

Nuclear activity and environment: isolated galaxies versus clusters and compact groups



Jose Sabater Montes

Institute for Astronomy, University of Edinburgh

Introduction

- Origin and evolution of galaxies.
 - Intrinsic properties of a galaxy. Nature.
 - Properties induced by the interaction with companions. Nurture.
- Examples of interaction induced evolution:
 - Star formation.
 - Morphology.
 - Nuclear activity.

Nuclear activity and environment

- Effect of environment on AGN not clear yet. Contradictory results found in the literature. Some open questions:
 - What is the prevalence of AGN with respect to environment and interaction?
 - Is there a relation between accretion modes (LERG, HERG) and environment?
- Aim: Study of the effect of the environment and interactions on nuclear activity.

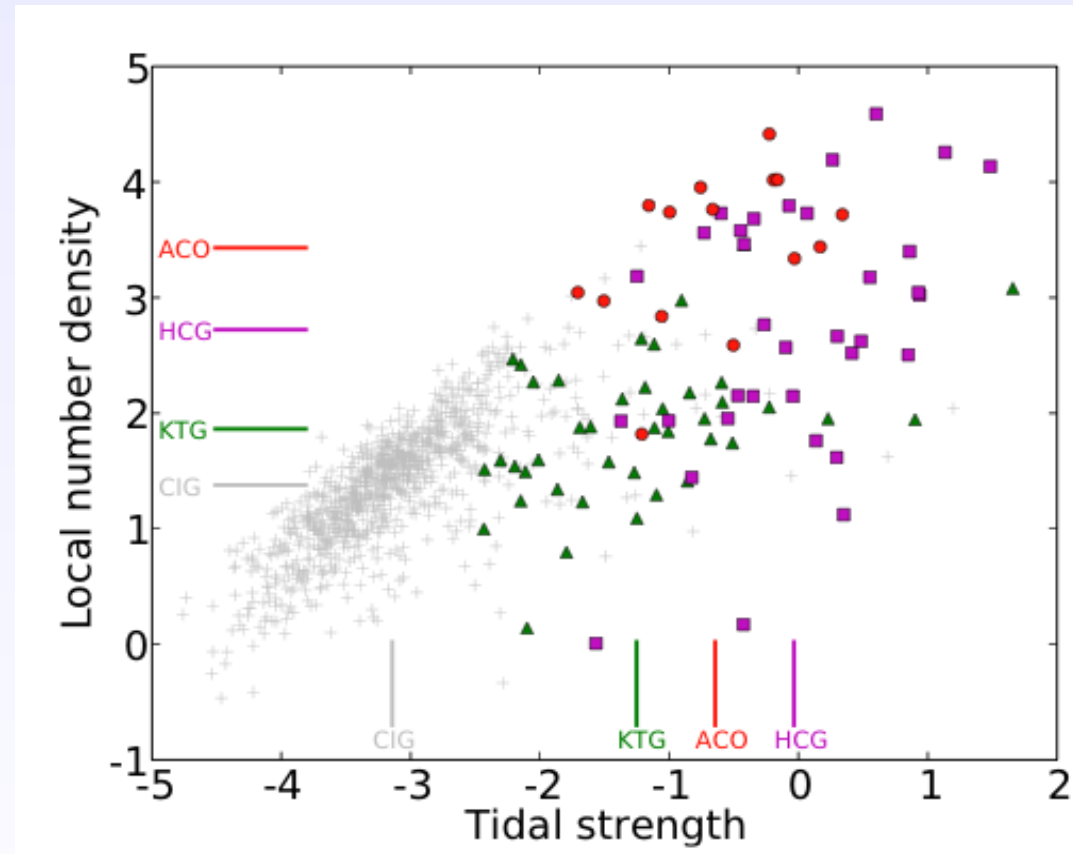
AMIGA sample of isolated galaxies.

Baseline

- Analysis of the interstellar Medium in Isolated GALaxies. <http://amiga.iaa.es/>
- Complete sample of isolated galaxies (n~1050) based on the CIG (Karachentseva 1973).
 - Multiwavelength data: HI, radio-continuum, optical, FIR, NIR, Halpha, CO(1-0).
 - Refined morphology, position, distance, isolation.
- One of the most nurture-free samples available.
- Quiescent galaxies.

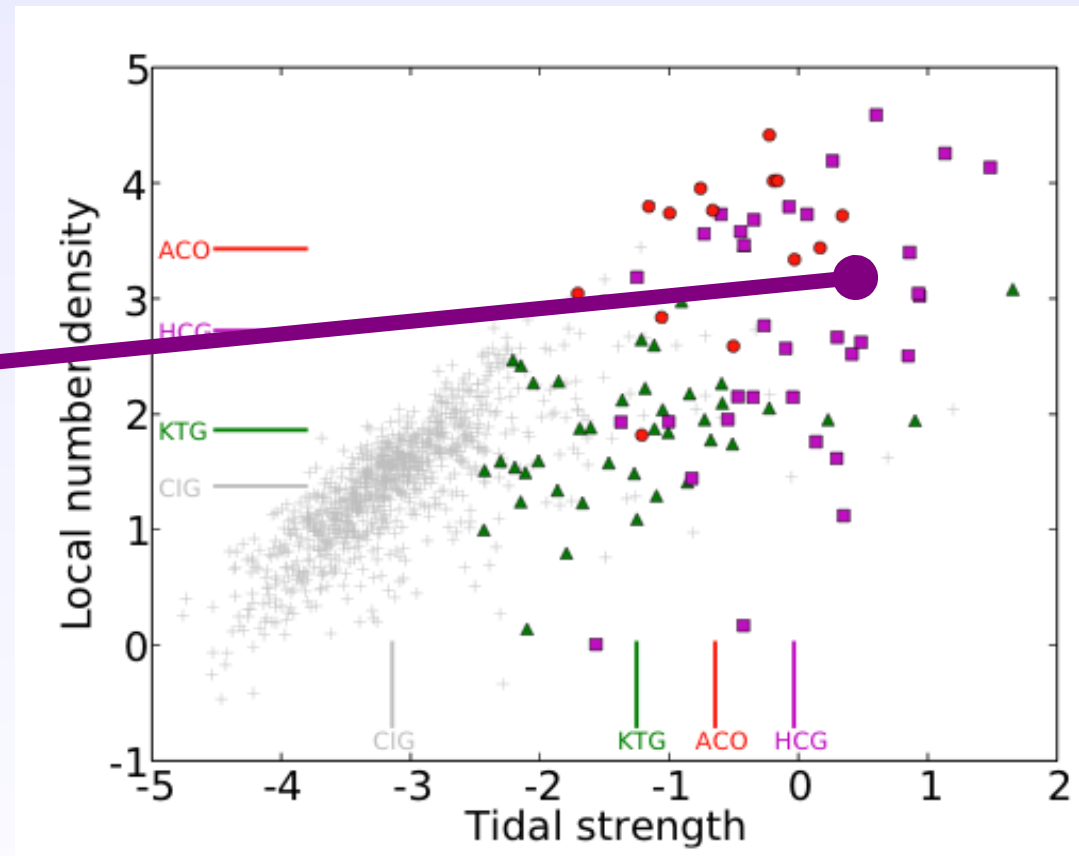
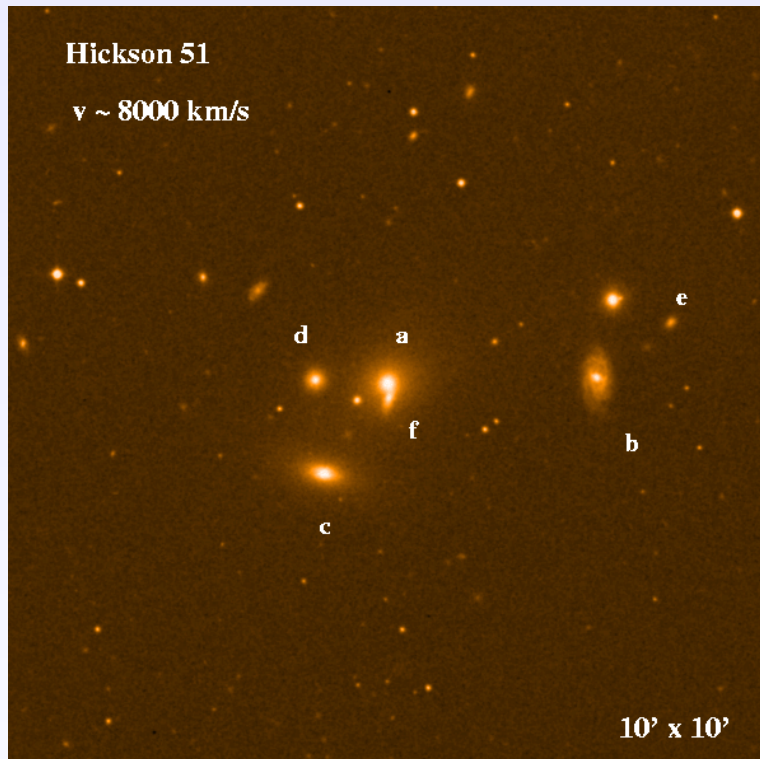
AMIGA: interaction estimators

