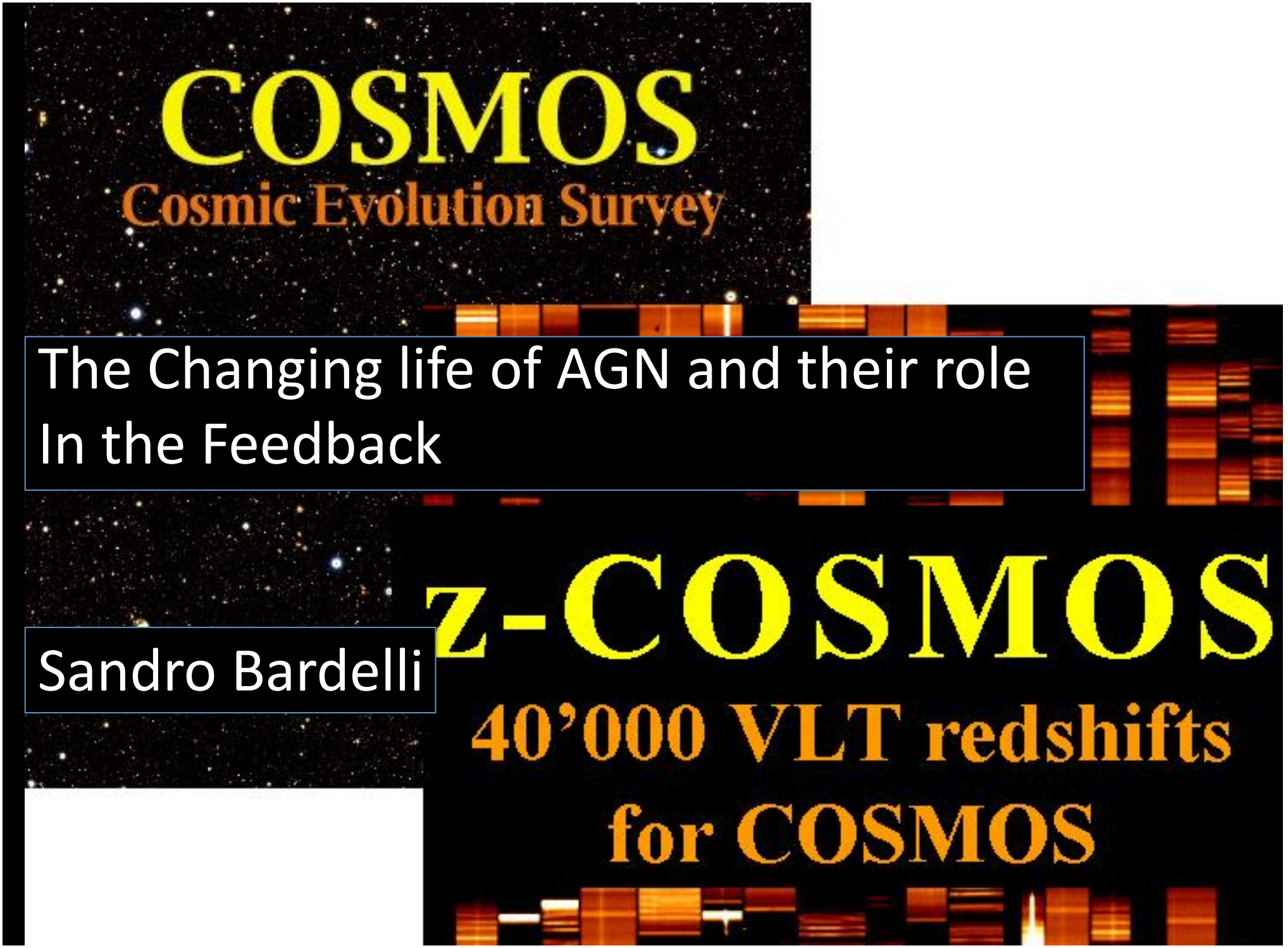
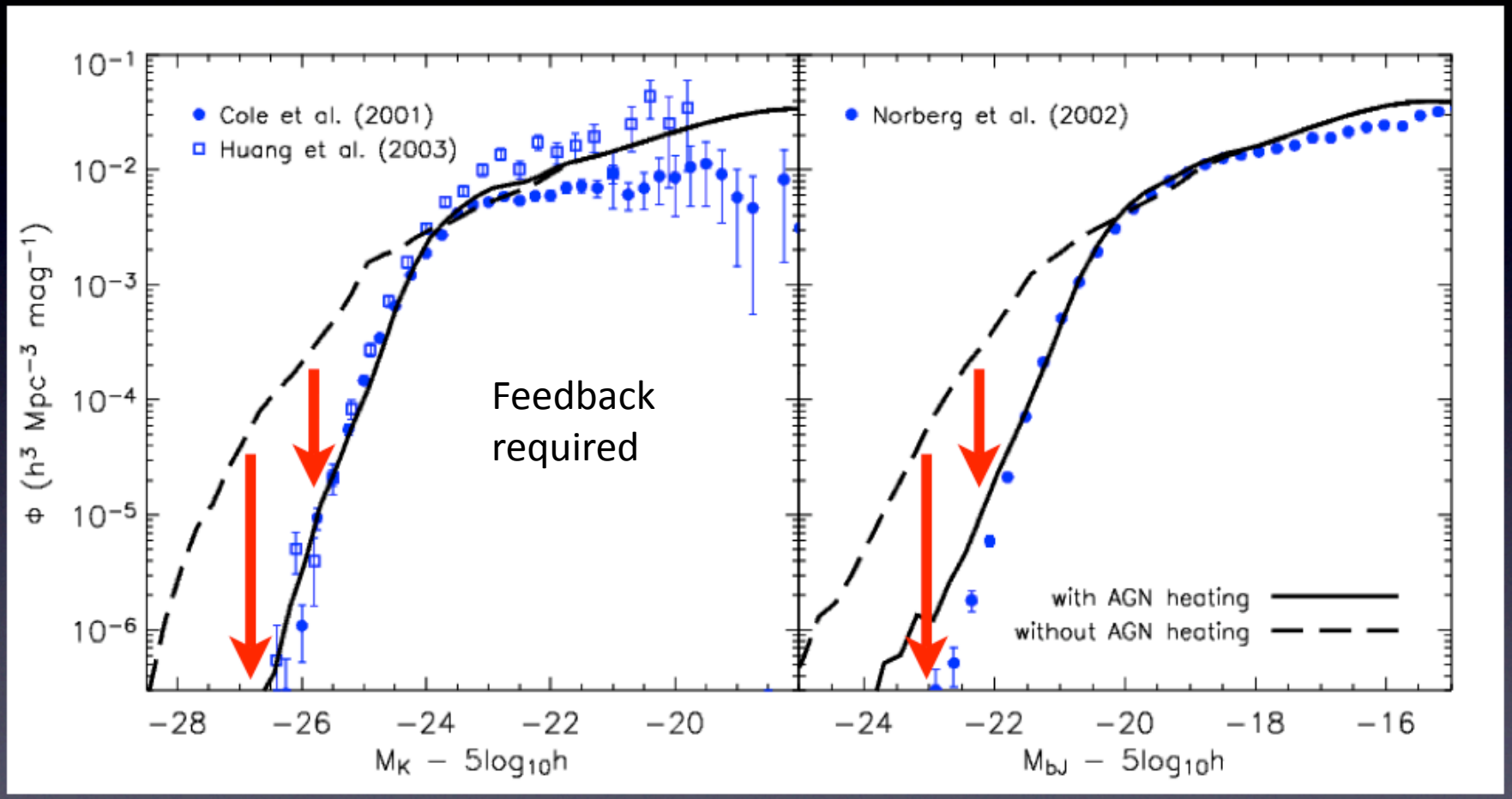


The Changing life of AGN and their role In the Feedback

Sandro Bardelli

From Hopkins

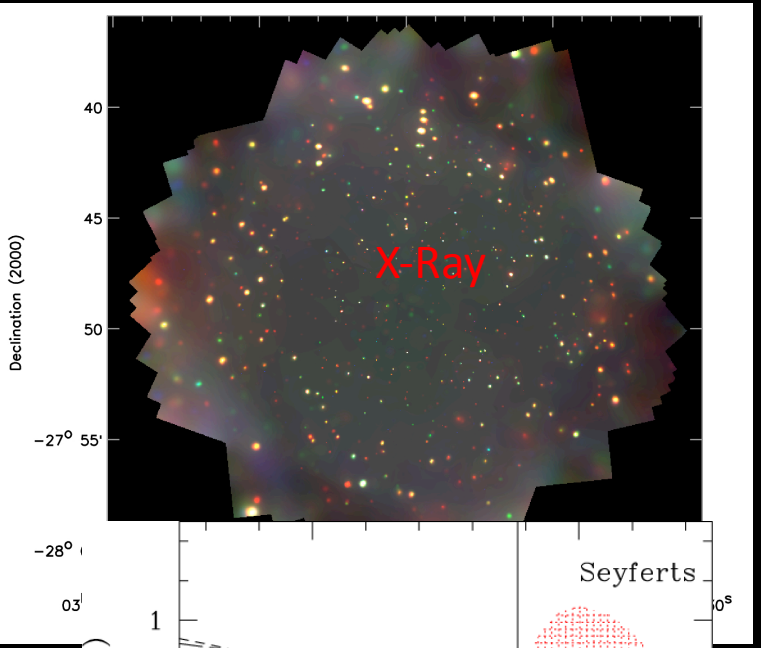
The luminosity function of galaxies

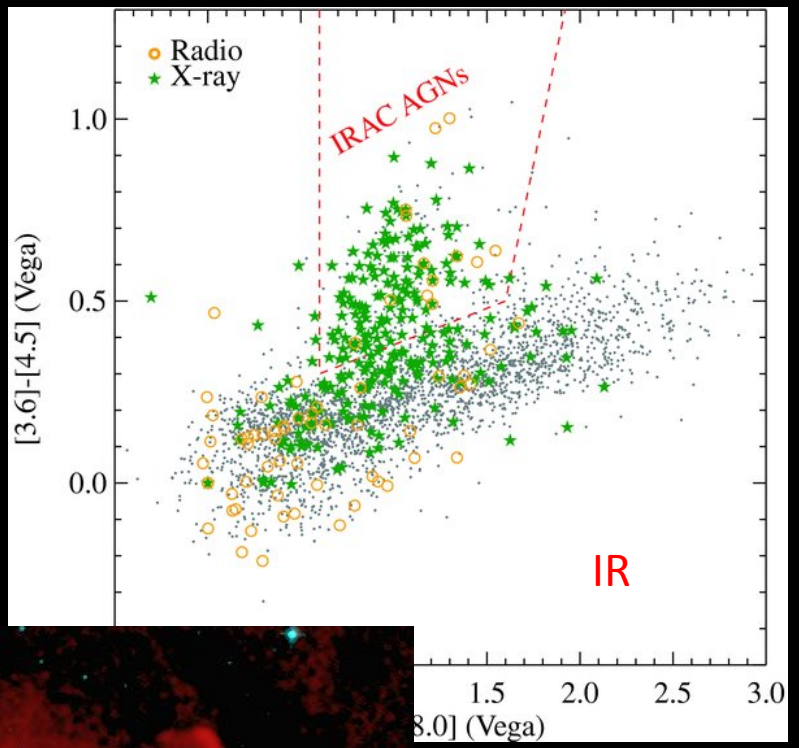


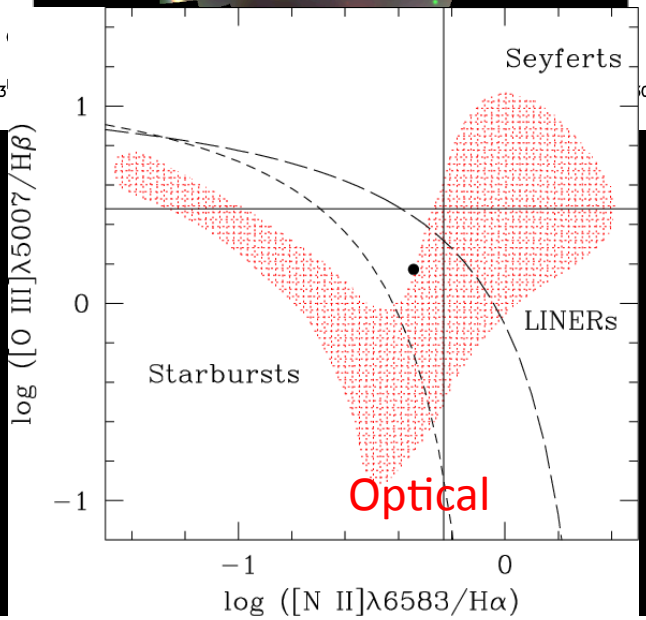
The heating source is able to produce the correct "knee" in the galaxy luminosity function

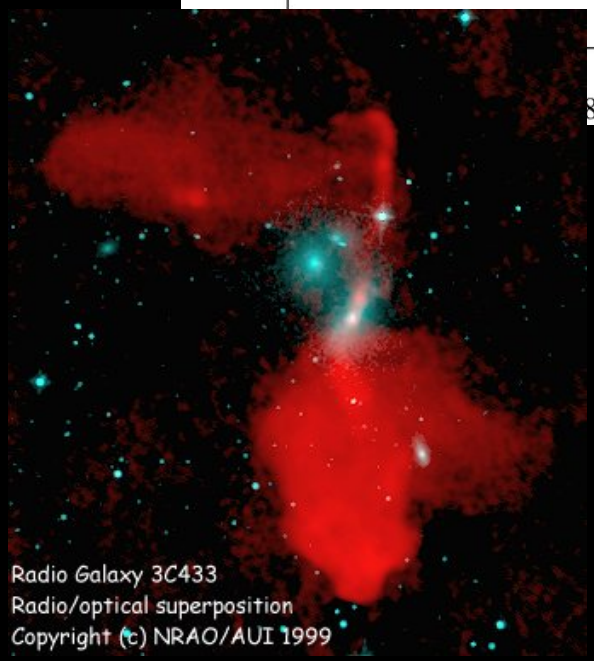
WHAT IS AN AGN?

From the observational point of view

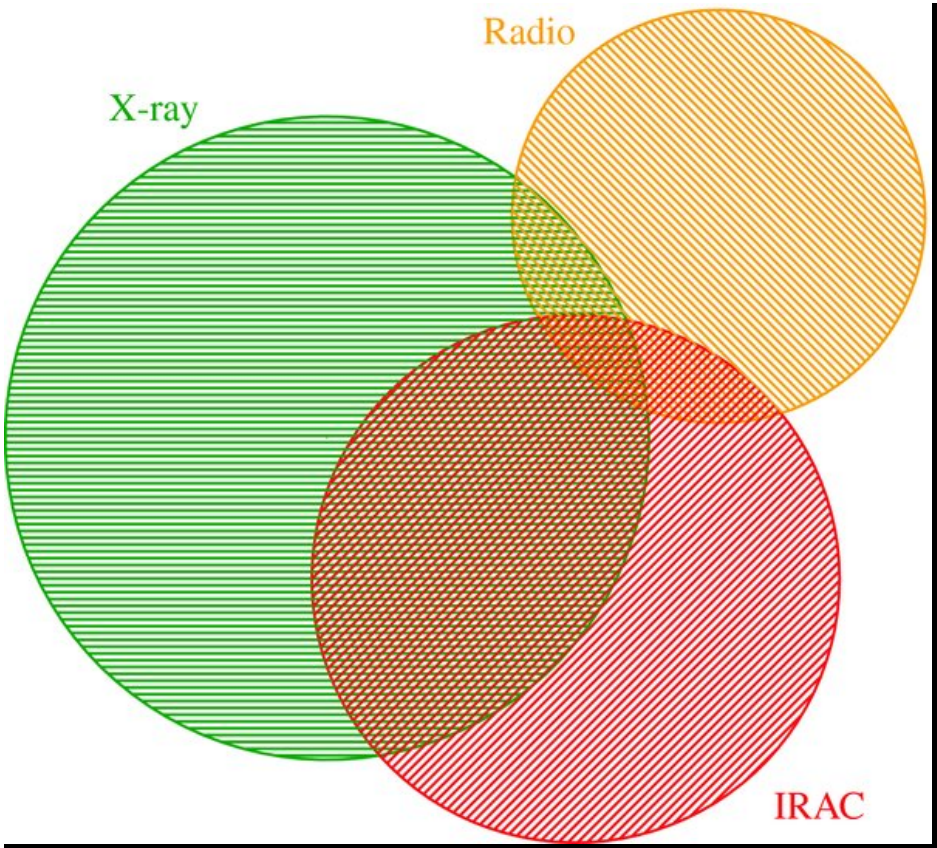








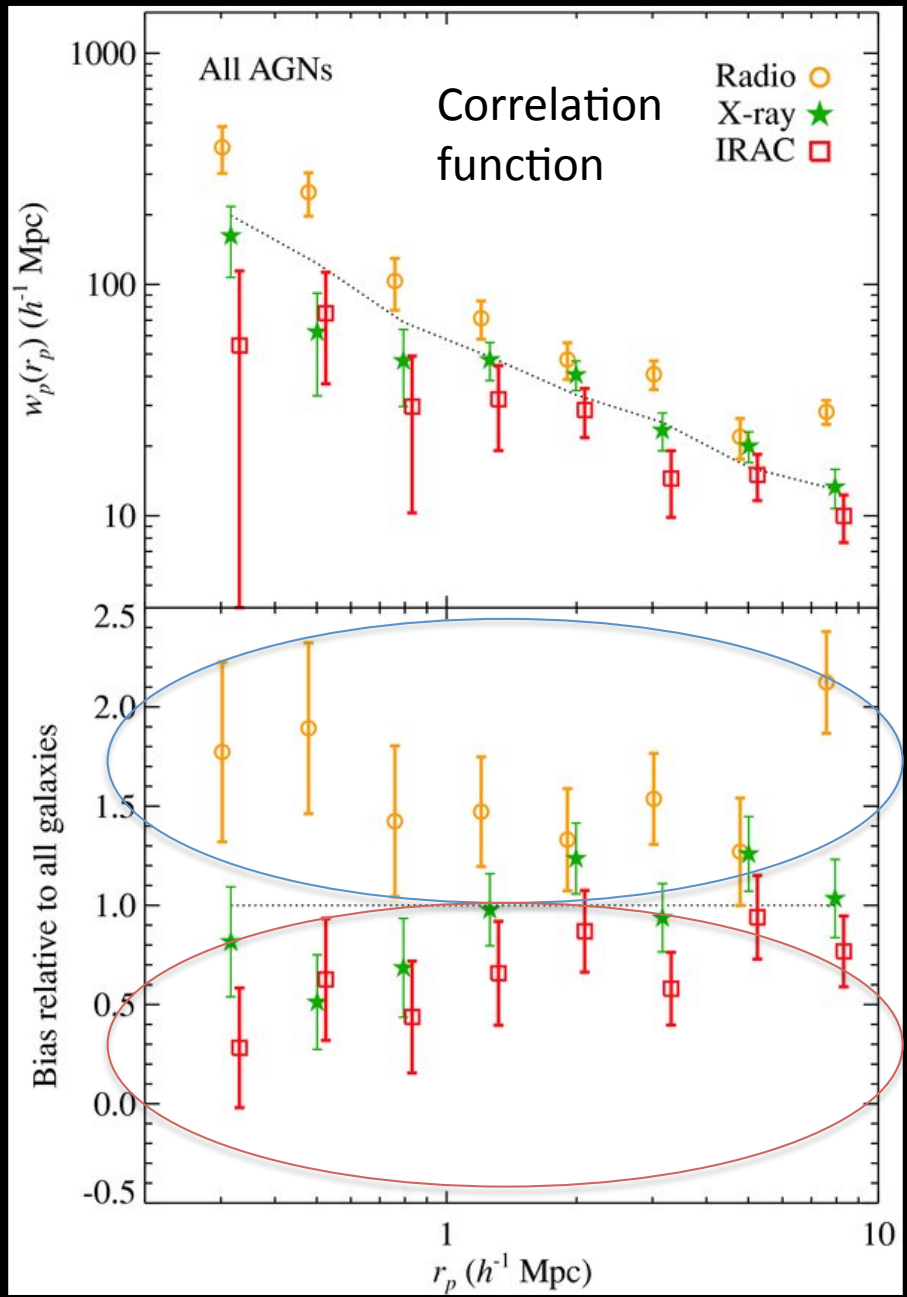
Radio



Overlap between AGN classes

Bias relative to all galaxies

Hickox et al. (2009)
AEGIS survey 0.2<z<0.8



Two type of AGN "modes"

1) Quasar mode: **cold disk gas** is driven onto central black hole → (X-Ray emission)

2) Radio mode: sub-Eddington accretion from **hot gas**
Efficient at late times, ongoing heating source
Mechanism observed in central part of clusters (Bubbles)
→ Radio emission

