Both sides of the coin: LLAMA view of active and inactive galaxies

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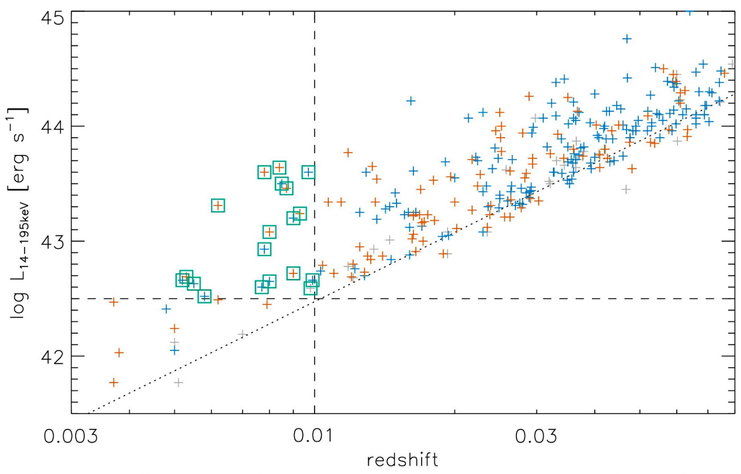
- LLAMA = Luminous Local AGN with Matched inactive Analogues.
- Inactive galaxies provide an essential context for understanding AGN, but in most cases one cannot simply compare them.
- Whether AGN are special depends on how and where one looks. Here we show that:
  - molecular gas on scales of kpc is similar in active and inactive galaxies, but there are striking differences on scales of 10-100pc.
  - a wider range of central stellar surface brightnesses is found among inactive galaxies than AGN.

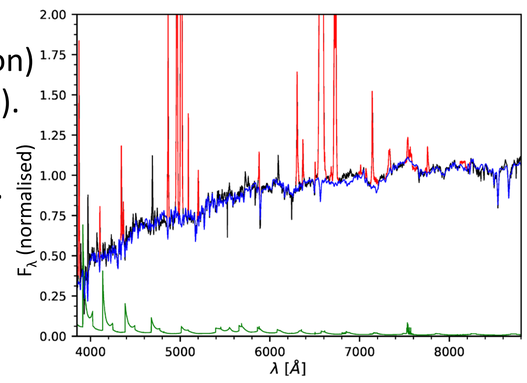
The sample



- Observe local AGN of similar luminosity to those at high redshift.
- Swift BAT, 6 years all-sky monitoring,
  14-195keV for least biased selection wrt host properties.
- Complete volume limited sample of *all* such AGN accessible to VLT:
  19 AGN + matched inactive comparison sample: LLAMA (Davies+ 15).

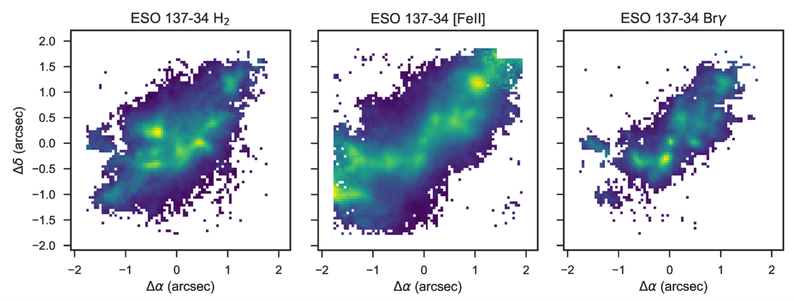
What sort of data do we have?

- XSHOOTER (spectral resolution) & SINFONI (spatial resolution).
- Also single dish CO 2-1 measurements (Rosario+ 18).
- HST imaging for V-H dust structure maps (in prep).



NGC 5728
Sy 2
$N_H > 10^{24}$ cm^{-2}

Black: data
Red: masked
Blue: fit
Green: noise

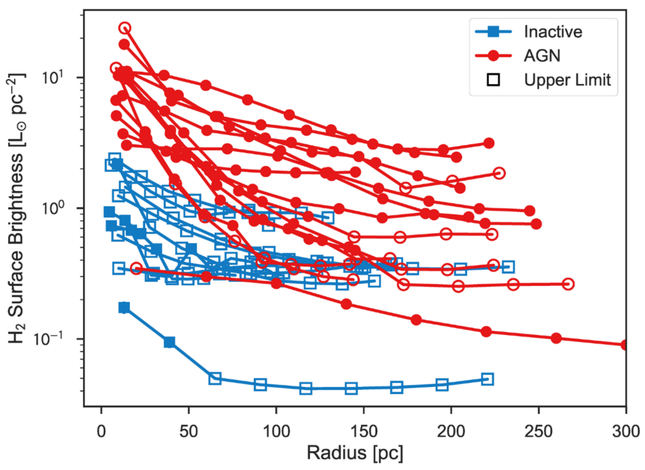


ESO 137-G034
Sy 2
$N_H > 10^{24}$ cm^{-2}

Molecular Gas

H_2 1-0S(1)

2.1 μm line for warm molecular gas at ~2000 K,
but only 10^{-5} of total molecular mass.



x10 more 1-0S(1) in AGN

- X-ray heating by AGN? Only on smaller scales.
- UV fluorescence? No OB stars.
- Shocks from inflowing gas?
- Simply more gas?