- Local number density
 - log of the volume defined by the distance to the 5th or 10th neighbour.
- Tidal strength
 - log of the sum of (companion tidal force / internal binding force)



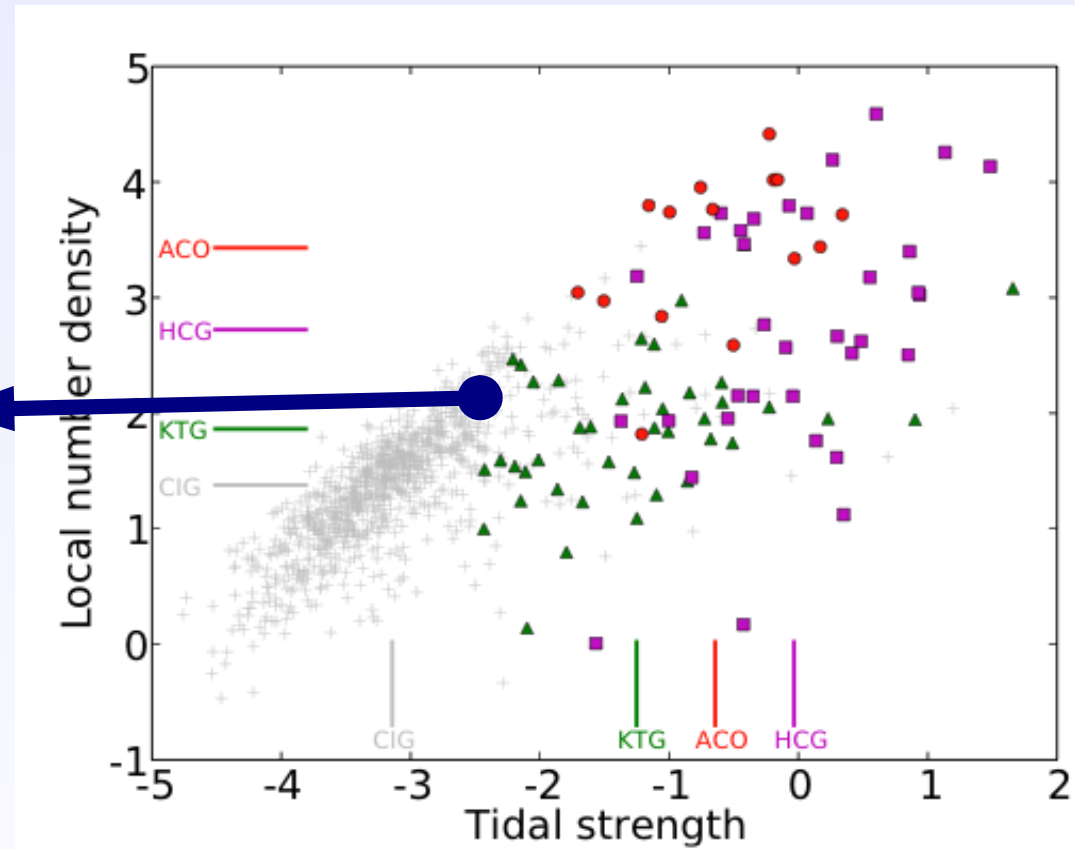
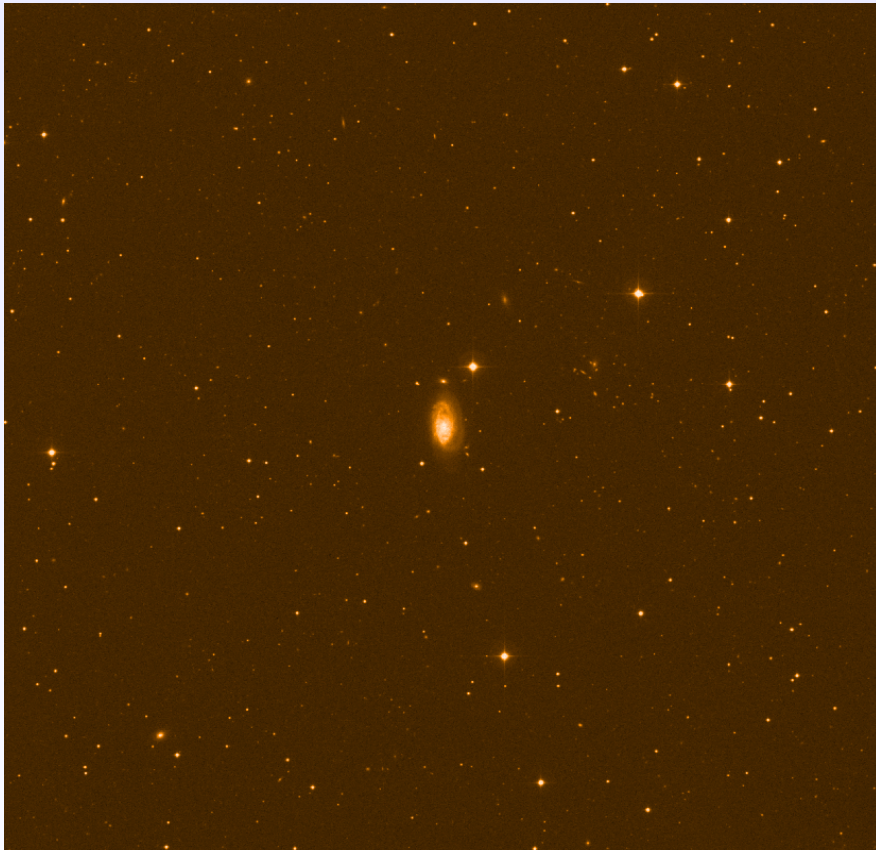
Verley et al. 2007

