Multiple **AGN A**ctivity in galaxy mergers: the remarkable case of SDSS J0959+1259

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on behalf of MAGNA team

http://www.issibern.ch/teams/agnactivity/Home.html




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INTRO

Multiple supermassive black holes systems are of wide astrophysical relevance

- Their detection and number estimates provide important constraints on models for galaxy formation and BHs evolution (feedback).
- formation of the torus-like structure in the environment of the SMBHs
- differences between different classes of radio-loud AGN
- the distortions and the bending in radio jets
- coalescing binary SMBHs are strong emitters of gravitational waves detectable with eLISA.

Selection methods

- Spectroscopic measurements of offset AGN broad emission-lines (double peaked systems) separated each other and the host galaxy's stellar continuum light
- image of a binary AGN which forms a gravitationally bound system. Requires high spatial resolution ~mas (VLBI, e.g. 0402+379)
- nearly periodic variability on a time scale associated with the orbital period of the binary (OJ 287)
- ***High penetrative X-ray emission***

MAGNA goal is the first systematic study of a well defined sample of multiple SMBHs **using multiband information**

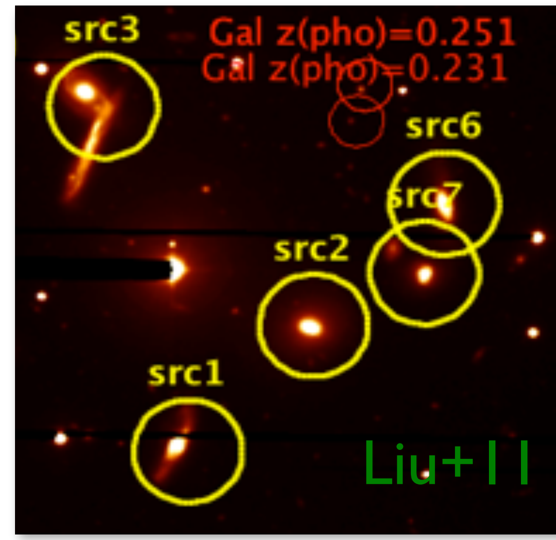
The quintet group SDSS 0959+1259

Composite gri SDSS image (100”x100”)
z=0.03

- ✓ The only Quintet group in the huge optical sample (Liu+11)
- ✓ XMM 20 ks exposure
- ✓ Follow-up 2.2 m telescope in Calar Alto BUSCA optical image

The crowded field

BUSCA R-filter

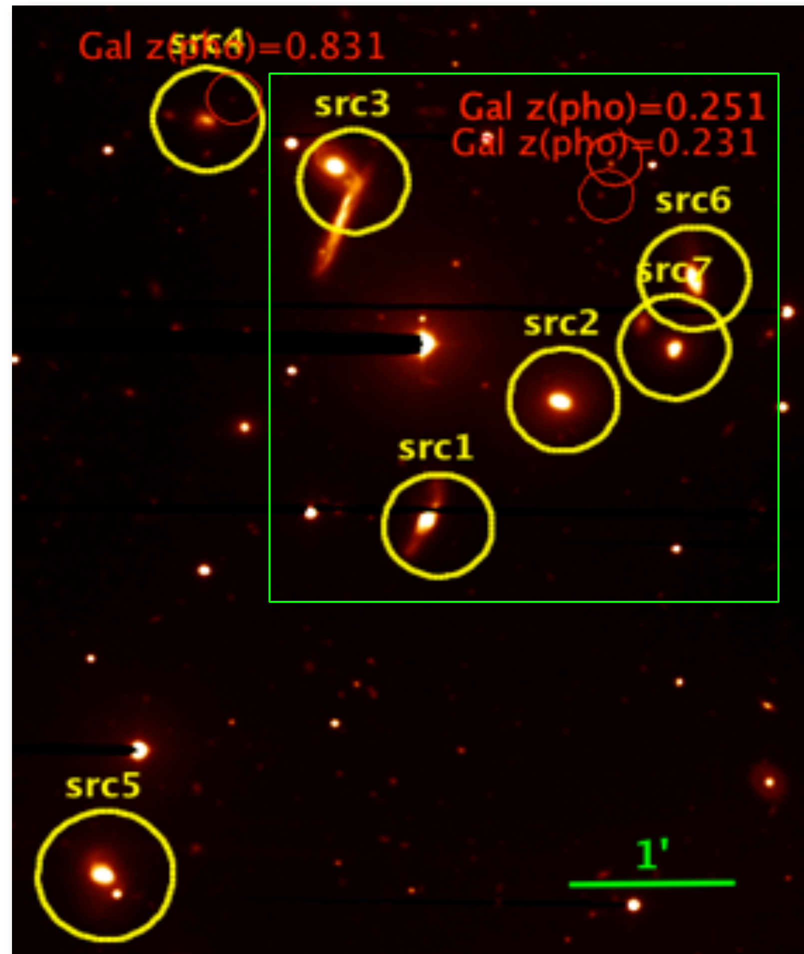


~70 kpc (1.5 arcmin)