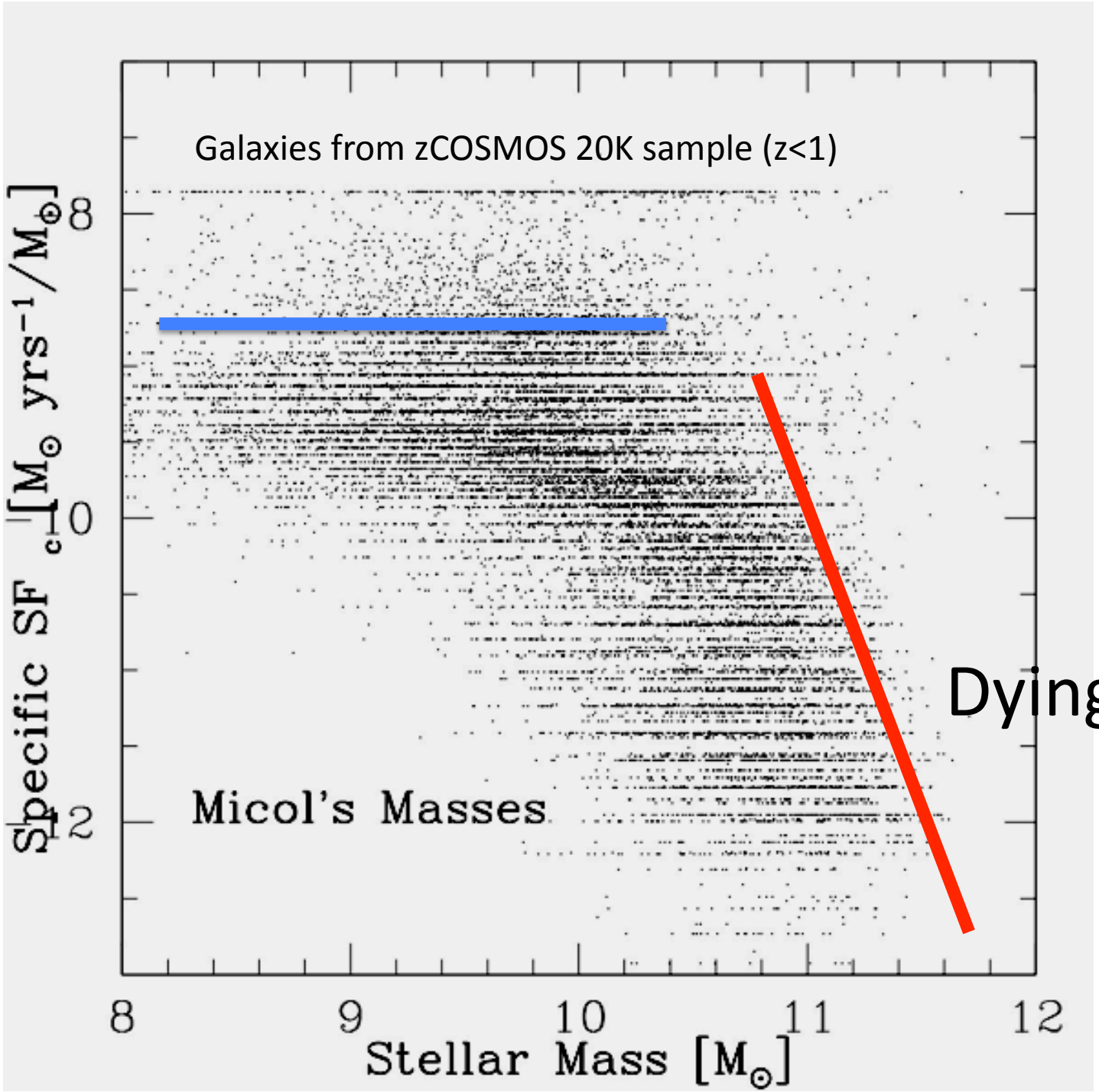
See Croton et al. (2006)

If there is AGN Feedback that stop the star formation, there should be a clear co-evolution between AGN and normal galaxies

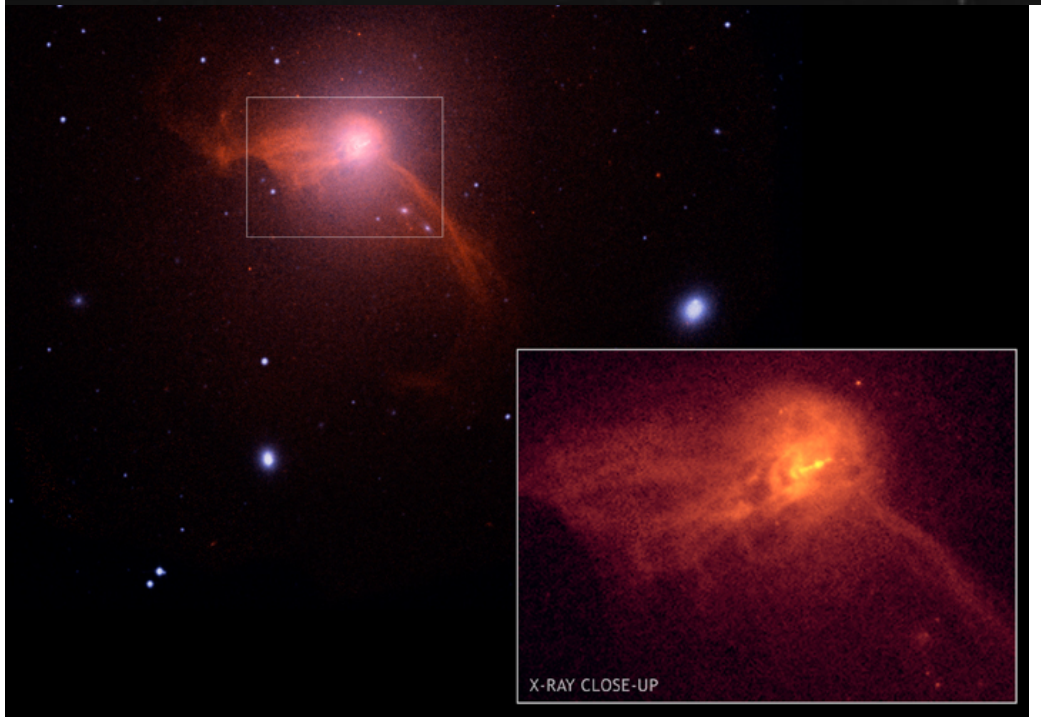
We know how evolves the stellar mass function (Micol talk), but AGN?

DIFFICULTIES

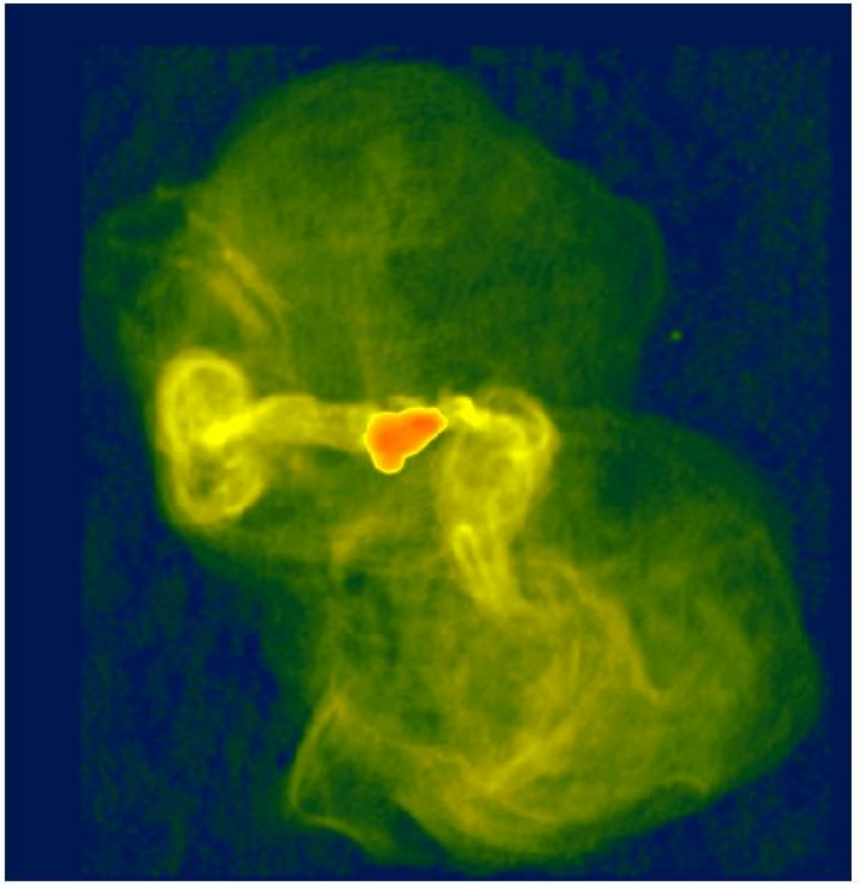
1)What type of AGN (Spectral, X-ray, Radio ……)
2) Occurrence (different life time)
3) Different detectability



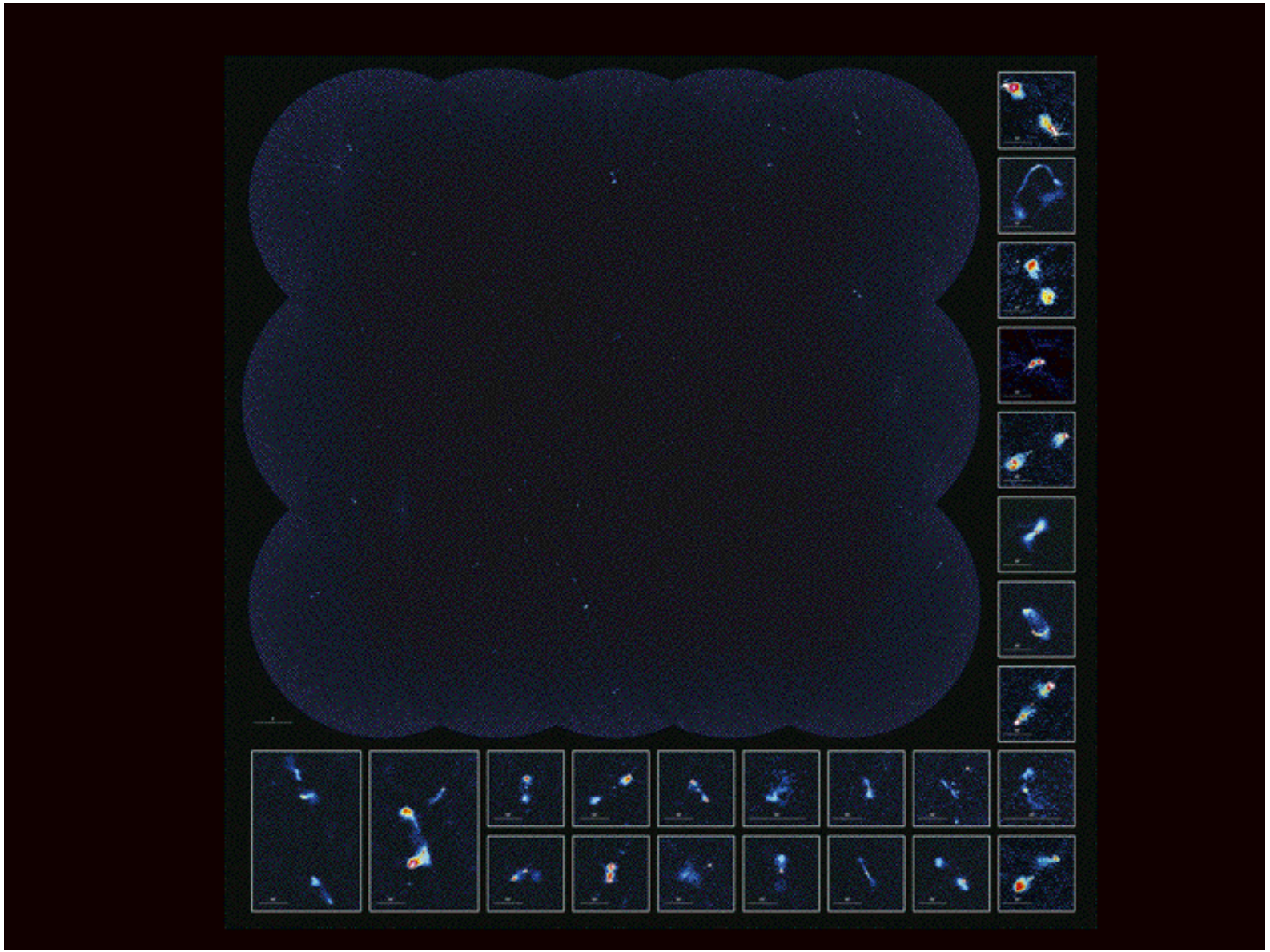
Dying sequence



The RADIO SIDE



VLA-COSMOS (Schinnerer et al. ,2007; 2010)



VLA-COSMOS

Bondi et al. (2008)

1.4 GHz over 2x2 deg^2 ~2417 sources

1.5 arcsec resolution to 11μ Jy

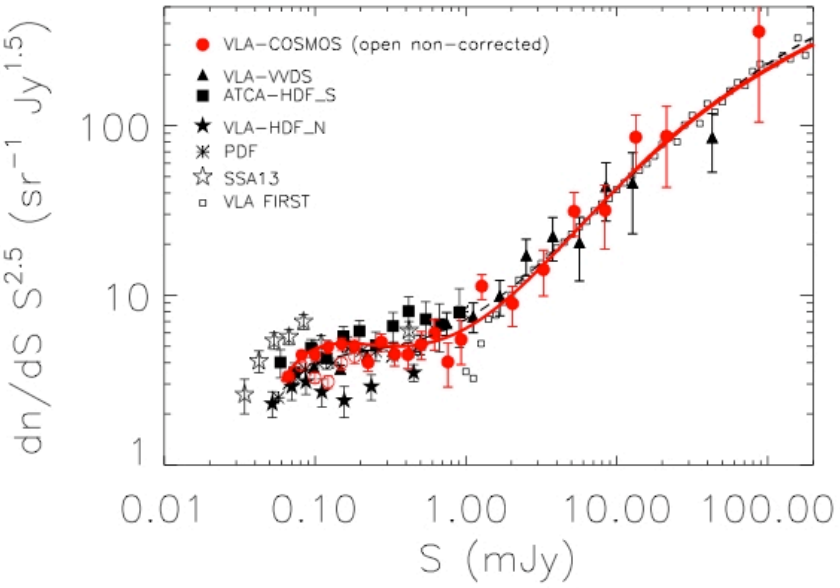


Fig. 5.— Radio source counts at 1.4 GHz from the VLA-COSMOS survey (dots) and from other surveys. Empty circles show the radio counts not corrected for incompleteness, filled circles the corrected ones using $m = 0.5$. The VLA-COSMOS source counts are shown along with those obtained by other deep surveys (see text). The solid line is least-squares sixth-order polynomial fit obtained using the VLA-COSMOS and the FIRST source counts. The dashed line is the fit obtained by Hopkins et al. (2003).

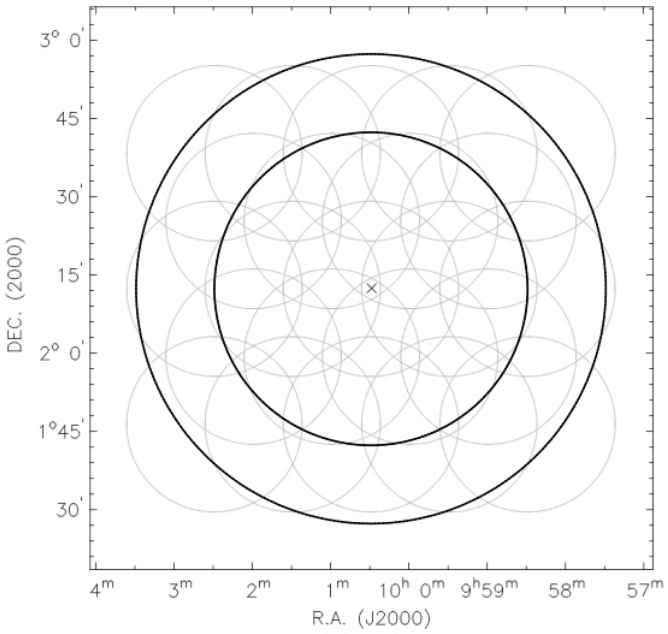
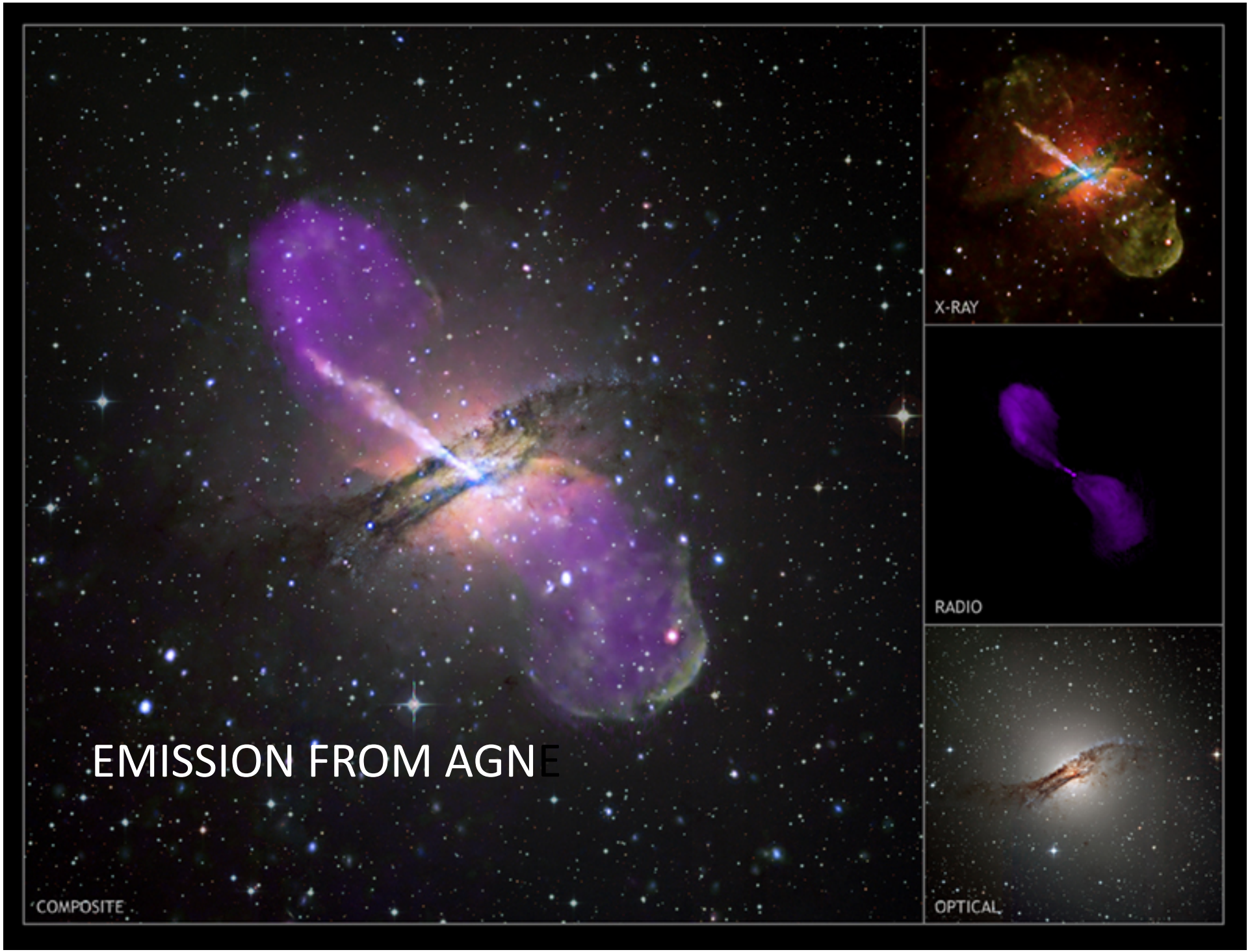
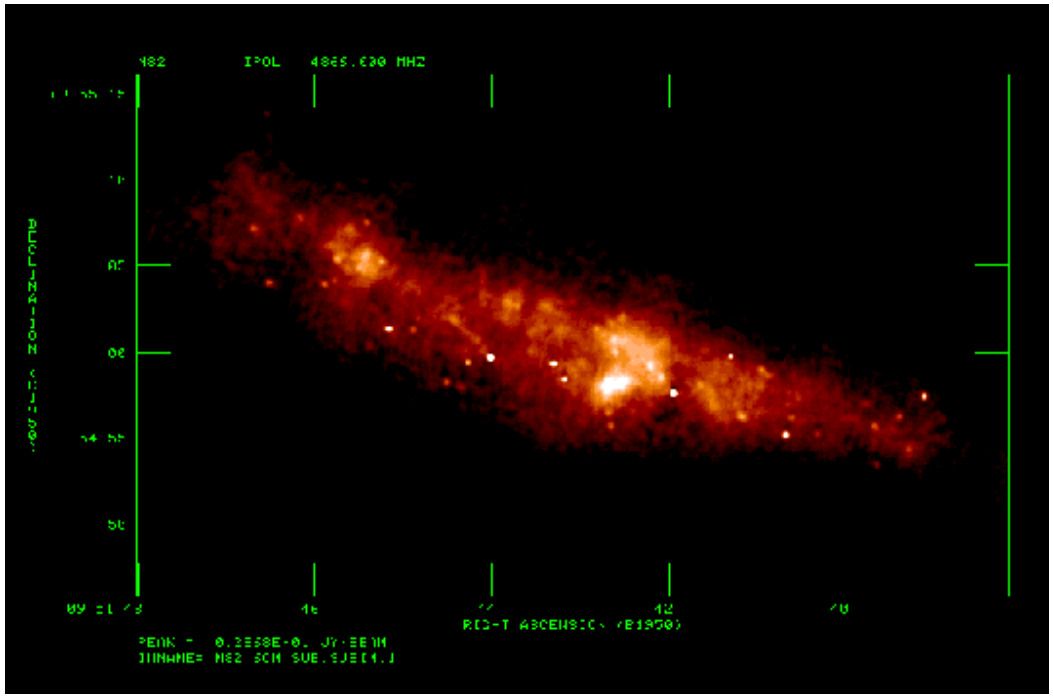


Fig. 2.— Layout of the 23 pointings for the VLA-COSMOS observations. The two circles have a radius of 30′ and 45′.