AMIGA: interaction estimators



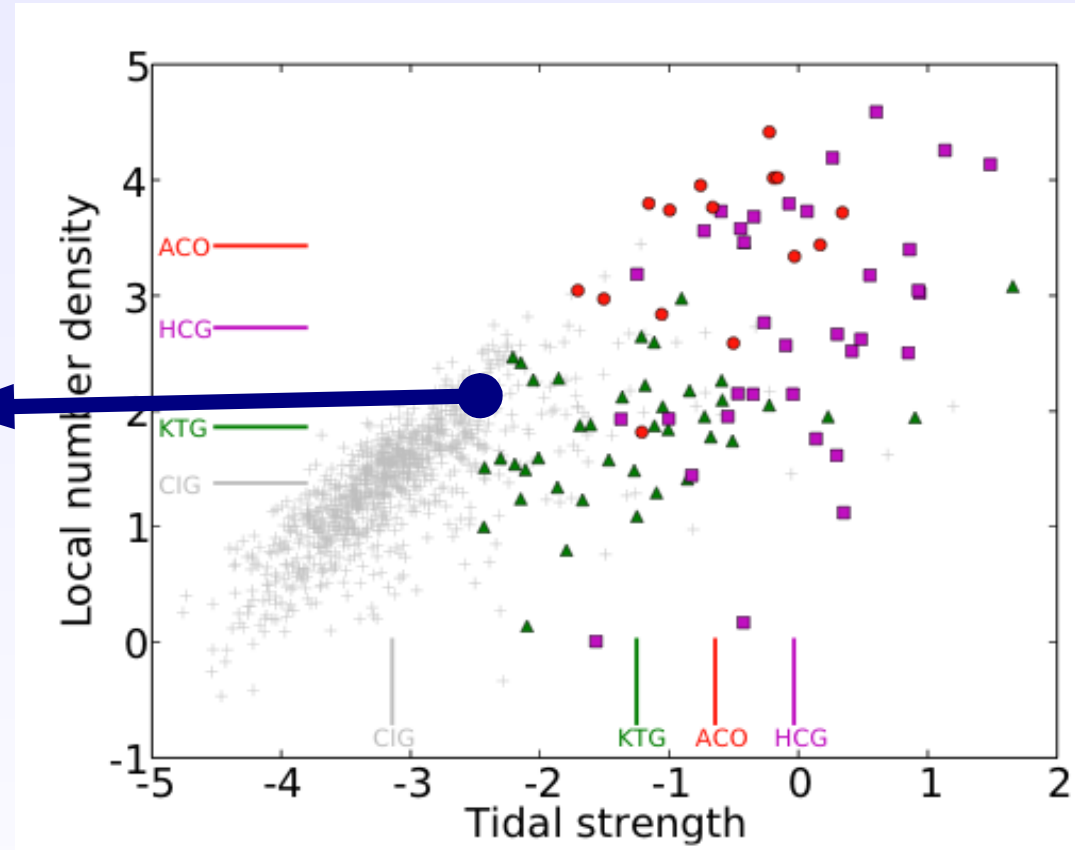
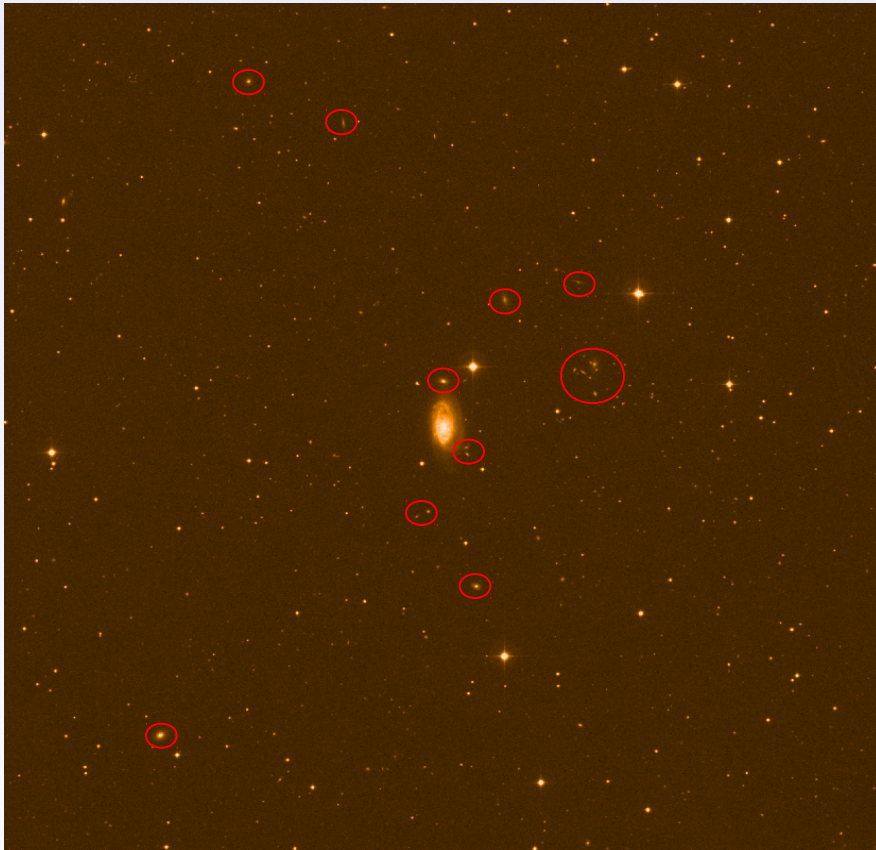
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AMIGA: interaction estimators



