

A Runaway Black Hole in NGC1277?



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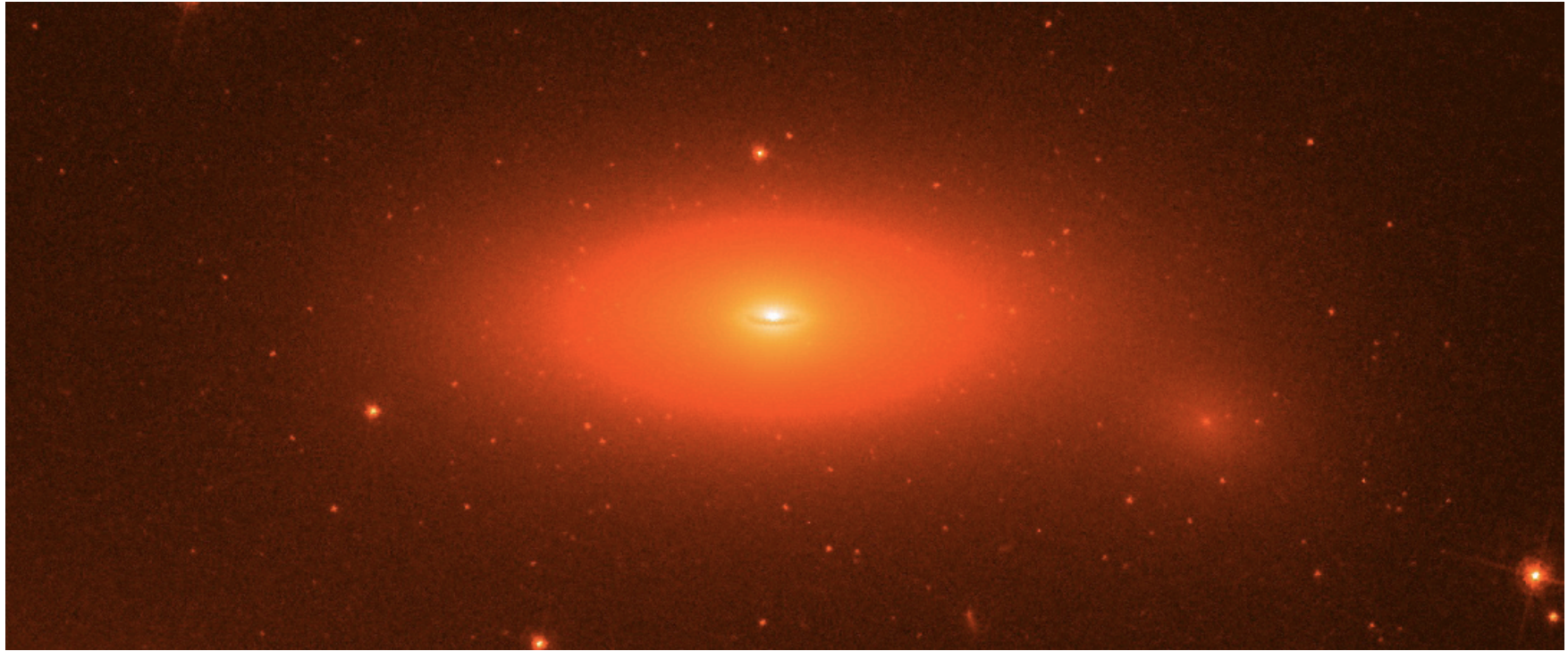
BH Conference, KITP 2013 Aug 8

Abstract

- 17 billion M_{sun} BH in modest S0 galaxy in Perseus cluster (van den Bosch+ 2012) [see references at end]
- Far exceeds expected M_{BH}
- Could it have formed in NGC 1275 (BCG) and migrated to new host?

Black Hole Recoil

- Numerical relativity has found big “kicks” when spinning black holes merge. Velocities up to 5000 km/s (Lousto & Zlochower 2013)
- Runaway quasars fueled by accretion disk? (Loeb 2007; Bonning+ 2007)
- Best candidate CID-42? (Blecha+ 2012, and refs. therein) [But see Blecha this conference.]
- Stellar entourage? (Merritt+ 2009)
- Black hole migration and BH-bulge scatter (Volonteri 2007; Blecha+ 2011)



