Dense galaxies and SMBHs

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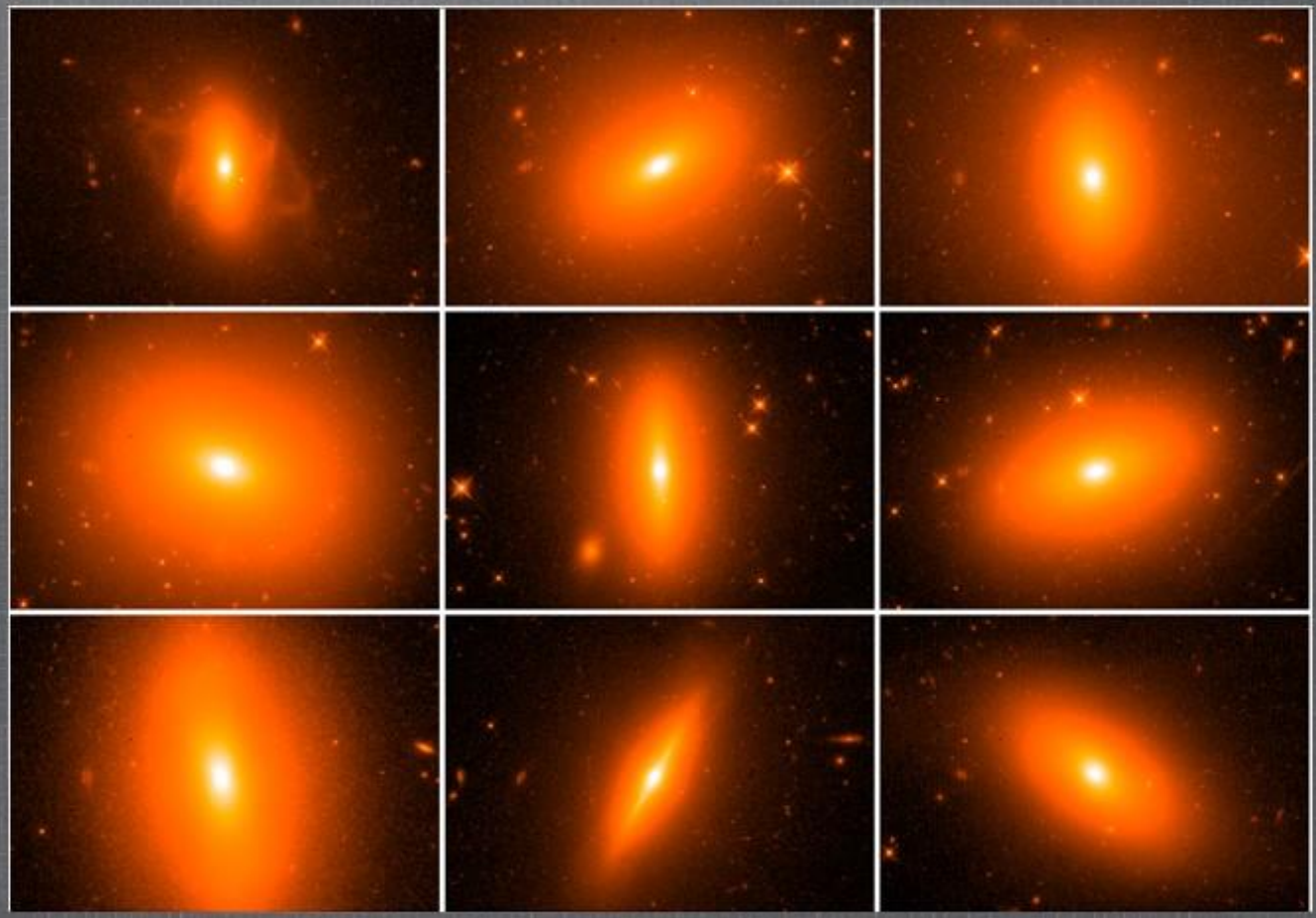
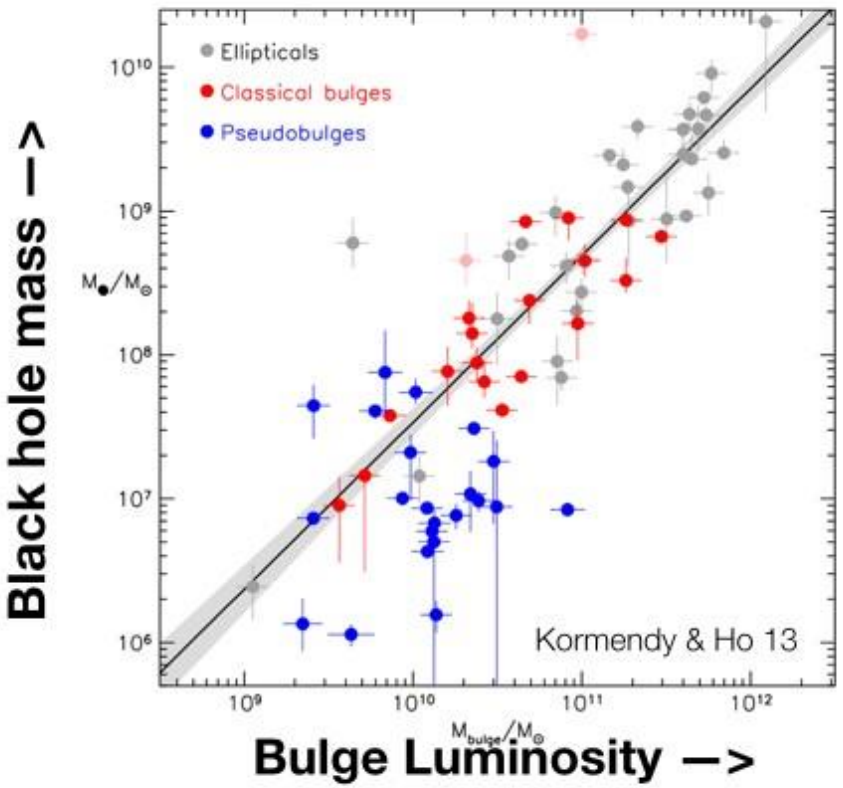


DIRECT BLACK HOLE MASSES

- The direct black hole masses in nearby galaxies are the basis for all other BH mass estimates.
- Only ~80 have been measured to date.
- Requires high spatial resolution spectroscopy ELTs (Do+14), ALMA Davis14)