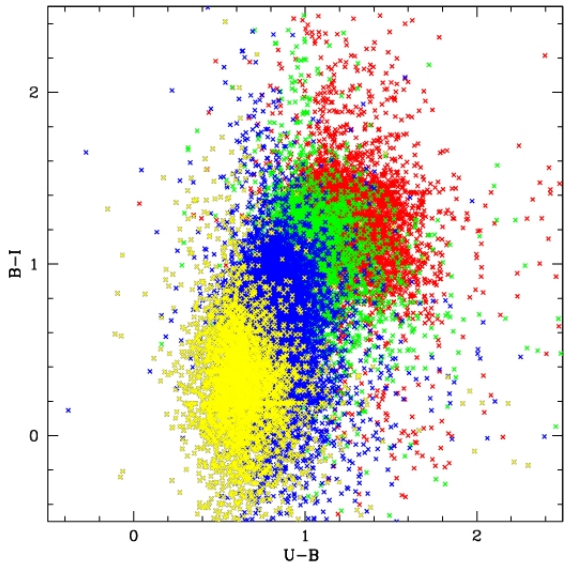

EMISSION FROM AGNE
COMPOSITE
X-RAY
RADIO
OPTICAL

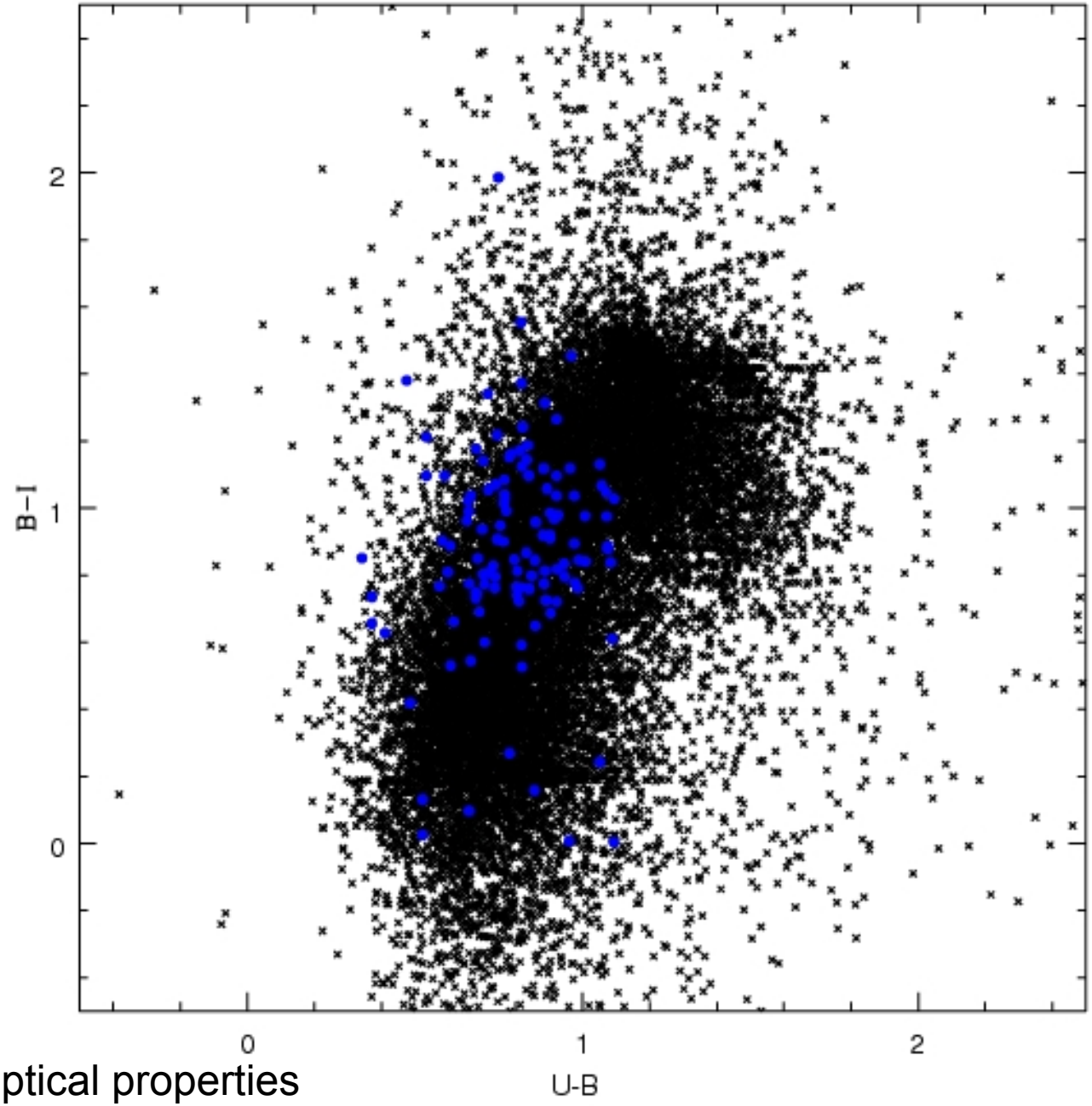


A 6cm MERLIN/VLA image of nearby starburst galaxy M82.
The discrete sources are mostly supernova remnants with ages less than 1000 years and compact HIIregions.
The non-thermal extended background is mainly due to relativistic electrons generated by older remnants M>8 M0 time ~10**8 yrs

Radio emission associated to late type galaxies

COLORS DISTRIBUTION

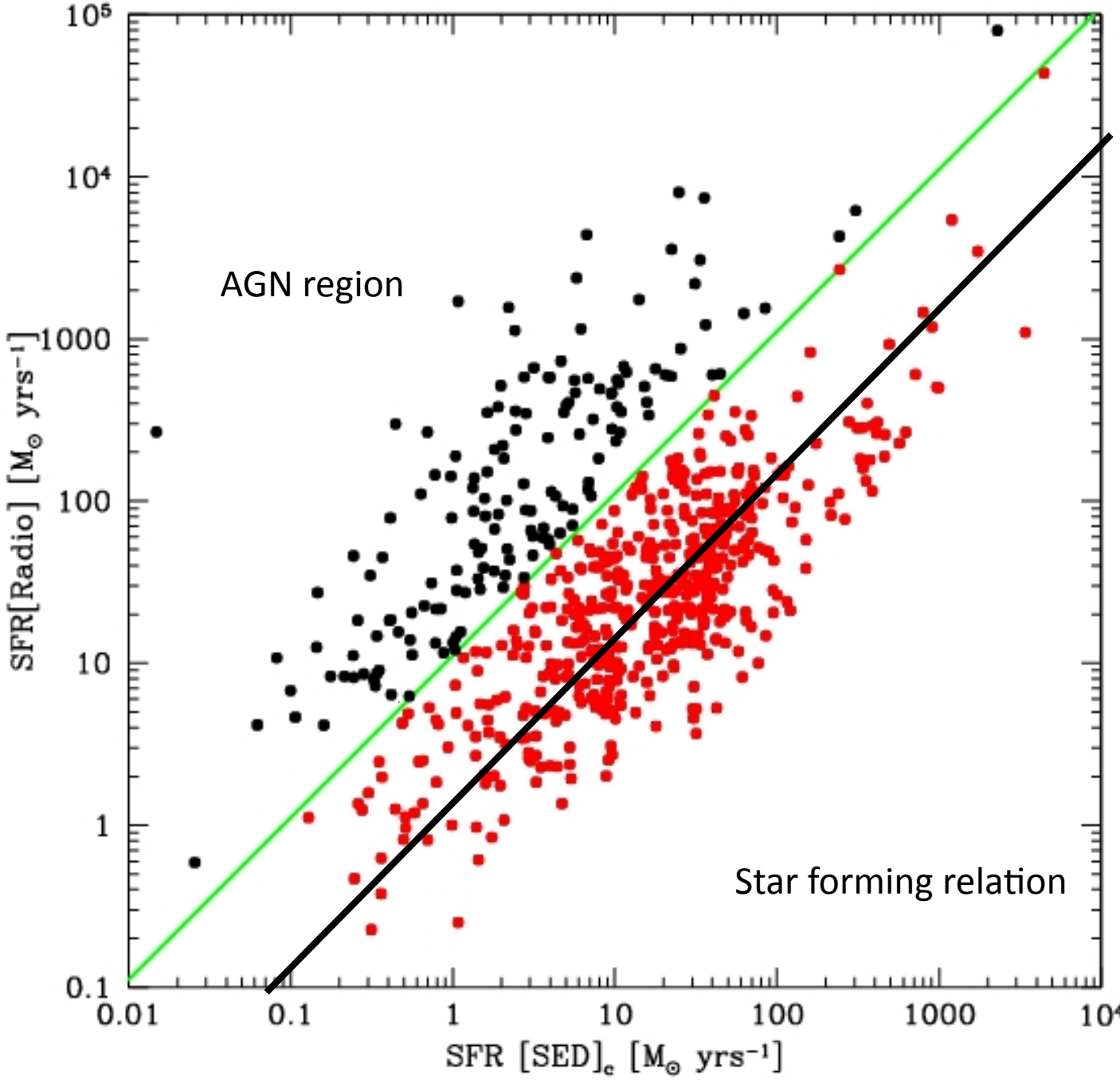




Red points:
Type 1 radiogalaxies

Blue points:
Type 3+4 radiogalaxies

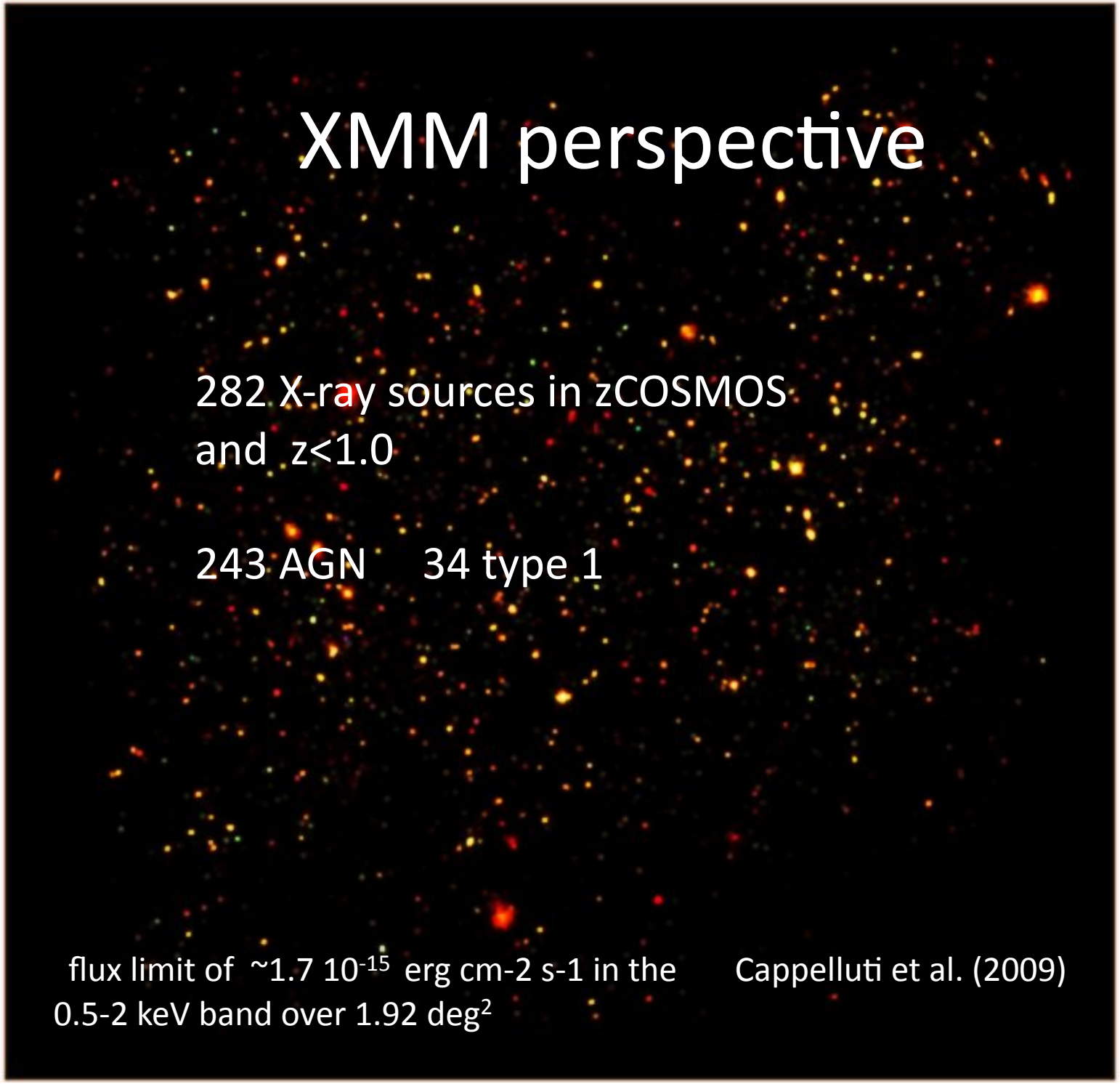
NORMALLY the
Division between
AGN and star forming
is done on the basis of optical properties

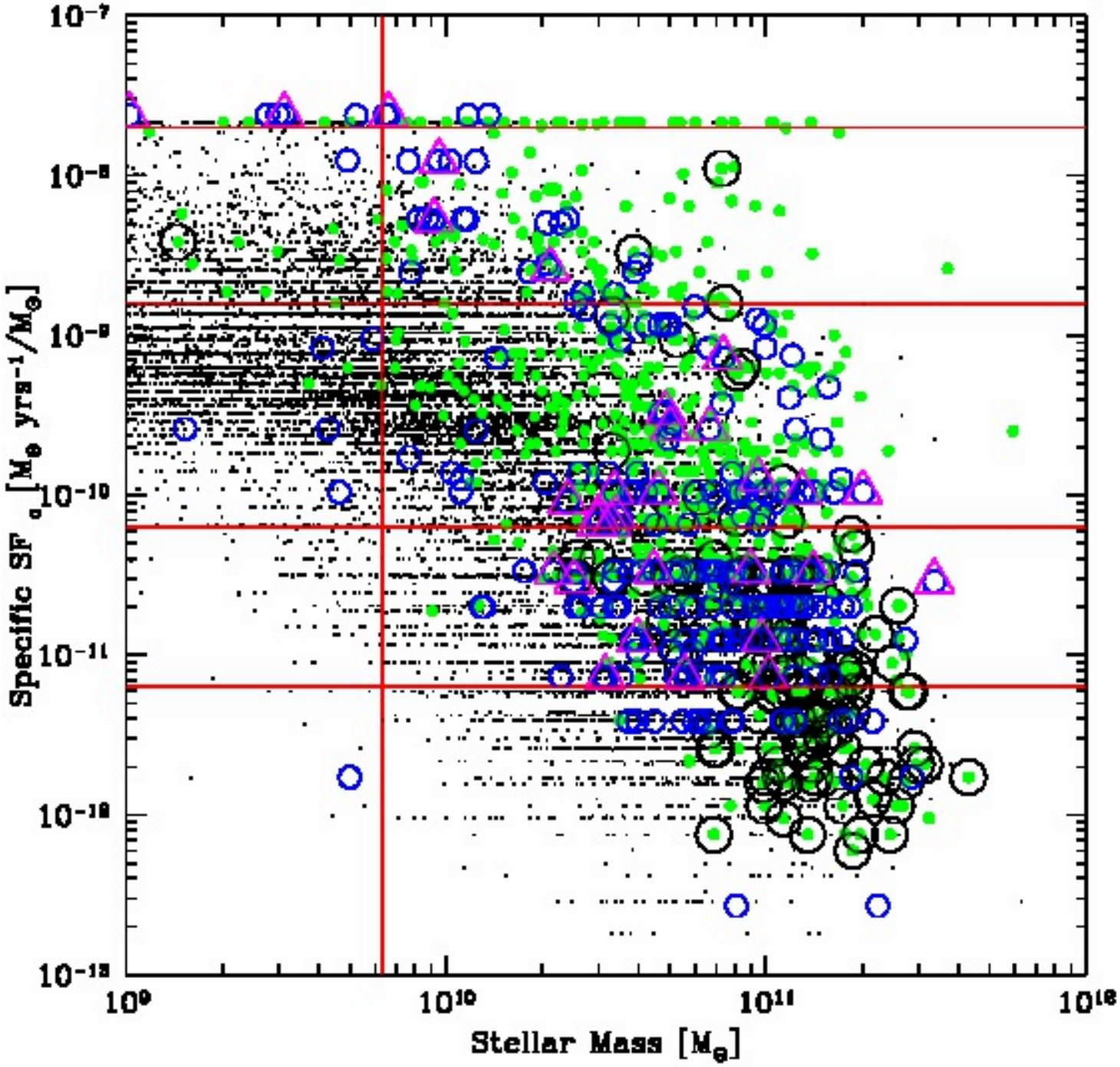


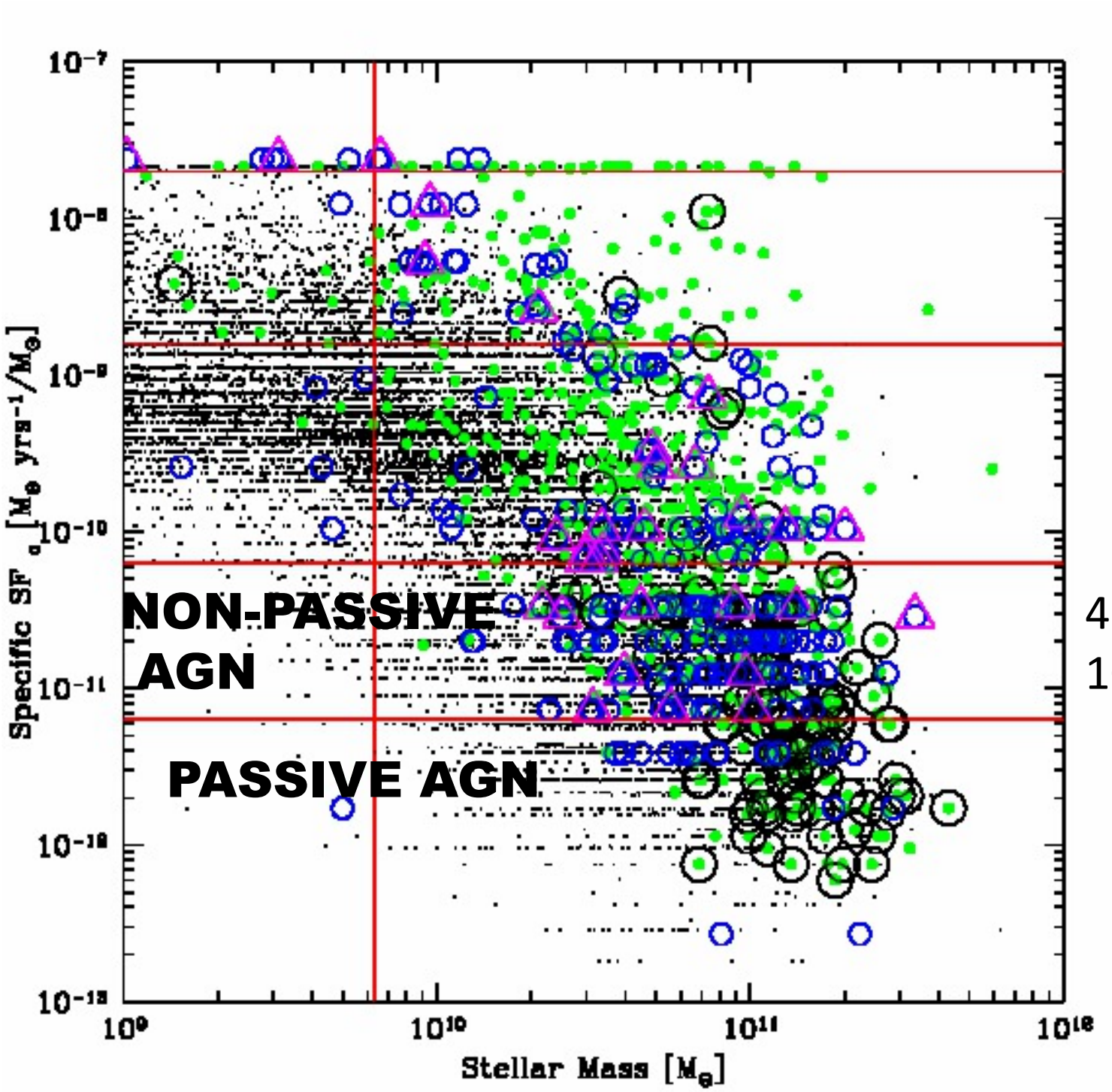
673 radio sources with spectroscopic sample

140 AGN

Bardelli et al. (2010)
A new method for identifying Radio AGN


XMM perspective
282 X-ray sources in zCOSMOS and z<1.0
243 AGN 34 type 1
flux limit of ~1.7 10-15 erg cm-2 s-1 in the 0.5-2 keV band over 1.92 deg2
Cappelluti et al. (2009)