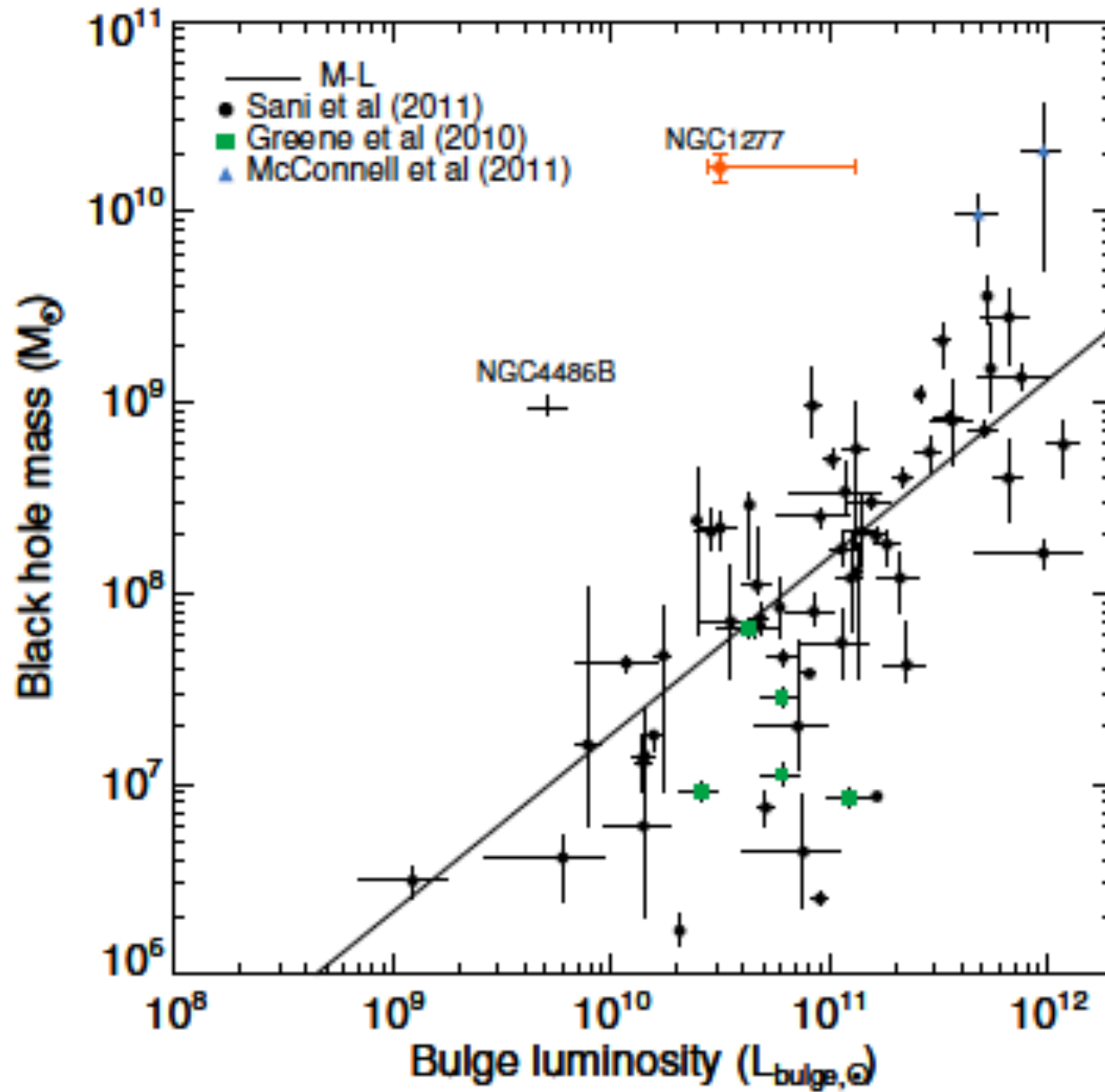
NGC 1277

M_{BH} 17 billion M_{sun}

59% of bulge mass

14% of total stellar mass

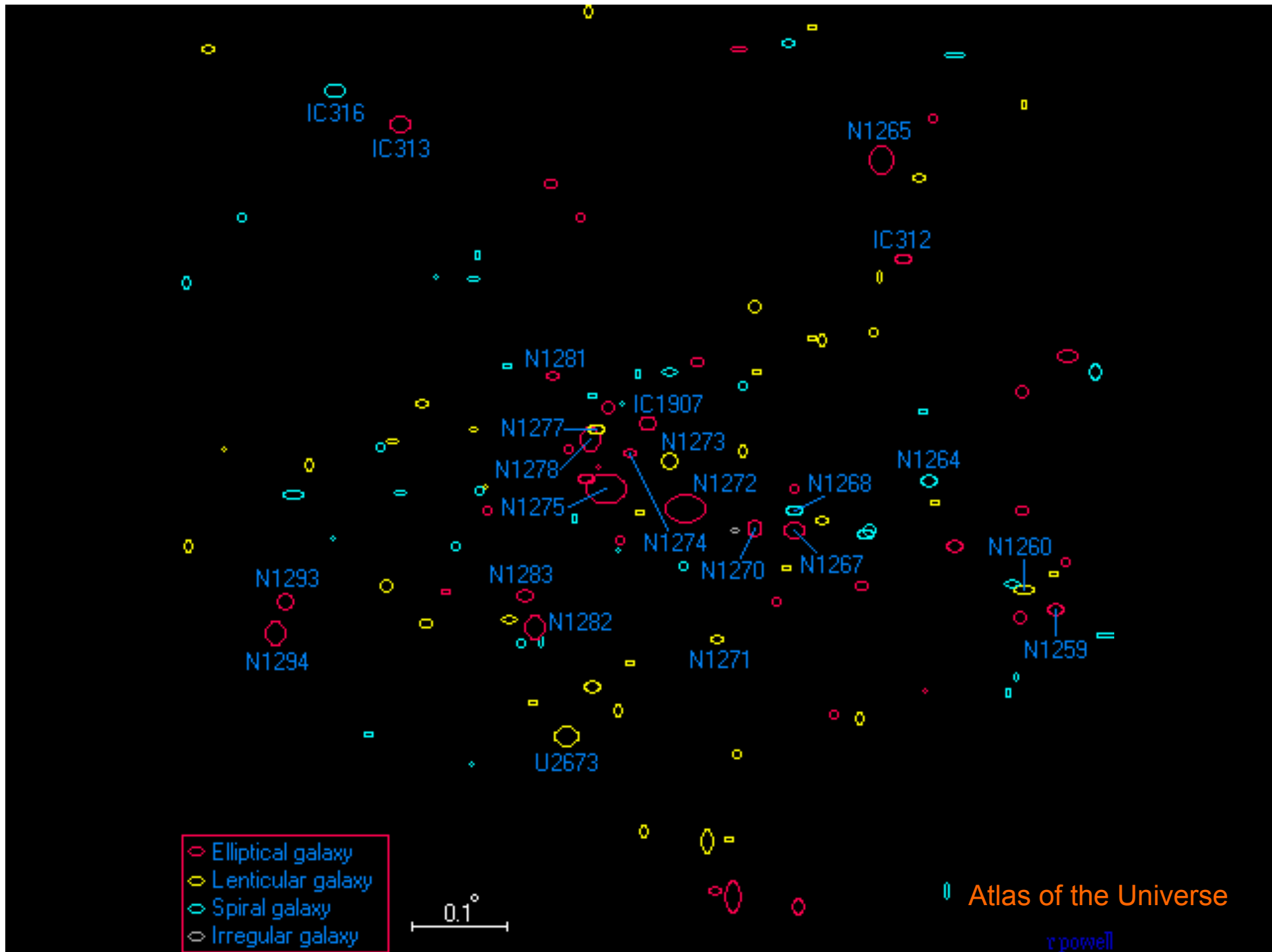
Van den Bosch+ 2012



