

A Sample of Radio Galaxies Spanning Three Decades in Radio Luminosity – The Fundamental Plane

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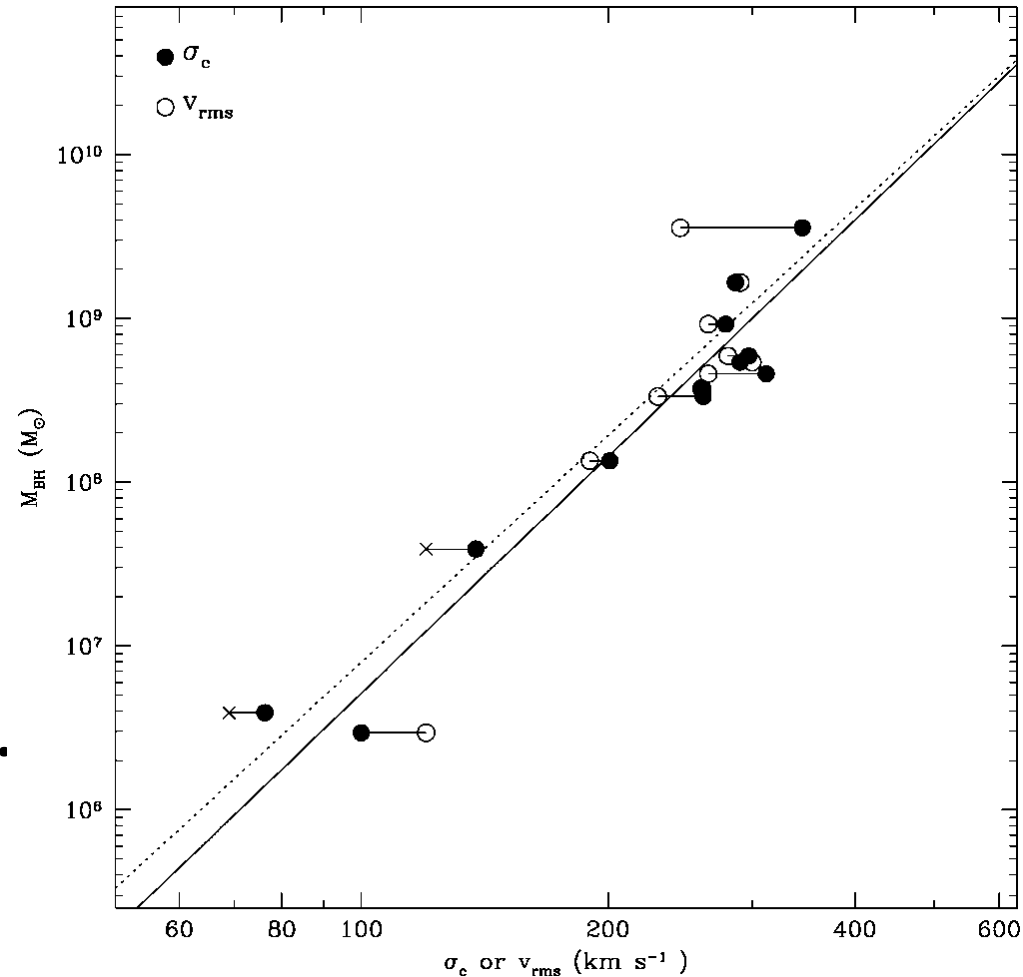
Outline

1. Introduction
2. Our Sample
3. HST Imaging
4. WHT Spectroscopy & Spectral Fitting
5. Results
6. Future Work

AGN Feedback & Galaxy Evolution

Various relationships between AGN central black holes and their host galaxies

⇒ AGN feedback in Galaxy evolution (e.g. Silk & Rees, 1998; Croton et al., 2006)?



