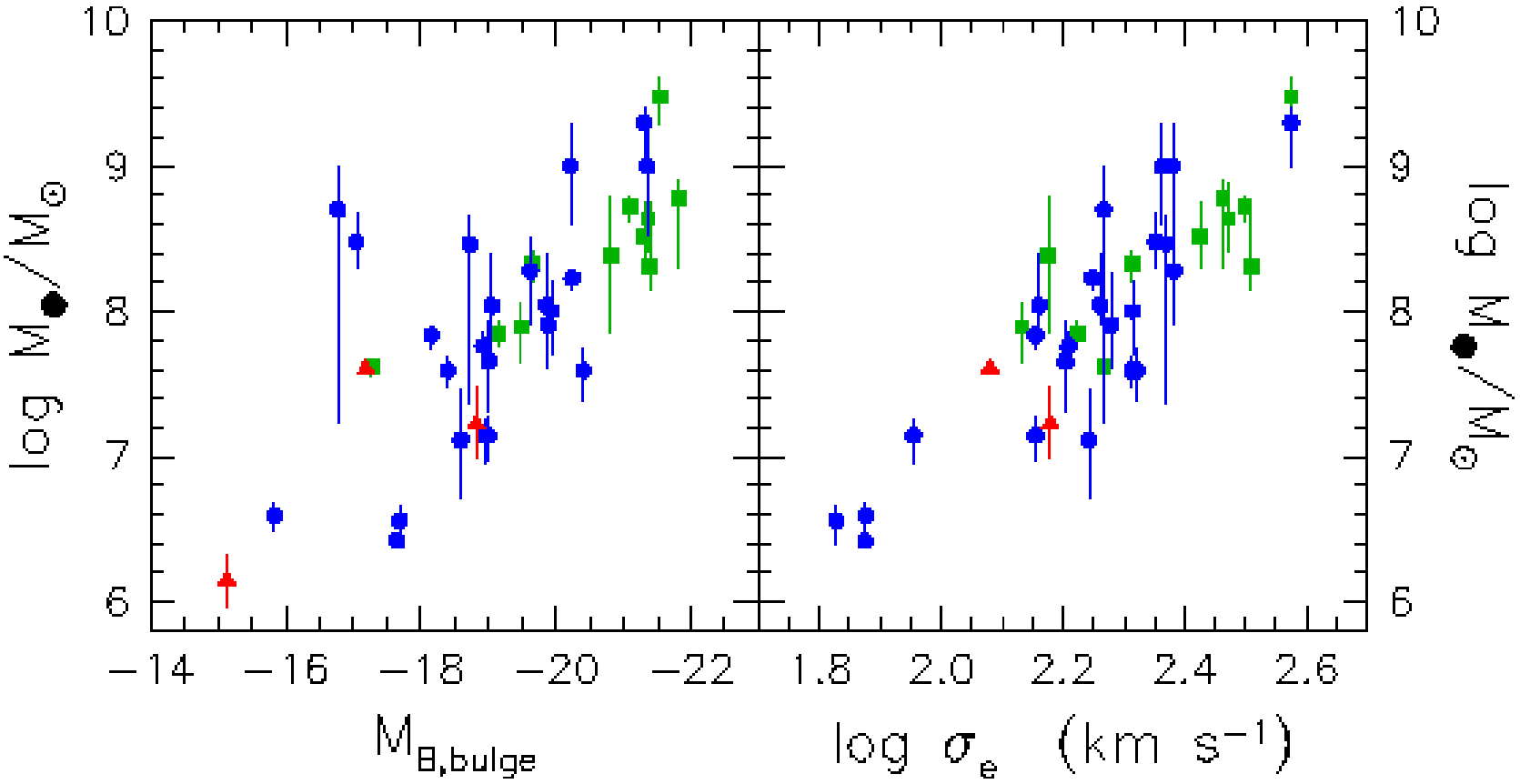
A Correlation between SMBHs and Globular Clusters

Burkert & Tremaine 2010, ApJ, 720, 516
(arXiv1004/0137)