Specific SF [M⊙ yrs⁻¹/M⊙]
Stellar Mass [M⊙]
10⁻⁷
10⁻⁸
10⁻⁹
10⁻¹⁰
10⁻¹¹
10⁻¹²
10⁻¹³
10⁹
10¹⁰
10¹¹
10¹²

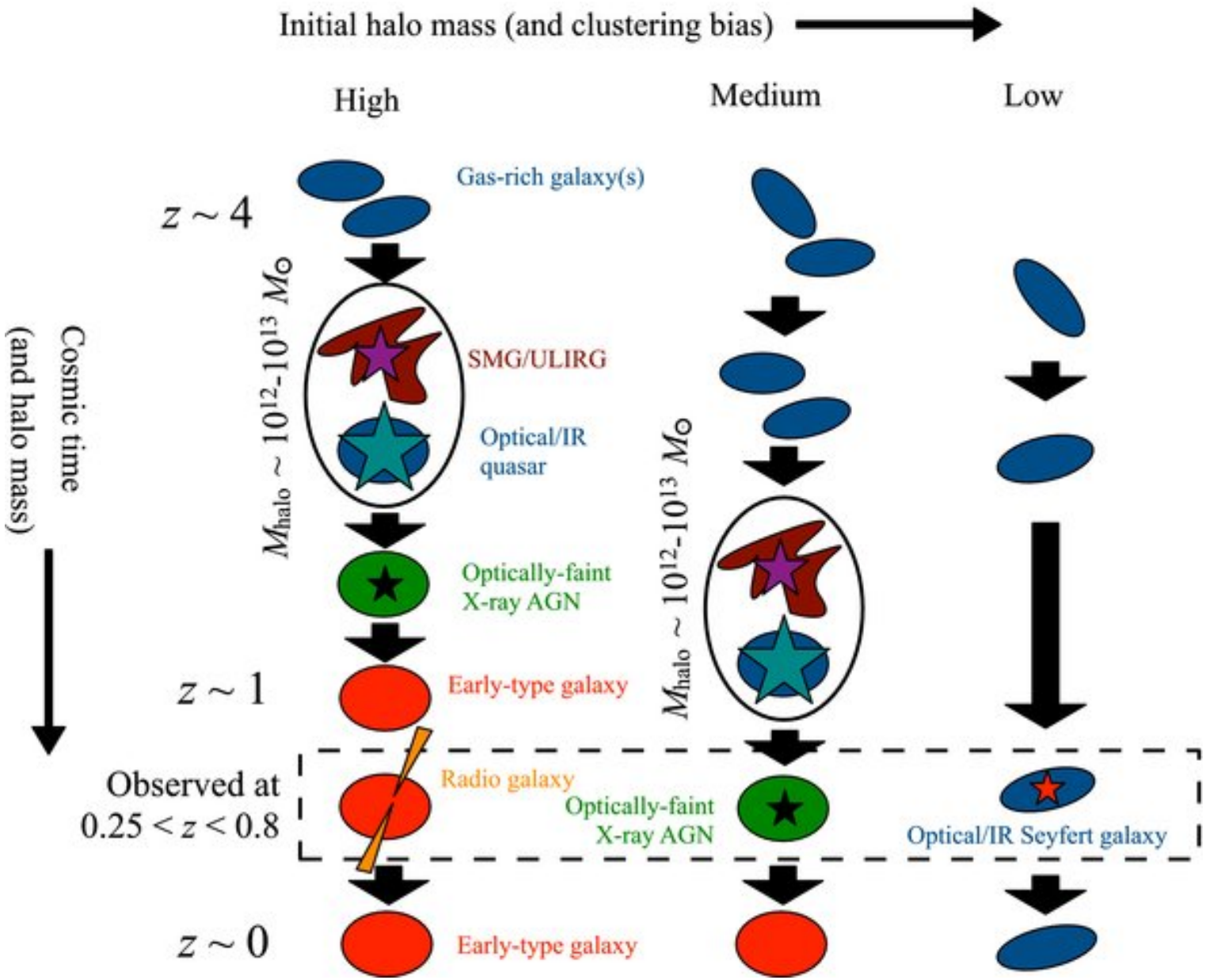


49 passive radio
105 Xray

64 passive radio
28 Xray

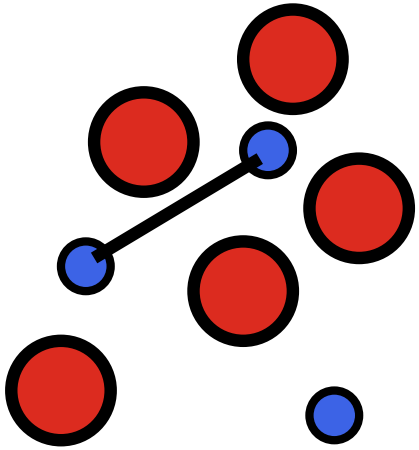
Hickox et al. (2009)

Signature of evolution?

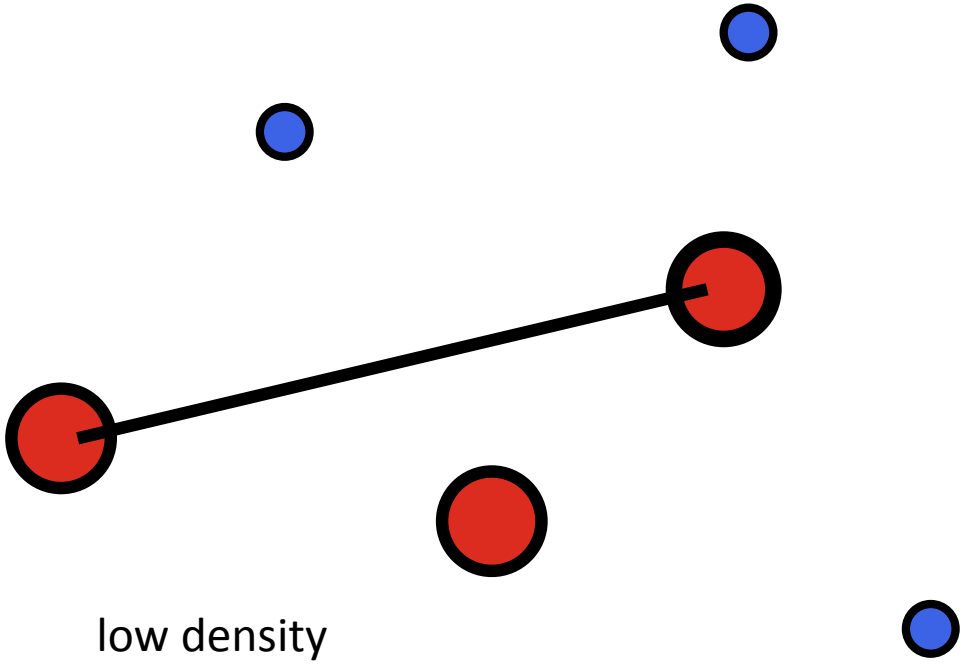


ENVIRONMENT

1) Nearest Neighbour Statistic Kovac et al. (2008)

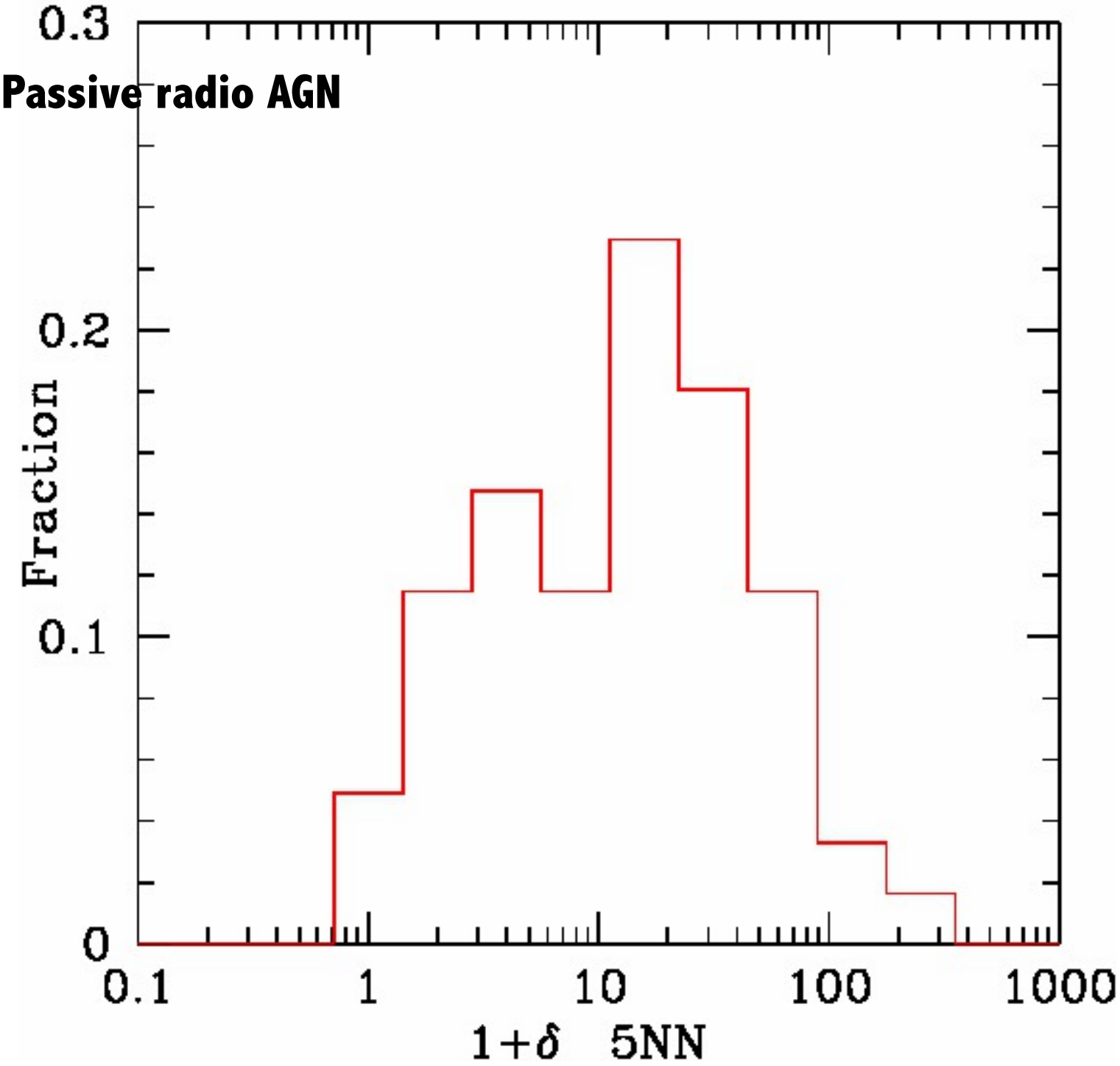


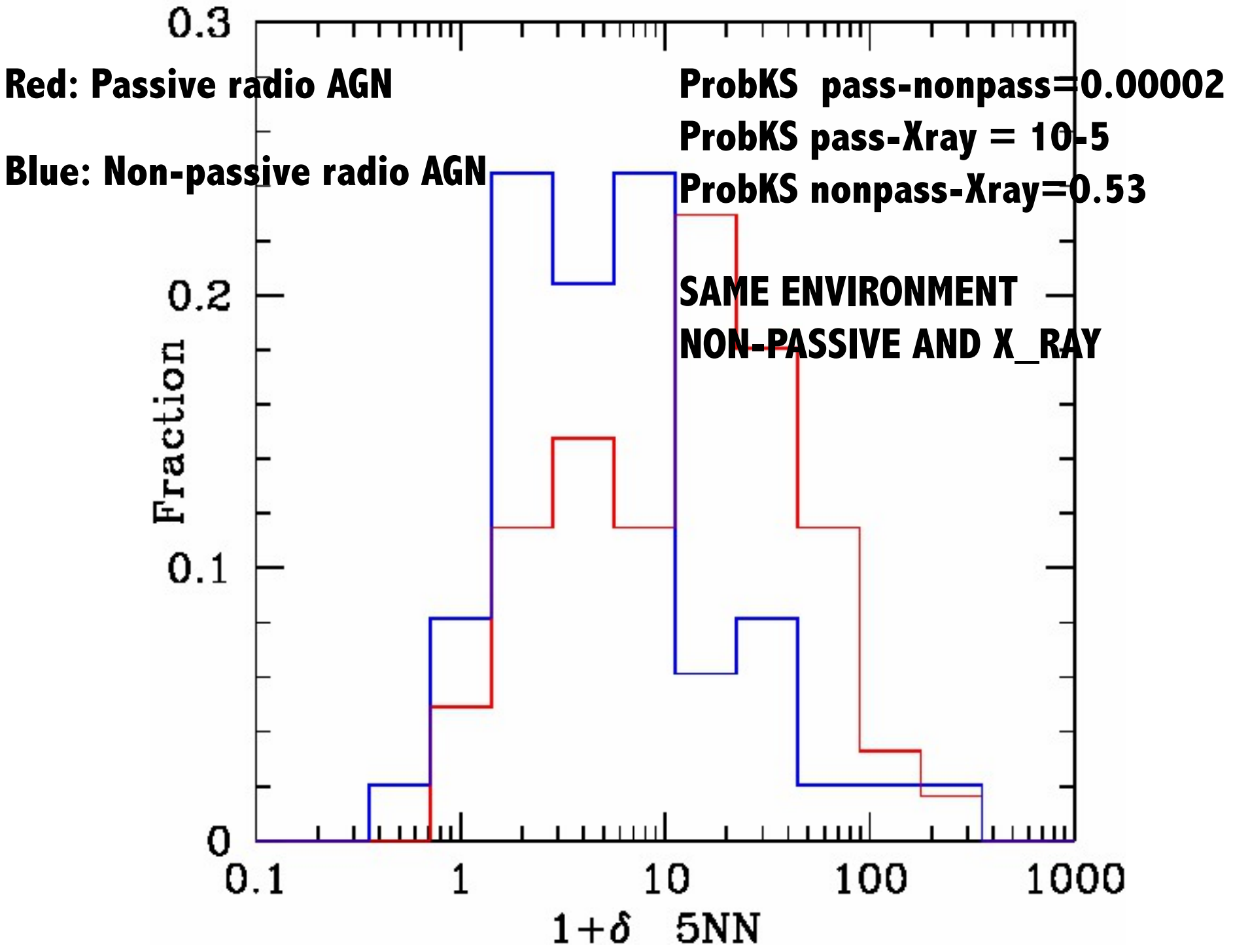
High density
environment

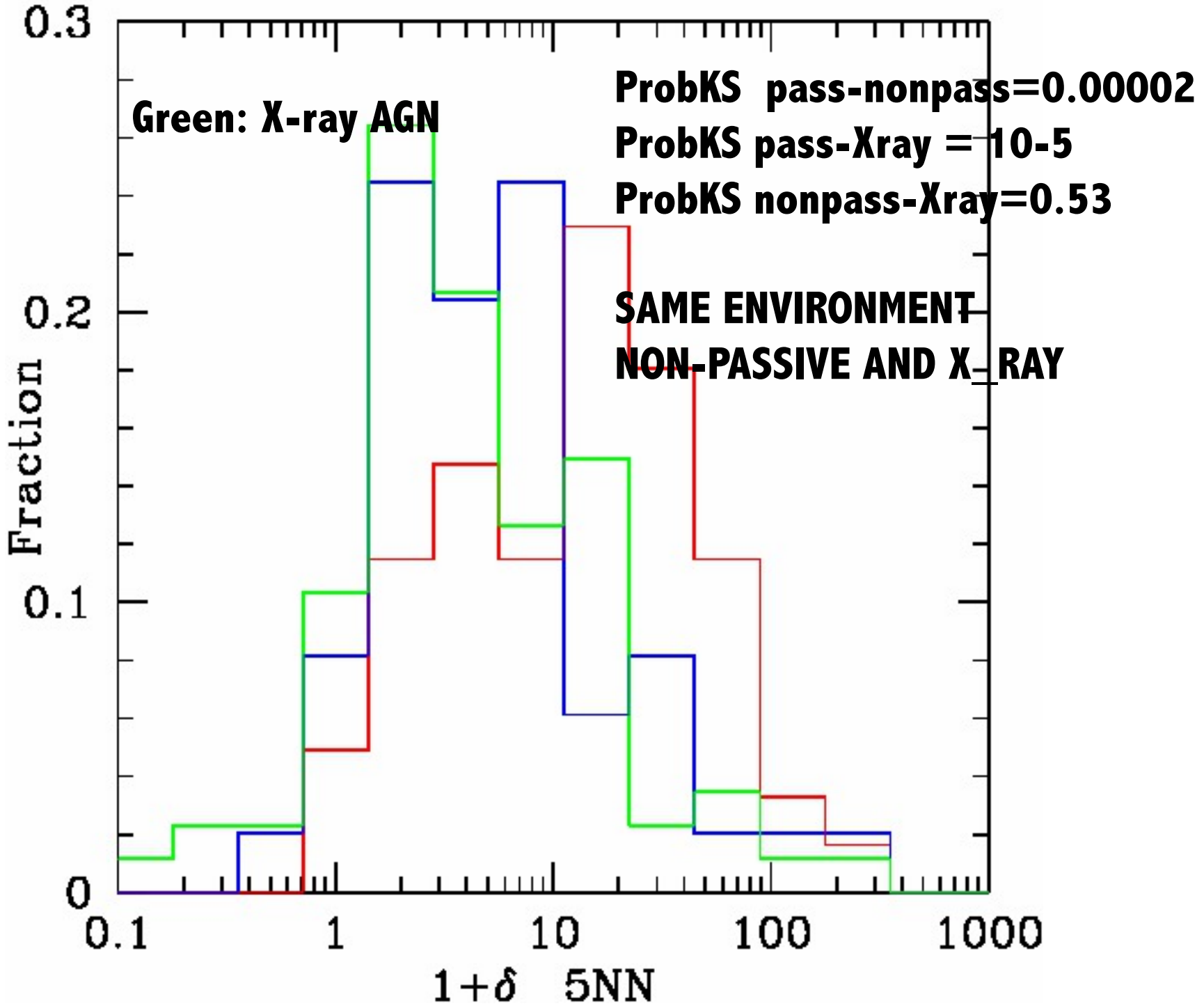


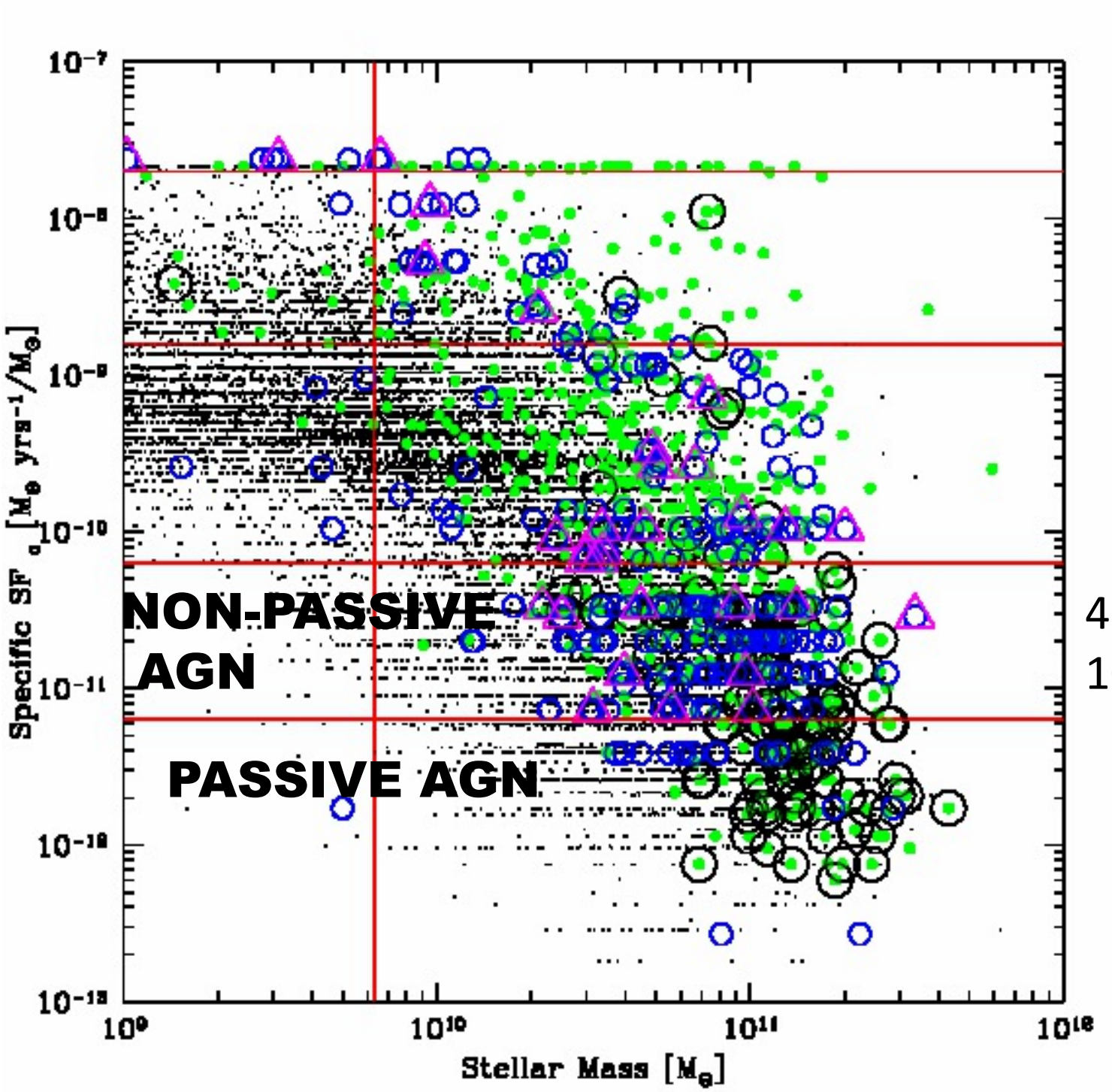
low density
environment

Red: Passive radio AGN




Red: Passive radio AGN
Blue: Non-passive radio AGN
ProbKS pass-nonpass=0.00002
ProbKS pass-Xray = 10-5
ProbKS nonpass-Xray=0.53
SAME ENVIRONMENT
NON-PASSIVE AND X_RAY
0.3
0.2
0.1
0
Fraction
0.1
1
10
100
1000
1+δ 5NN