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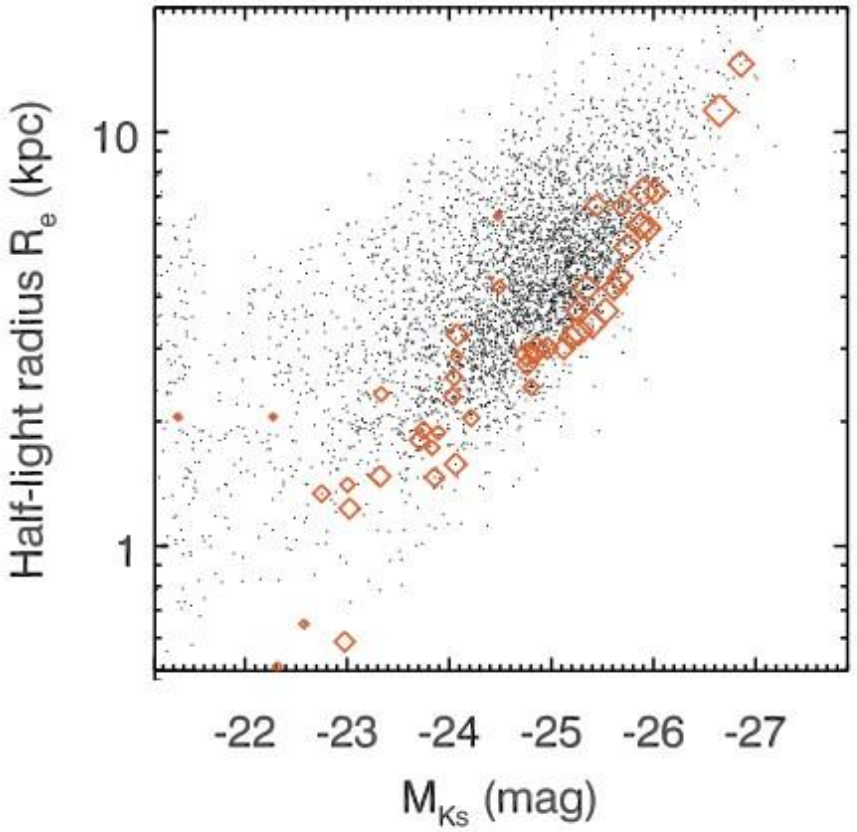

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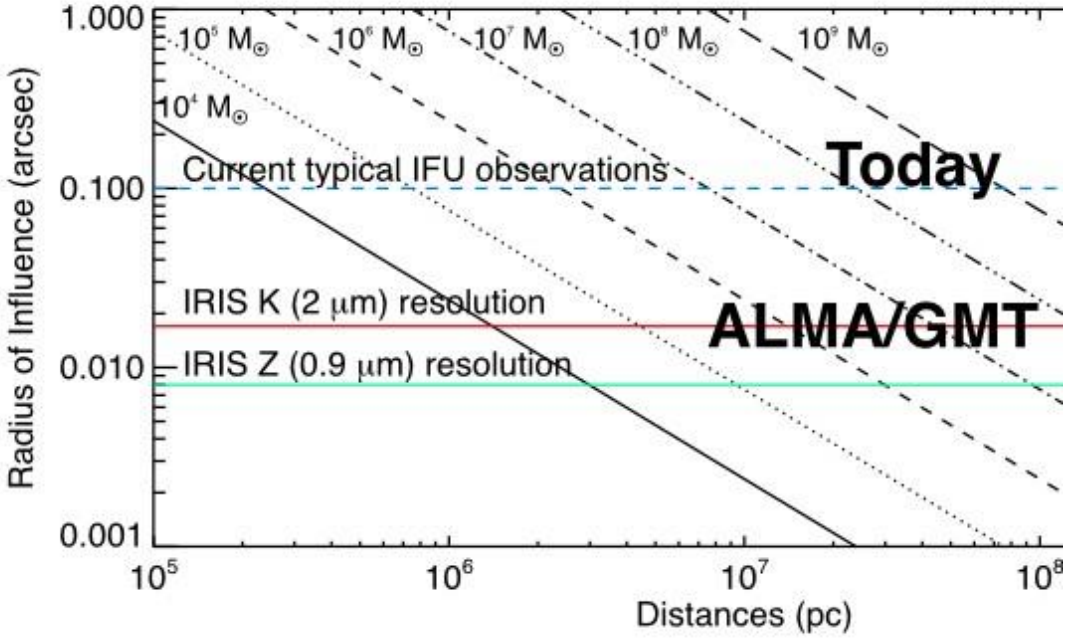
$$R_{soi} = \frac{GM_\bullet}{D\sigma^2} \propto \frac{\sigma^{2.2}}{D}$$



Do+2014

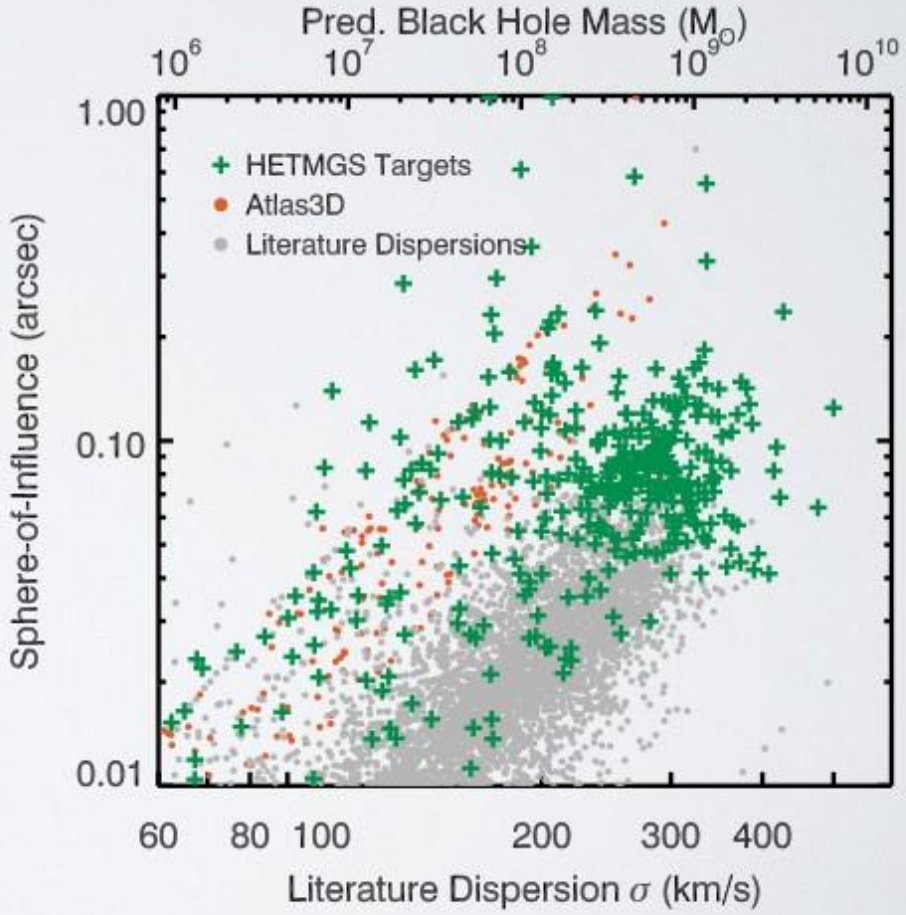
HET SURVEY

- Targeting the galaxies with the largest sphere of influences.
- Probing the massive nearby galaxies
- Extended to 1021 galaxies over 9 trimesters
- Long slit spectra with the Marcario Low Resolution Spectrograph
- 4200-7400 AA, 106 km/s resolution, 1''x2.5' slit
- Distances less then ~140 Mpc