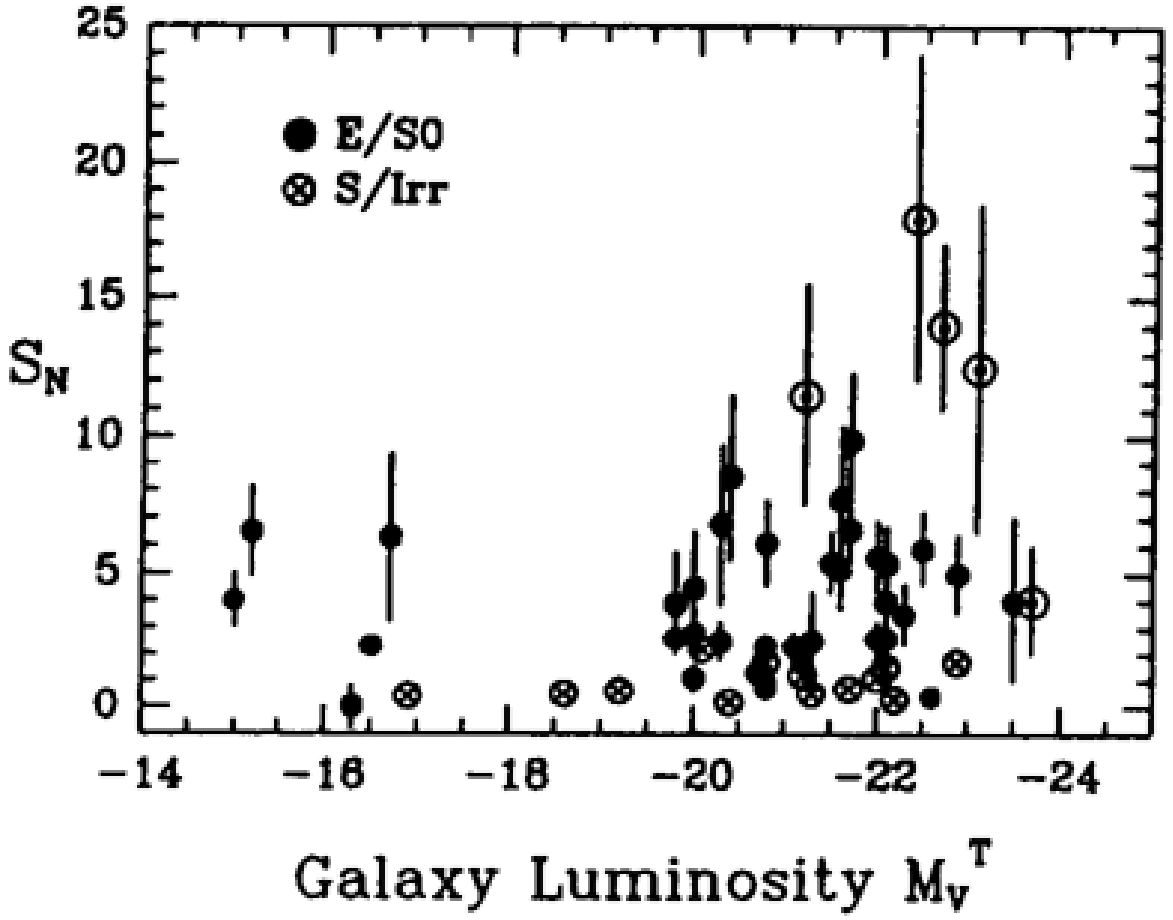


(Kormendy)

Globular cluster specific frequency

$$S_N \equiv N_{GC} \times 10^{0.4(M_V+15)}$$

$$M = 9 \cdot 10^7 M_\odot \left(\frac{M}{L}\right) \frac{N_{GC}}{S_N}$$



(Harris)

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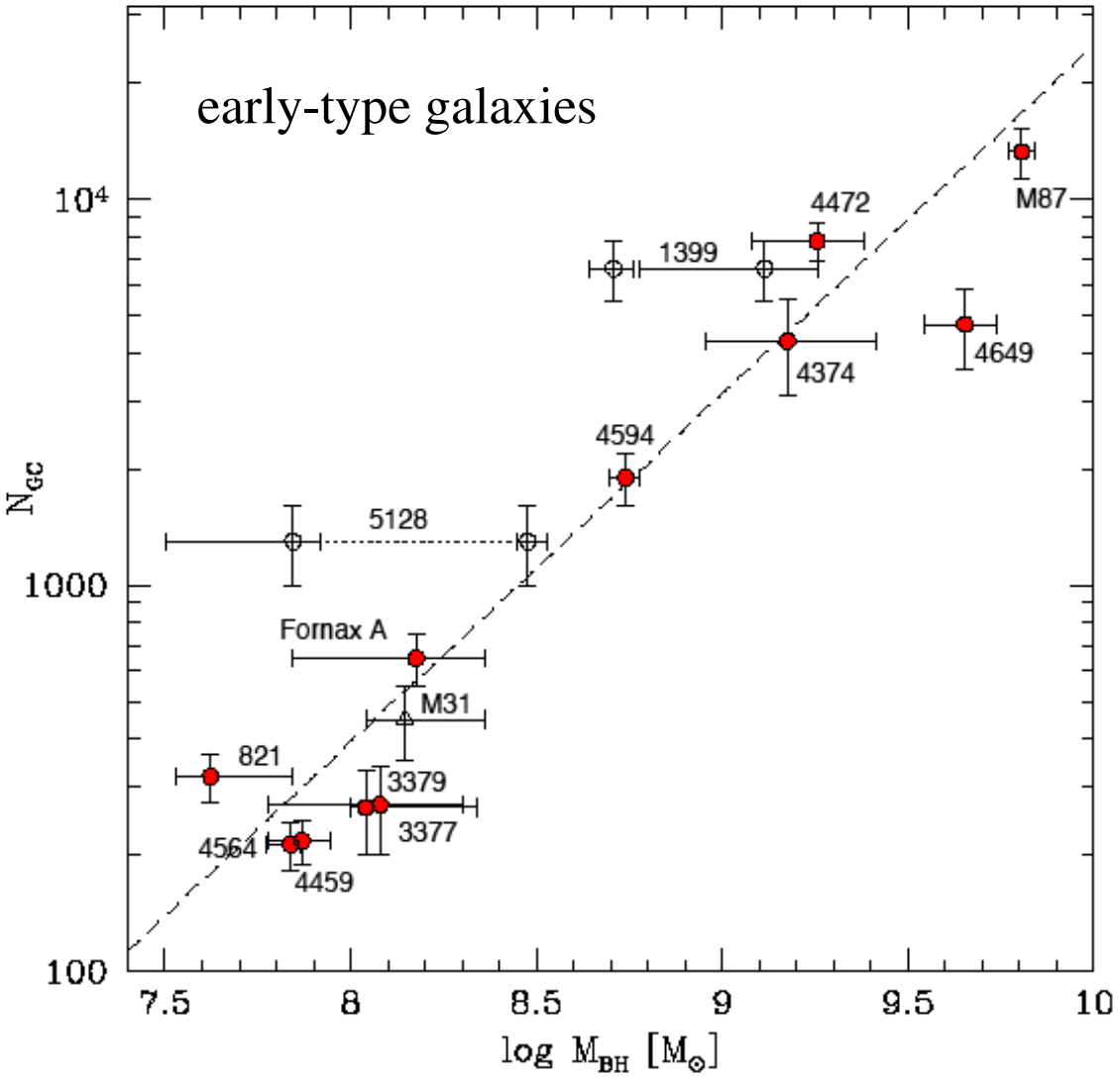