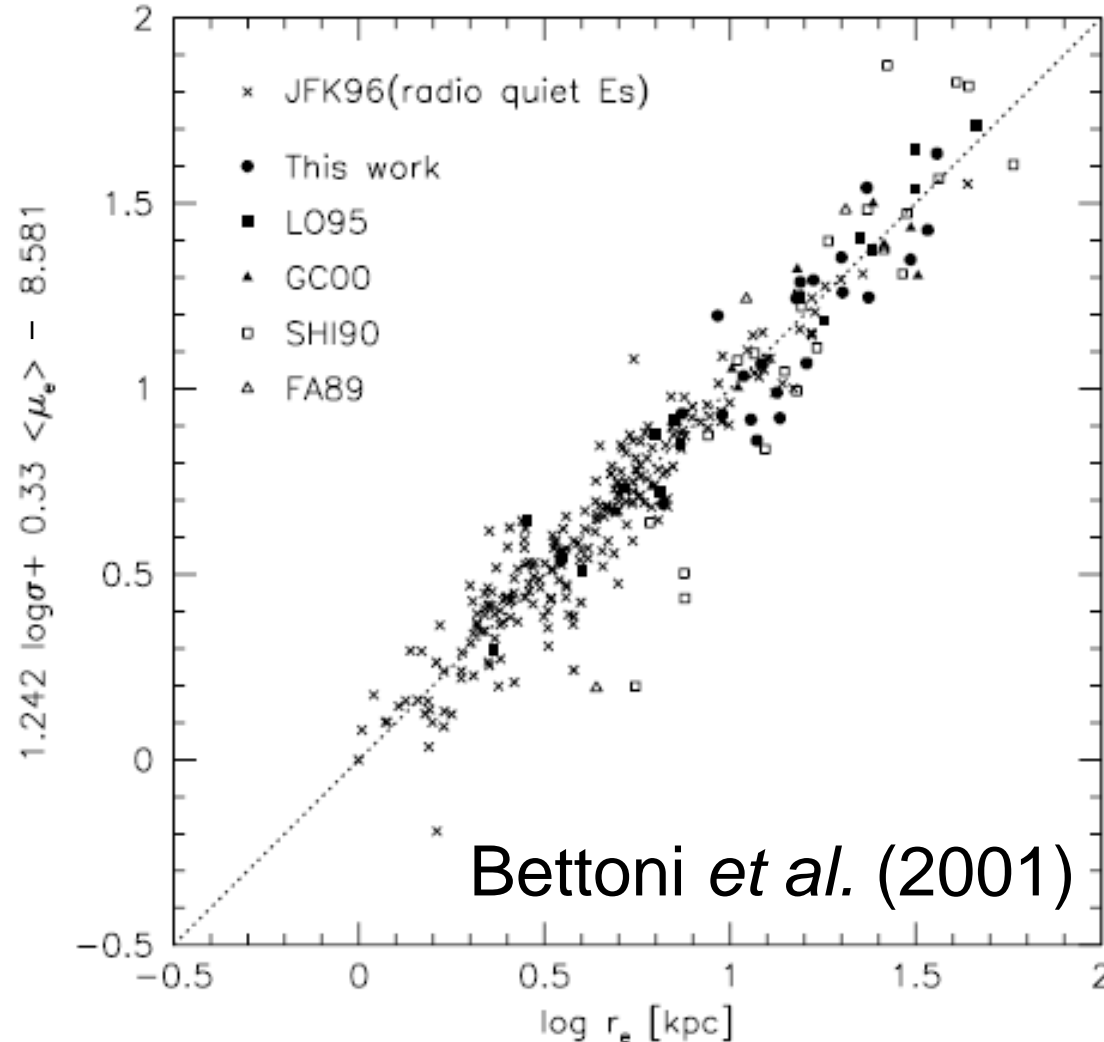
$$M_{BH} \propto \sigma^{(4.8 \pm 0.5)} \text{ (Ferrarese \& Merritt, 2000)}$$

The Fundamental Plane

(Djorgovski & Davis, 1987;
Dressler *et al.*, 1987)

$$\log(r_e) = 1.242 \log(\sigma) + 0.33 \langle \mu_e \rangle - 8.581$$

(Jørgensen *et al.*, 1996)



$$r_e \propto \sigma^\alpha I_e^{-\beta}$$

Virial Theorem (Faber
et al., 1987):

$$\alpha = 2; \beta = 1$$

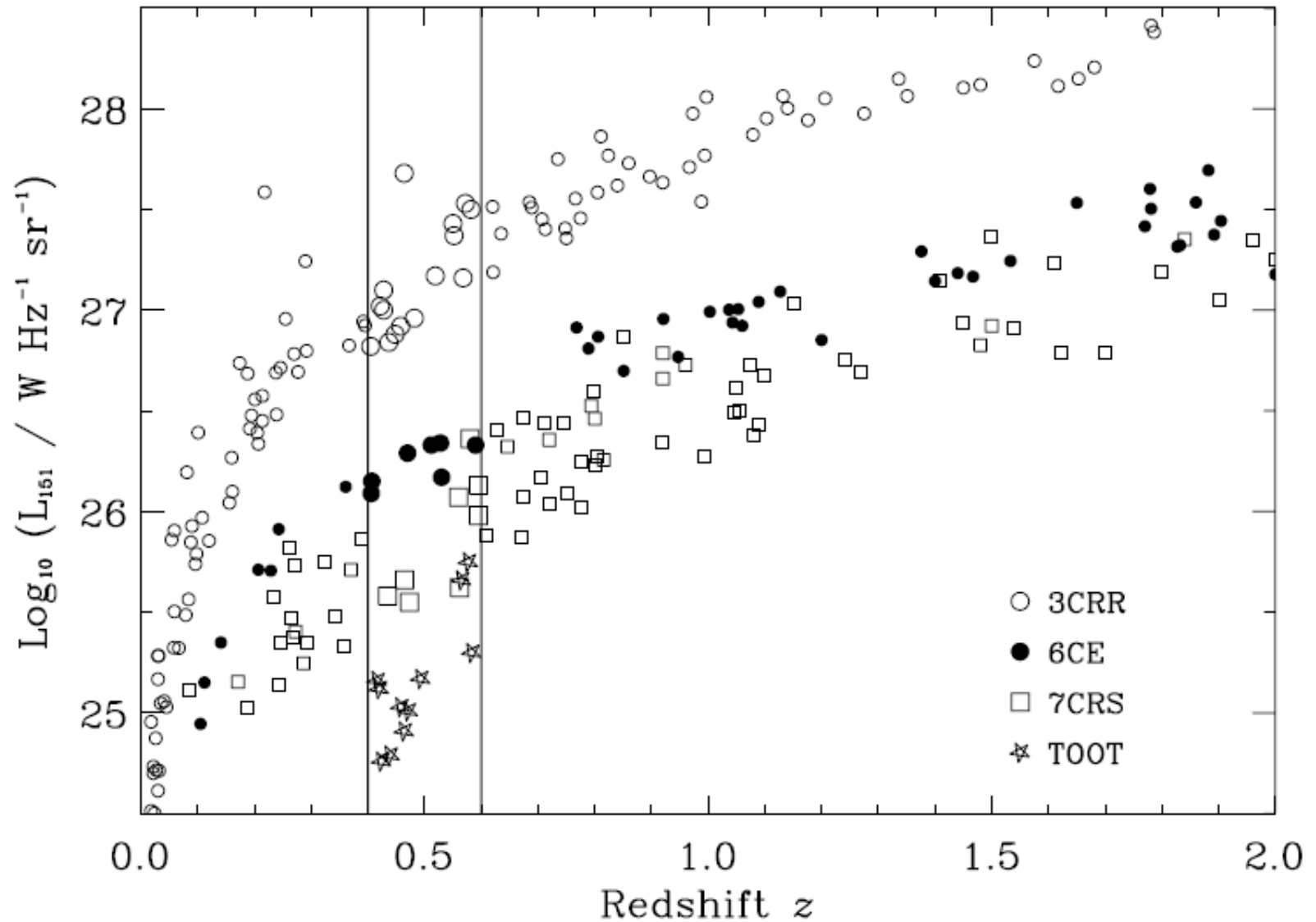
Jørgensen *et al.*, 1996:

$$\alpha = 1.24; \beta = 0.82$$

The RHALFS (ZP5) Sample

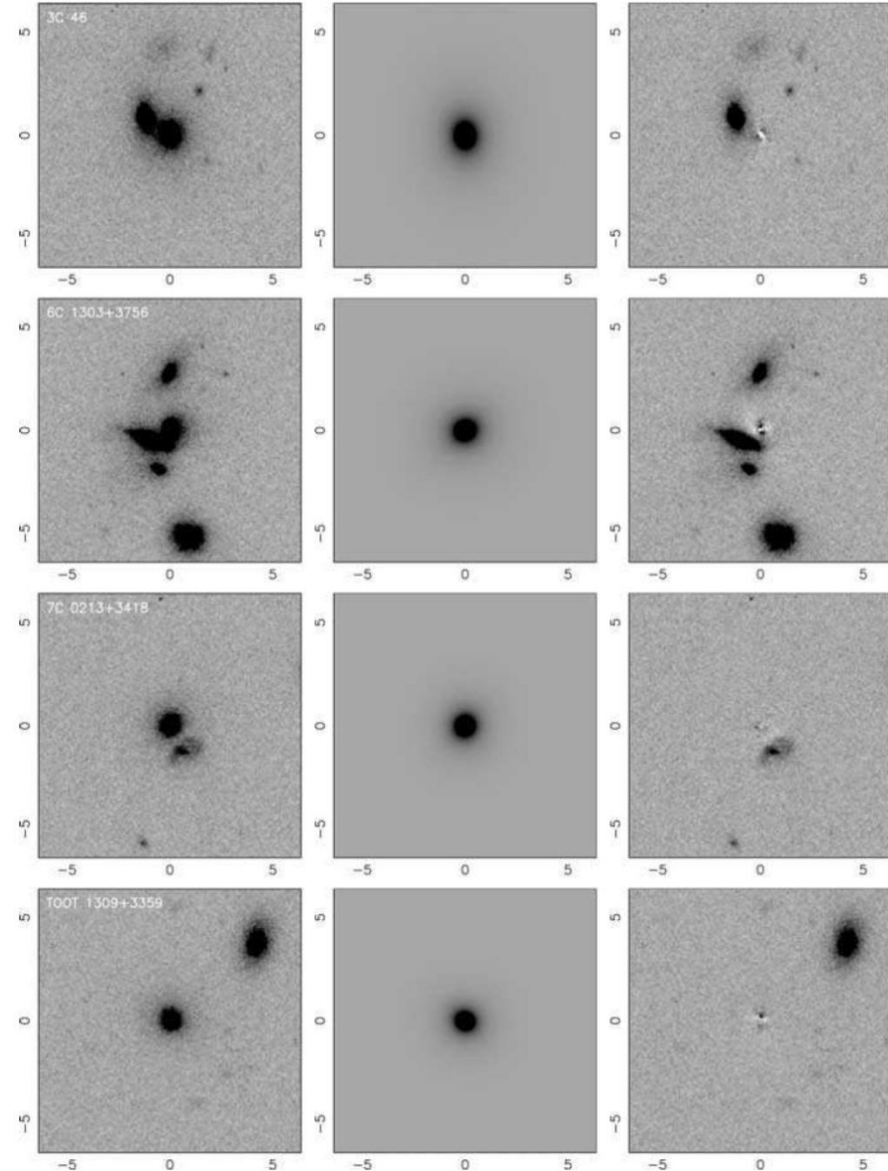
- 41 objects at $z \approx 0.5$
- All of the narrow-line galaxies at $0.4 < z < 0.6$ from four complete, low-frequency selected radio surveys: 3CRR, 6CE, 7CRS and TexOx-1000 (“TOOT”)
- Full sample details in McLure et al. (2004)