De Rosa+ 2015

The crowded field

BUSCA R-filter

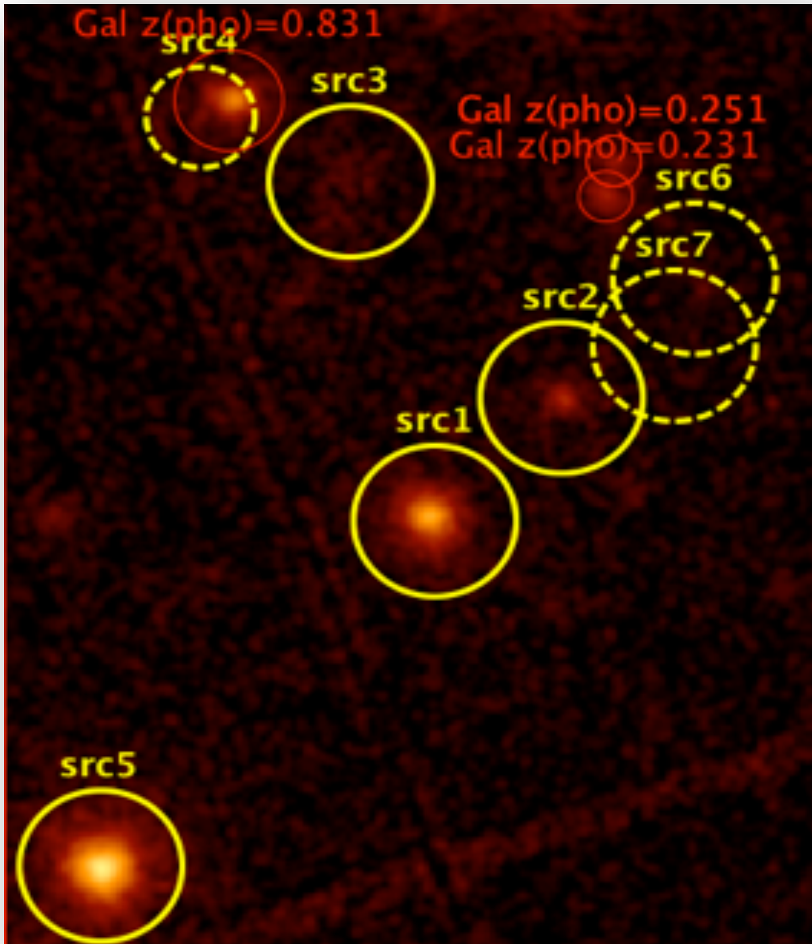


~200 kpc (4.5 arcmin)