$$M_\bullet = m_{\bullet/*} \times N_{GC}^{1.1}$$

$$m_{\bullet/*} = 1.7 \times 10^5 M_\odot$$

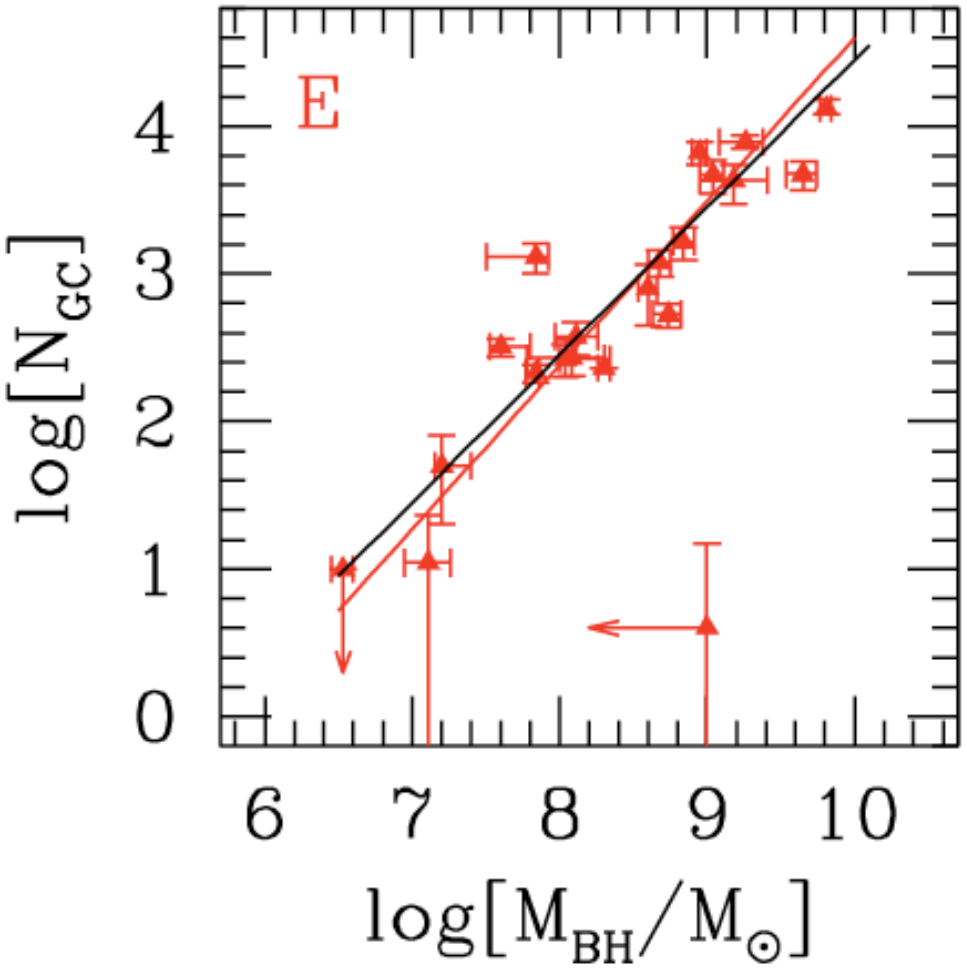
$$M_\bullet - N_{GC}: \quad \chi^2 = 5.9$$