vdB+15

HET MASSIVE GALAXIES SURVEY

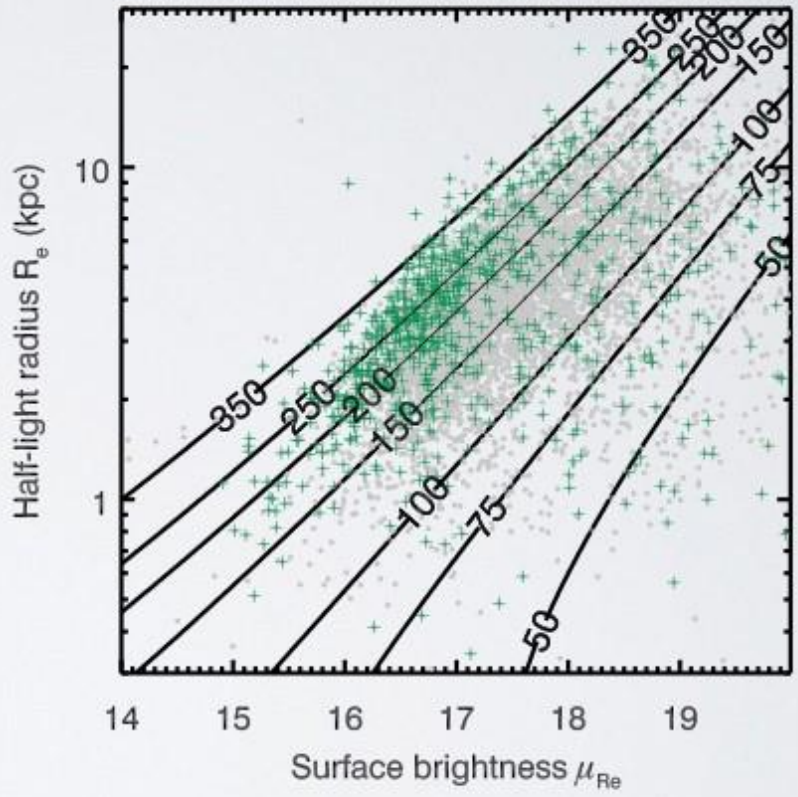
- **Select candidate galaxies using literature velocity dispersion from Hyperleda database**
- Predict black hole mass using M-sigma
- Few targets with SOI>0.1"
- Most nearby galaxies are not in SDSS



vdB+15

SAMPLE ACROSS THE FACE OF THE FUNDAMENTAL PLANE

- What if the M-σ relation is not the best predictor for black hole mass?



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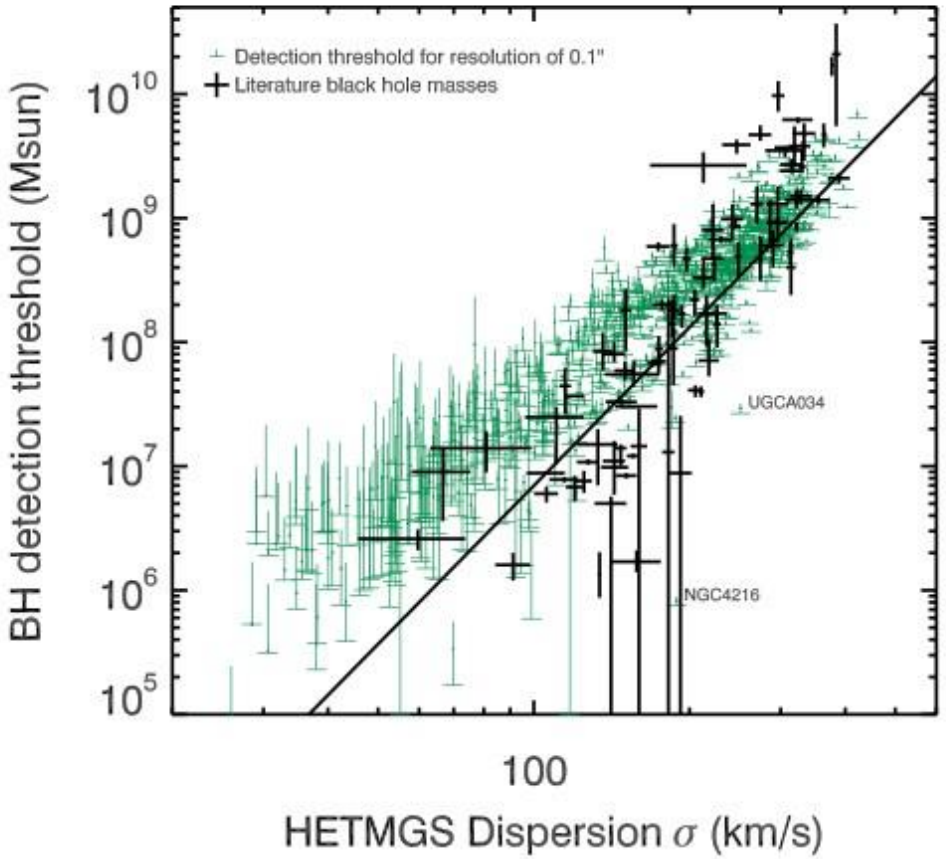
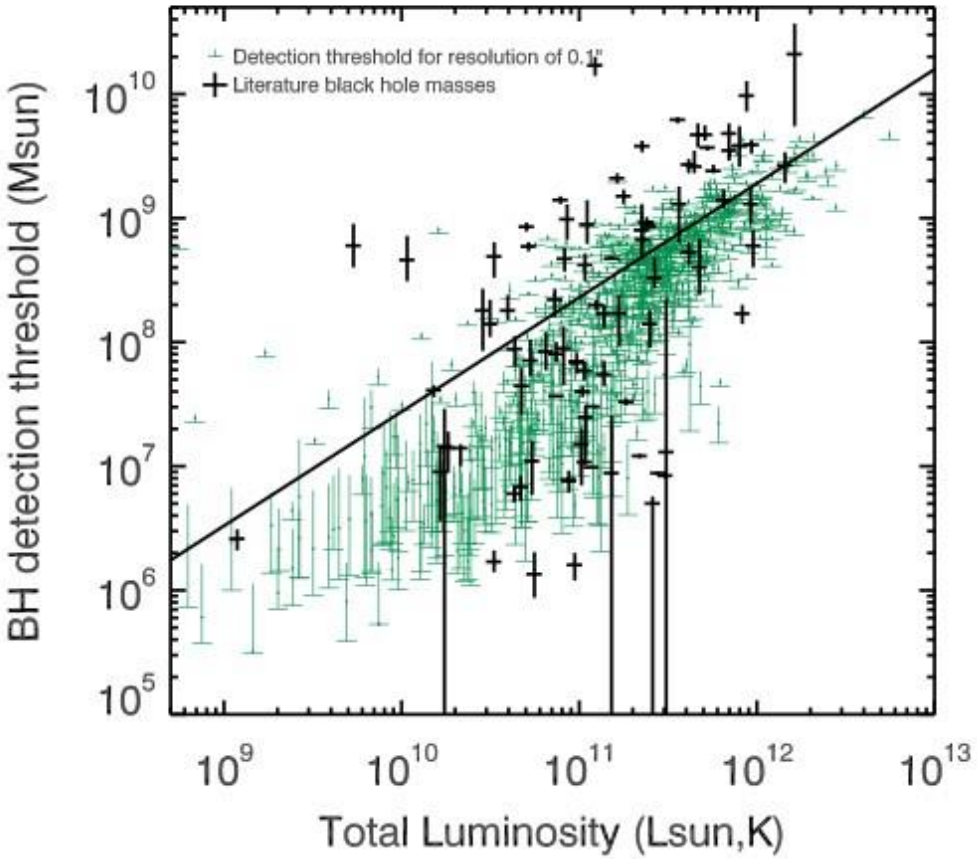