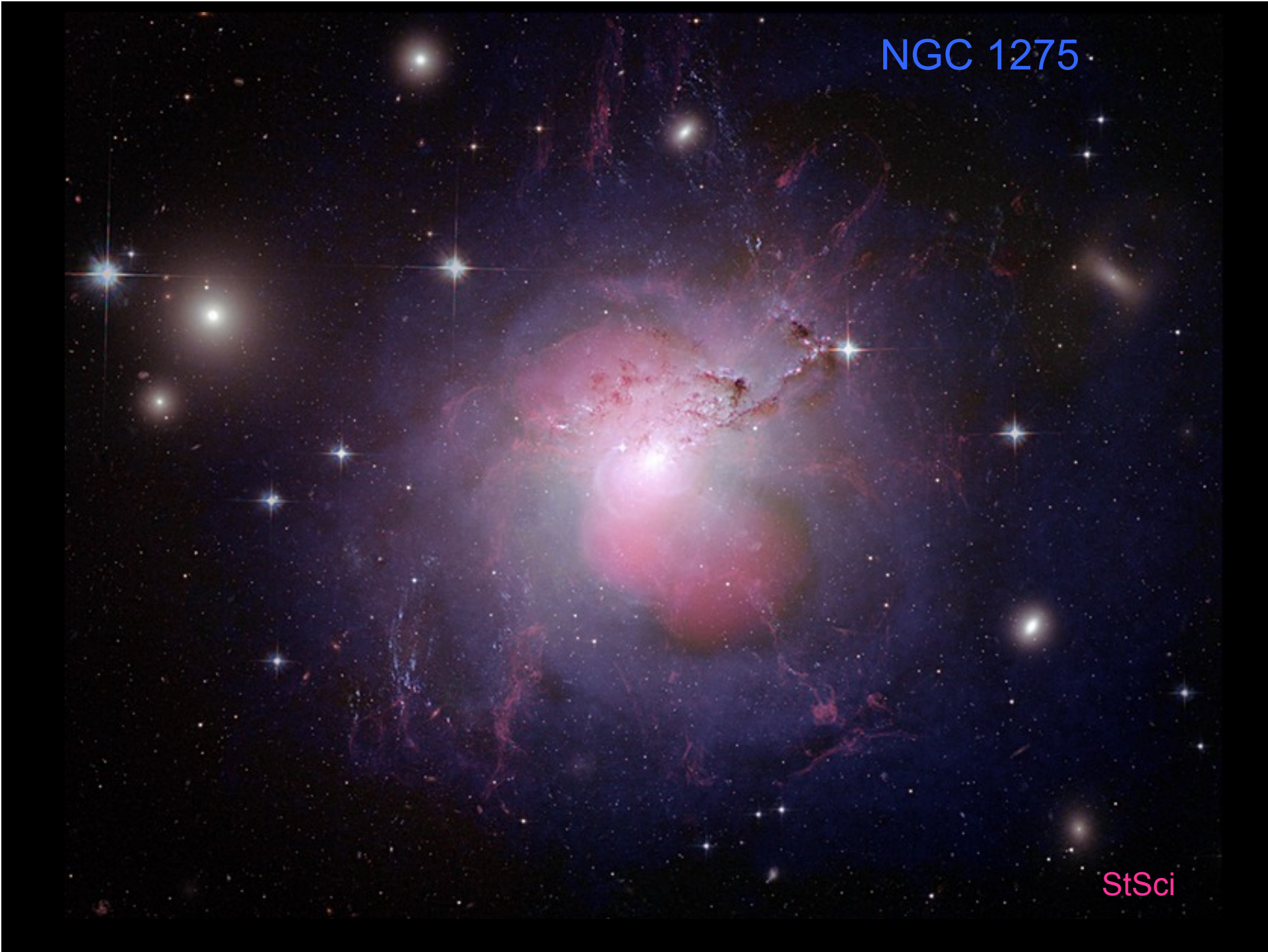


Perseus Cluster

APOD/CFHT



NGC 1275



StSci

Escape

M_{BH} up to 20 billion M_{sun} in BCGs
(e.g., McConnell+ 2012)

NGC 1275 (Perseus cluster BCG)

$V_{\text{esc}} = 5\sigma_* = 1250 \text{ km/s}$ (Heckman+ 1985)

BH merger with random parameters: prob = 25% for escape (Lousto+ 2011, equal masses)

BH masses can differ factor 2 or more, so more than one chance for big kick?