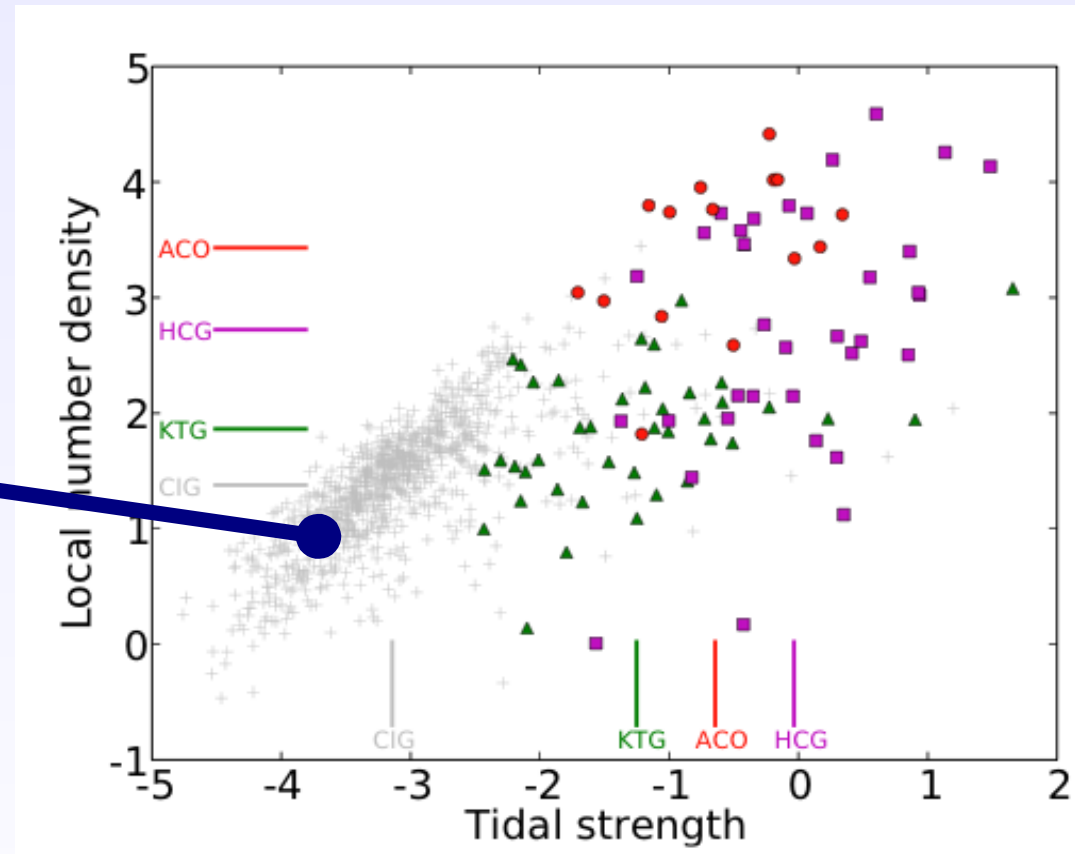
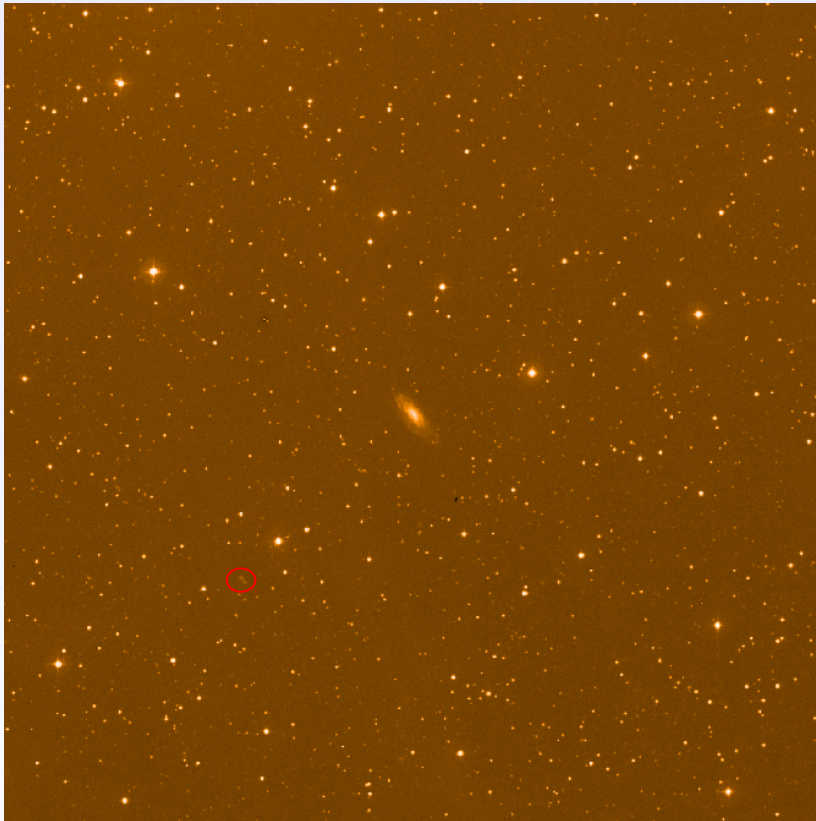
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AMIGA: interaction estimators