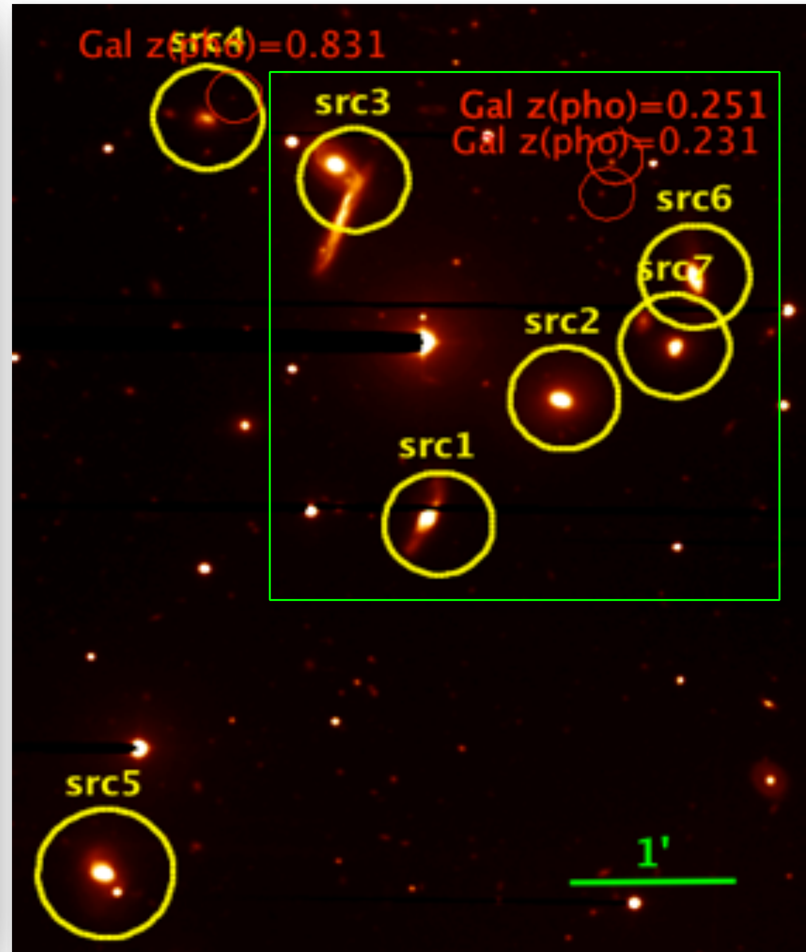
De Rosa+ 2015

The crowded field

XMM pn+MOS12

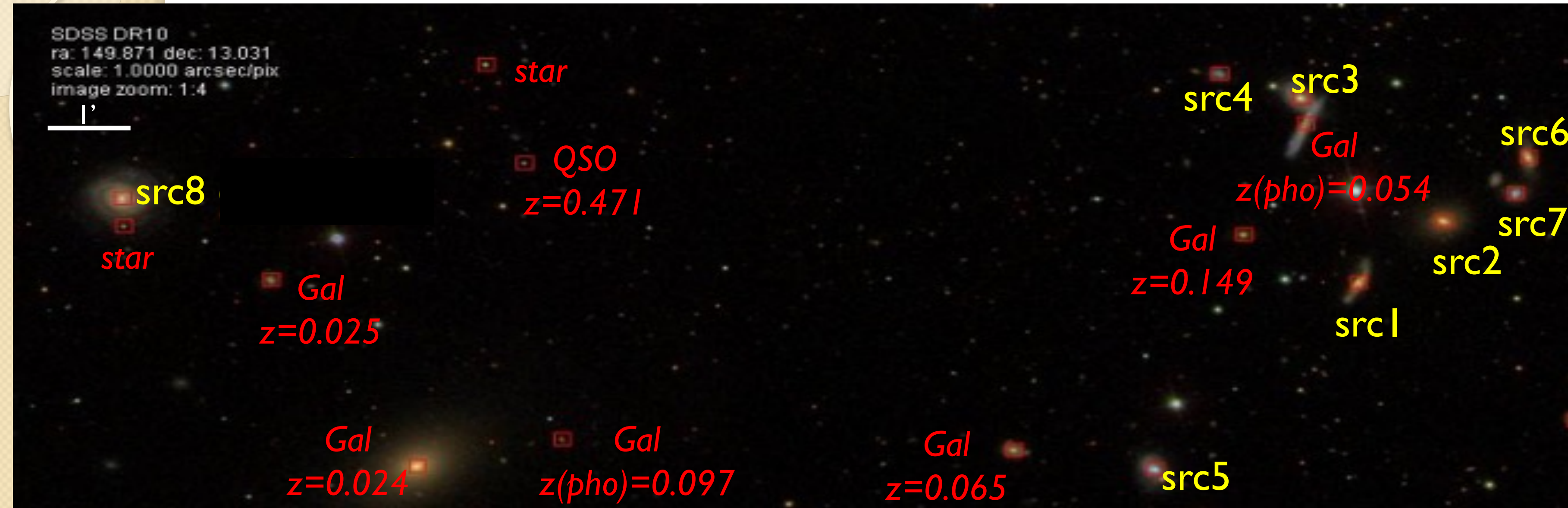