The RHALFS (ZP5) Sample



HST Imaging

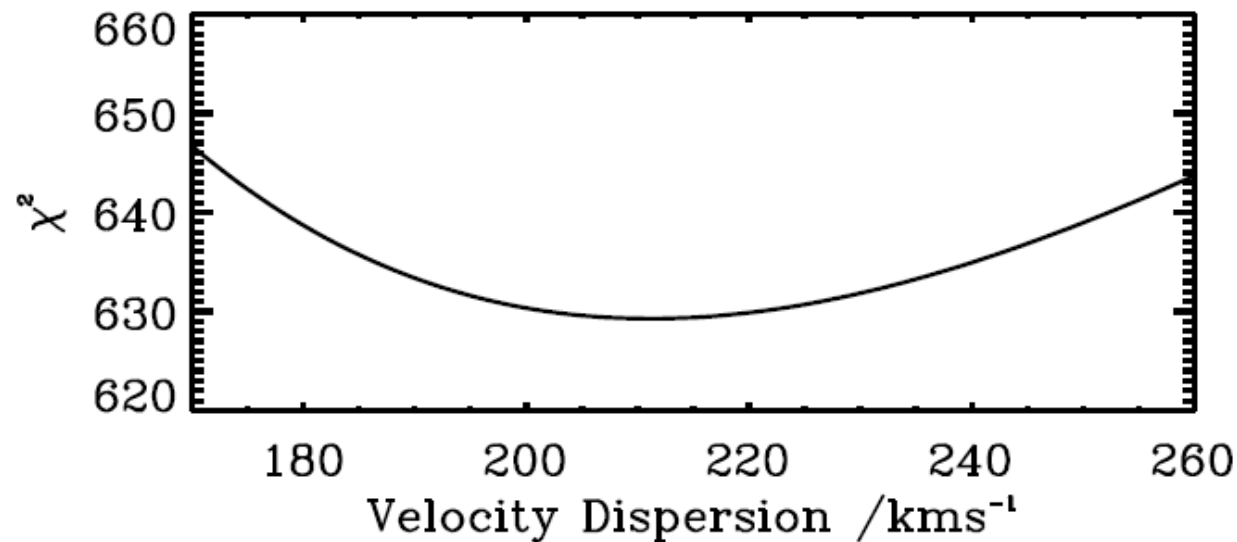
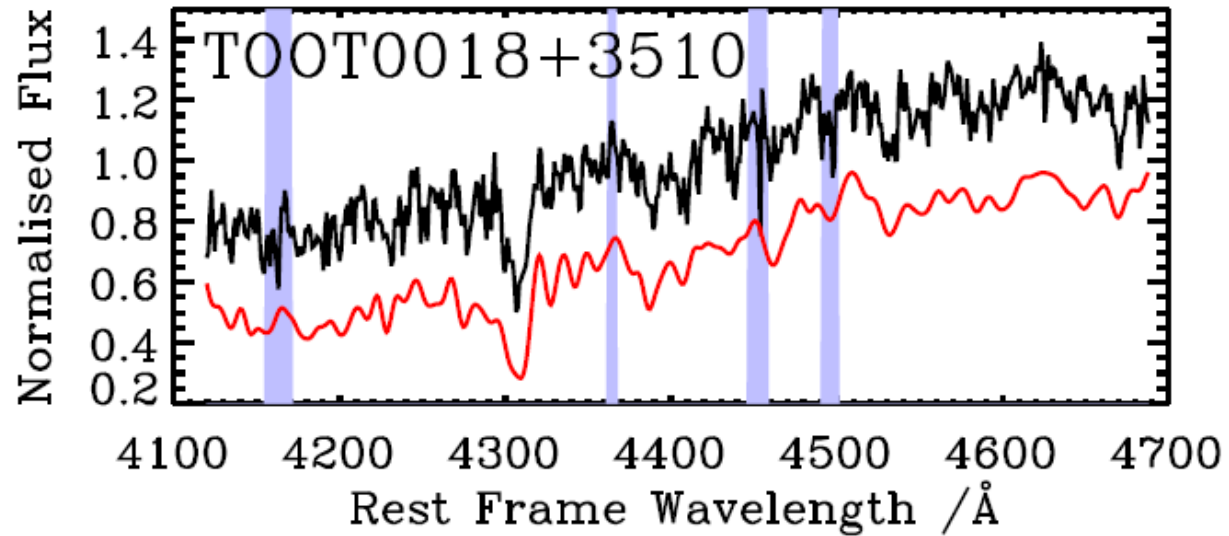
- HST *I*-band imaging; McLure et al. (2004)
- 2D modelling of host galaxies:
 - Left: the radio galaxy
 - Centre: the best fitting 2D host galaxy model
 - Right: the residual image
- Provides r_e and $\langle\mu_e\rangle$ for our galaxies