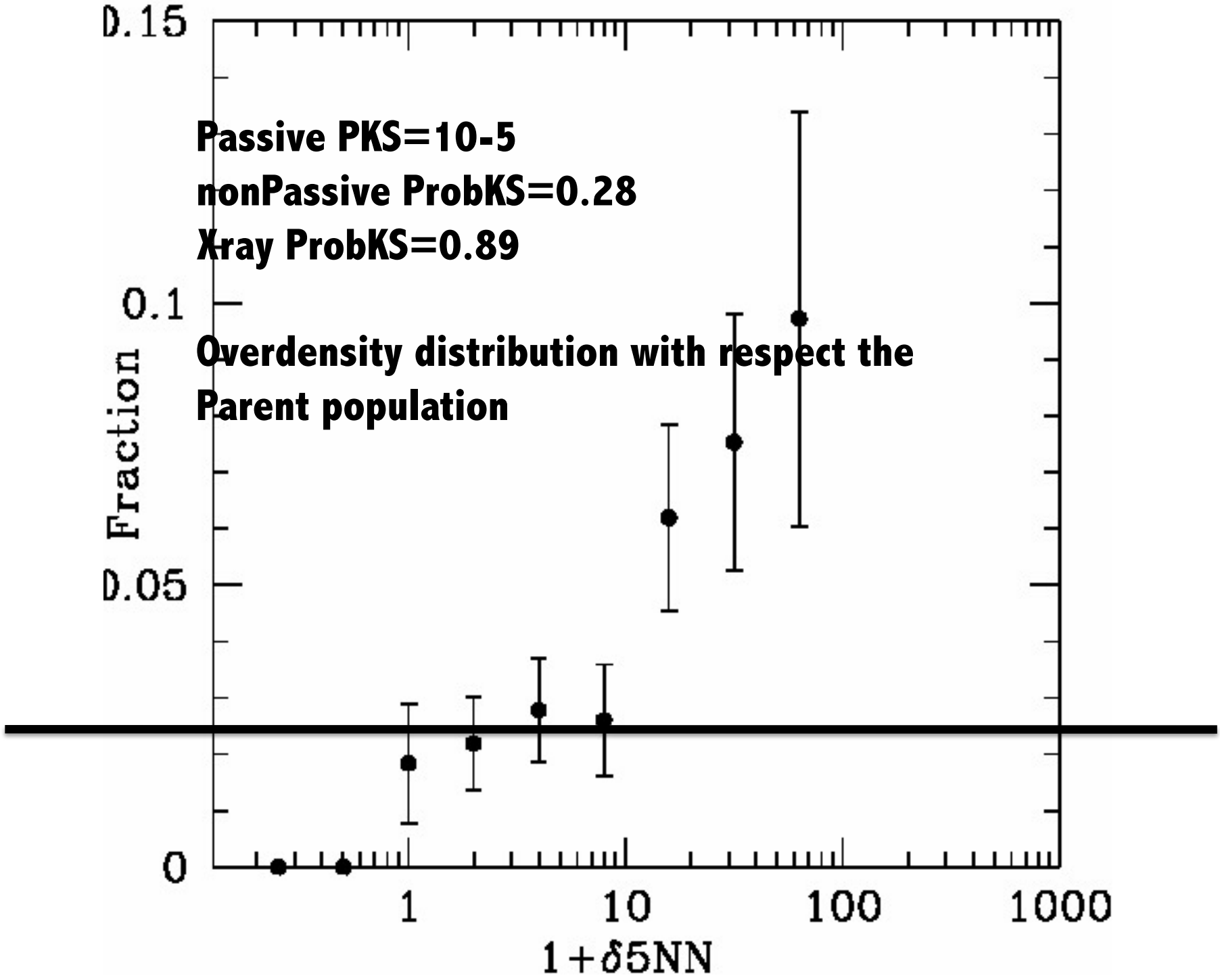

Green: X-ray AGN
ProbKS pass-nonpass=0.00002
ProbKS pass-Xray = 10-5
ProbKS nonpass-Xray=0.53
SAME ENVIRONMENT
NON-PASSIVE AND X_RAY
Fraction
0.3
0.2
0.1
0
0.1
1
10
100
1000
1+δ 5NN

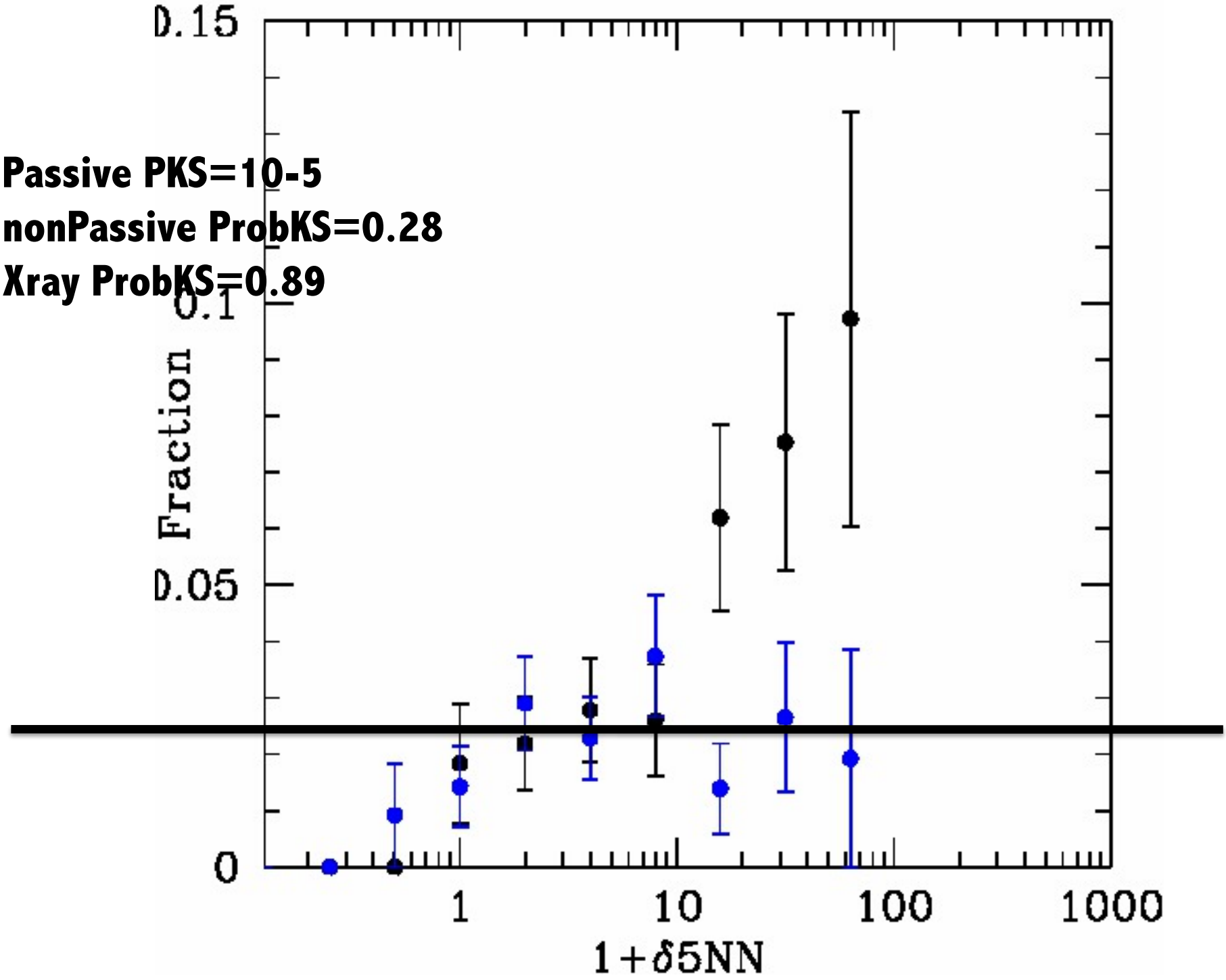


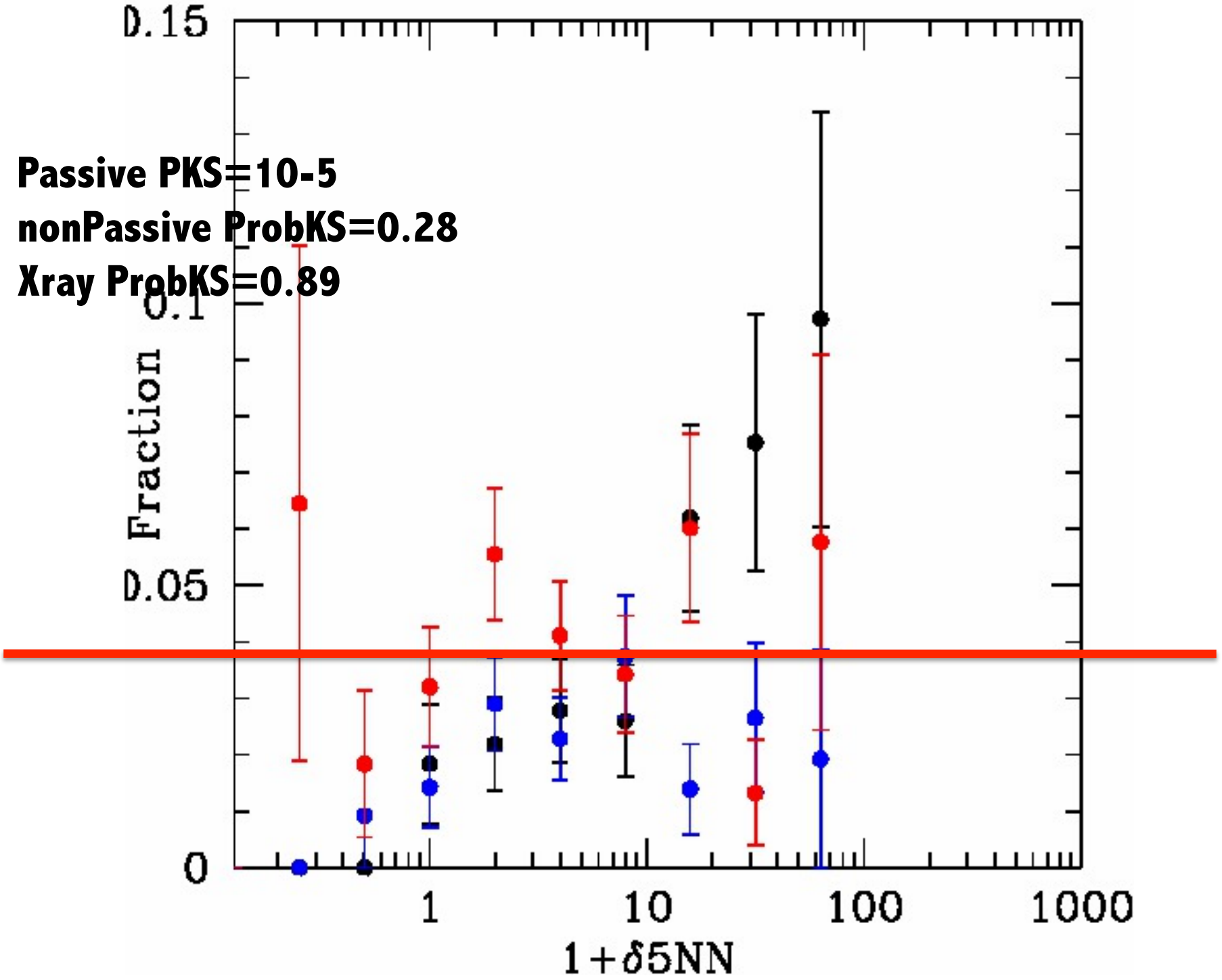
What about
Non emitting
Galaxies?

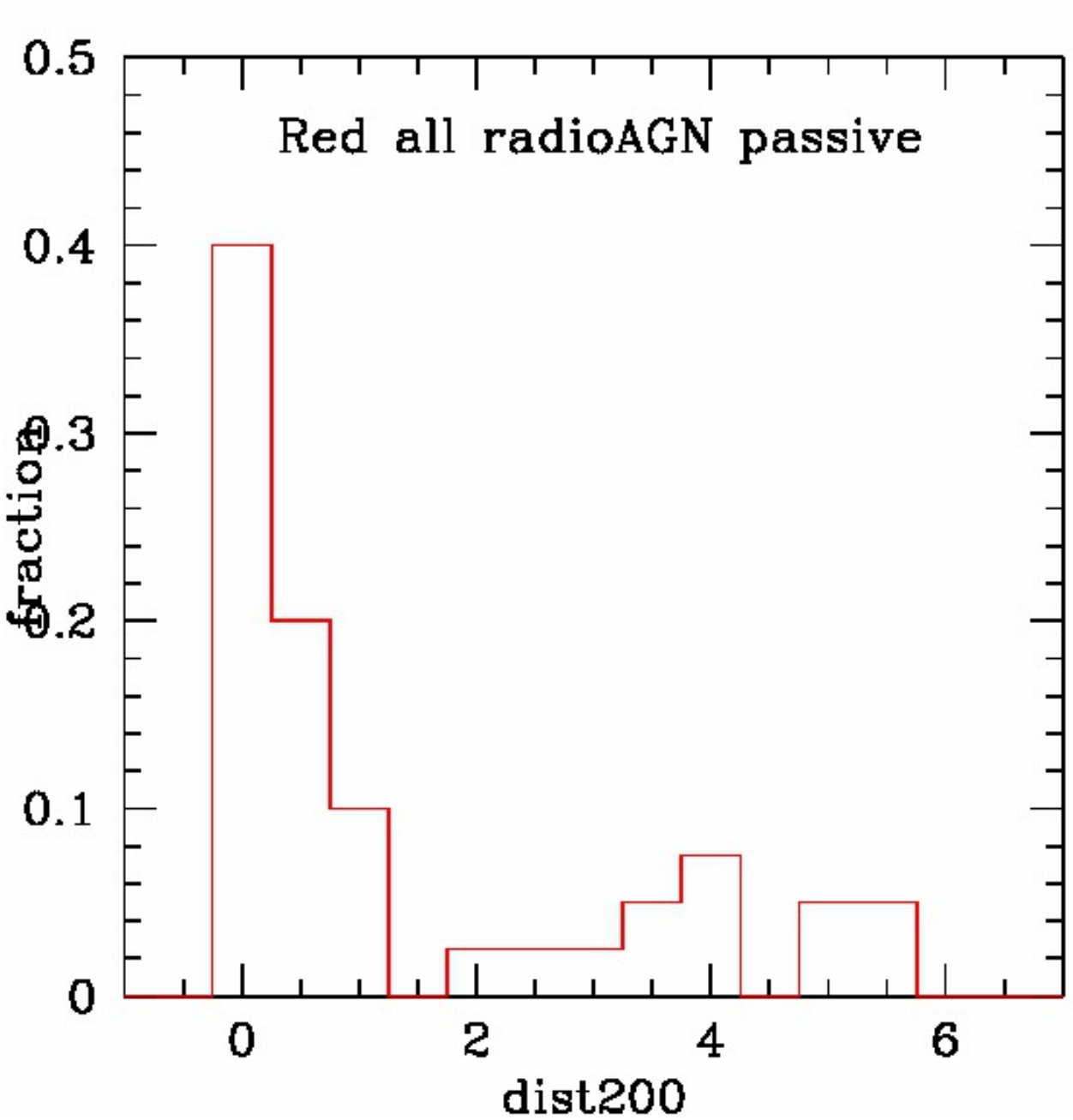
49 passive radio
105 Xray

64 passive radio
28 Xray

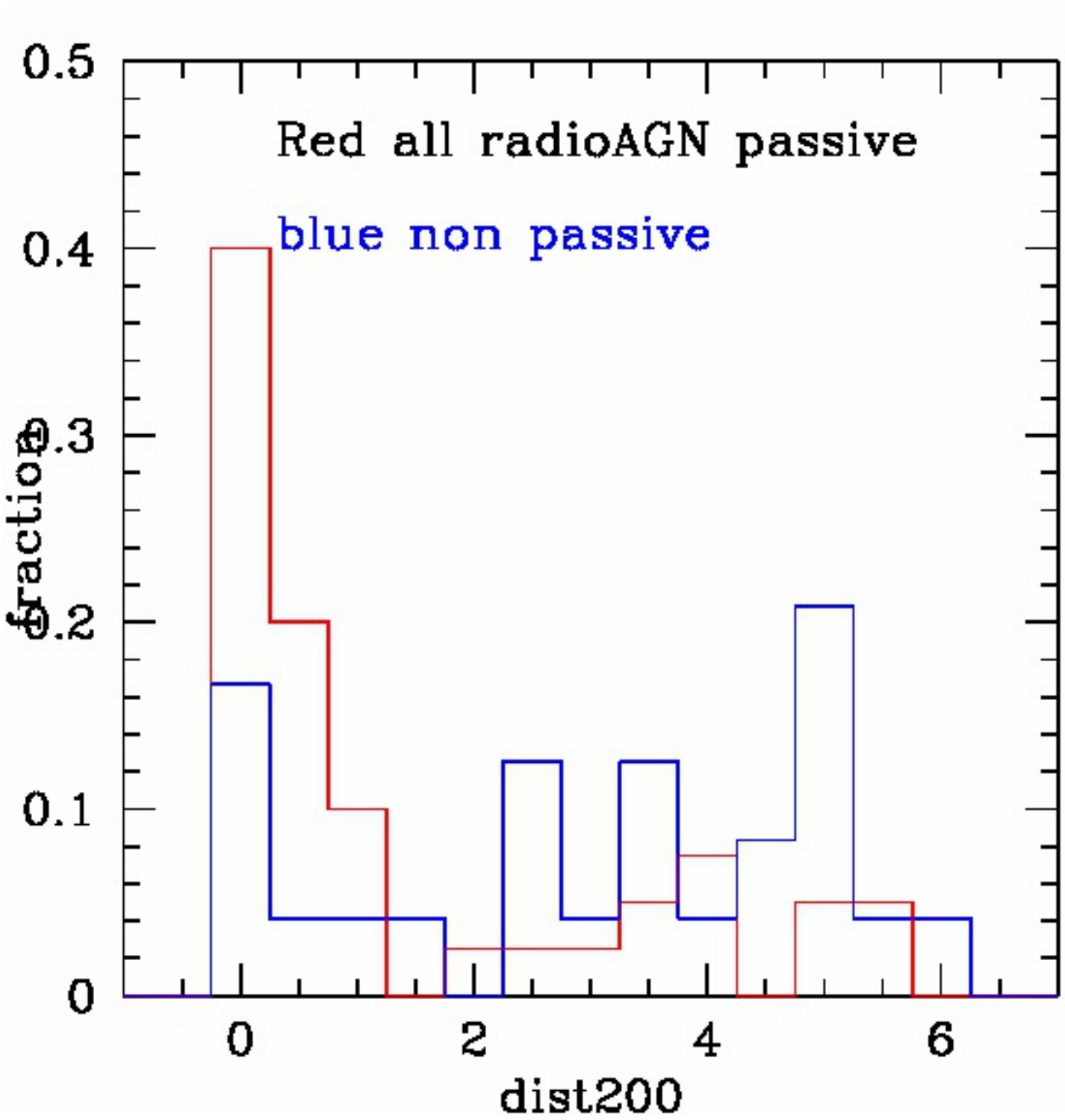

0.15
0.1
0.05
0
Fraction
Passive PKS=10-5
nonPassive ProbKS=0.28
Xray ProbKS=0.89
Overdensity distribution with respect the
Parent population
1
10
100
1000
1+δ5NN


Passive PKS=10-5
nonPassive ProbKS=0.28
Xray ProbKS=0.89
0.15
0.1
0.05
0
Fraction
1
10
100
1000
1+δ5NN