Verley et al. 2007

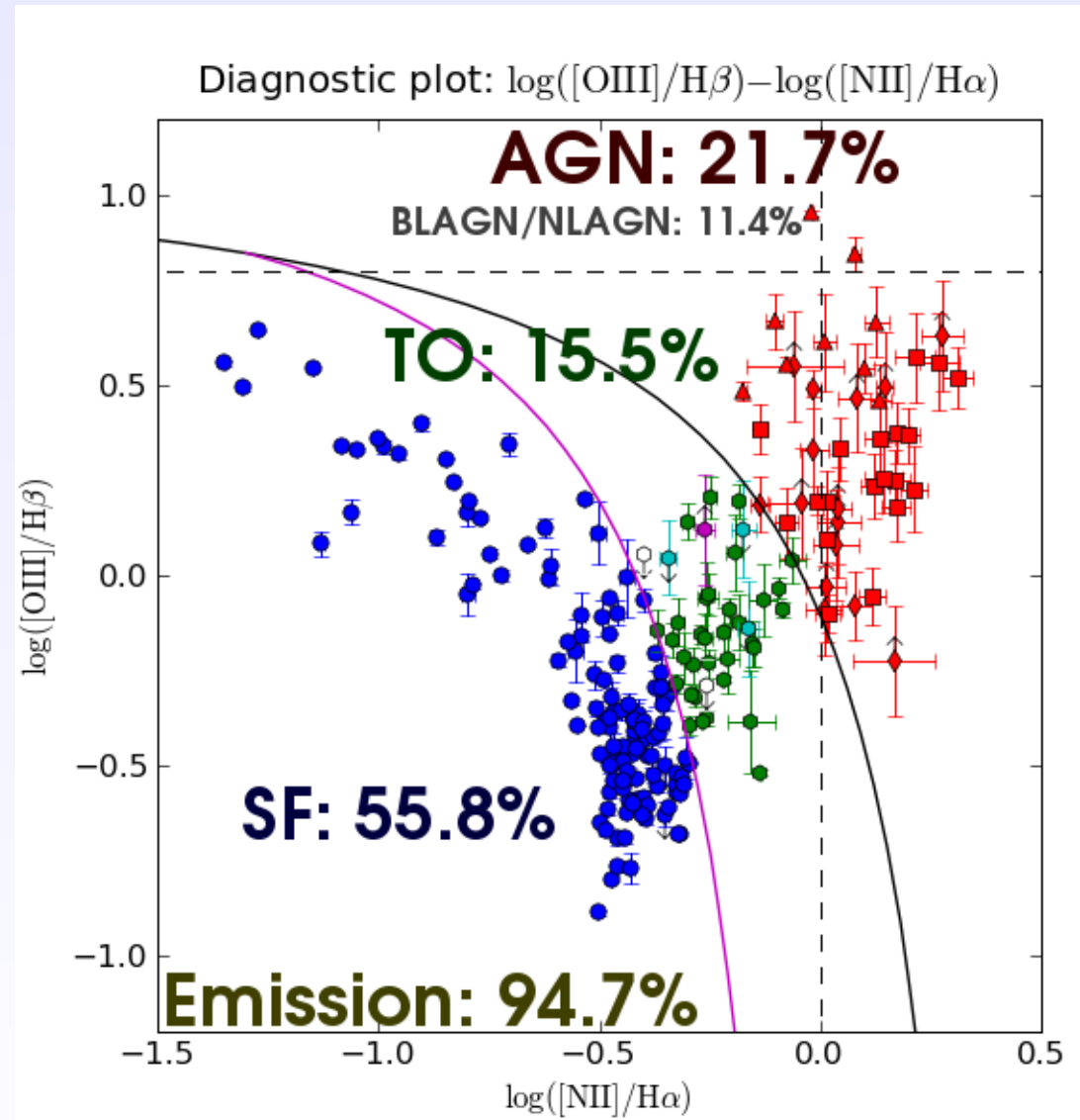
AMIGA: interaction estimators



Verley et al. 2007

AMIGA: AGN

- Optical AGN
 - Optical spectra, diagnostic diagrams (SDSS spectra)
 - ~56% SFN; ~16% TO
 - ~22% AGN

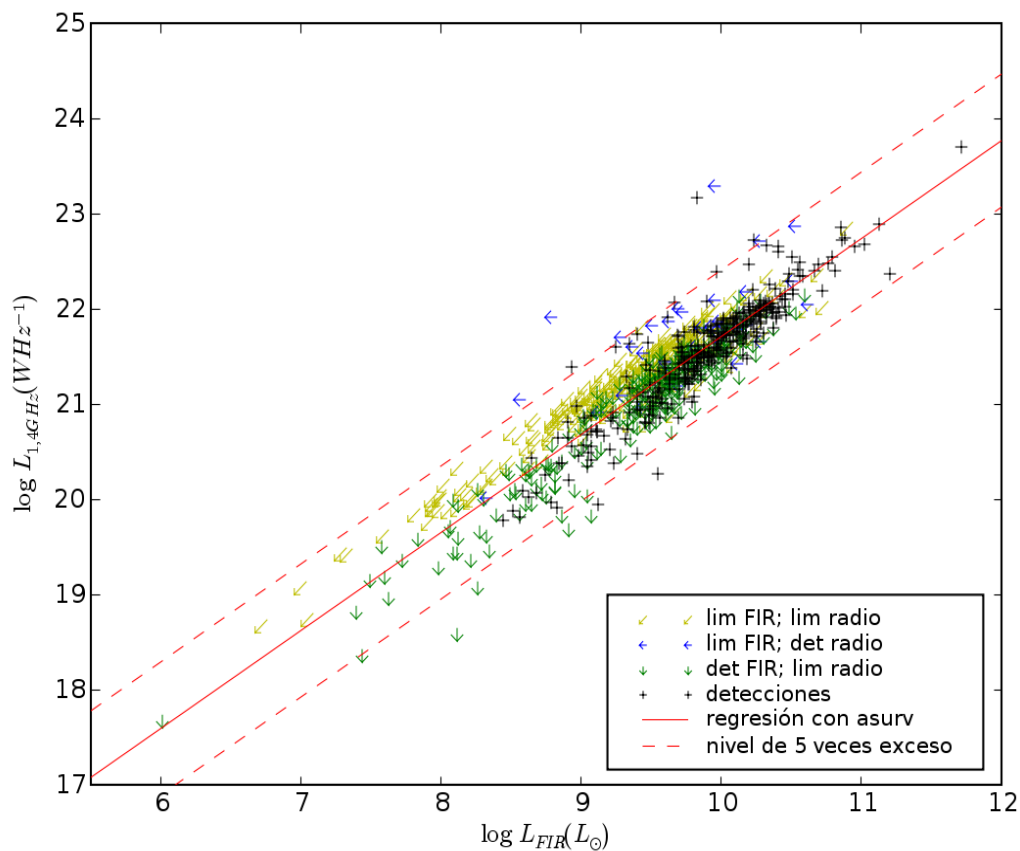


Sabater et al. 2012 submitted

AMIGA: AGN

● Optical AGN

● Radio AGN



Sabater et al. 2008

- Radio-continuum to FIR correlation (NVSS and IRAS data)
- Radio AGN above a factor 5 radio excess (Yun et al. 2001)
- VLA follow up observations
- **0% radio AGN**

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Comparison with samples in denser environments

- Optical AGN

- Hickson Compact Groups - Martínez et al. 2010 (n~270)