$$\varepsilon = 0.21$$

Gültekin et al. (09)
Peng et al. (08)
Gebhardt

Harris & Harris 2010

- 33 galaxies: 21 ellipticals, 4 spirals, 8 S0

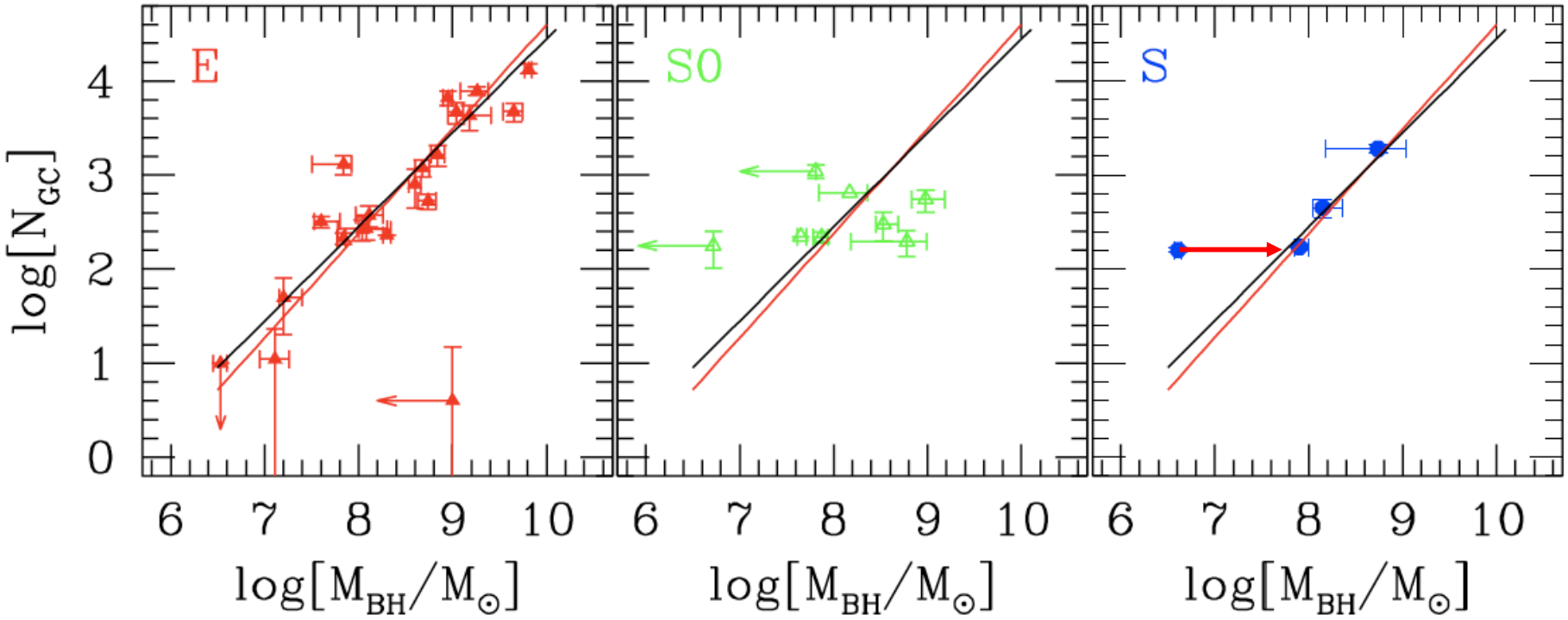


$$M_{BH} = 3.55 \times 10^5 M_\odot \times N_{GC}$$

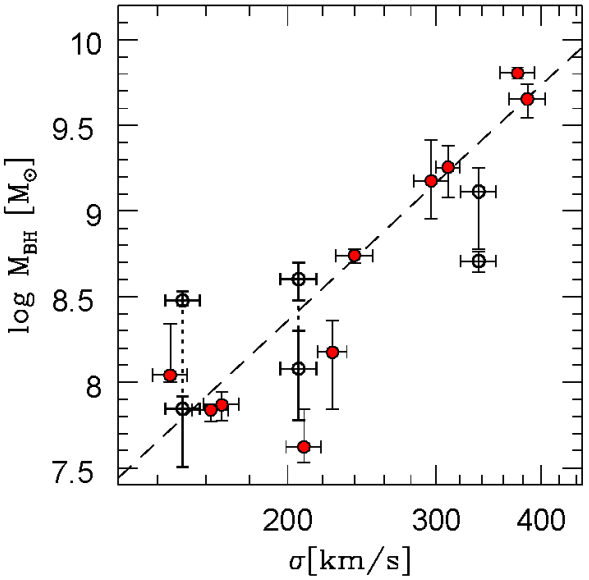
$$\varepsilon = 0.2$$

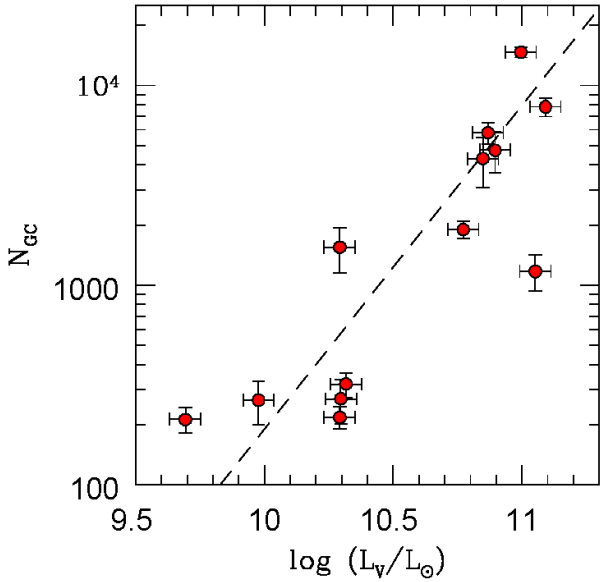
Harris & Harris 2010

- 33 galaxies: 21 ellipticals, 4 spirals, 8 S0



A Secular Correlation?