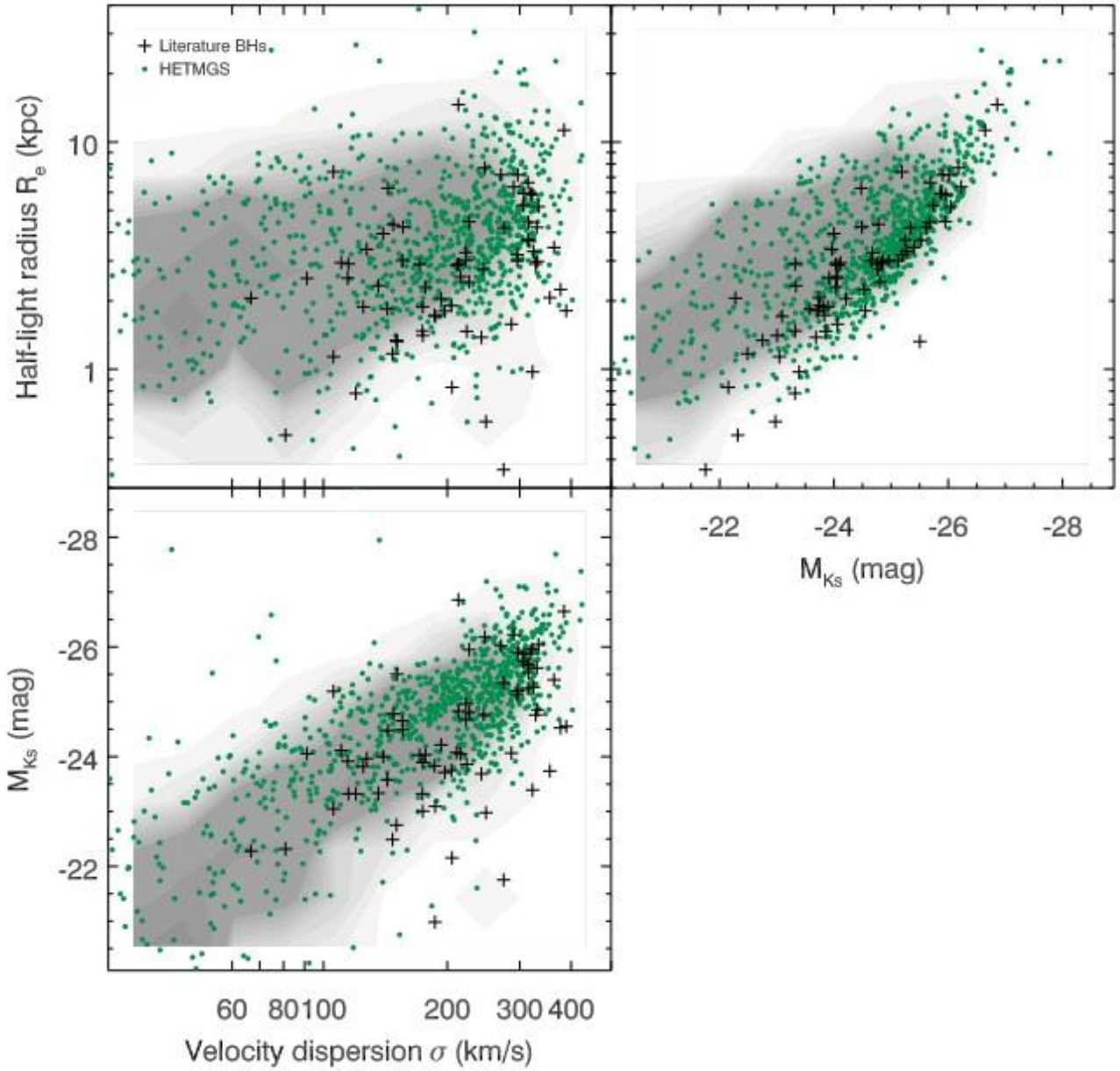


What can we expect?

$$R_{soi} = \frac{GM_\bullet}{D\sigma^2}$$

See also Batcheldor10, Gültekin+11

vdB+15



Distribution of BH hosts

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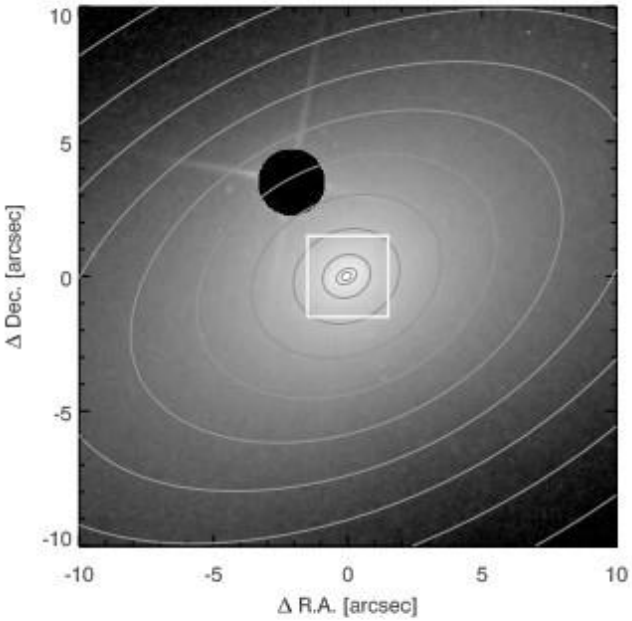
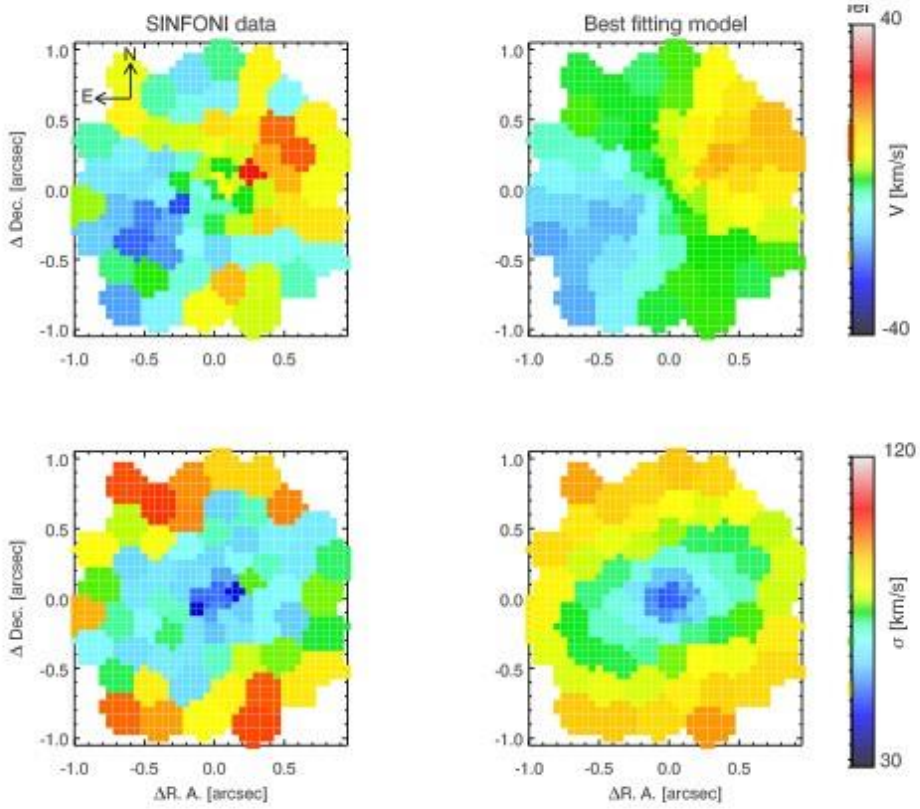
NSC IN FCC227