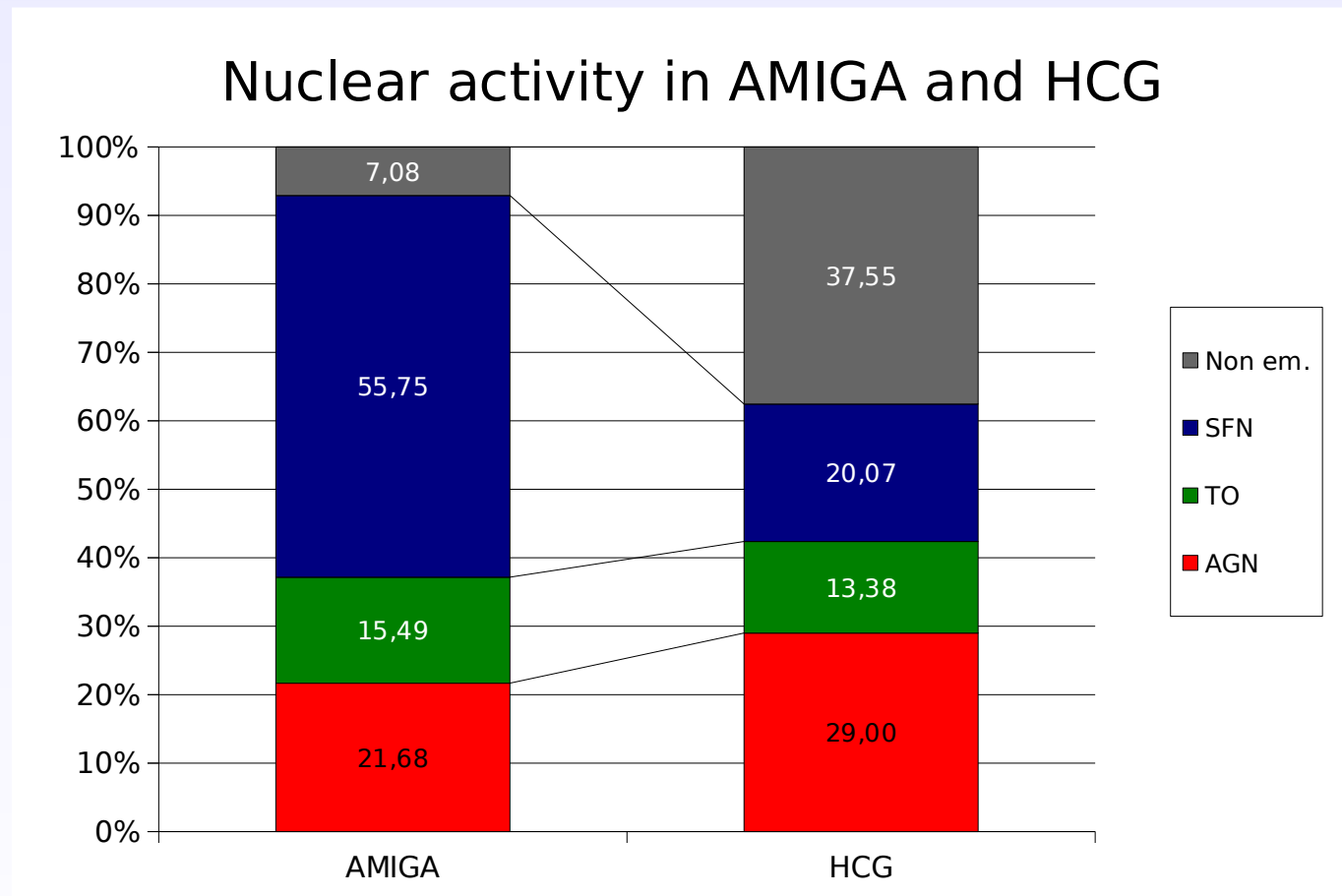
- Radio AGN

- Nearby X-ray clusters - Reddy et al. 2004
- Abell clusters - Miller & Owen 2001

Comparison with samples in denser environments

● Optical AGN

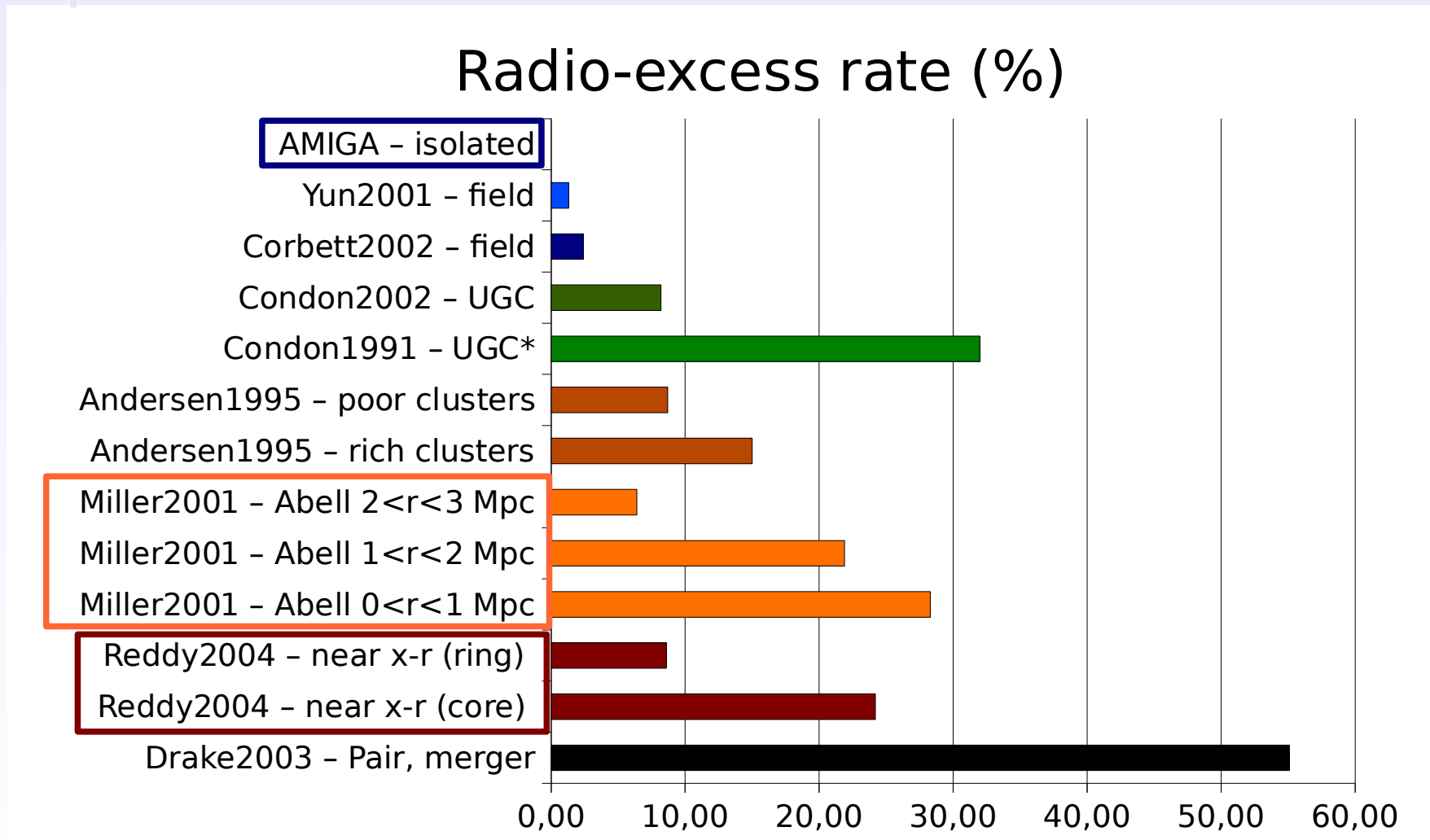
● Radio AGN



Comparison with samples in denser environments

● Optical AGN

● Radio AGN



Comparison with samples in denser environments

- Optical AGN:

- AMIGA ~22%
- HCG ~29%

- Radio AGN:

- AMIGA ~0%
- Clusters ~15%

Comparison with samples in denser environments

- Optical AGN:
 - AMIGA ~22%
 - HCG ~29%
- Radio AGN:
 - AMIGA ~0%
 - Clusters ~15%
- Known relation between mass and AGN prevalence (Best et al. 2005; Kauffmann et al. 2003)
- Percentages probably biased by the mass and morphology distribution

Comparison with samples in denser environments

- New comparison method: Statistical test that compares the fraction of AGN with respect to the mass and morphology ($f[M,t]$) in the common region between both samples.