$M_\bullet - N_{GC}$: $\chi^2 = 5.9$

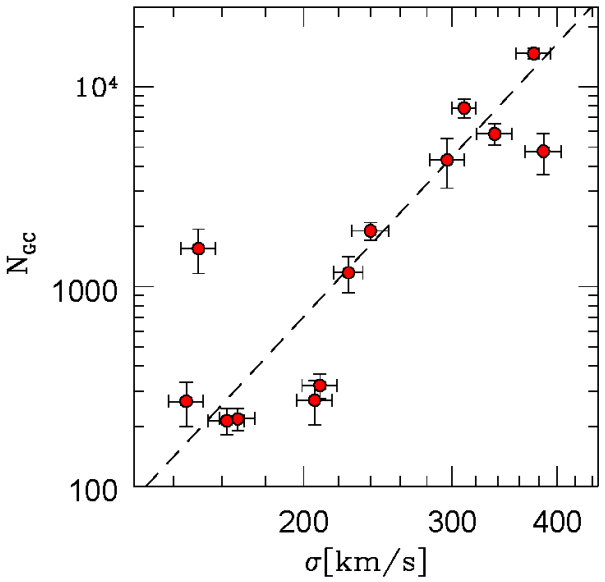
$\varepsilon = 0.21$

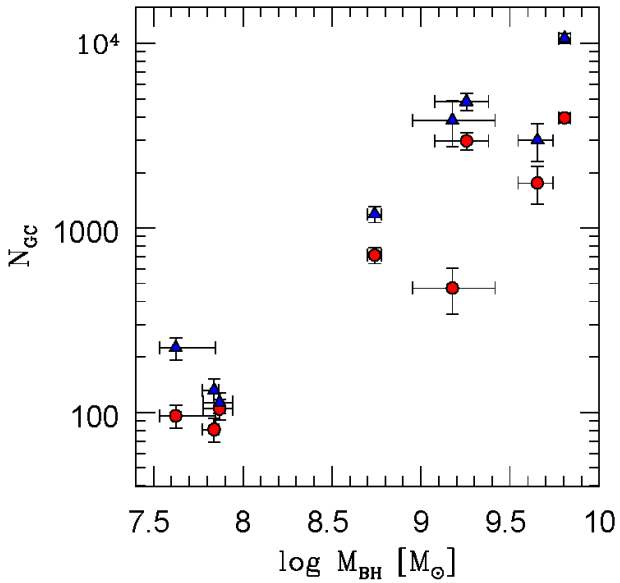
$M_\bullet - \sigma$: $\chi^2 = 9.2$

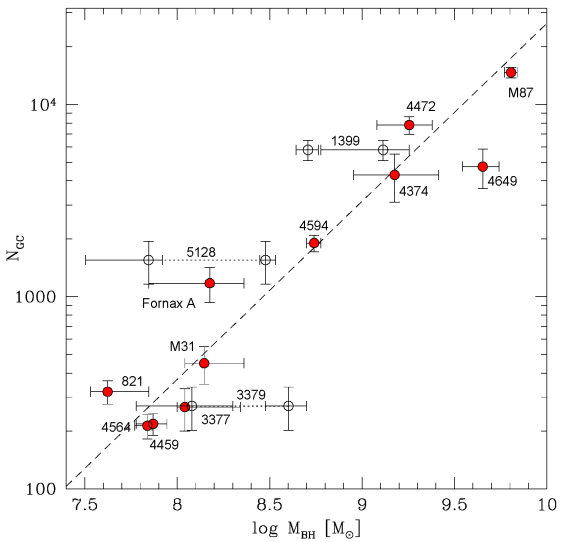
$\varepsilon = 0.3$

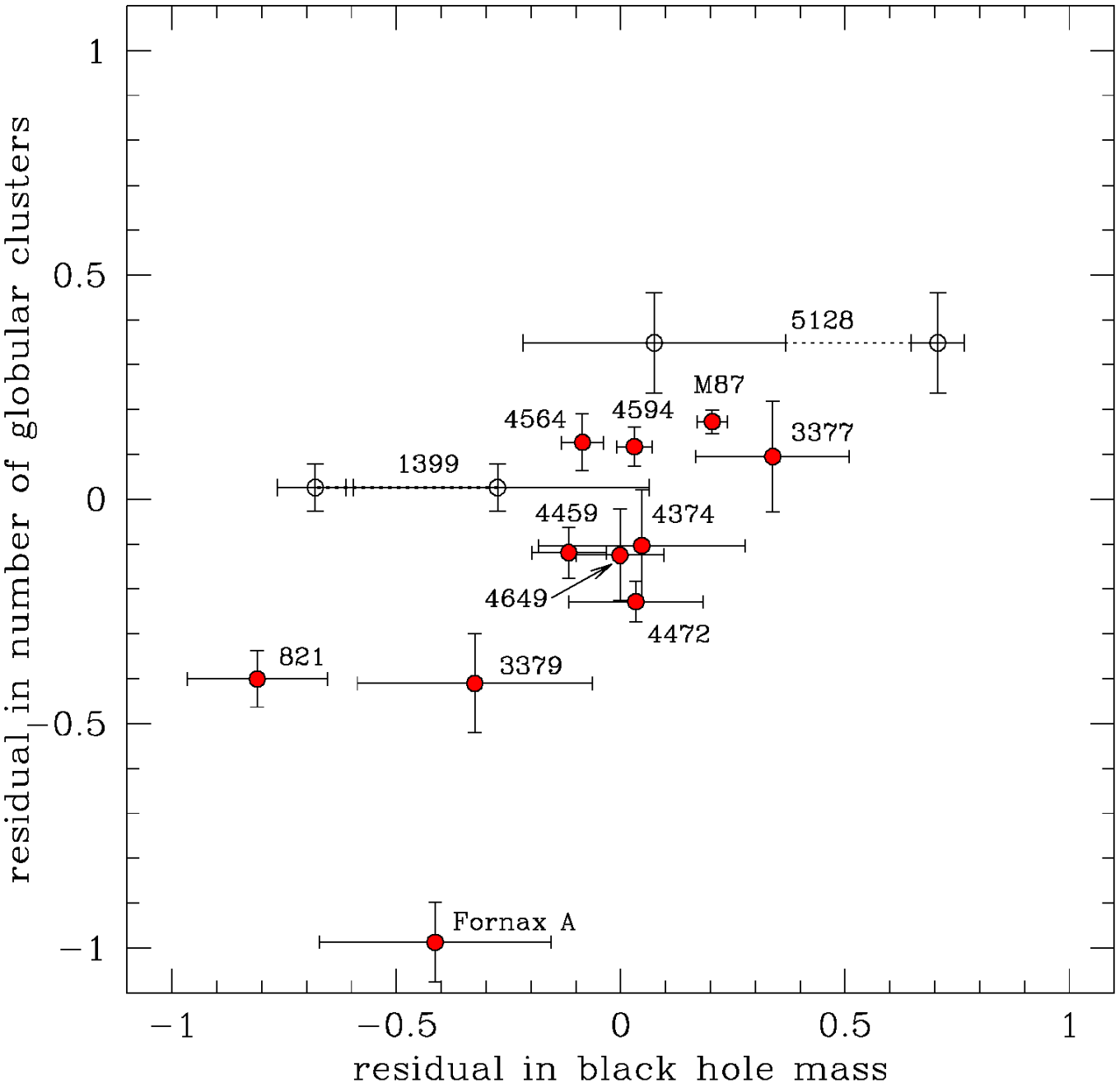