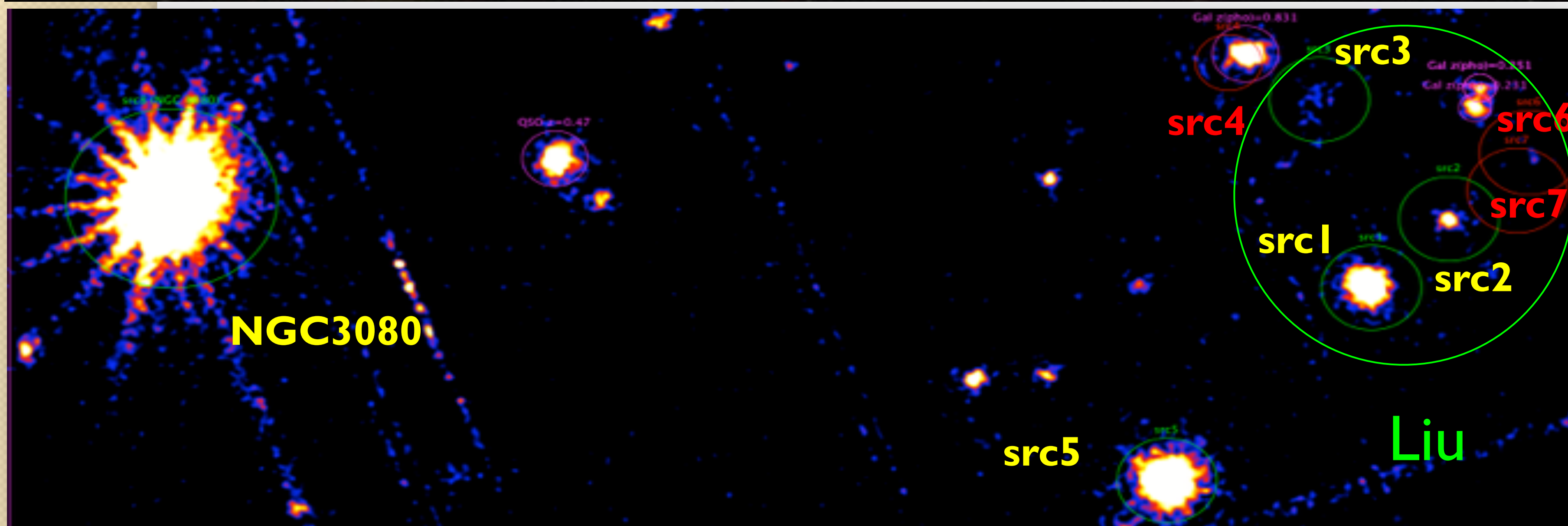
BUSCA R-filter



~200 kpc (4.5 arcmin)

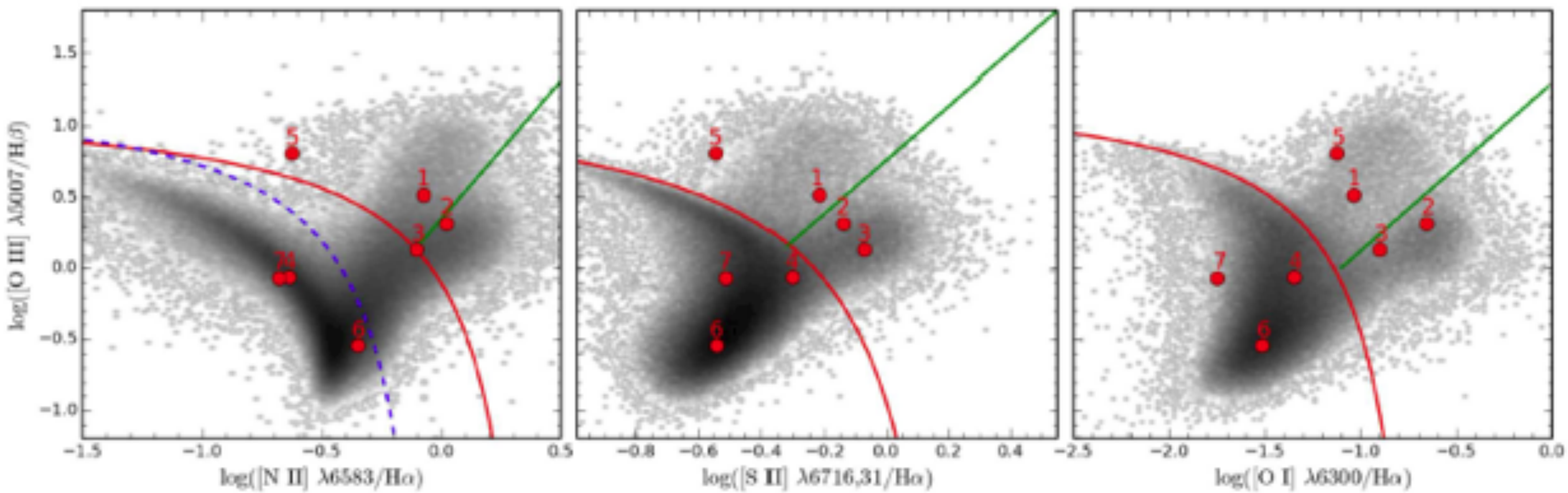
De Rosa+ 2015





600 kpc (15 arcmin)

