometric luminosities from SEDs
Figure showing a scatter plot with data points labeled RLQ, RQQ, SY 1, and SY 2. The plot compares $L_{\text{bol}}$ (erg/sec) on the y-axis with $M_{\text{BH}}/M_{\odot}$ on the x-axis. The plot includes a line indicating $L=L_{\text{Edd}}$, and another line indicating $L=0.001 L_{\text{Edd}}$. The image is credited to Woo et al. 2002.
Radio luminosity vs. $M_{BH}$

Woo et al. 2002
The $M_{\text{BH}} - M_{\text{Bulge}}$ relation for low-z AGN

McLure and Jarvis 2004
The $M_{BH} - M_{Bulge}$ relation for low-z AGN

The Sloan sample

Redshift range: $0.01 < z < 0.3$

$\frac{deV_r}{r} > 0.8$

Sloan flag “QSO” or “High-z QSO”

$EW H_\beta > 5$

$EW O\text{III} > 0$
The $M_{\text{BH}}$-$M_{\text{Bulge}}$ relation for low-z AGN

Two steps:

Measure the spectra and derive $L_{5000}$ and FWHM of $H_{\beta}$

Analyse the images using GALFIT in order to separate the Bulge luminosity from the luminosity of the central Point Source
The $M_{BH} - M_{Bulge}$ relation for low-z AGN
The $M_{BH}$-$M_{Bulge}$ relation for low-z AGN

![Graphs showing the relation between $M_{BH}$ and $M_{Bulge}$ for low-redshift AGN using EqW OIII and EqW Hβ.]
The $\text{M}_{\text{BH}} - \text{M}_{\text{Bulge}}$ relation for low-z AGN
The $M_{\text{BH}} - M_{\text{Bulge}}$ relation for low-z AGN
The $M_{\text{BH}}-M_{\text{Bulge}}$ relation for low-z AGN
The $M_{BH} - M_{Bulge}$ relation for low-z AGN
The $M_{\text{BH}}-M_{\text{Bulge}}$ relation for low-z AGN

Fit: $R^{1/4} + \text{PSF}$

Fit: $R^{1/4} + \text{PSF} + \text{Point source}$
The $M_{\text{BH}}$-$M_{\text{Bulge}}$ relation for low-z AGN
The $M_{BH} - M_{Bulge}$ relation for low-z AGN
The $M_{\text{BH}} - M_{\text{Bulge}}$ relation for low-z AGN

Fit: $R^{1/4} + \text{PSF}$

Fit: $R^{1/4} + \text{PSF} + \text{Point source}$
The $M_{BH} - M_{Bulge}$ relation for low-z AGN
The $M_{BH} - M_{Bulge}$ relation for low-z AGN
The $M_{\text{BH}}$-$M_{\text{Bulge}}$ relation for low-z AGN

Fit: $R^{1/4} + \text{PSF}$  
Fit: $R^{1/4} + \text{PSF} + \text{Point source}$
The $M_{\text{BH}} - M_{\text{Bulge}}$ relation for low-z AGN
The $M_{\text{BH}}-M_{\text{Bulge}}$ relation for low-z AGN
The $M_{\text{BH}}-M_{\text{Bulge}}$ relation for low-z AGN

Fit: $R^{1/4} + \text{PSF}$

Fit: $R^{1/4} + \text{PSF} + \text{Point source}$
The $M_{\text{BH}}$-$M_{\text{Bulge}}$ relation for low-z AGN

Fit: $R^{1/4} + \text{PSF}$
The $M_{BH} - M_{Bulge}$ relation for low-z AGN
The $M_{\text{BH}}$-$M_{\text{Bulge}}$ relation for low-z AGN

Results

We have to check the $L_{5000}$ and $H_\beta$ data to correct for stellar continuum

YES: Using GALFIT we can derive the bulge magnitude in AGN until $z\sim 0.25-0.3$

Using GALFIT we can also measure the effective radius ($r_e$) of the true bulge component and derive the Kormendy relation for these AGN