Are QSOs really quenching star formation in massive galaxies?

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Why do we care about AGN hosts?

- clear galaxy bimodality
- build up of red galaxies

rapid quenching of star formation in the blue cloud

Caused by AGN feedback at high accretion rates?

1. AGN winds/outflows
2. AGN heating
3. other mechanisms?

This mechanism is not understood at all!
BH-host galaxy co-evolution

- Link between SF and AGN accretion at high luminosity
  ➔ What about AGN-induced negative feedback?

- The relation breaks down at low AGN accretion
  ➔ AGN accretion is a stochastic process (Hickox+14)

Cold gas reservoir is necessary but not sufficient
## Methods to estimate the SFR

<table>
<thead>
<tr>
<th><strong>FIR luminosity</strong></th>
<th><strong>Ha line luminosity</strong></th>
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# Methods to estimate the SFR

## FIR luminosity
- Reprocessed dust emission
- Obscured star formation
- AGN-SF composite SED fitting
  - probes SF on \(~100\)Myr scales
  - only observable from space
  - low spatial resolution
  - *Herschel* is dead...

- FIR overestimates SFR in post-starburst hosts (*Hayward+14*)

## Hα line luminosity
- HII regions around OB stars
- observable from ground
- good spatial resolution
- probes SF on \(<5\)Myr scale
- issue of dust obscuration
- difficult to separate ENLR/HII
- strong contamination by AGN

- Ground-based IFU observation can trace Hα very accurately
QSO-host deblending with IFUs

QDeblend$^{3D}$

Current IFU Data Cube:
HE1228_orange.rscube.fits

1. Select Spatial Regions
- Regular Masks
- Custom Masks
- QSO Box size
- Host Box width
- Show Mask

2. Select Spectral Regions
- 2 Broad + 2 Cont
- 1 Broad
- 2 Broad
- 1 Cont
- 2 Cont
- Interpolate Continuum
- Show Regions

3. Method Control
- Correction Mode:
  - Manual Factor
  - Edit Host Model
  - Iterations
- Region use:
  - mean
  - Radius

Mouse Mode:
- View
- Zoom
- Select
- display both

Max: 975e00
Min: -4.145e-04

http://sourceforge.net/projects/qdeblend/

Husemann+13, Husemann+14

Most Massive Galaxies and their Precursors, Sydney, 12 Feb 2015
18 “luminous” QSOs (0.04<z<0.2)
UBVRIJHK photometry (Jahnke+04)

**Optical VLT-VIMOS IFU data**

- **HE 1239–2426 (z=0.082)**
  - [OIII] image
  - Hα image

- **HE 1405–1545 (z=0.196)**
  - [OIII] image
  - Hα image

**BPT diagram**

- Husemann+14

**Broad band**

Most Massive Galaxies and their Precursors, Sydney, 12 Feb 2015
Enhanced, normal or suppressed star formation in QSO hosts?

Most of our QSO host galaxies are on the MS

Most Massive Galaxies and their Precursors, Sydney, 12 Feb 2015
Combing optical IFU and sub-mm data

IRAM 30m CO(1-0)

VLT-VIMOS IFU data

HE 1239–2426 (z=0.0821)

HE 1405–1545 (z=0.1939)

Most Massive Galaxies and their Precursors, Sydney, 12 Feb 2015
The conditions for star formation in luminous QSO host galaxies

QSO hosts show quite normal gas fractions and depletion times

Most Massive Galaxies and their Precursors, Sydney, 12 Feb 2015
Clues on the AGN-host galaxy co-evolution

Assumptions:
- \( n=4 \), \( r_e = 4 \text{kpc} \)
- AGN fuel < 100pc
- \( t_{AGN} = 10^7 \text{yr} \)
- \( \epsilon = 0.1 \)

Assumptions:
- \( n=1 \), \( r_e = 4 \text{kpc} \)
- AGN fuel < 100pc
- \( t_{AGN} = 10^7 \text{yr} \)
- \( \epsilon = 0.1 \)
Clues on the AGN-host galaxy co-evolution

We want a **multi-wavelength spatially-resolved** dataset for a **large sample** of **luminous AGN** host galaxies

Assumptions:
- \( n=4 \), \( r_e = 4 \text{kpc} \)
- AGN fuel < 100pc
- \( t_{\text{AGN}} = 10^7 \text{yr} \)
- \( \epsilon = 0.1 \)
The Close AGN Reference Survey (CARS)

A snapshot survey of 40 local AGN (0.01<z<0.06) with

All targets have been observed in CO(1-0) with IRAM 30m
→ Aim for ALMA, AO+NIR of core, VLA maps, SOFIA (FIR)

Most Massive Galaxies and their Precursors, Sydney, 12 Feb 2015
Conclusions

- The Hα line can be reliably used to estimate the current SFR in luminous QSOs using IFU techniques.

- Early-type QSO hosts display rather high SFR and are mainly located on the MS of star formation.

- Gas fractions and depletion time scales consistent with the inactive galaxy population (→ no feedback!?).

- Link between AGN accretion rate and total gas mass → caused by gas density distribution on host scales?

Thanks! Watch out for CARS.