The galaxy compact group



The selection

I. Concordant redshift, 0.033-0.037,
II. Dv < 500 km/s or less
III. Proj. dist d < 300 h^{-1} kpc

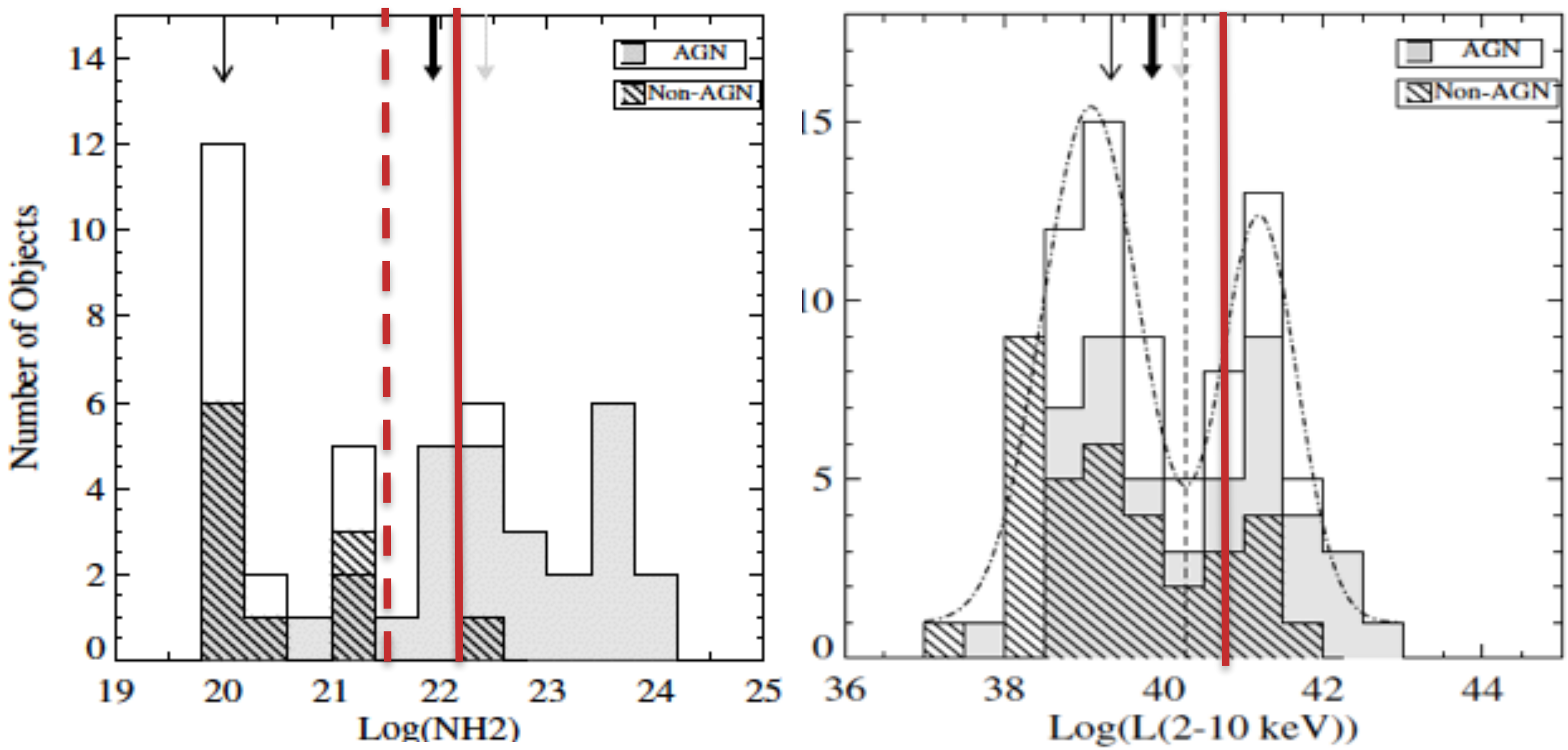
➔

The CG

1. Type 2 AGN -- X-ray
2. LINER – X-Ray
3. LINER - X-ray
4. SFG – X ray UL
5. Type 2 AGN - X- ray
6. SFG - X ray UL
7. SFG - X ray UL
8. Type 1 AGN - X-ray