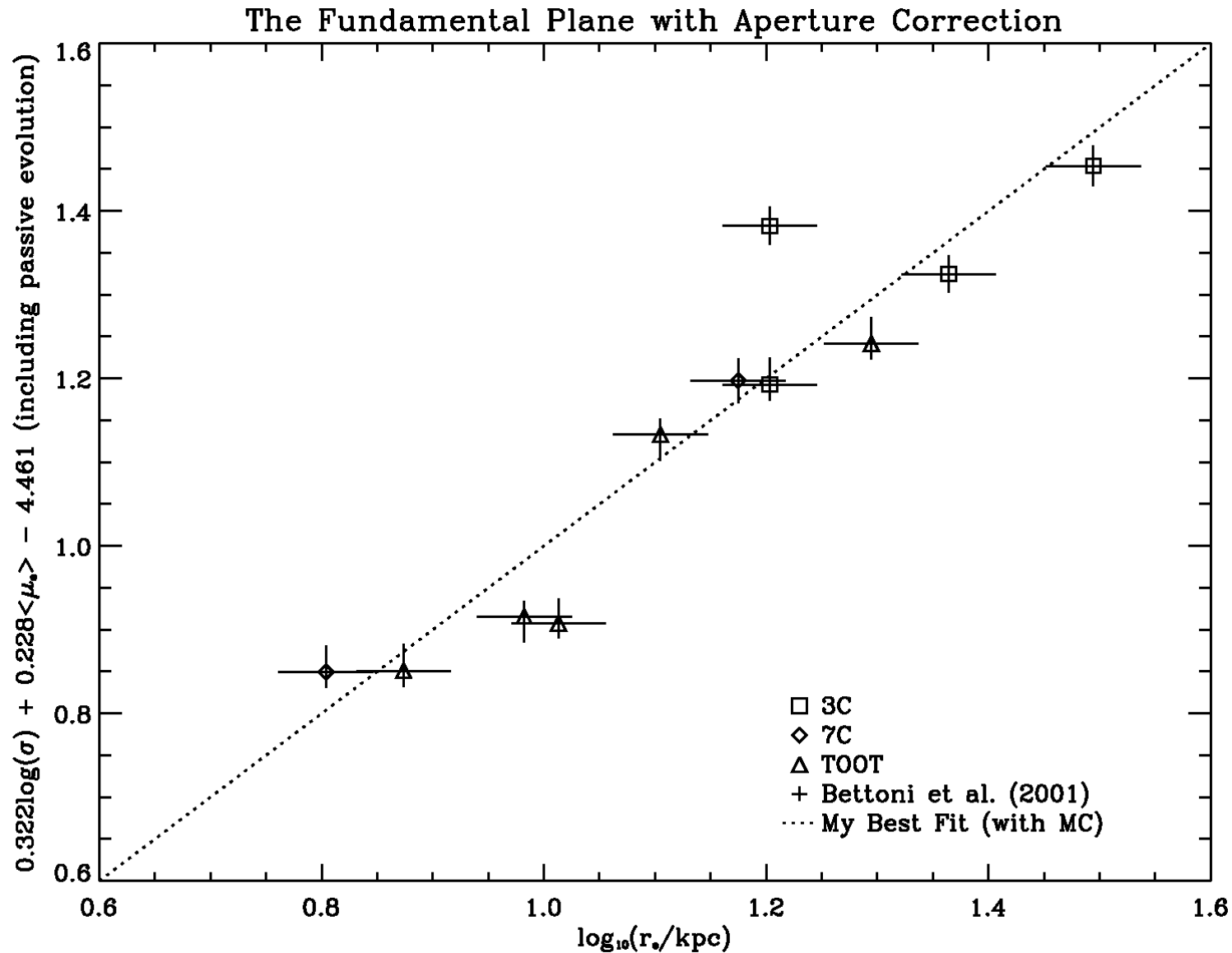
WHT Spectroscopy

Gaussian width:

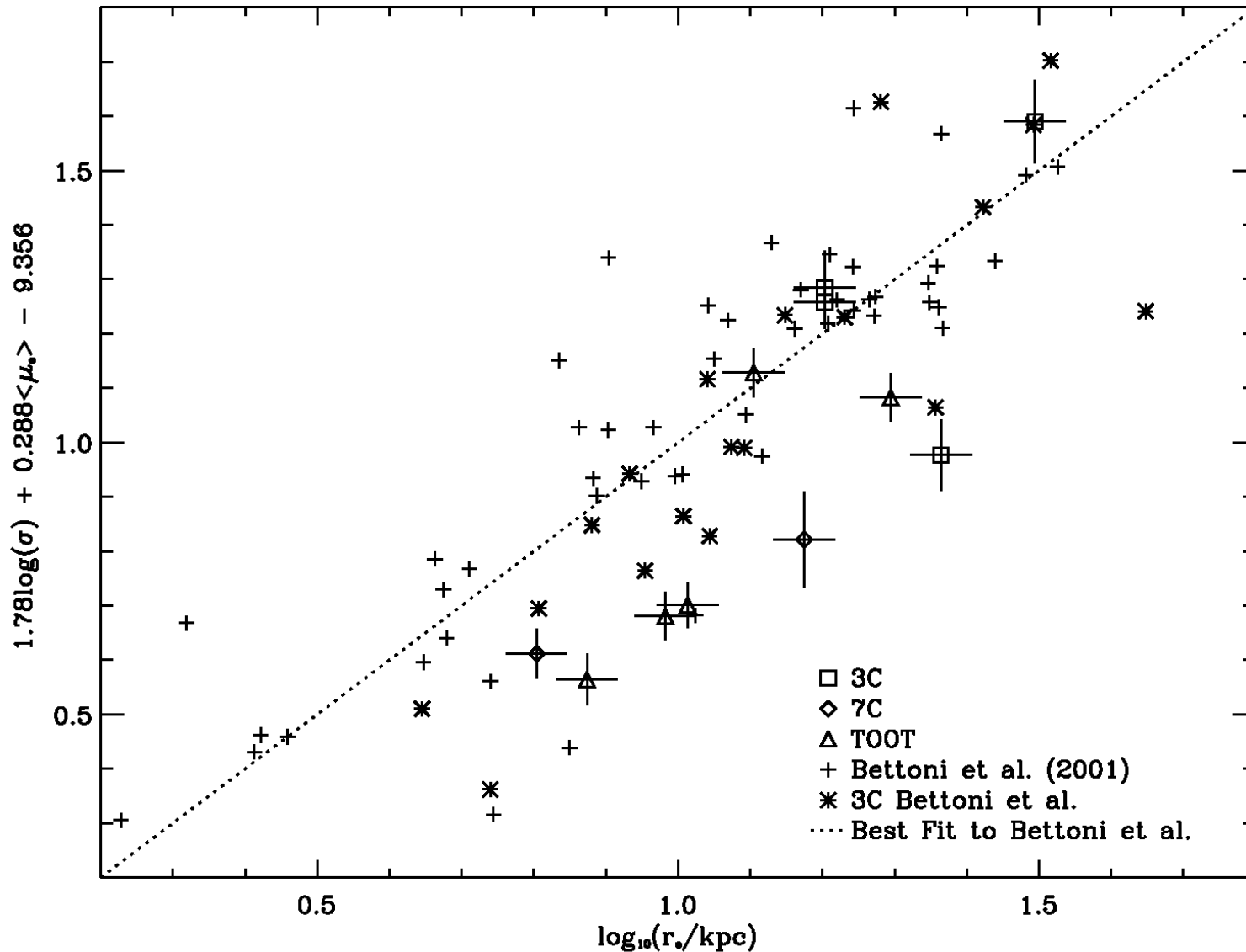
$$\frac{\lambda\sigma}{c}$$



The ZP5 Fundamental Plane



The Local Fundamental Plane



Results

$$\log \langle \epsilon_e \rangle = \alpha \log \langle \sigma \rangle + \beta \langle \mu_e \rangle - \gamma$$

| | Bettoni <i>et al.</i> | This Work |
|----------|------------------------------|------------------------------|
| α | 1.78 | $0.322^{+0.013}_{-0.005}$ |
| β | 0.29 | $0.2284^{+0.0008}_{-0.0004}$ |
| γ | 9.36 | $4.46^{+0.07}_{-0.06}$ |