$N_{GC} - L_V$: $\chi^2 = 35$

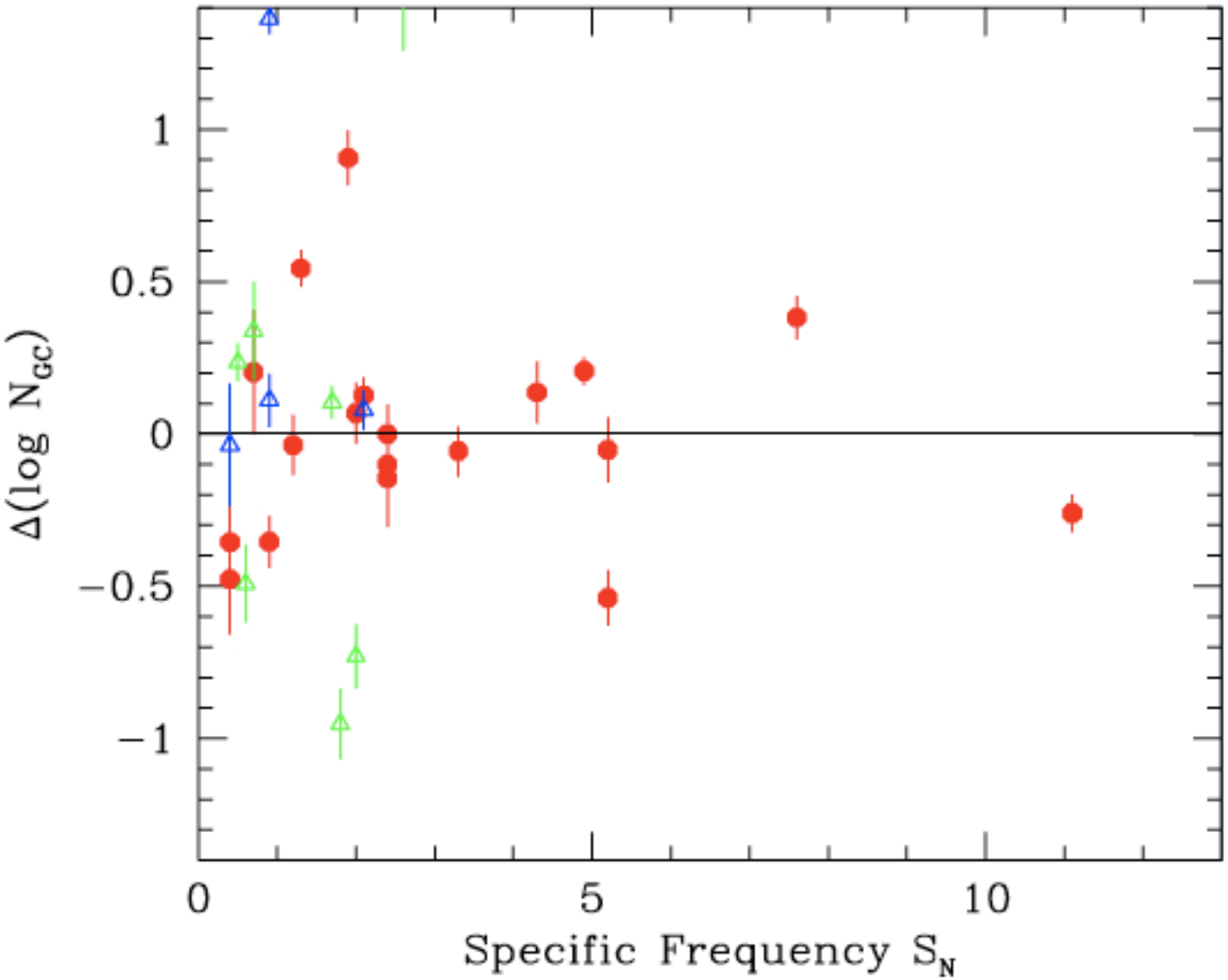
$\varepsilon = 0.38$





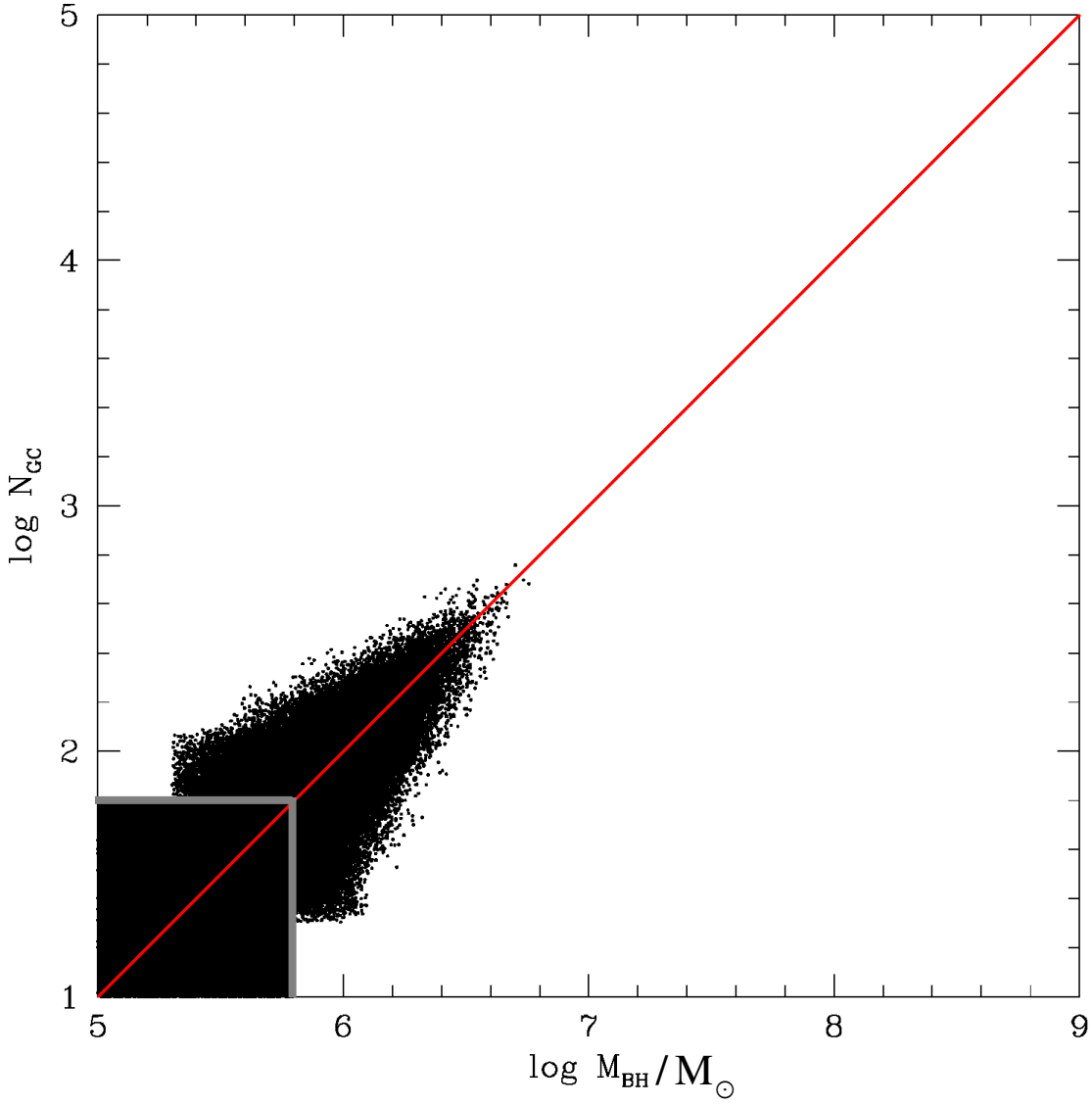



residual in number of globular clusters
residual in black hole mass
1
0.5
0
−0.5
−1
−1
−0.5
0
0.5
1
5128
M87
4564
4594
3377
1399
4459
4374
4649
4472
821
3379
Fornax A