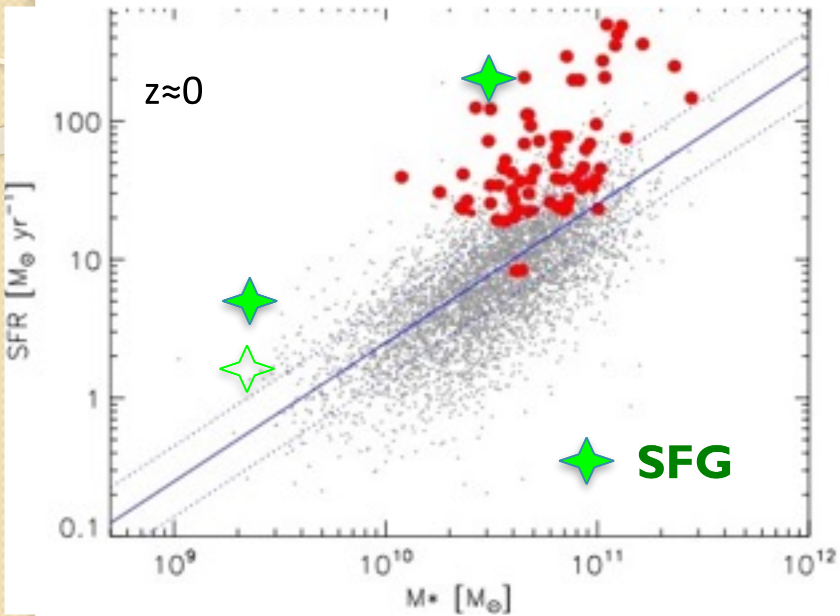
LINERSs in our CG are likely accretion driven

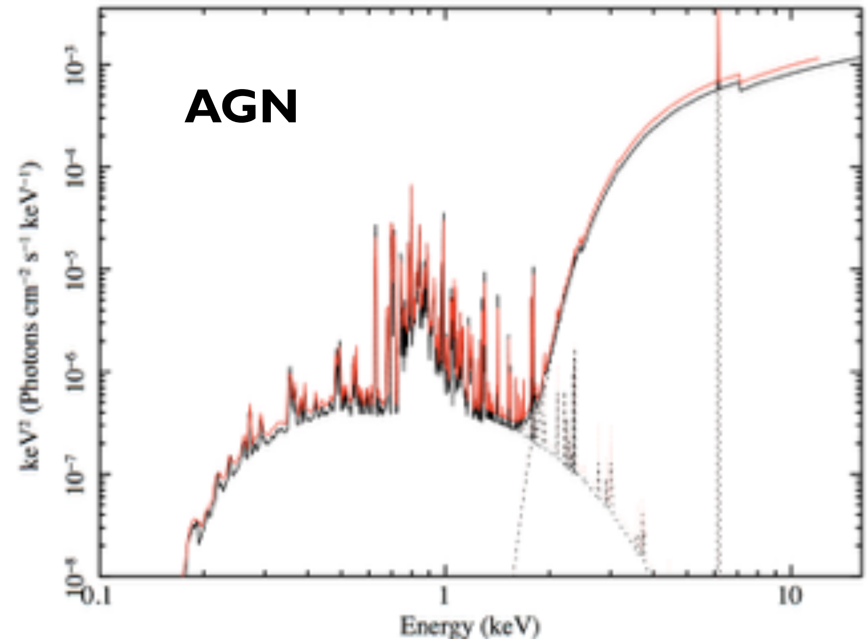
X-ray view of LINERs with XMM and Chandra