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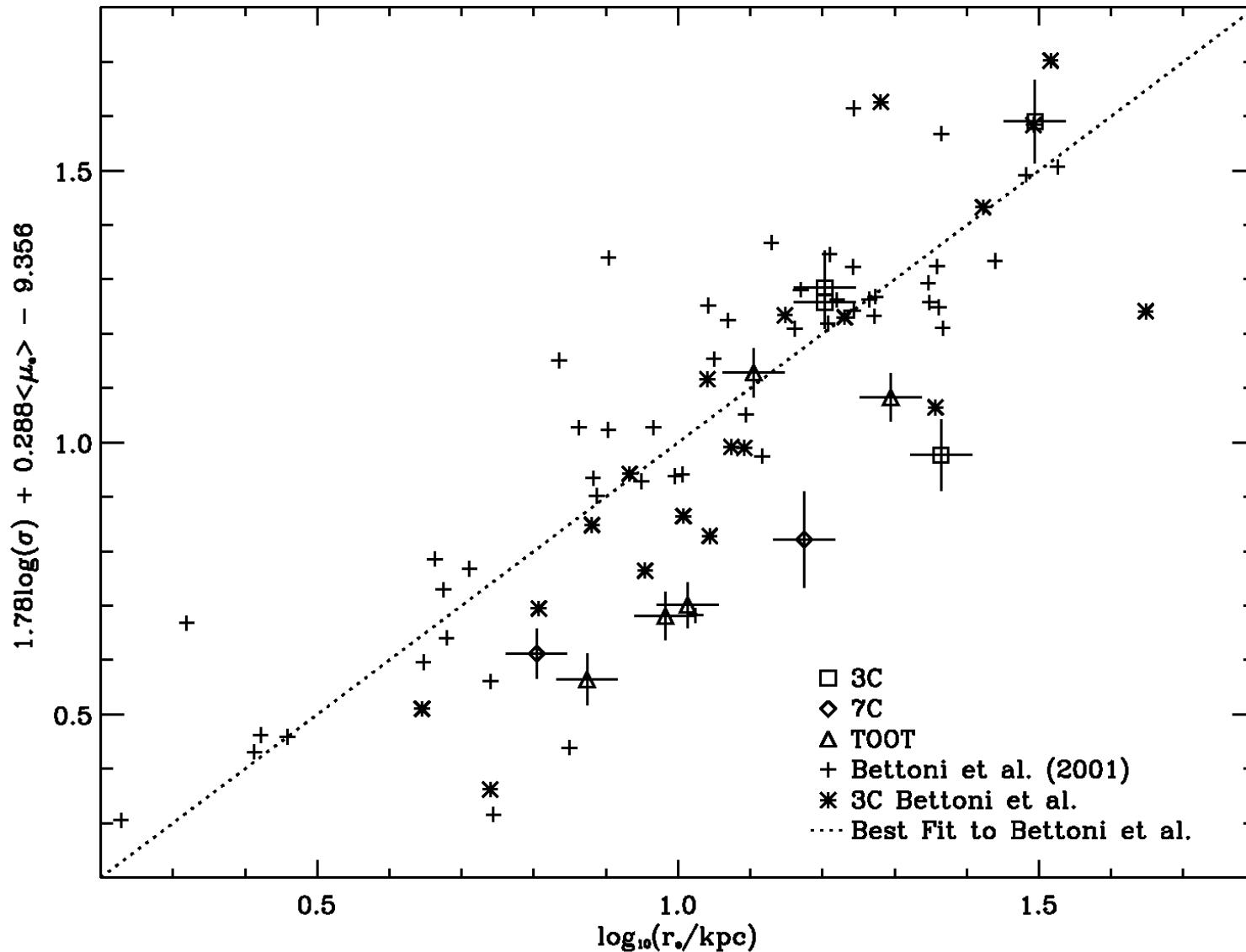
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What Next?

- GMOS Spectroscopy (2008B) for 8 more RHALFS objects:
 - Fill in central regions of the fundamental plane
 - Allow the fundamental plane to be studied in radio luminosity bins
 - Disentangle radio and evolutionary effects
- Data reduced, fittings in progress...

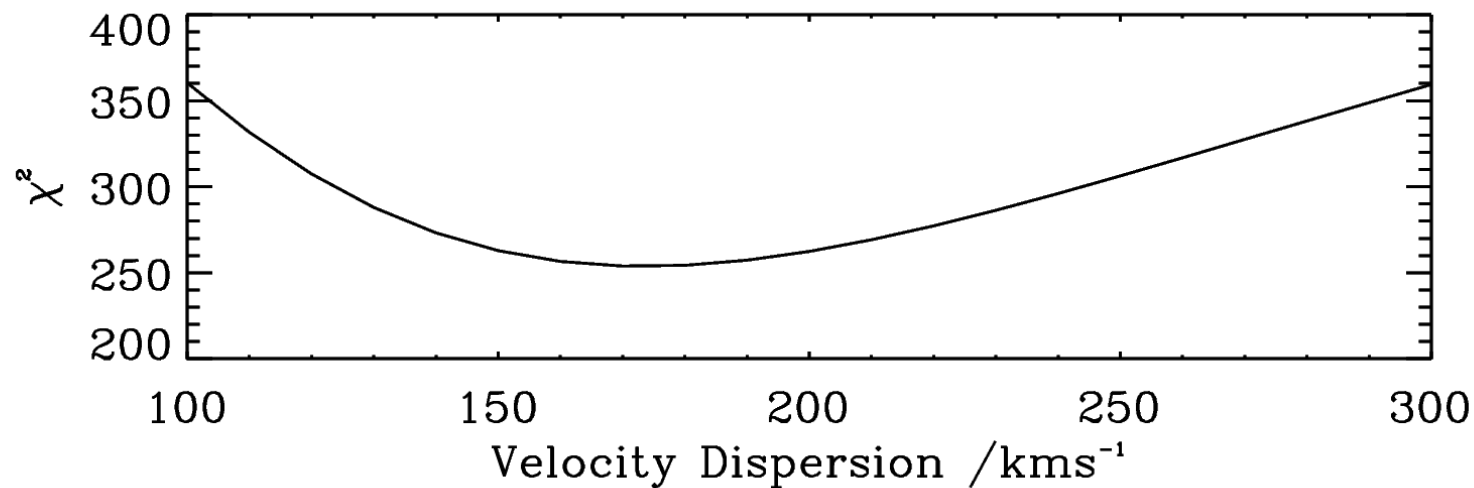
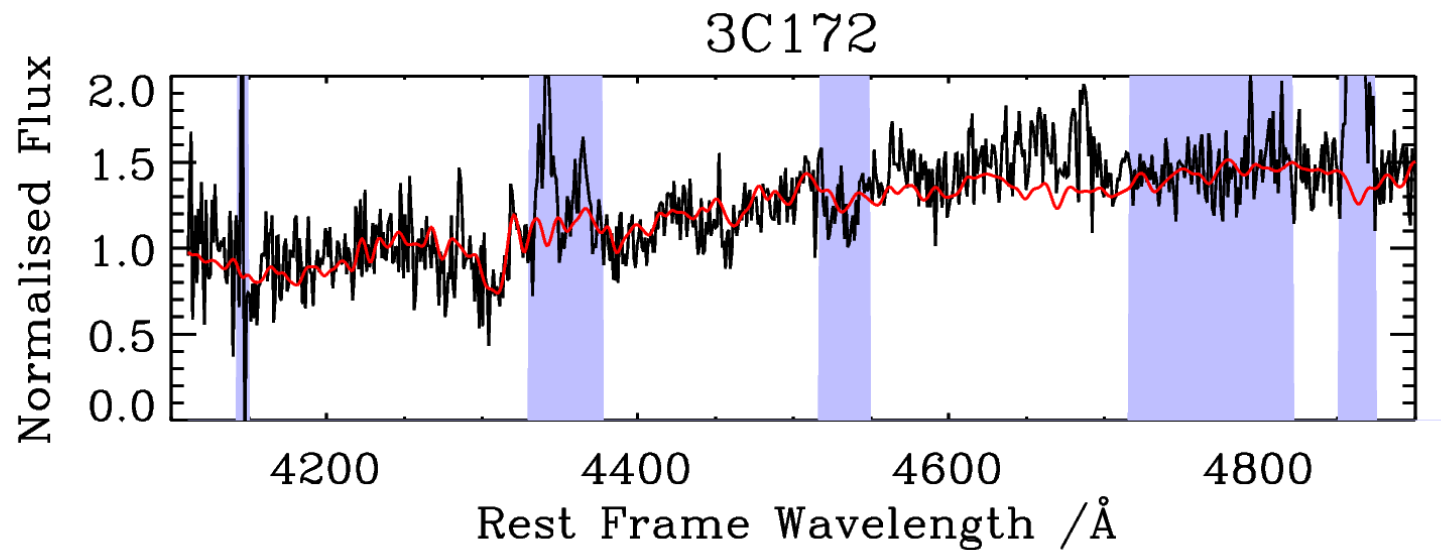
The Local Fundamental Plane