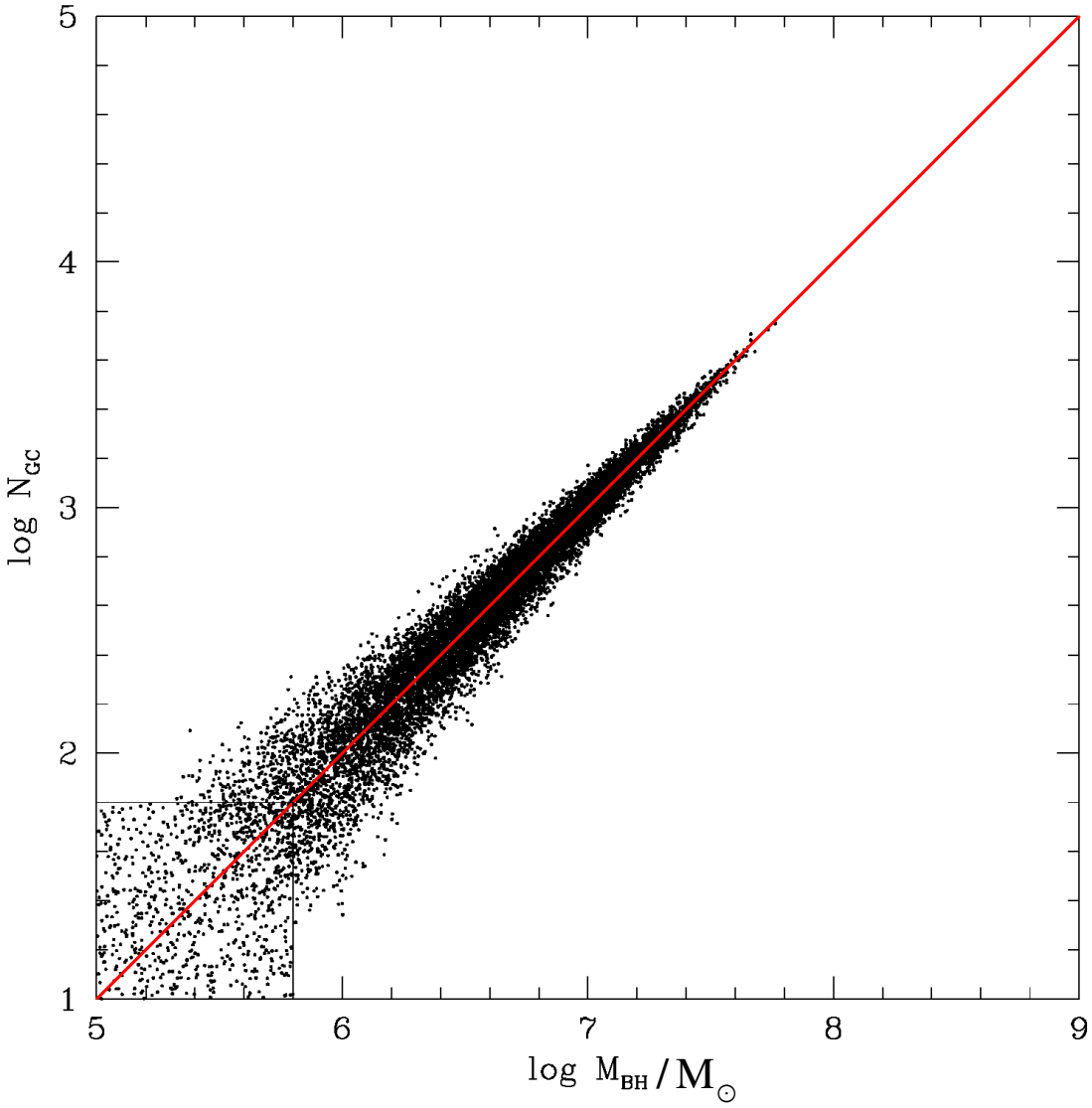

1
0.5
0
−0.5
−1
Δ(log N_GC)
0
5
10
Specific Frequency S_N

Origin: The Power of the Central Limit Theorem

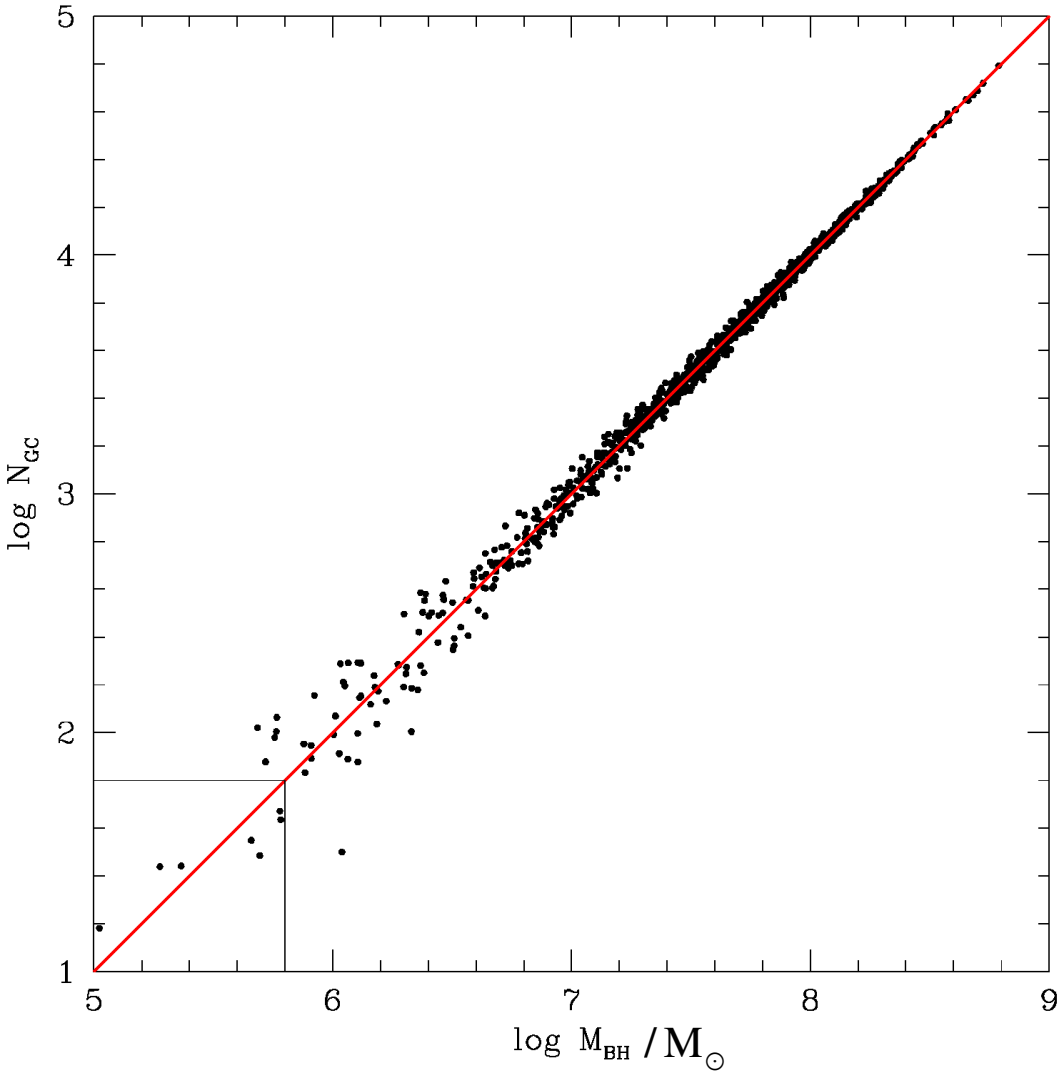
(Hirschmann et al. 10; Jahnke & Maccio 10)