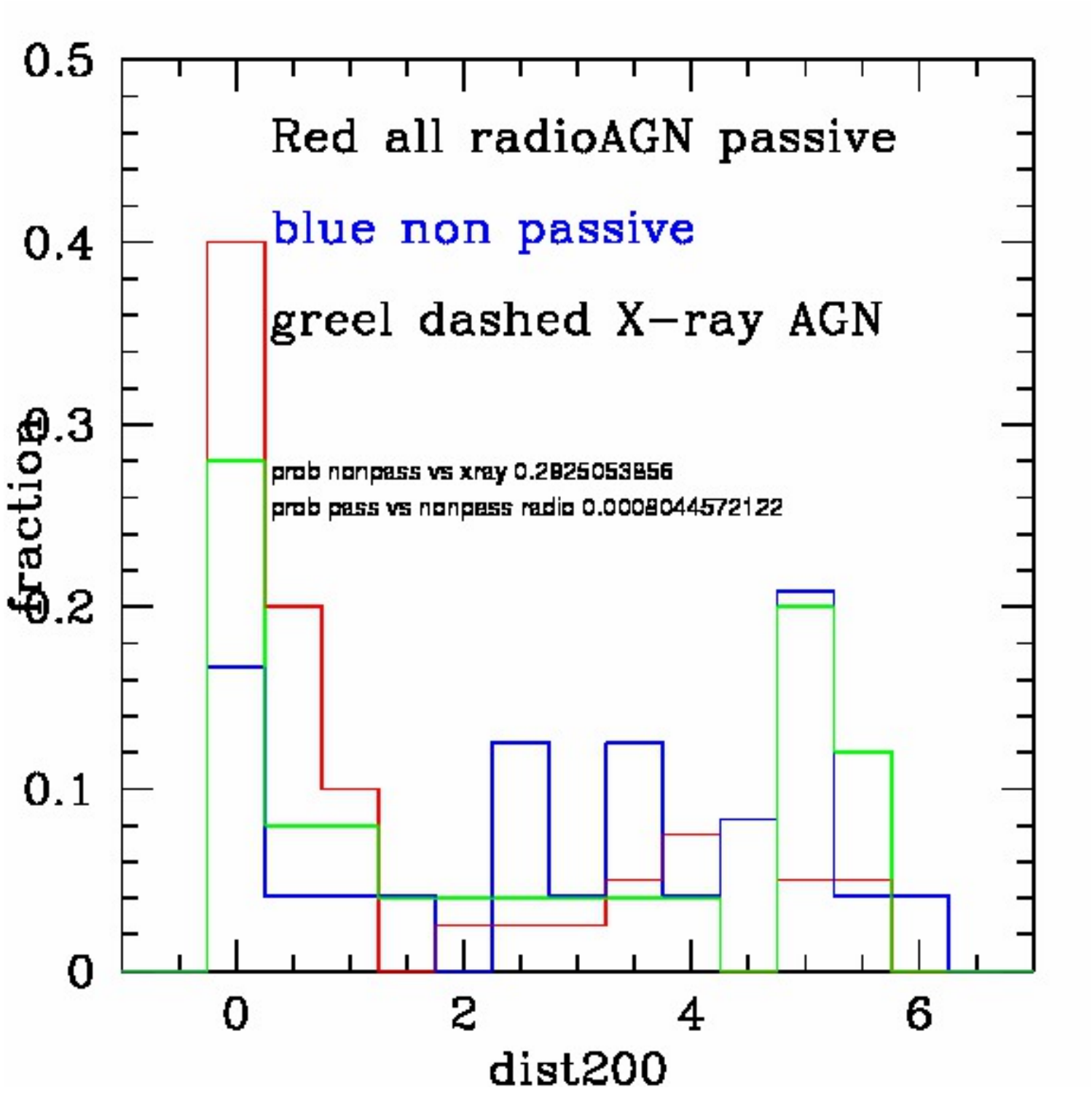

Passive PKS=10-5
nonPassive ProbKS=0.28
Xray ProbKS=0.89
0.15
0.1
0.05
0
Fraction
1
10
100
1000
1+δ5NN



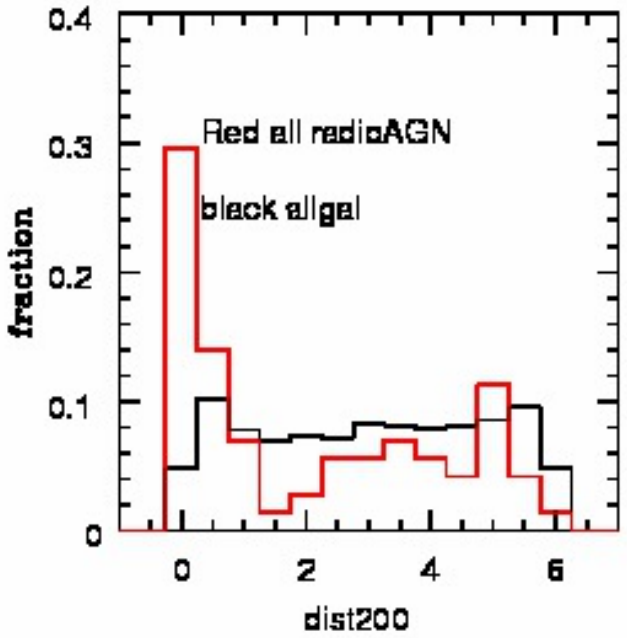
XMM
Groups
Finoguenov et al.
(2011)

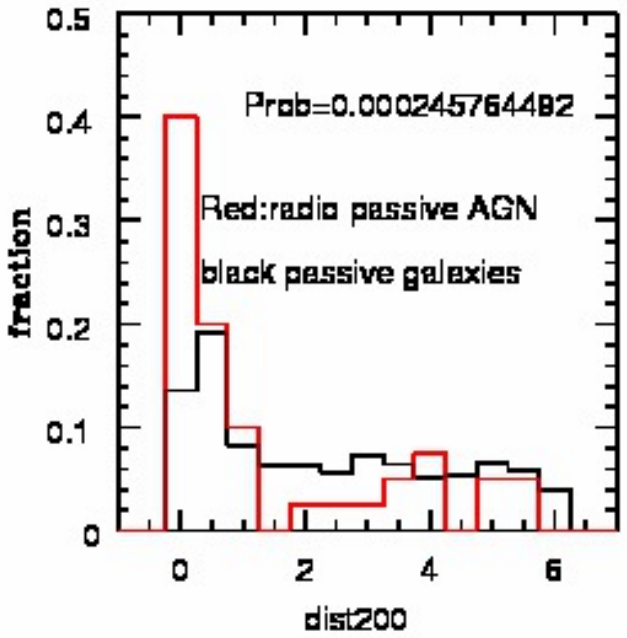


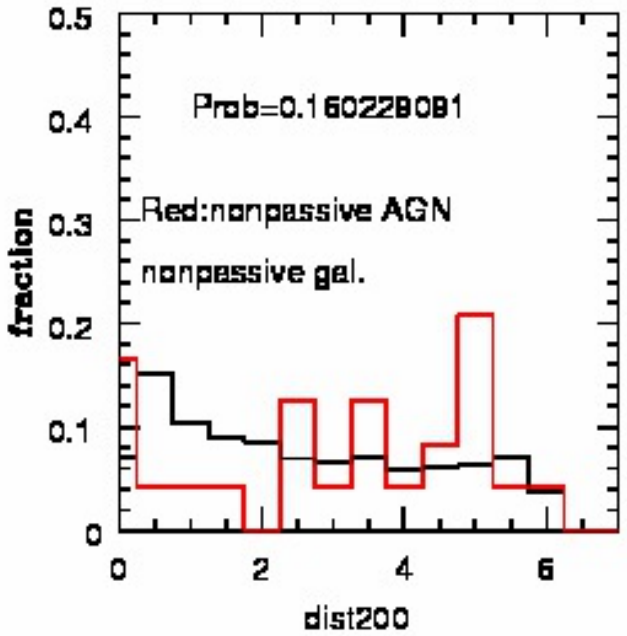
XMM
Groups
Finoguenov et al.
(2011)

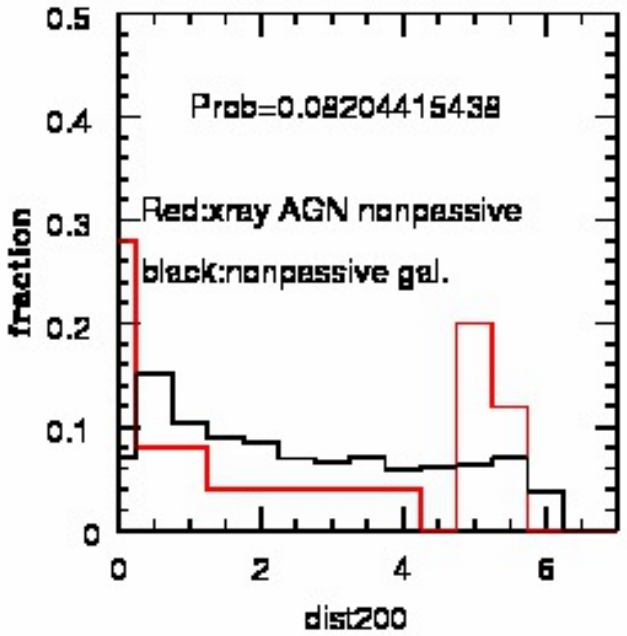


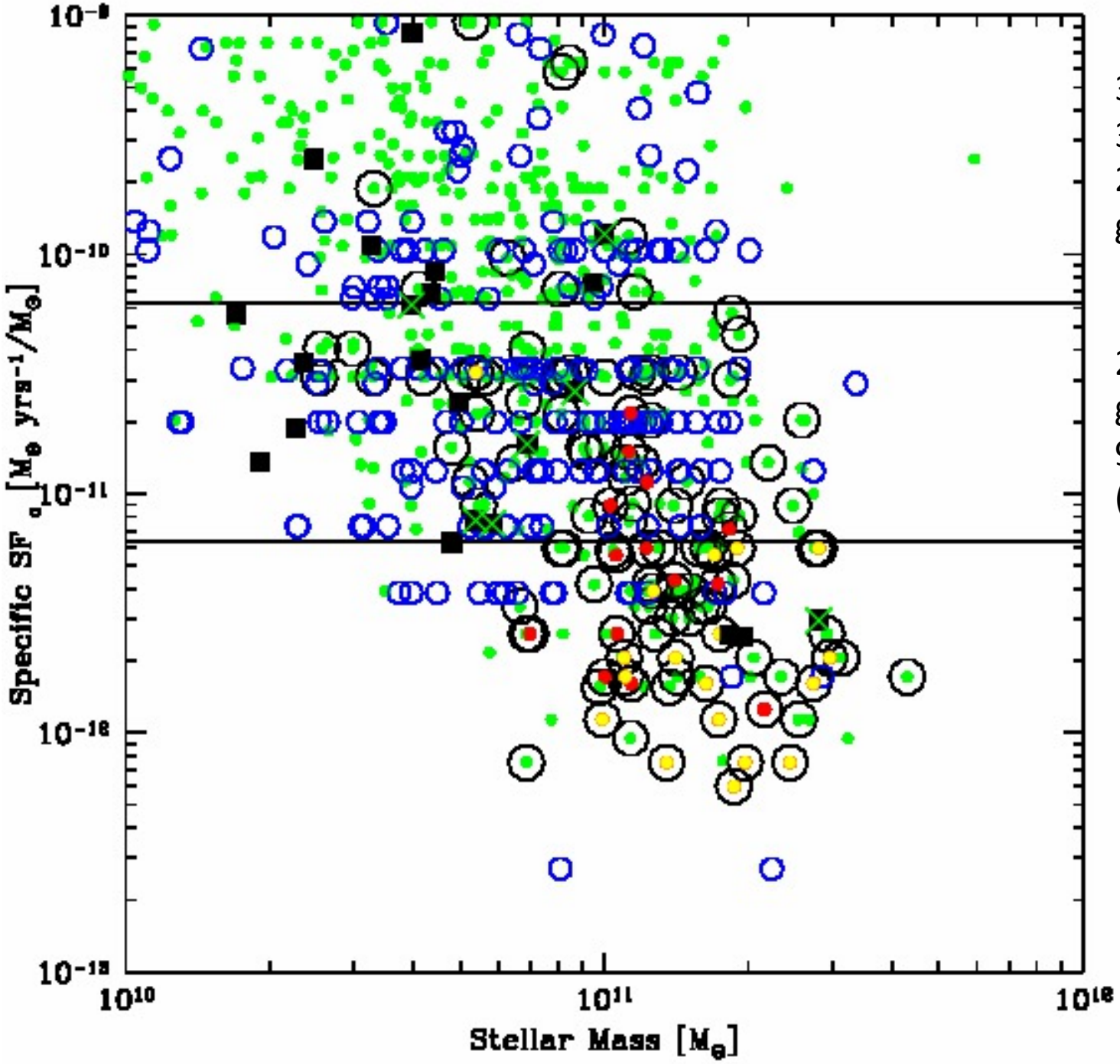
XMM
Groups
Finoguenov et al.
(2011)


Red all radioAGN
black allgal
fraction
dist200


Prob=0.000245764492
Red:radio passive AGN
black passive galaxies
fraction
dist200


Prob=0.160228081
Red:nonpassive AGN
nonpassive gal.
fraction
dist200

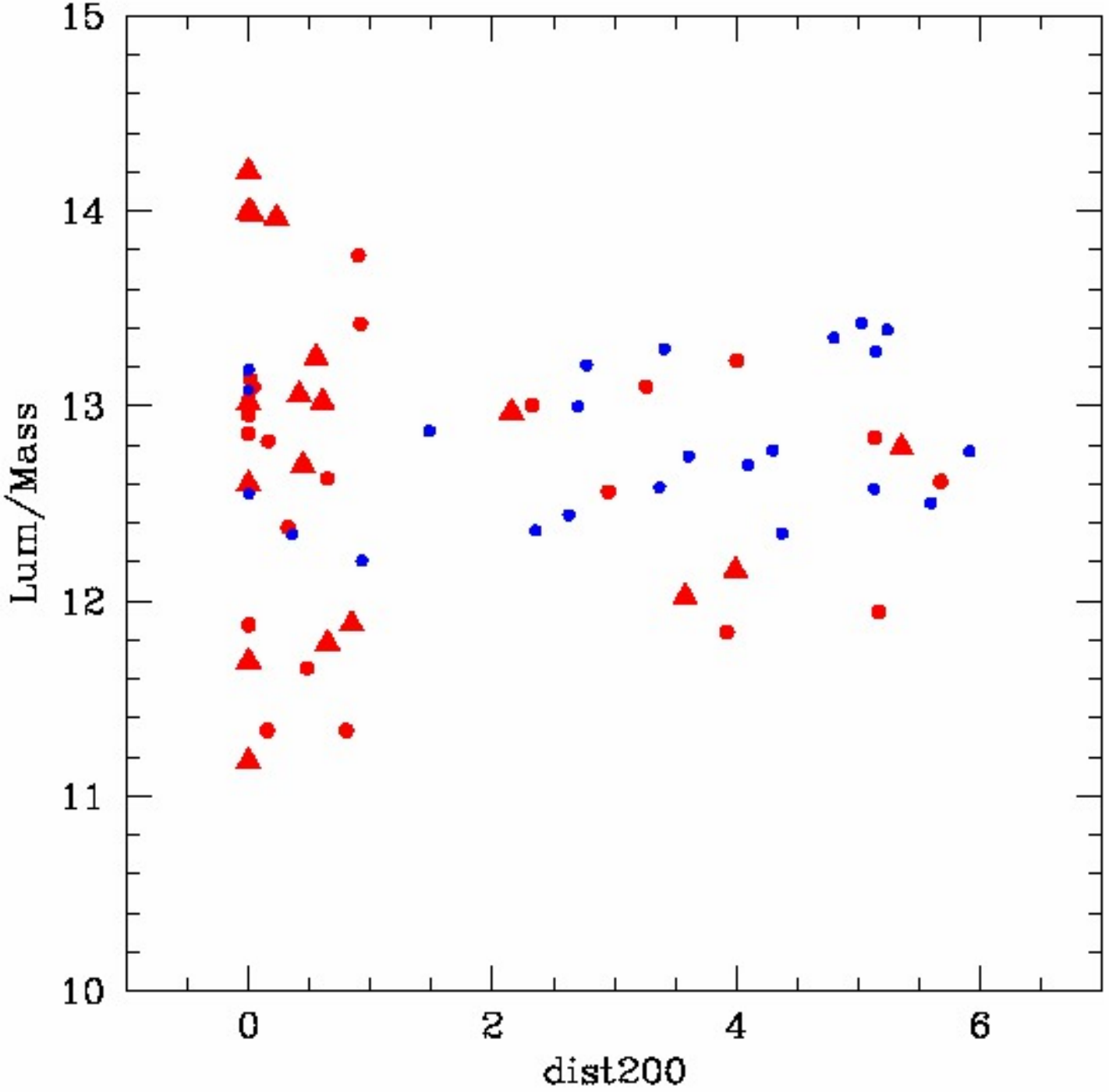

Prob=0.08204415438
Red:xray AGN nonpassive
black:nonpassive gal.
fraction
dist200

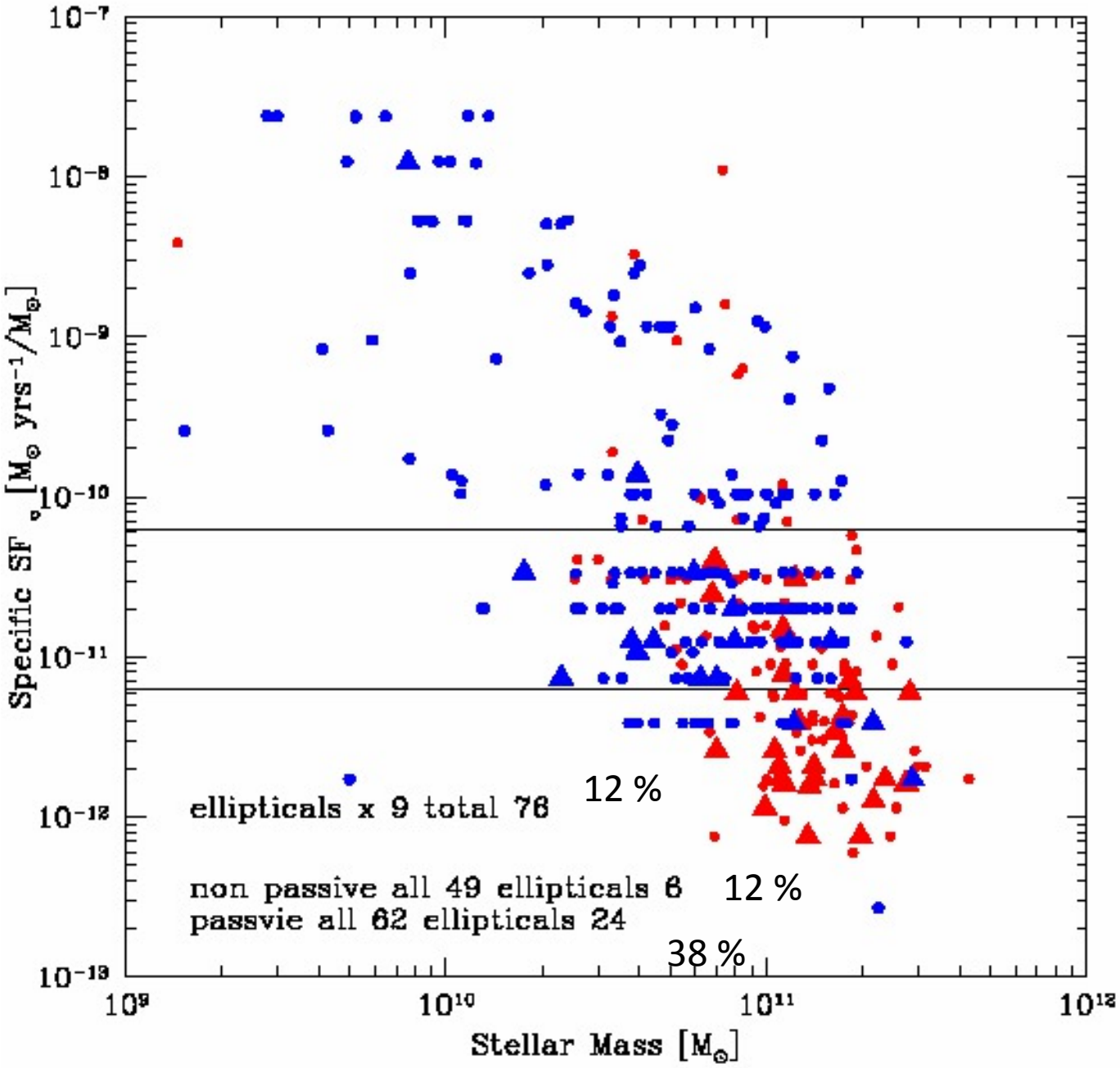


36 radio AGN in groups
30 are passive (red)
21 are the most massive galaxies (yellow)