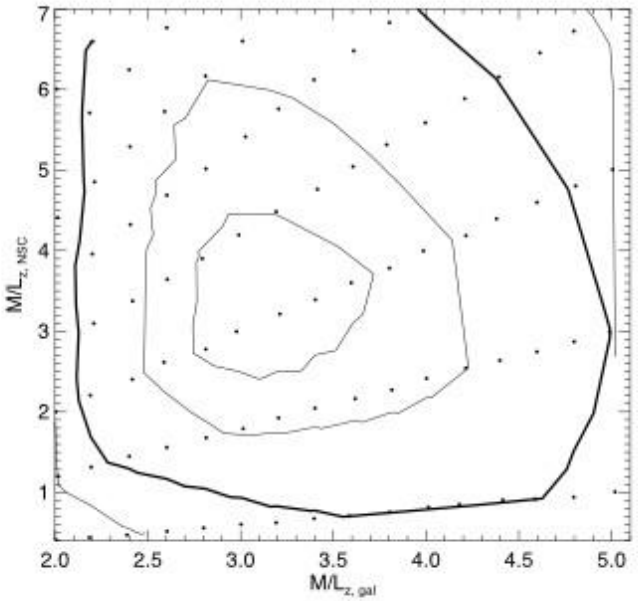
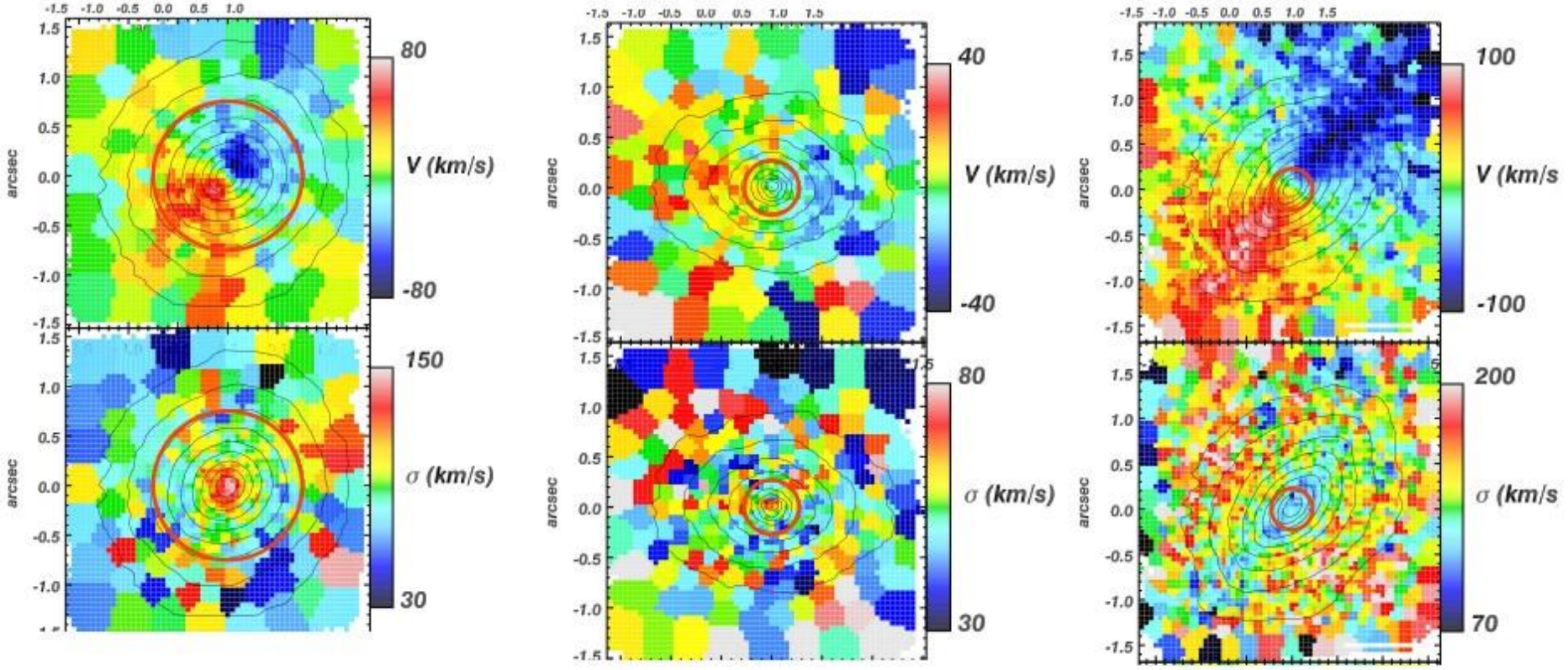


Figure 8. Confidence interval of the dynamical models of FCC 277 for the mass-to-light ratio in z-band. The black dots indicate the location of the models and the contours indicate 1, 2, and 3σ intervals, where the 3-sigma level is indicated by a thick line.