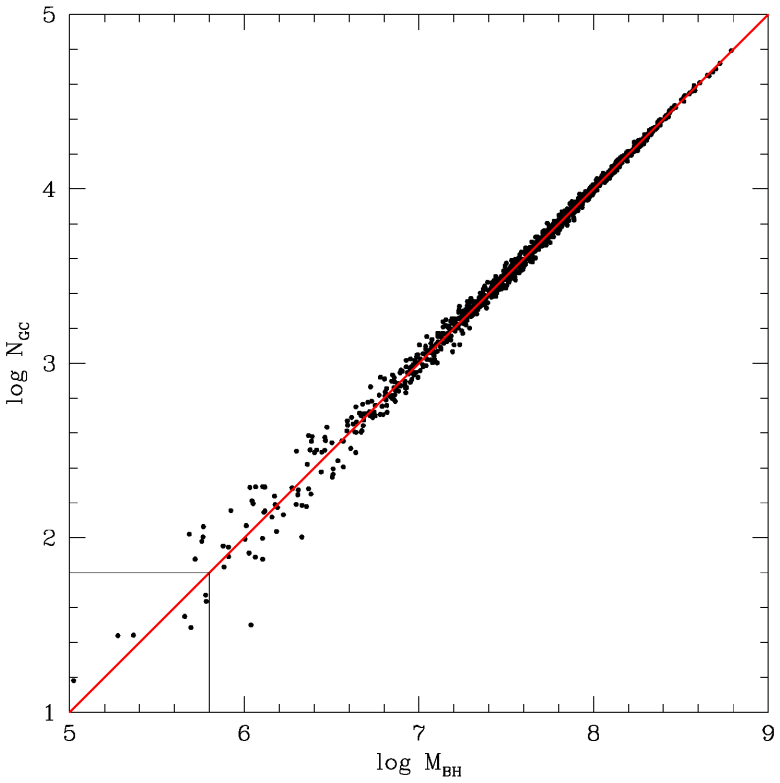
Origin: The Power of the Central Limit Theorem



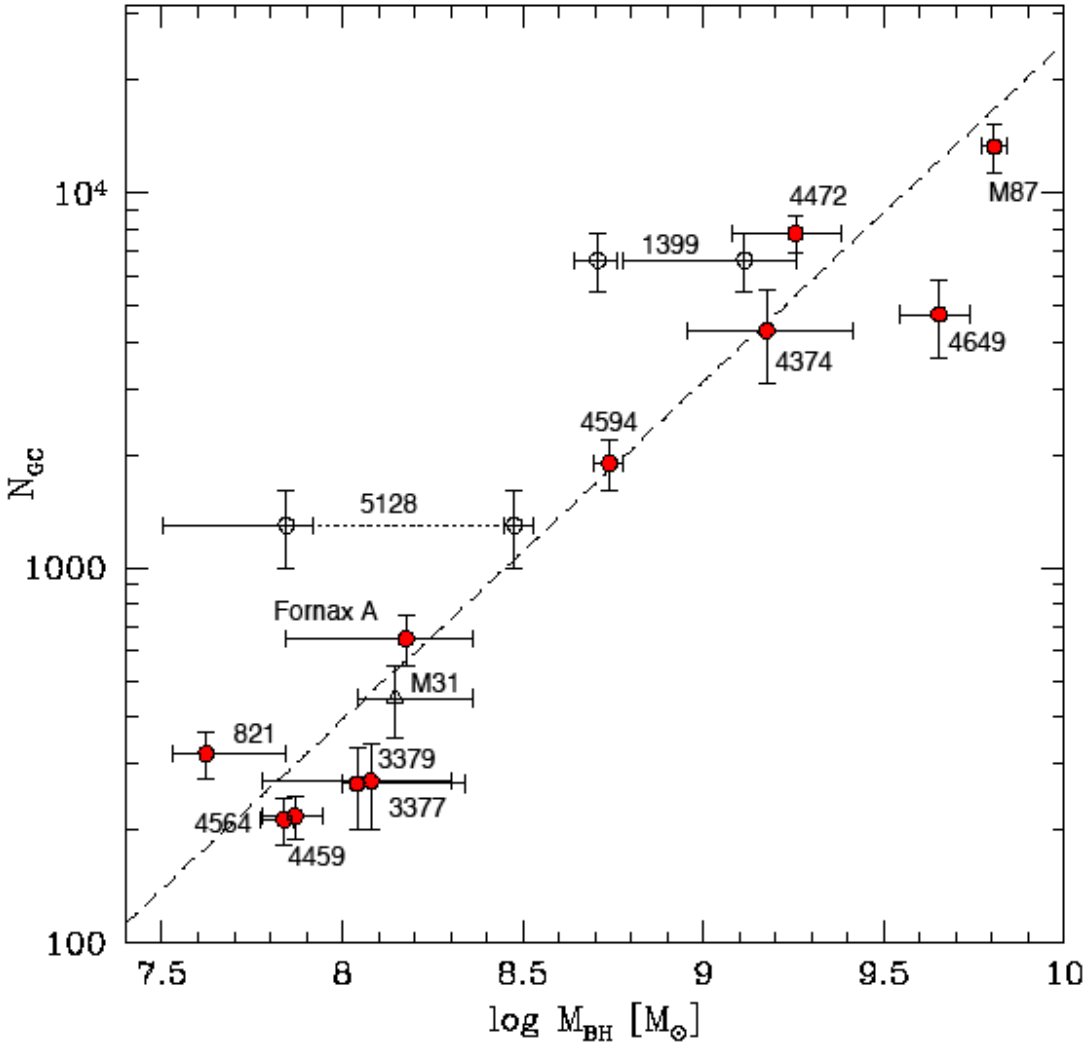
Origin: The Power of the Central Limit Theorem



Implications



- For every GC on average one **seed BH** of similar mass formed.
- BH growth by **accretion** is negligible compared to **dry** BH **mergers**
- **Secular formation** of **GCs** is negligible
- **Disruption** of **GCs** by secular processes is negligible


10^4
1000
100
N_{GC}
7.5
8
8.5
9
9.5
10
log M_{BH} [$M_\odot$]
M87
4472
1399
4649
4374
4594
5128
Fornax A
M31
821
3379
3377
4564
4459