Comparison with samples in denser environments

- Optical AGN

- p-value between 0.46 and 0.52
- No clear difference in the case of optical nuclear activity

- Radio AGN

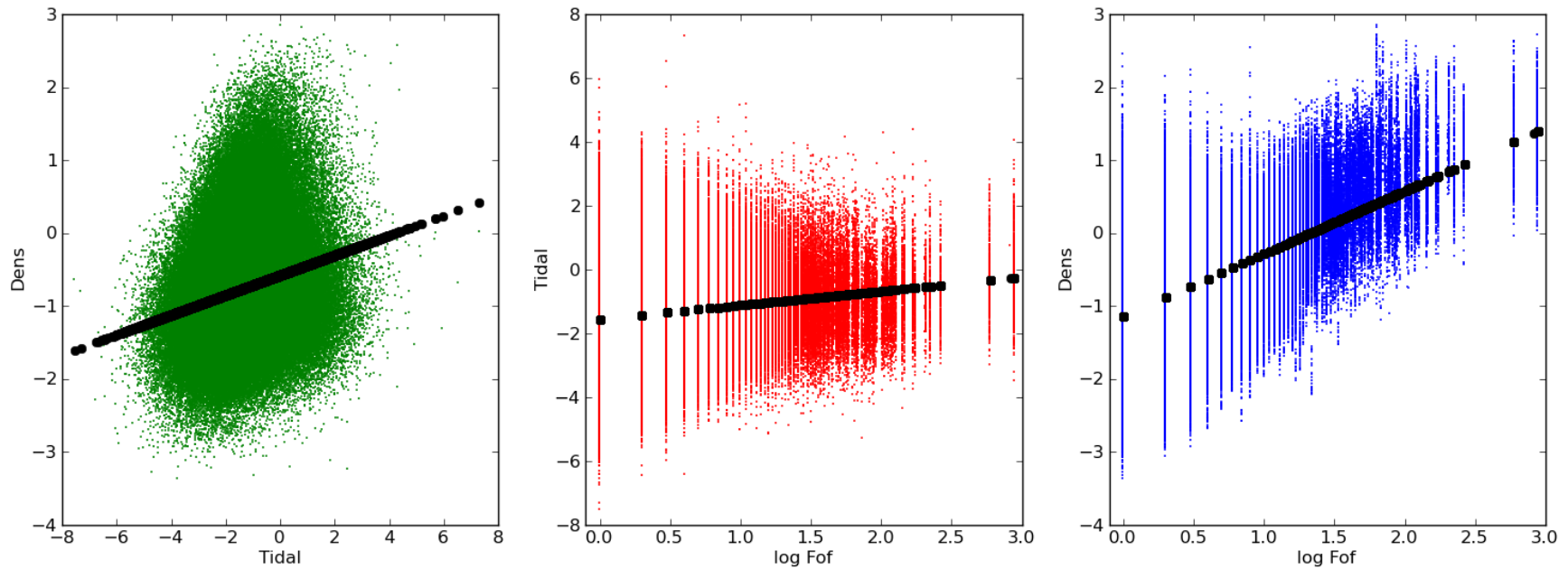
- p-value lower than 0.00008
- Clearly different distributions
- **Environment is fundamental for the triggering of radio nuclear activity**

Extension of the study. Large scale surveys

- SDSS, NVSS, FIRST. Best et al. 2005
- ~300,000 galaxies between $z=0.03$ and $z=0.1$
- Interaction parameters:
 - Local density estimator
 - Tidal forces estimator
 - Friends of friends algorithm (Tago et al. 2010)

Preliminary results

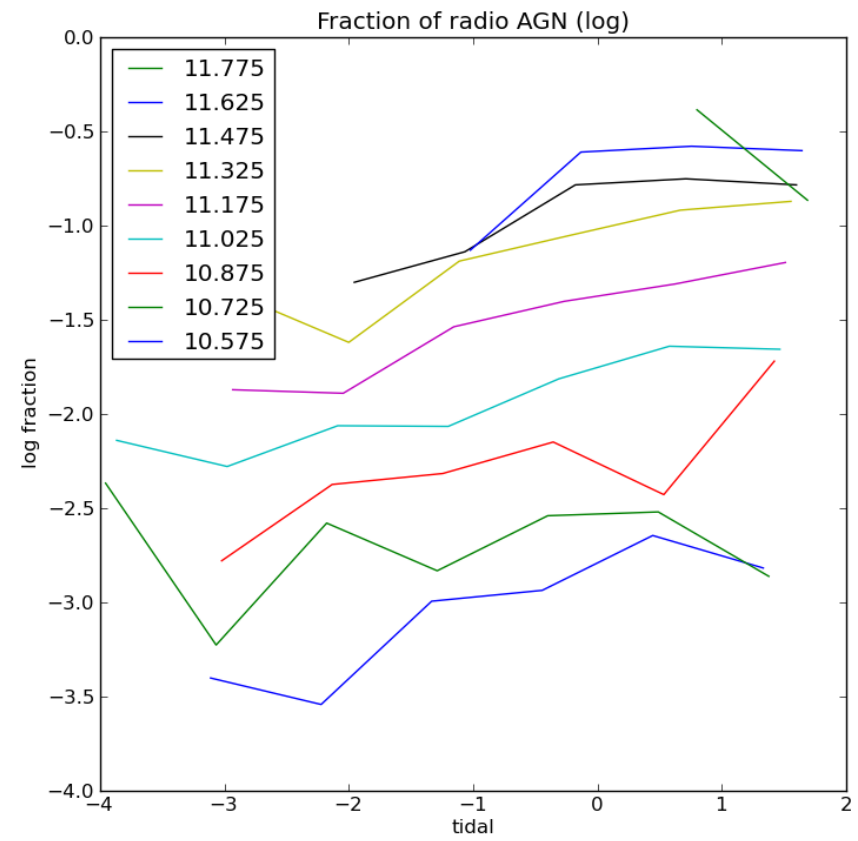
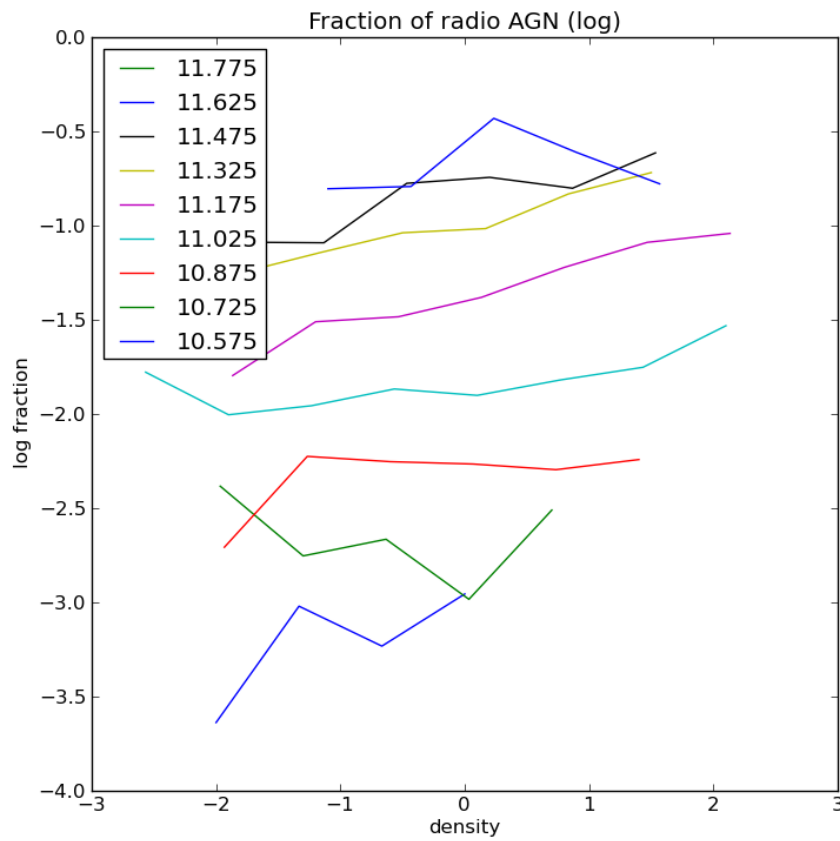
- Tidal, density and FoF estimators