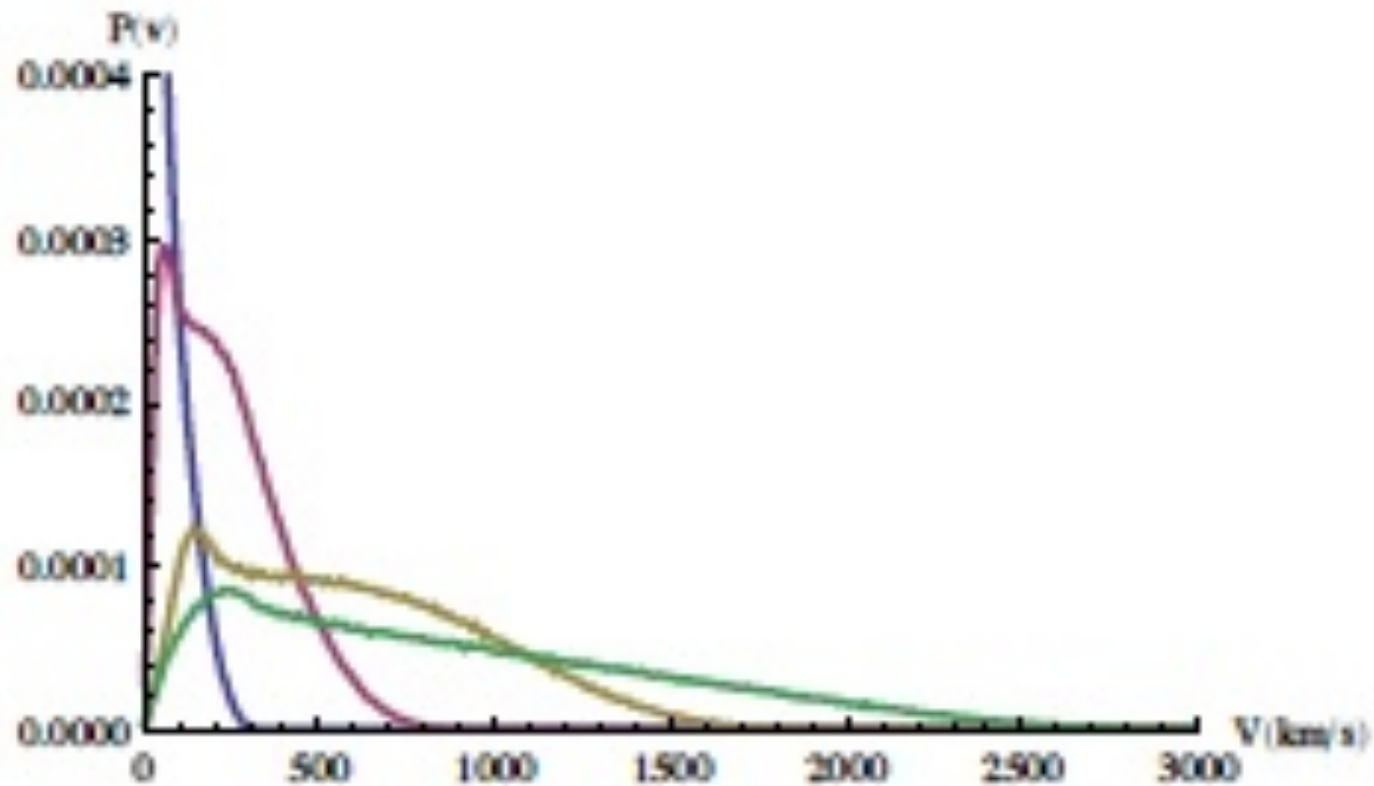


FIG. 26: The recoil velocity magnitude distribution for a uniform distribution in mass ratio and spin-magnitude distribution in Fig 19 (with uniform spin direction). The plot shows the recoil velocity distribution for mass ratios in the range $0 \leq q \leq 0.1$, $0.1 \leq q \leq 0.2$, $0.3 \leq q \leq 0.4$, and $0.9 \leq q \leq 1$. The distributions become successively broader for larger values of q (i.e. similar masses).

Capture

Stellar entourage only 1% of M_{BH} ; must merge with new galaxy

Cluster velocity dispersion high, hurts dynamical friction.

For slow encounter (300 km/s), impact parameter 10 to 30 kpc works

- Best chance: central subcluster (10 galaxies like NGC 1277 in region 0.25 Mpc across)
- $T_{\text{coll}} = (10^{9.7} \text{ yr}) f_{\text{v}}^{-1} b_{10}^{-2}$
- Rough probability: 10% in Hubble time.

Issues

NGC 1275:

- Small BH? Maybe.
- Large core? Maybe not.
- But could re-grow BH and refill core.
- Merger thru final pc without aligning spins?

NGC 1277:

- Disk survive merger?
- Angular momentum from merger?
- Time for BH settle to center?

--Hard to hide QSO if BH grew by accretion?
(Fabian+ 2013)

--How common are these objects?

--Examples outside clusters?

--BH migration common?
(Volonteri 2007; Blecha+ 2011)

--If not NGC 1277, somewhere else?

Press coverage

-- *Science News* “New Home for Runaway Black Hole” (2013, Vol. 183, #7, by Andrew Grant)

-- *Scientific American* “Are Galaxies Playing Catch with Black Holes?” (2013 July 18, on-line news article by Christopher Crockett) [Also Podcast “Giant Black Hole may be Fugitive” (2013 July 15, by John Matson)]

References

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