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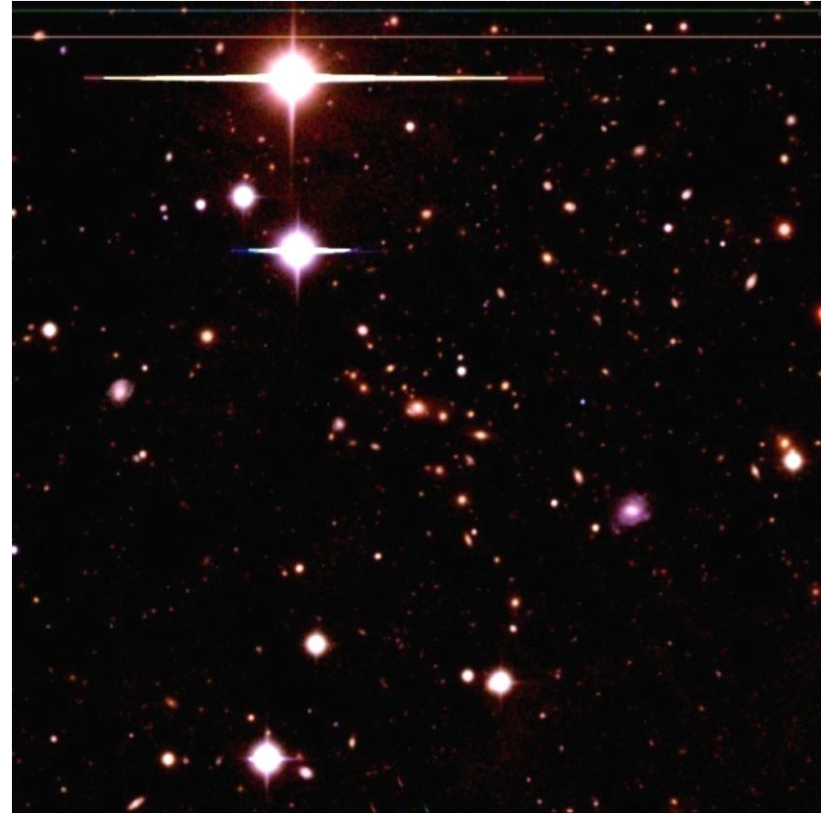
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What Else?

INT photometry (g, r & i bands) now completed for all objects in the RHALFS sample...

- Is the environmental density is related to the central radio galaxy?
- Is there a preferred orientation for the radio jets with respect to the environment?



5x5arcmin² field
around 3C244.1

Summary

- Direct fitting code to determine σ for 15 of our $z \approx 0.5$ radio galaxies
- Fundamental Plane of our $z \approx 0.5$ radio galaxies investigated
- Find a plane still exists, but one that is markedly different to the local Fundamental Plane (especially for lower luminosity objects)
- Currently investigating what causes this tilt