Gonzales-Martin+2009

Enhanced star forming rate





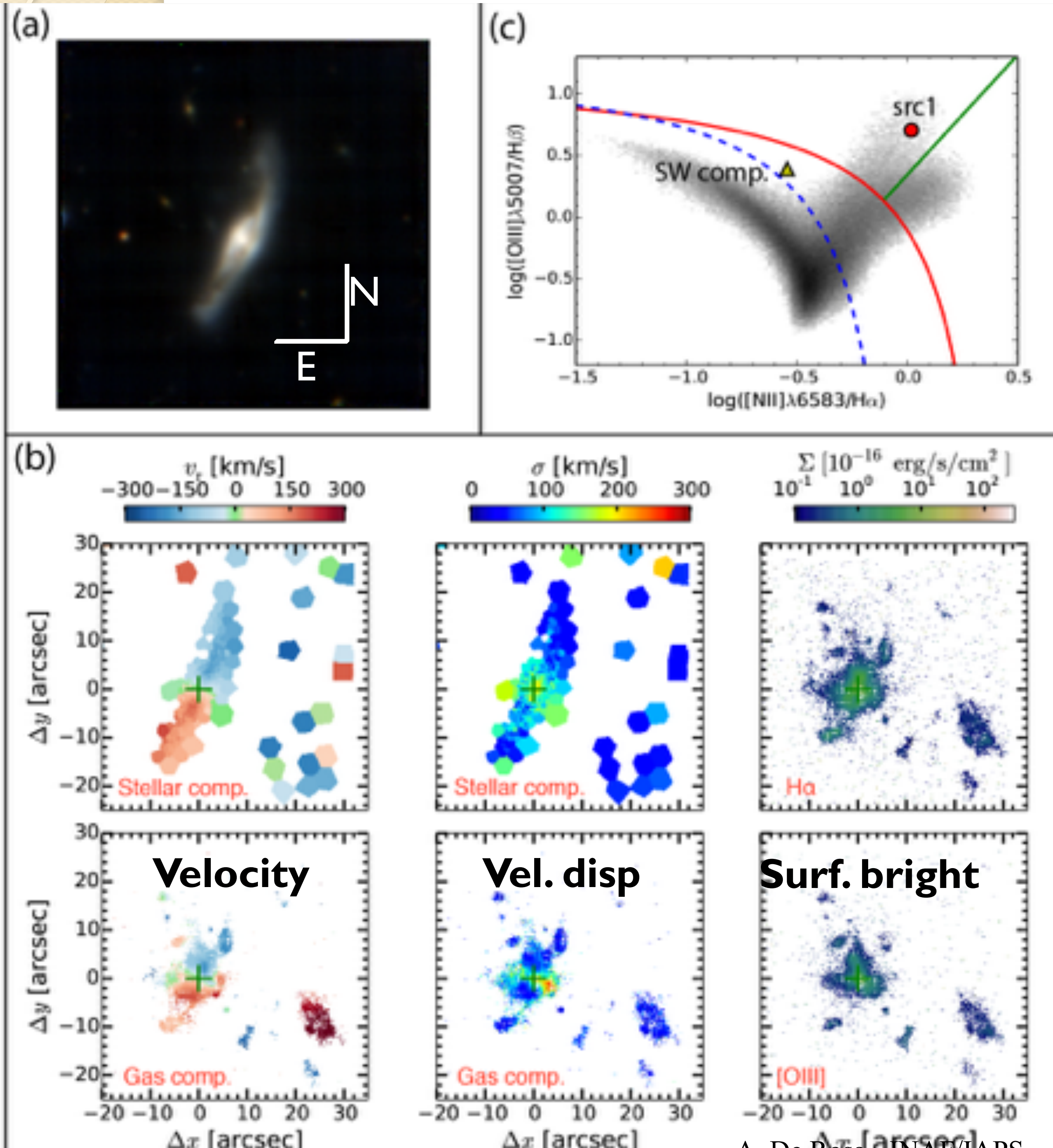
- Enhanced Star formation rate if compared to the local universe (Elbaz+11).
- high fraction of SFG (~40%) in our CG

- thermal component in the Sey2 is highly significant, 1–2% Lx in 0.5–2 keV.
- From Ranalli+03: SFR<20 Msun/yr (BUT NLR emission can contribute)

CG J0959+1259 a case study

- High Fraction of AGN/LINERs: 60% (5 over 8)
- X-ray study of 18 CG (Lx>1e40 erg/s, B mag <18) showed less than 1 AGN/group (Silverman+14)
- SFR enhanced
- Richness HI gas – tidal signature/distortion
- very low [NII]/Hα possibly due to recent interaction

All these properties allow detailed, spatially resolved mapping of the distribution and kinematics of the stellar and gaseous components



VLT MUSE PI. B. Husemann

- A strong galactic wind in the ionized gas perpendicular to the disc seen as a rise in the gas velocity dispersion.
- A prominent ionized gas region to the SW, and the lack of a counterpart in the broad-band image, possibly indicative of a gas outflow.
- BPT: AGN-dominated region and the SW component in the star-forming dominated region.