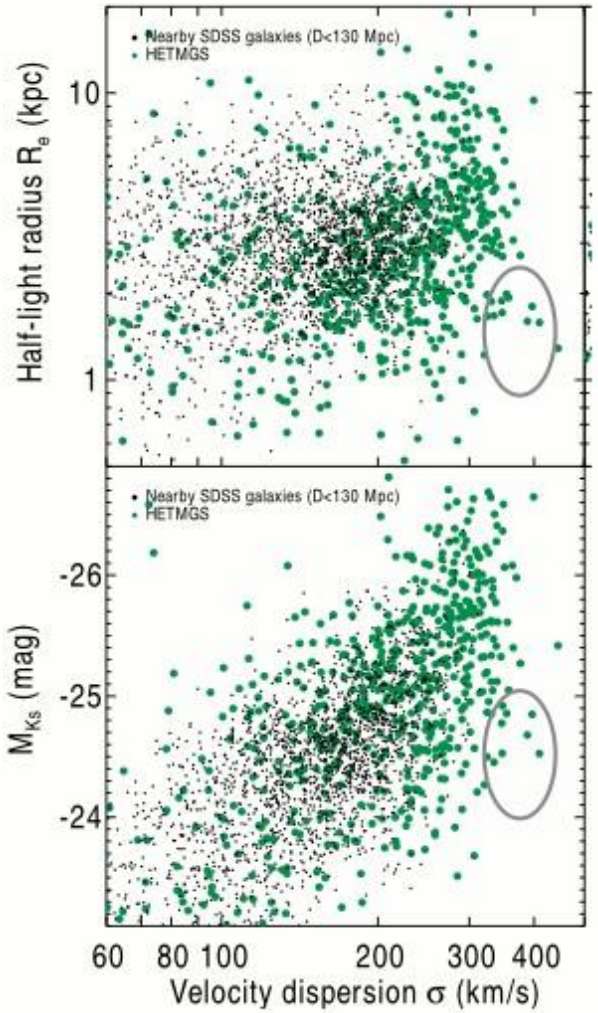
Lyubenova+13

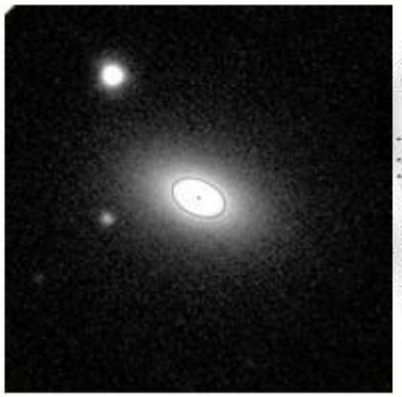
3 more NSCs in Fornax ETGs

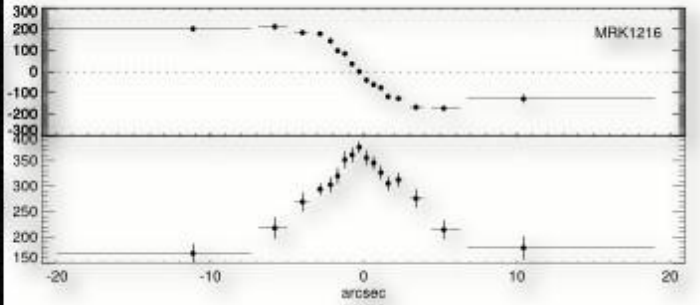


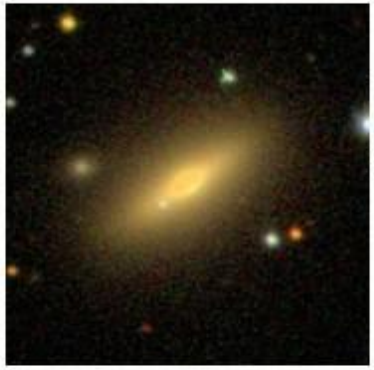
Lyubenova in prep

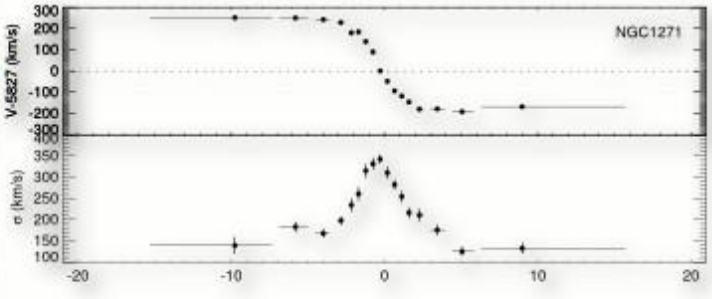
COMPACT GALAXIES

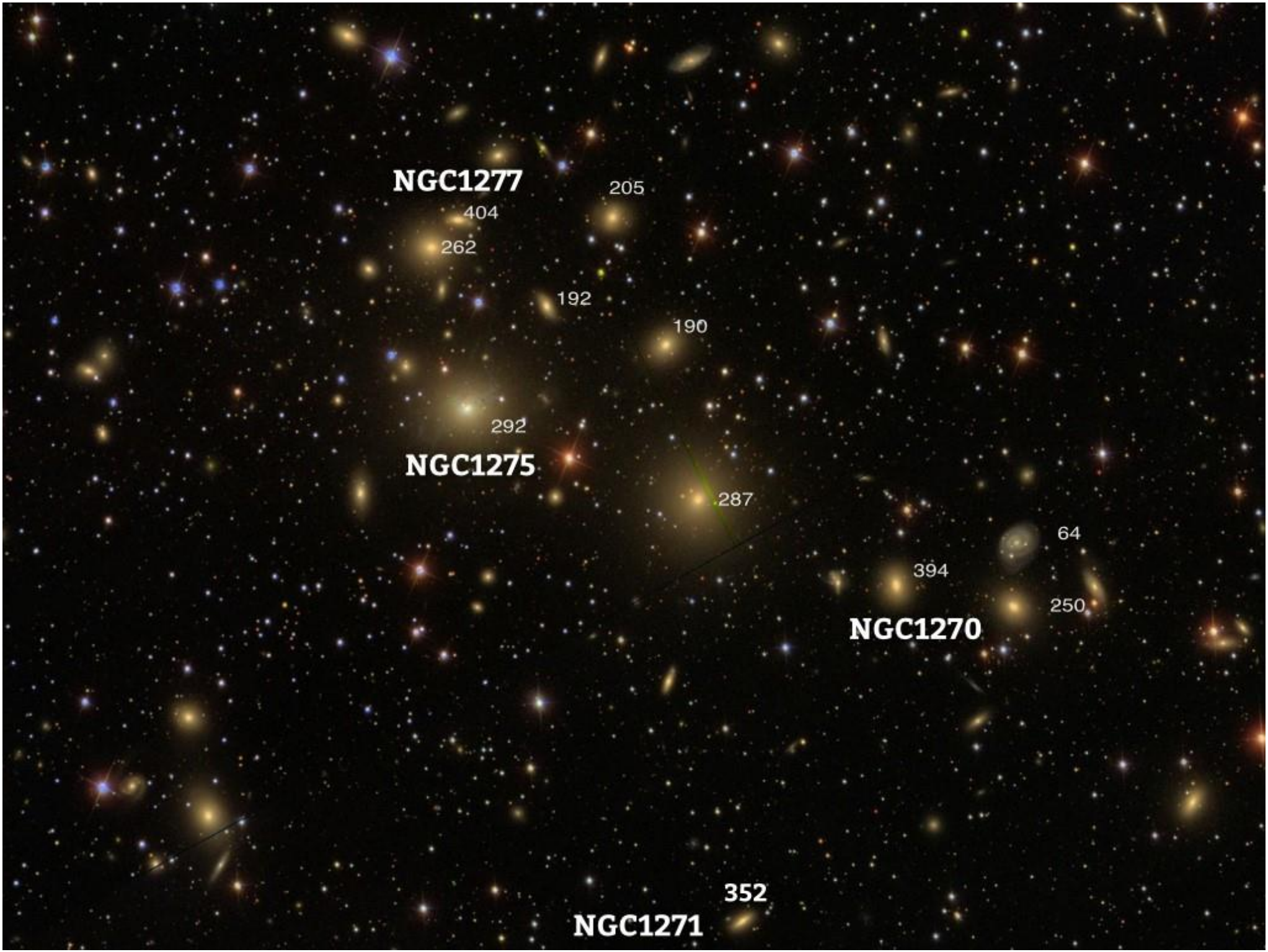


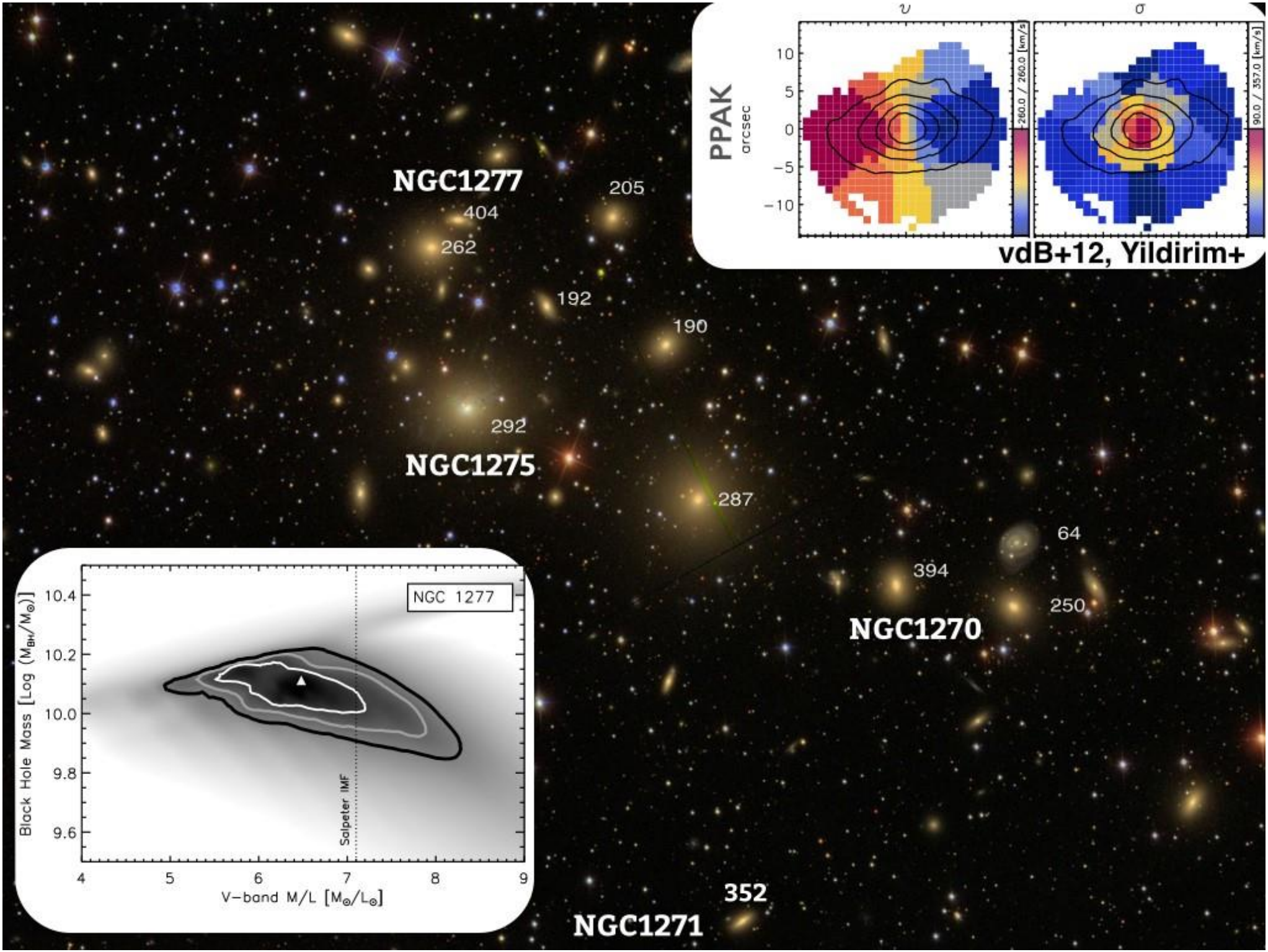


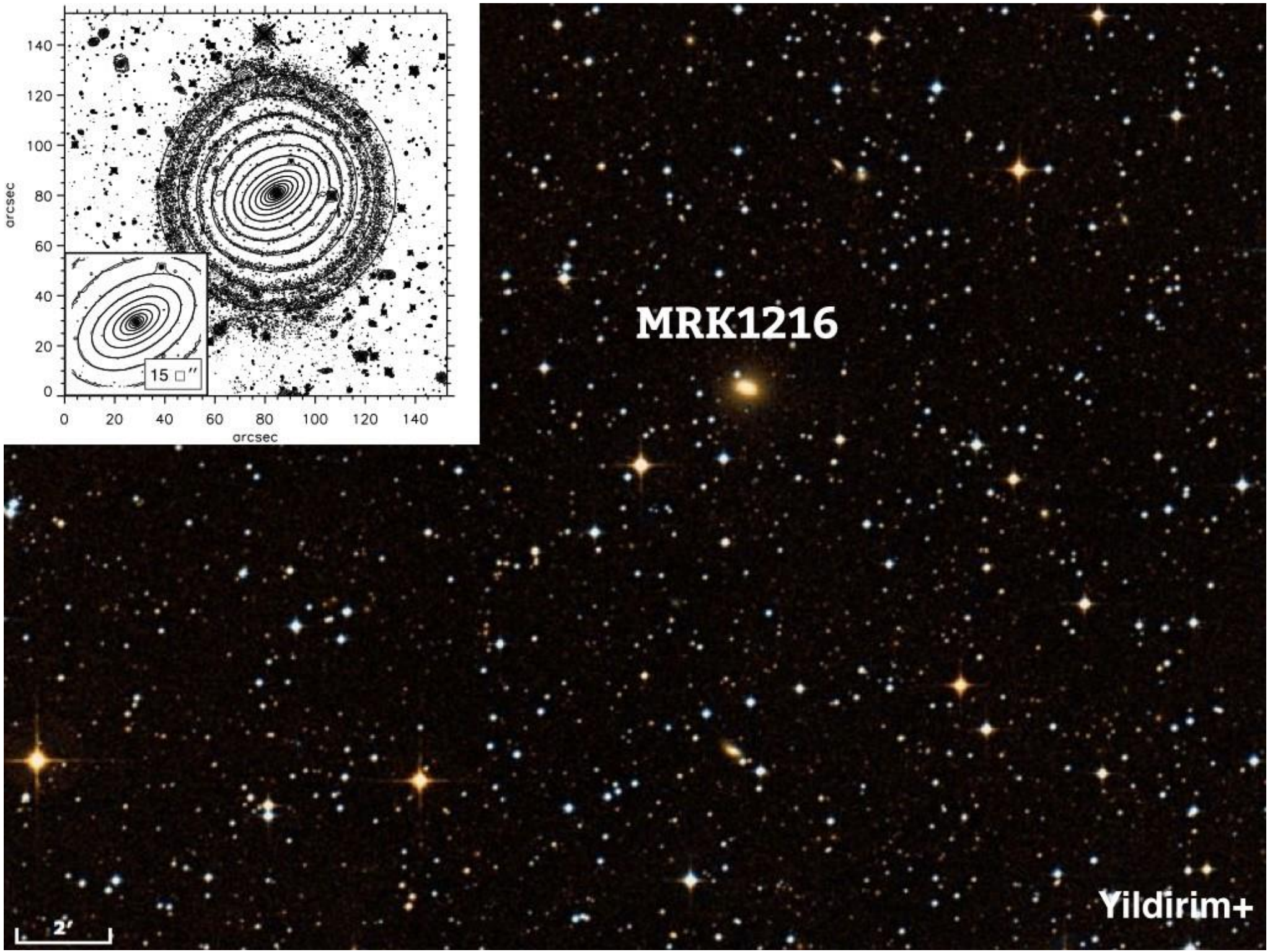