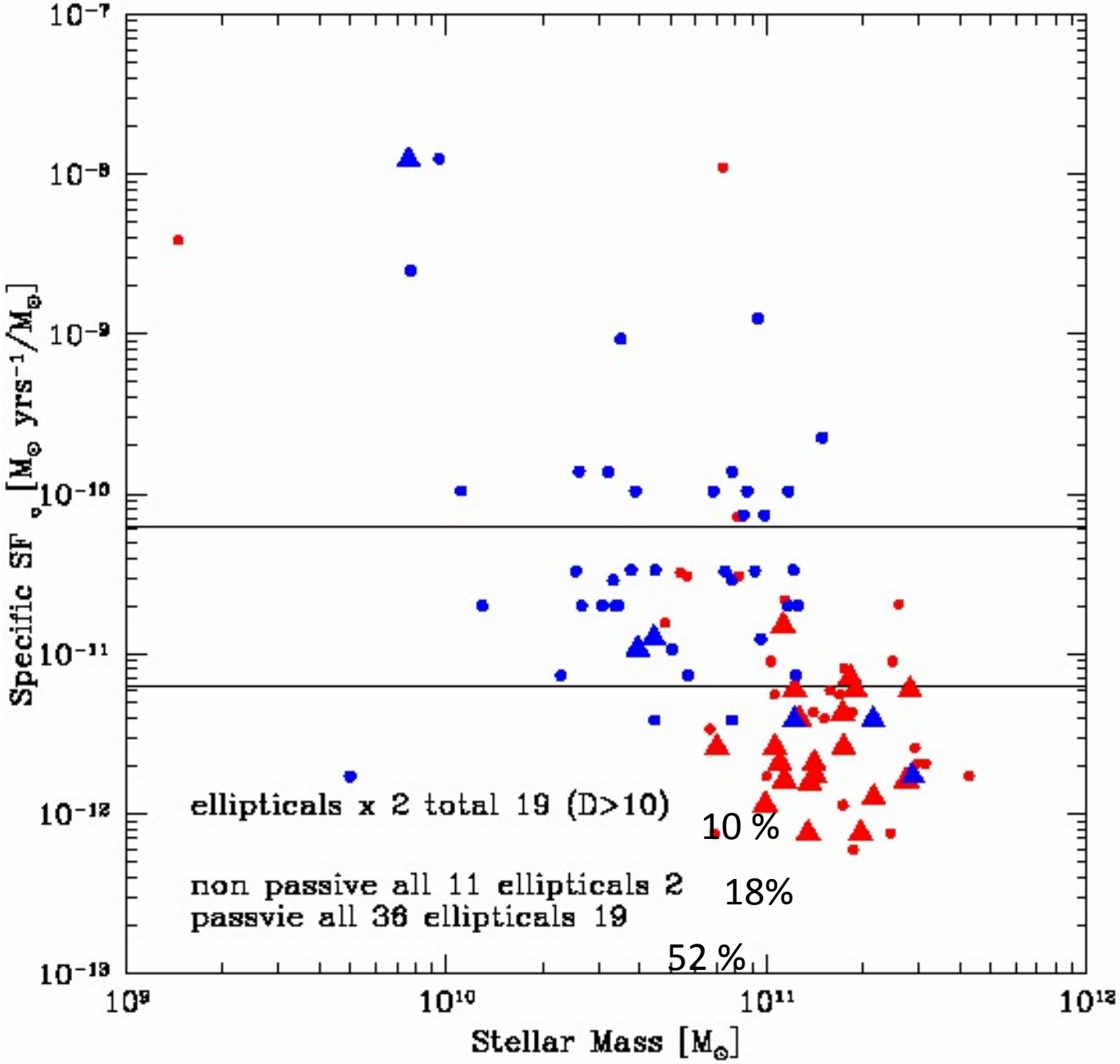
28 xray AGN are in groups (black)
9 are the most massive (green crosses)

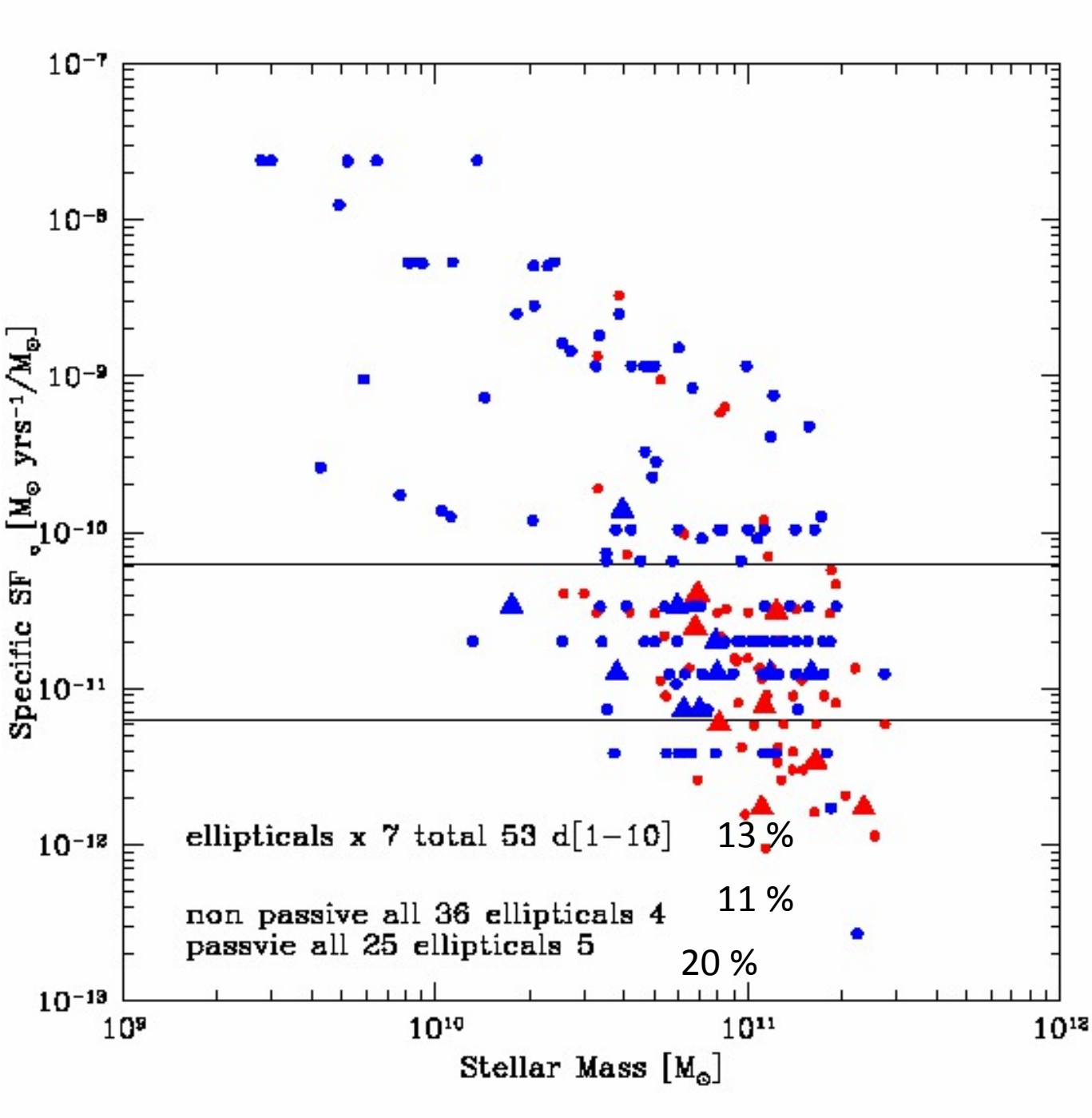
Knobel et al.
(in prep)

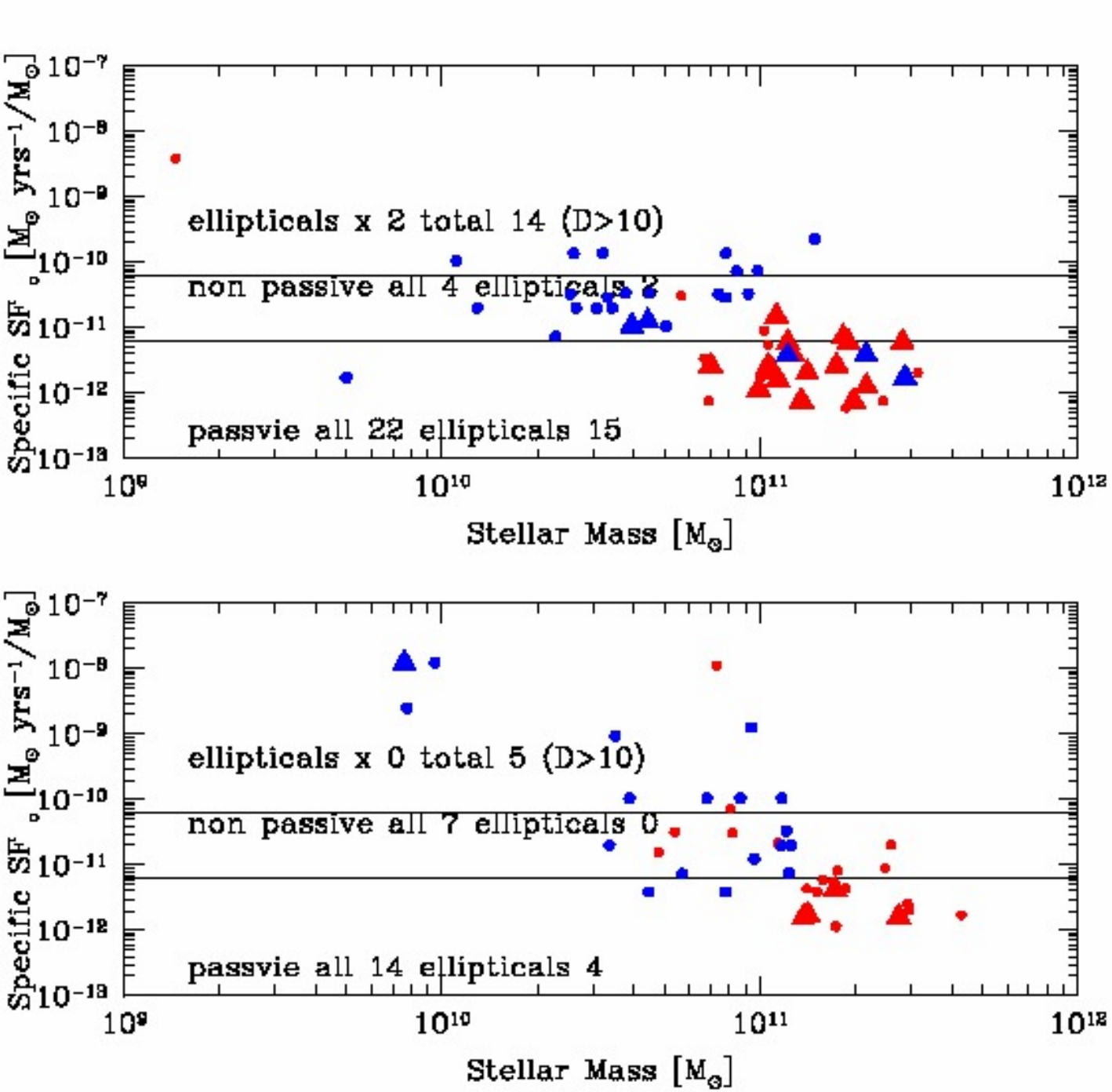

15
14
13
12
11
10
Lum/Mass
0
2
4
6
dist200

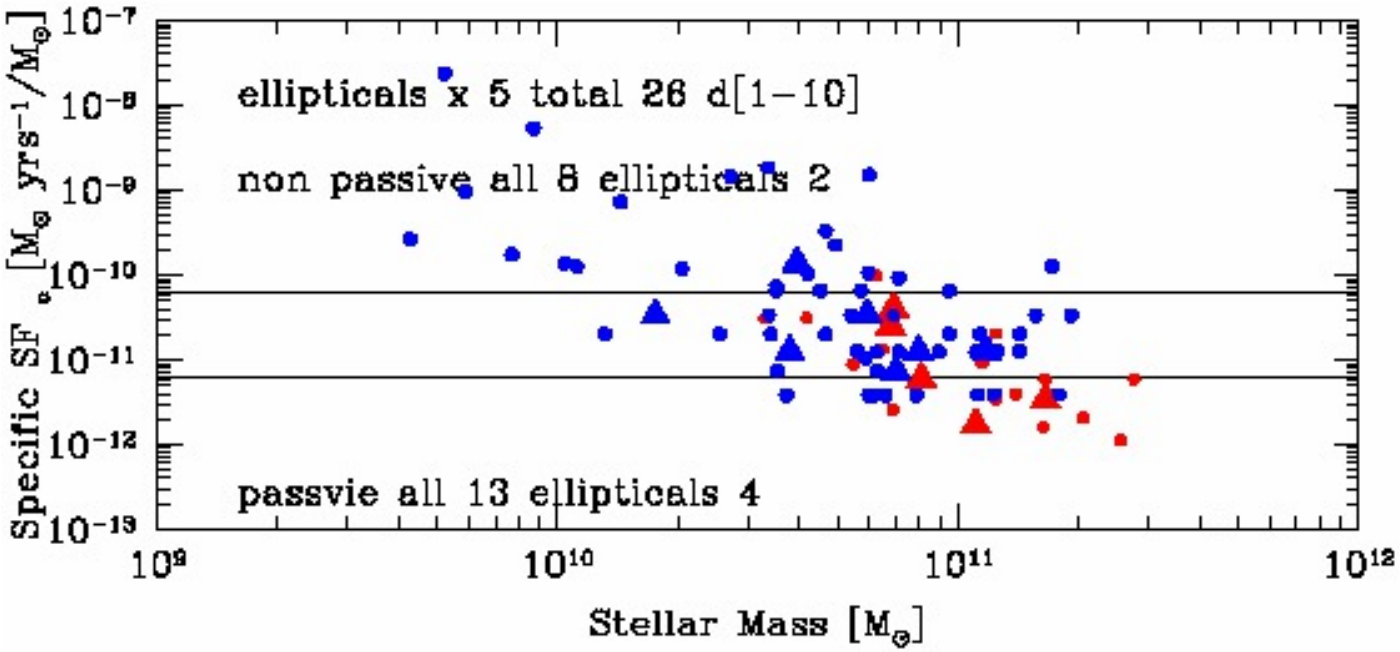


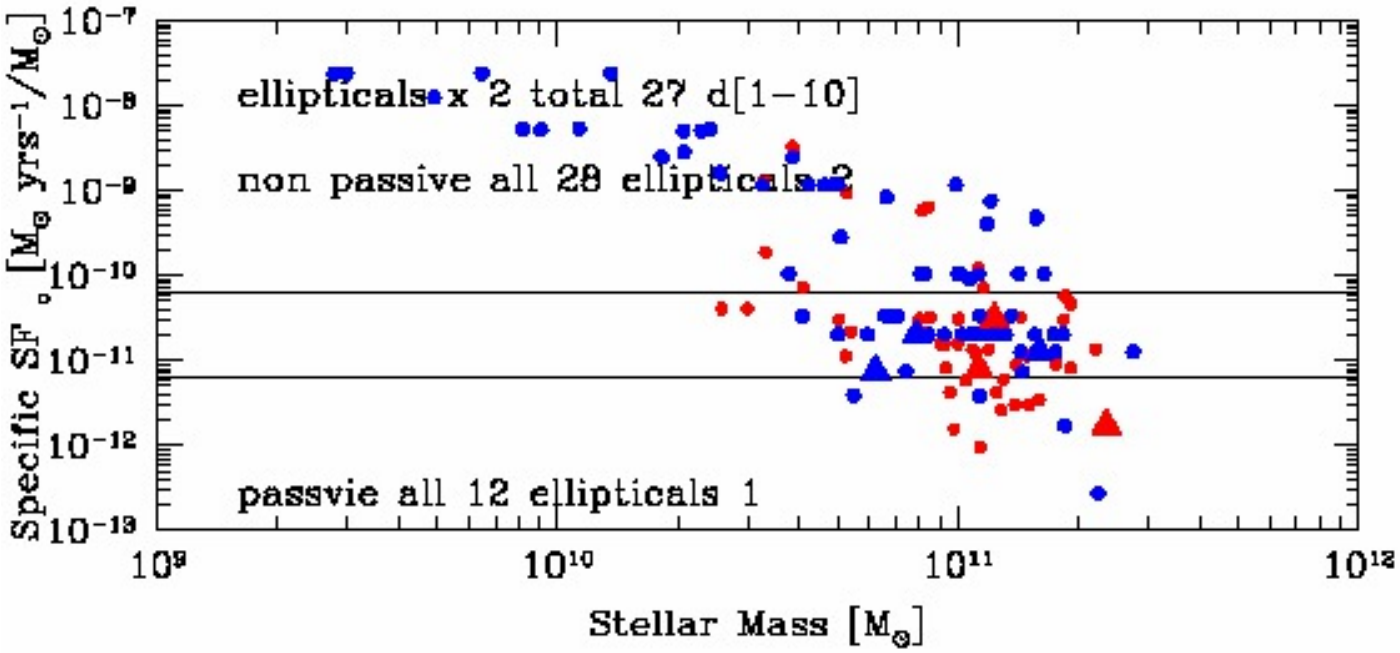
Morphologies
Nair et al.
(in prep)


Specific SF [M⊙ yrs⁻¹/M⊙]
Stellar Mass [M⊙]
ellipticals x 2 total 19 (D>10)
10 %
non passive all 11 ellipticals 2
18%
passvie all 36 ellipticals 19
52 %

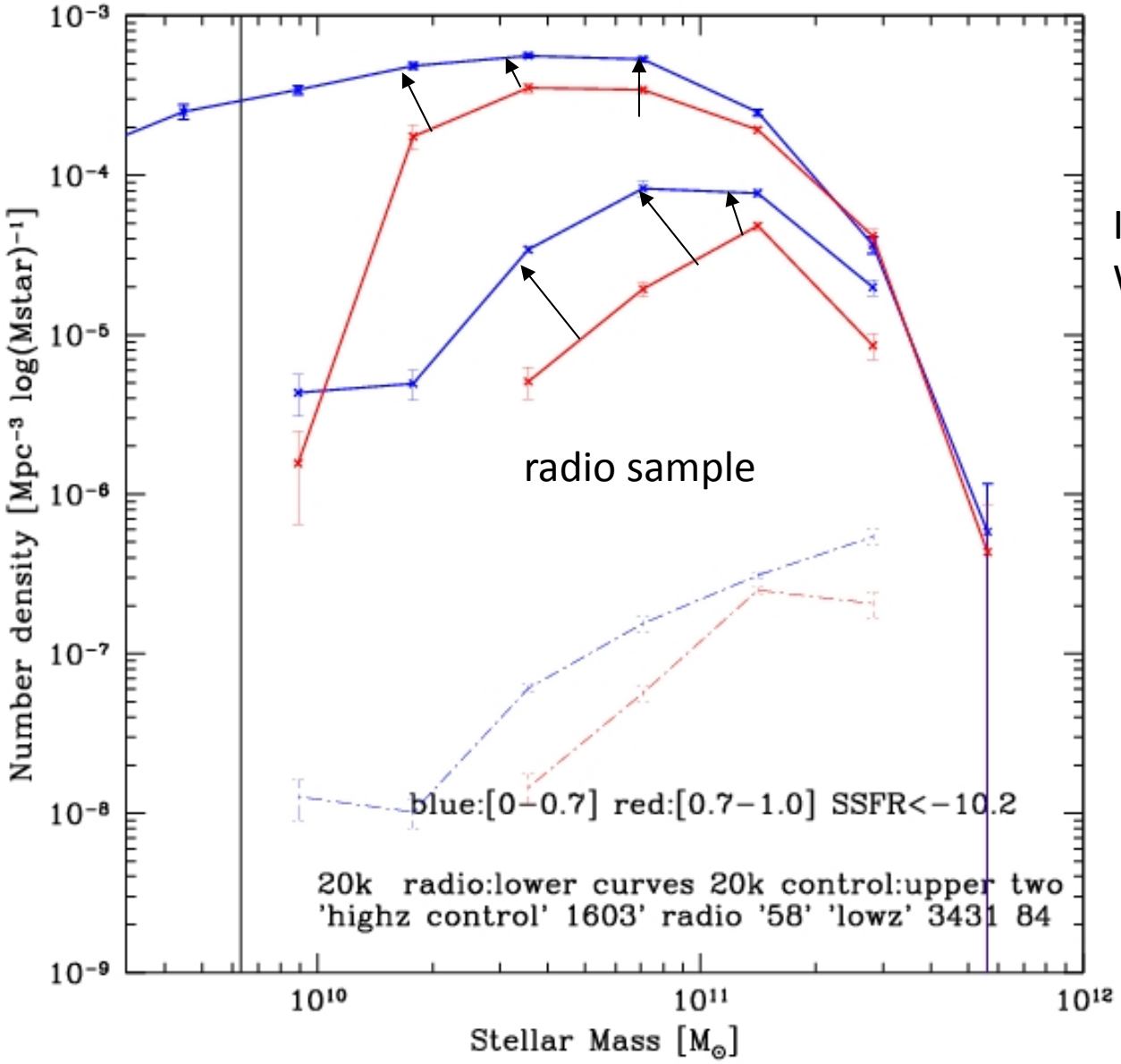

Specific SF [M⊙ yrs⁻¹/M⊙]
Stellar Mass [M⊙]
ellipticals x 7 total 53 d[1−10]
13 %
non passive all 36 ellipticals 4
11 %
passvie all 25 ellipticals 5
20 %


ellipticals x 2 total 14 (D>10)
non passive all 4 ellipticals 2
passvie all 22 ellipticals 15
Specific SF [M⊙ yrs⁻¹/M⊙]
Stellar Mass [M⊙]
ellipticals x 0 total 5 (D>10)
non passive all 7 ellipticals 0
passvie all 14 ellipticals 4
Specific SF [M⊙ yrs⁻¹/M⊙]
Stellar Mass [M⊙]


ellipticals x 5 total 26 d[1−10]
non passive all 8 ellipticals 2
passvie all 13 ellipticals 4
Specific SF [M⊙ yrs⁻¹/M⊙]
Stellar Mass [M⊙]