Credit B. Husemann

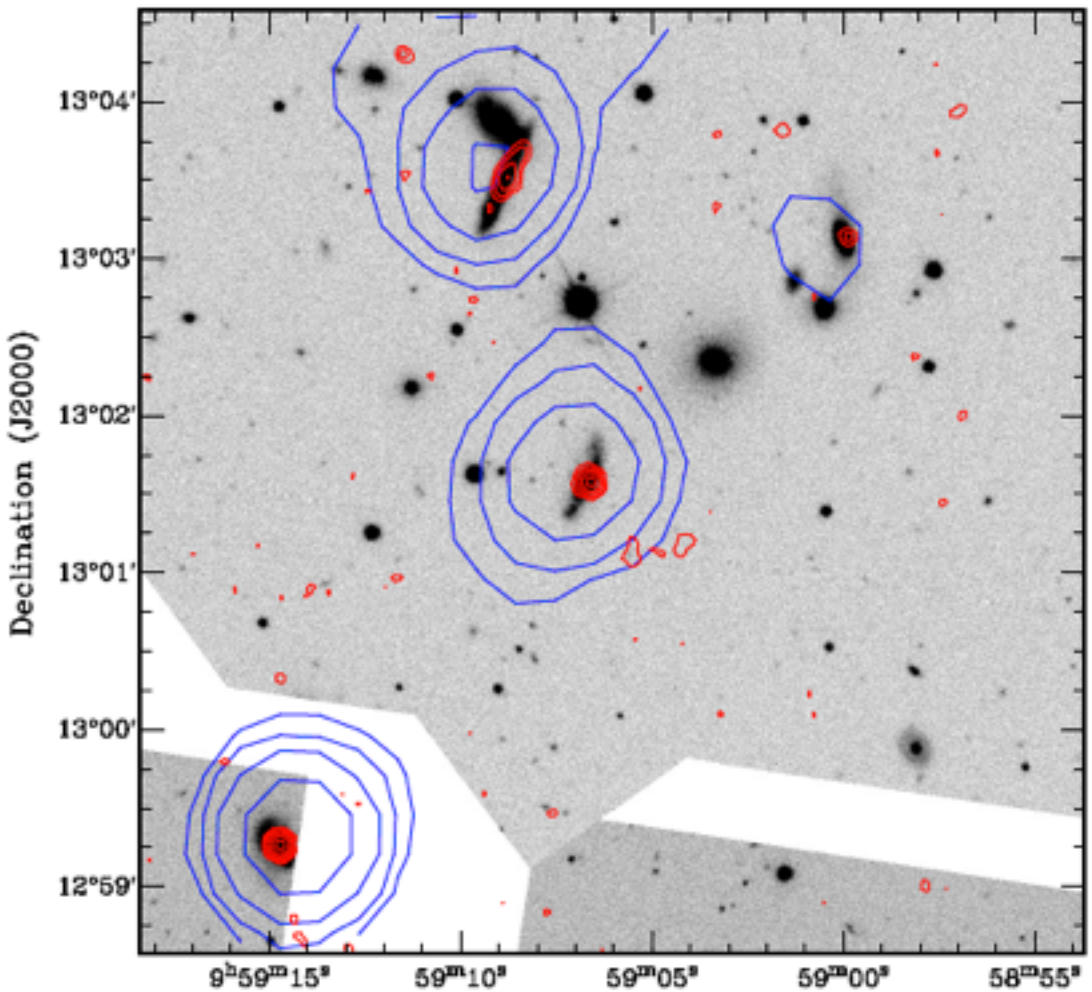
VLA - PI R. Herrero-Hellana

- The distribution and kinematics of neutral atomic gas will unveil the link among the galaxies in the group and the origin for the enhanced nuclear activity

- The HI content concentrated in group members and in the form of intragroup medium, and how this is linked to their AGN and SF

- The amounts of both neutral (VLA HI) and ionized (MUSE Ha & [O iii]) in order to understand how effective and spatially distributed is the AGN feedback within this CG

eEVN - PI. Z. Paragi



- AGN jets on 1--100 pc scales
- LLAGN in the LINERS
- LLAGN activity in some of the SF galaxies.
- impact of the jet on the kinematics
- of the ionized gas and compare the H-based star formation rates locally (jet-induced star formation) and globally

Credit Z. Paragi

MAGNA-Master Sample (MMS)

- AGN systems optically classified (Liu+11)
- Sy-Sy systems through BPT diagram
- Max proj. dist = 60 kpc (only interacting systems)

Final sample of 16 Systems

- Proj. disc ≈ 10-60 kpc and z≈0.03-0.17
- **XMM AO15 (PI De Rosa) approved the 6 systems with ang sep. >10" (~200 ks)**
- XMM Campaign just started May 5th first observation!
- Chandra proposal for the systems with ang sep. <10"
- All systems observed with VLA

In our case the MW approach is mandatory!

The scientific objective is optimized by performing short X-ray observations of small samples of systems

EWASS 2016 Special Sessions SS5

Web @ISSI
www.issibern.ch/teams/agnactivity/Home.html

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eas.unige.ch/EWASS2016/session.jsp?id=SS5

De Rosa et al. 2015, MNRAS, 453, 214

THANK YOU!