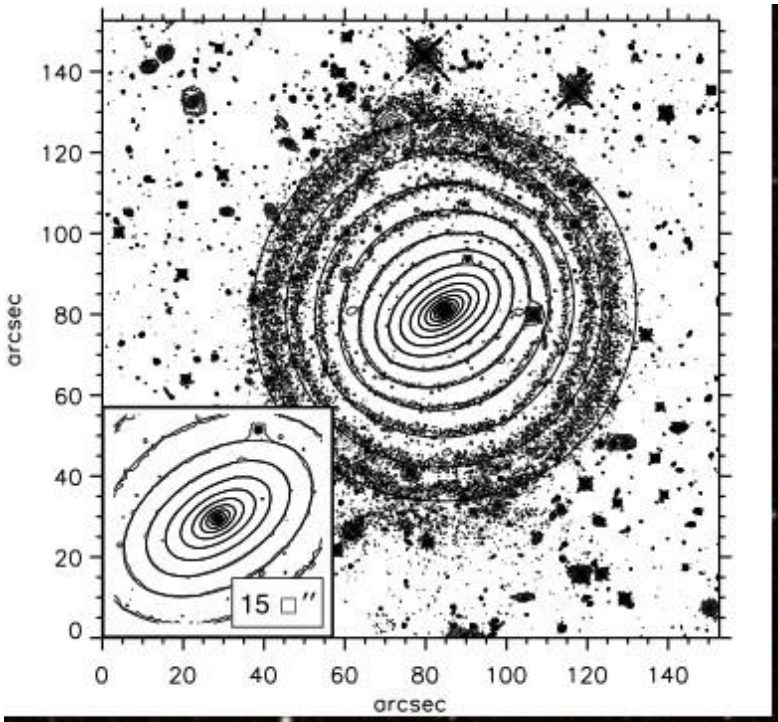




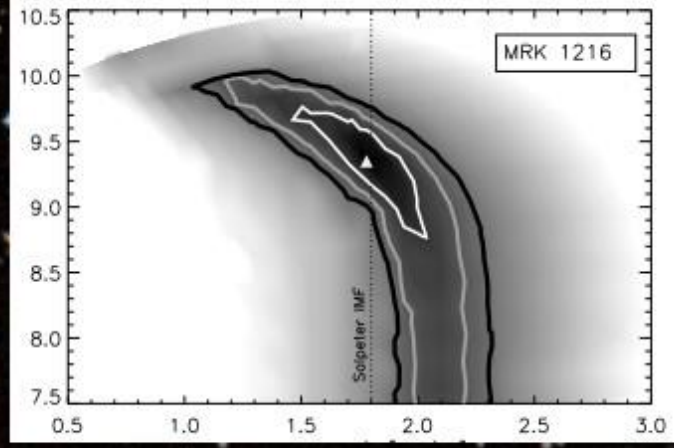

NGC1277
205
404
262
192
190
292
NGC1275
287
64
394
250
NGC1270
352
NGC1271


NGC1277
205
404
262
192
190
292
NGC1275
287
64
394
250
NGC1270
352
NGC1271
PPAK
arcsec
v
σ
10
5
0
−5
−10
260.0 / 260.0 [km/s]
90.0 / 357.0 [km/s]
vdB+12, Yildirim+
NGC 1277
Black Hole Mass [Log ($M_{BH}/M_\odot$)]
10.4
10.2
10.0
9.8
9.6