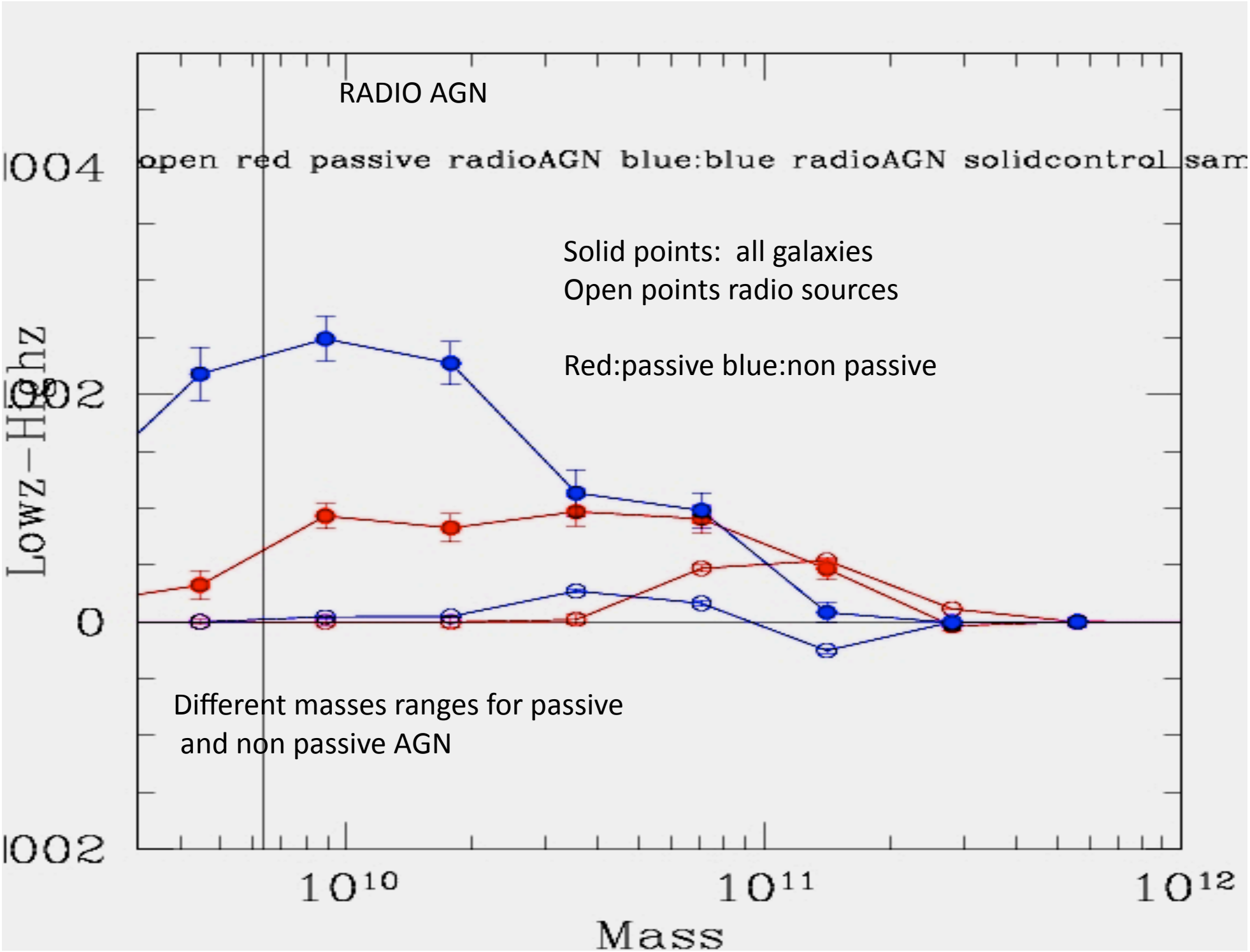

ellipticals x 2 total 27 d[1−10]
non passive all 28 ellipticals 2
passvie all 12 ellipticals 1
Specific SF [M⊙ yrs⁻¹/M⊙]
Stellar Mass [M⊙]

Control sample



Radio AGN

Increaese of num
With decreasing z


RADIO AGN
open red passive radioAGN blue:blue radioAGN solidcontrol sam
Solid points: all galaxies
Open points radio sources
Red:passive blue:non passive
Different masses ranges for passive
and non passive AGN
Lowz−Hihz
0
Mass
10¹⁰
10¹¹
10¹²

Passive AGN and Galaxies :
Mass range [10.55 – 11.45]

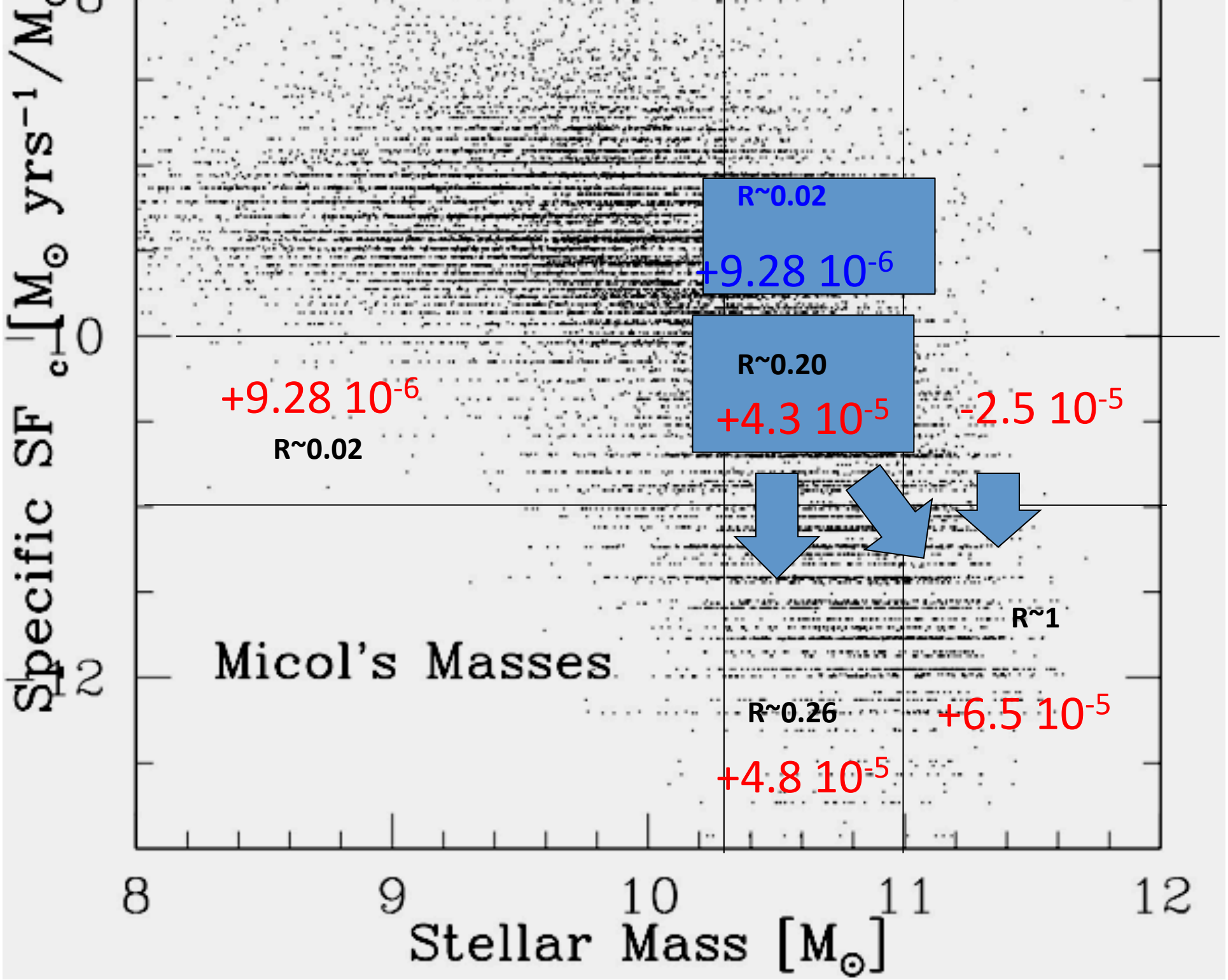
Diff radio 11.23 10^{-5} diff control 23.5 10^{-5}
RATIO= 0.47

Ratio of stellar masses lowz= 0.31 highz=0.10

➔ Higher fraction of AGN transit to passive

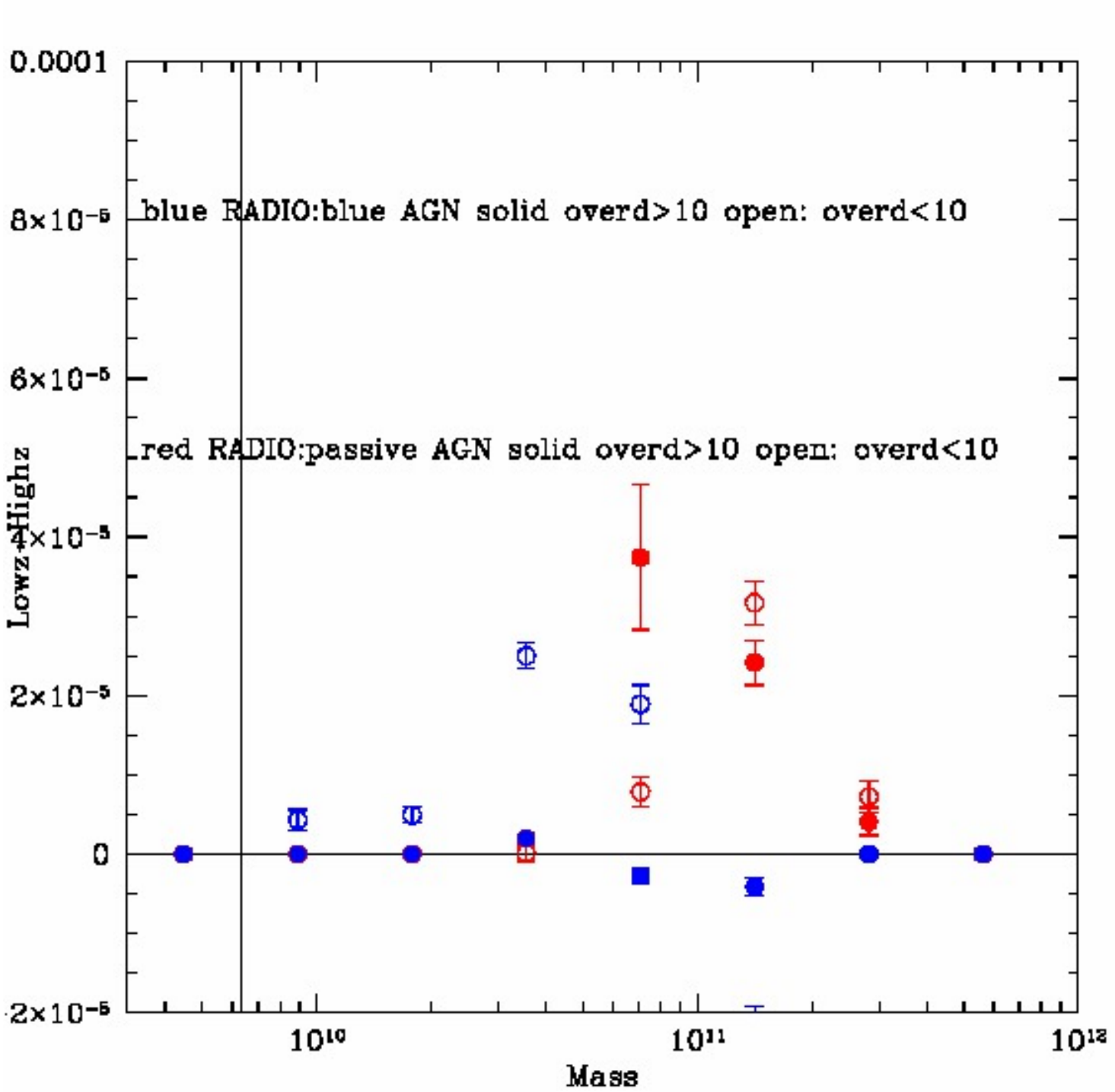
Non Passive
Mass range [9,95-10.85]
Diff radio 5.2 10^{-5} diff control 4.38 10^{-4}
RATIO =0.12 consistent with stellar masses ratios

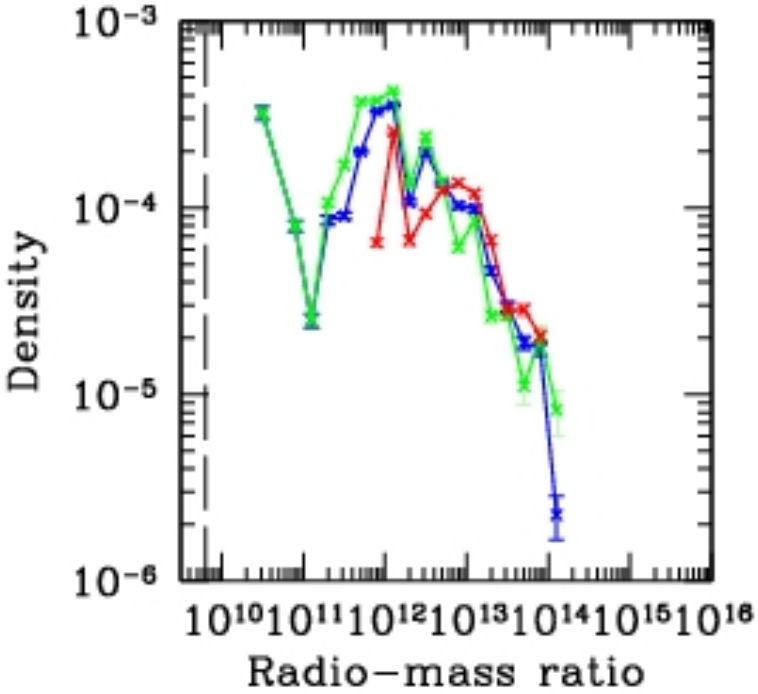
➡ Constant flow?


R~0.02
+9.28 10-6
R~0.20
+4.3 10-5
+9.28 10-6
R~0.02
-2.5 10-5
R~1
Micol's Masses
R~0.26
+6.5 10-5
+4.8 10-5
Specific SF [M⊙ yrs-1/M⊙]
-10
-12
8
9
10
11
12
Stellar Mass [M⊙]

Red passive
Blue non-passive

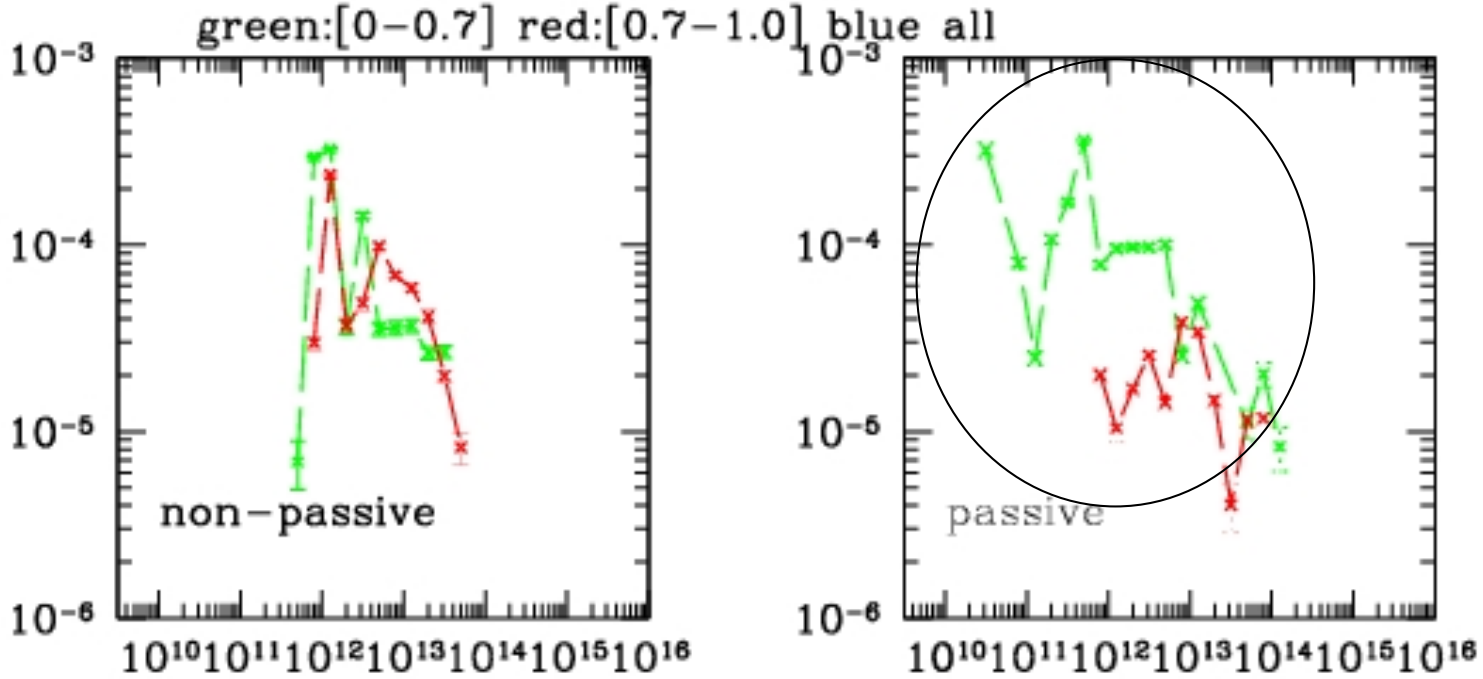
As a function of Overdensity (with all the caveats)

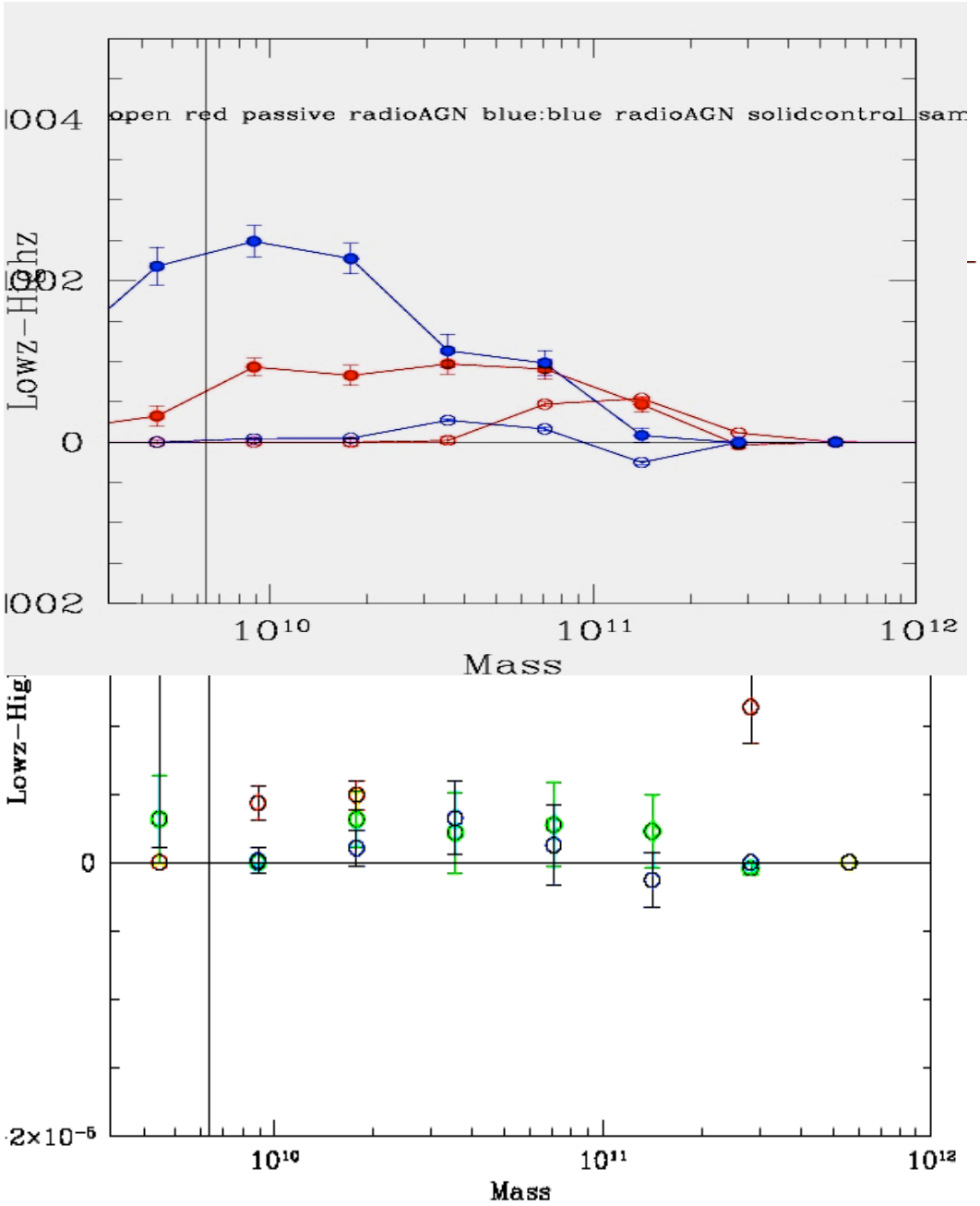




Luminosity-Stellar mass
Ratio (vmax corrected)

Increase of low lum radio AGN





Xray AGN same mass range
As non passive radio AGN

X-ray AGN

Conclusions

-Non passive radio AGN and type 2 x-ray AGN occupy same Stellar mass range and environment ➔ same population

-constat flow of both radio non passive and x-ray AGN With respect the general population (i.e. ratios are constant)

-New passive galaxies have almost all a central radio AGN And become ellipticals at high densities but with lower radio power with respect to pre-existing AGN