field \neq isolated

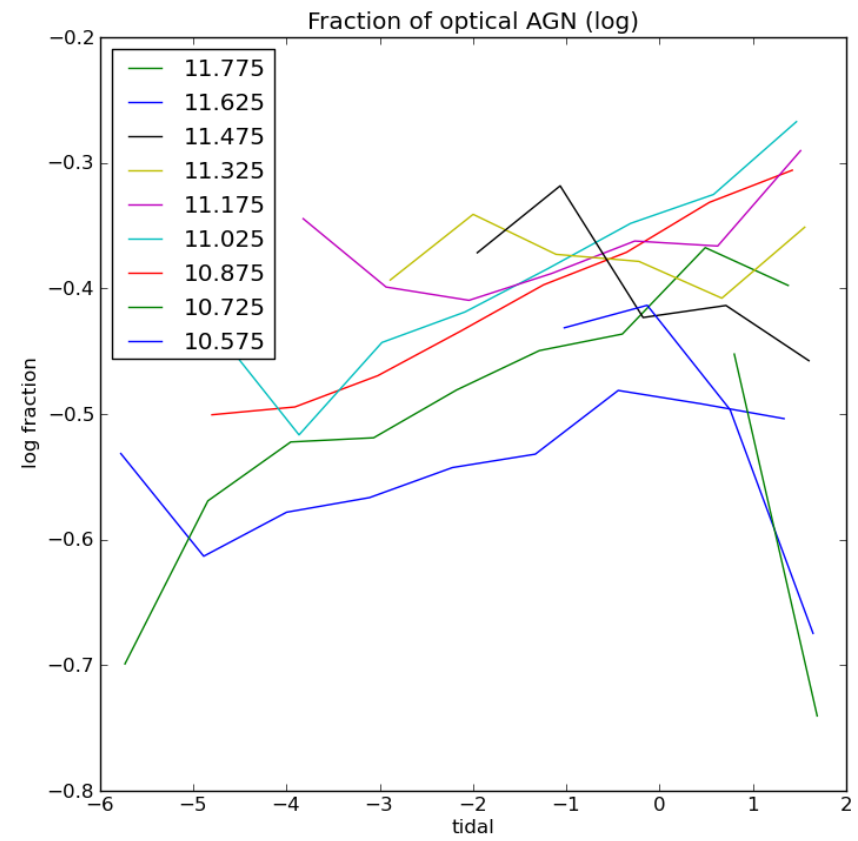
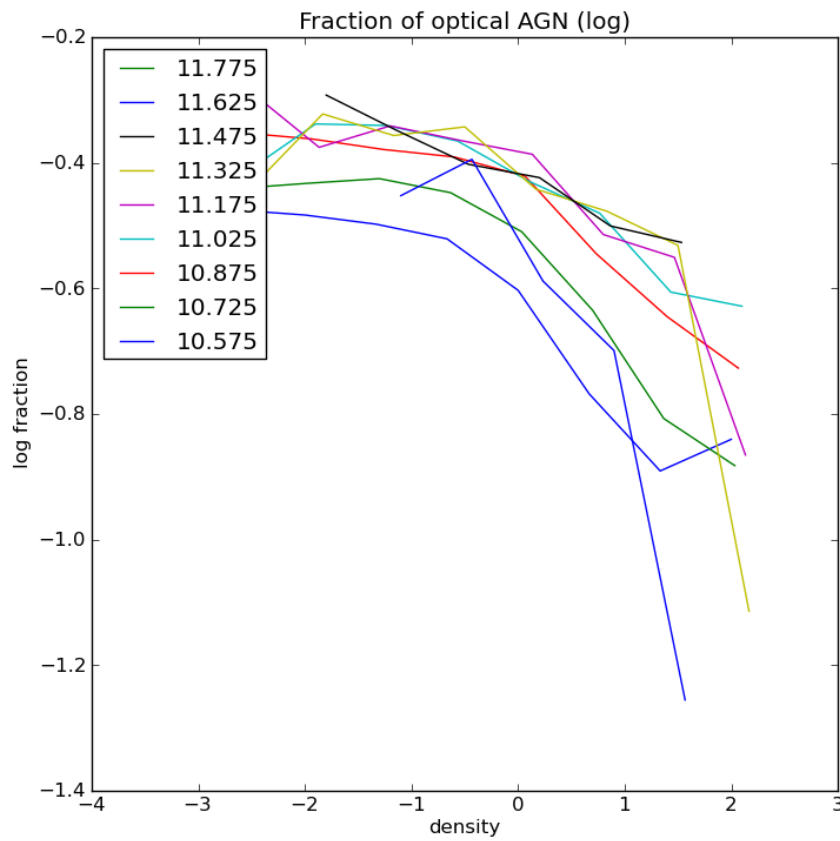
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● Radio AGN



Preliminary results

● Optical AGN



Future: LOFAR

- LOFAR surveys. Deeper, low frequency.
- Current status:
 - The Multifrequency Snapshot Sky Survey (MSSS) has begun. See also: <http://www.nature.com/news/radio-array-starts-work-1.9762>
 - The first deep survey operations will begin in the summer.