Salpeter IMF
4
5
6
7
8
9
V−band M/L [$M_\odot/L_\odot$]


MRK1216
arcsec
arcsec
15 □″
2′
Yildirim+

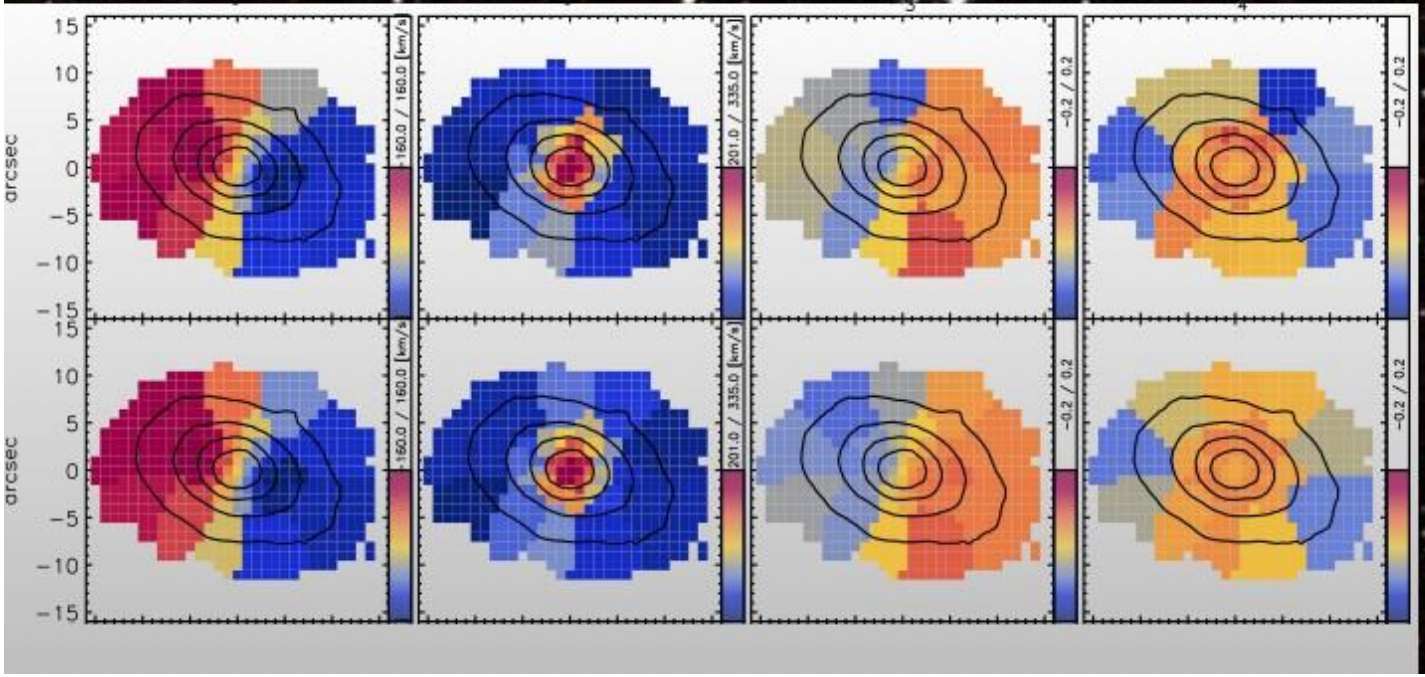


BH mass
log(Msun)



MRK1216

M/L$_H$



Yildirim+

Conclusions

- HET Massive Galaxy survey provides the necessary groundwork for future systematic black hole mass measurement campaigns.
- Finding over-massive black holes is easy.
- Probing the BH demography is hard.