Shimizu+ in prep
(similar to Hicks+ 13)

CO (2-1)

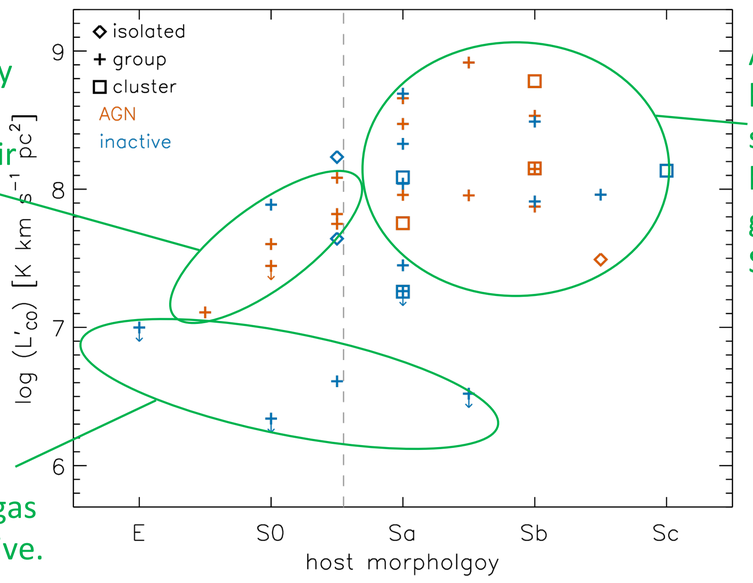
1.3 mm line for molecular gas at <100 K and densities <1000 cm^{-3}.

Hicks+ 09 & Davies+ 14 argued for 3 classes.

Similar scheme emerging from LLAMA sample.

- ***no gas*** (no inflow);
- **secular inflow** (disks, quasi steady state);
- **external accretion** (lenticulars, stochastic)

AGN in early type hosts acquire their gas from groups. External accretion.



AGN in spiral hosts have their own gas supply, and so can be isolated, or in groups or clusters. Secular inflow.

Galaxies without gas are inactive.

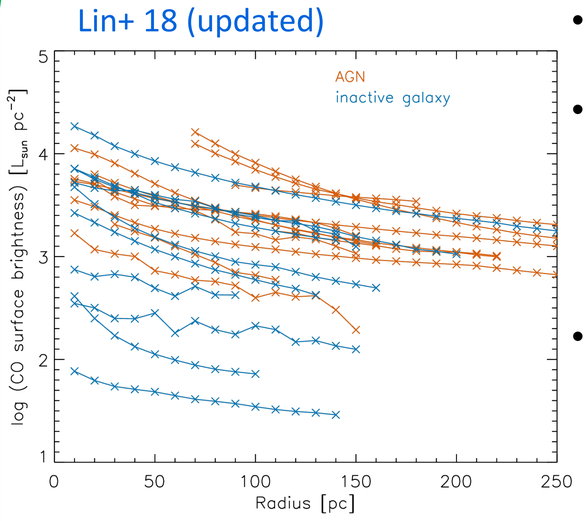
CO (2-1) from Rosario+ 18;
CO for ~200 BAT AGN will be in Shimizu+ in prep

Stellar Populations

Stellar surface brightness

Stellar CO 2-0 bandhead absorption at 2.3 μm.

Lin+ 18 (updated)



- No AGN with stellar surface brightness below 10^3 L_{sun} pc^{-2} in the central 50 pc.
- Possible link:
  - Gas inflow triggers star formation as well as AGN.
  - Without continued inflow, stellar population fades (to 1/10 over 300 Myr).
- Implies:
  - AGN associated with young stellar pops.
  - Inactive galaxies associated with both young & old populations.

Spectral synthesis

Fitting optical spectra – see Burtscher et al. (Poster 1E).

Burtscher+ in prep

- Fit stellar population library using STARLIGHT.
- Avoid degeneracies: assume Z_{sun} & bin to 4 age regimes.
  <30 Myr 30-300 Myr 0.3-3 Gyr >3 Gyr
- Compare central AGN stellar population to inactives, split into 3 groups.

- Old stars dominate in all cases, as expected for a (pseudo-)bulge; differences between active & inactive galaxies are more subtle.
- Stellar population in central ~200 pc of AGN is most similar to star forming inactive galaxies.
- AGN are associated with star formation in the last ~30 Myr (more recent than 300 Myr timescale for fading of stellar populations in low surface brightness inactive galaxies).