

Optical and CO observations of type 2 quasars at intermediate redshift

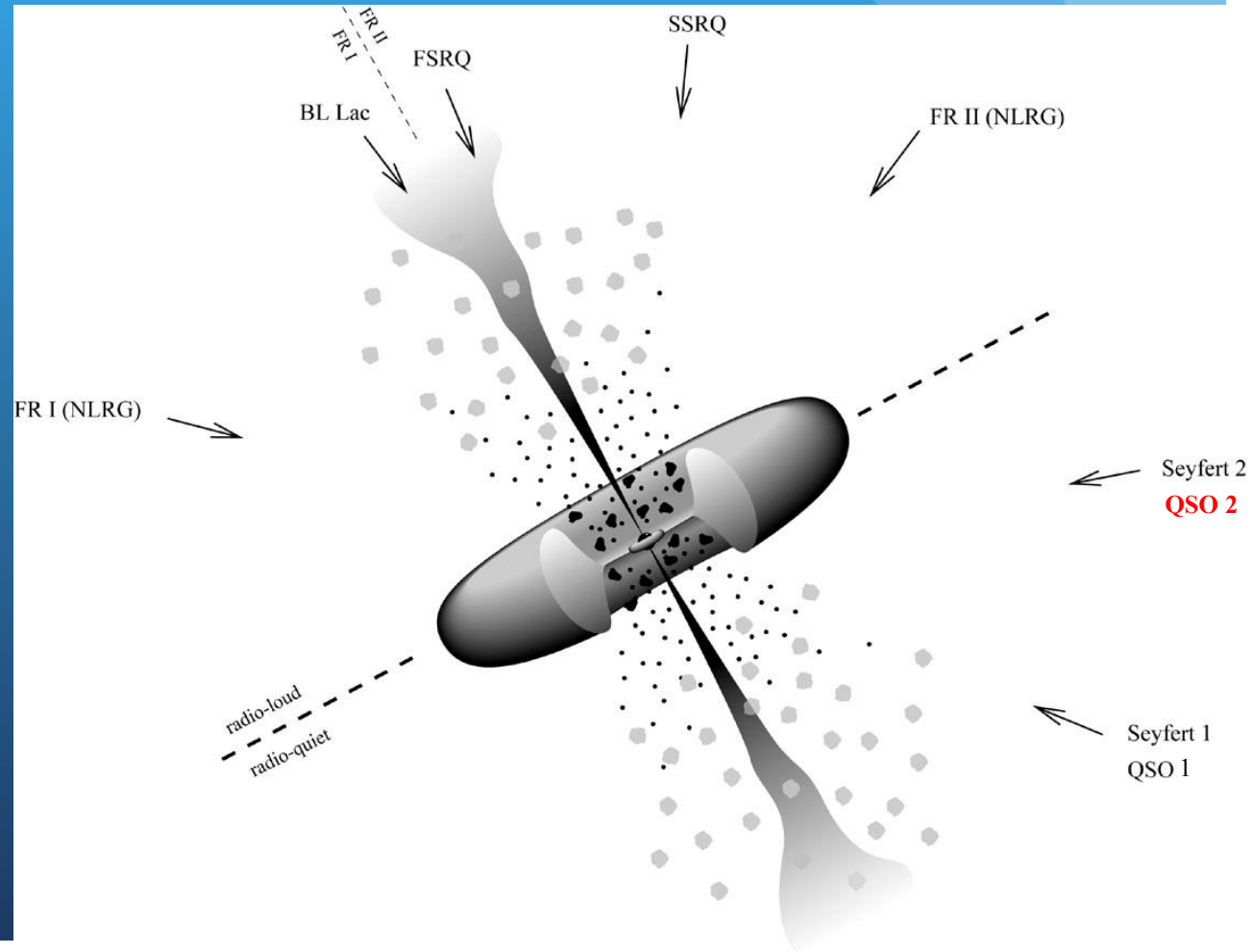
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The Collaboration

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- Luis Colina & Santiago Arribas (CAB, INTA/CSIC)
- Santiago García Burillo (OAN)

Type 2 quasars (radio quiet)

- Eluded for decades
- Selection from SDSS
 - $z=0.3-0.83$
 - $S/N > 7.5$ in 7th br. pixel
 - narrow permitted lines (2000 km/s)
 - high ionization lines (ratios)
 - $[OIII]/H\beta$, $[NII]/H\alpha$
 - ~300 now known (Zakamska et al. 2003)



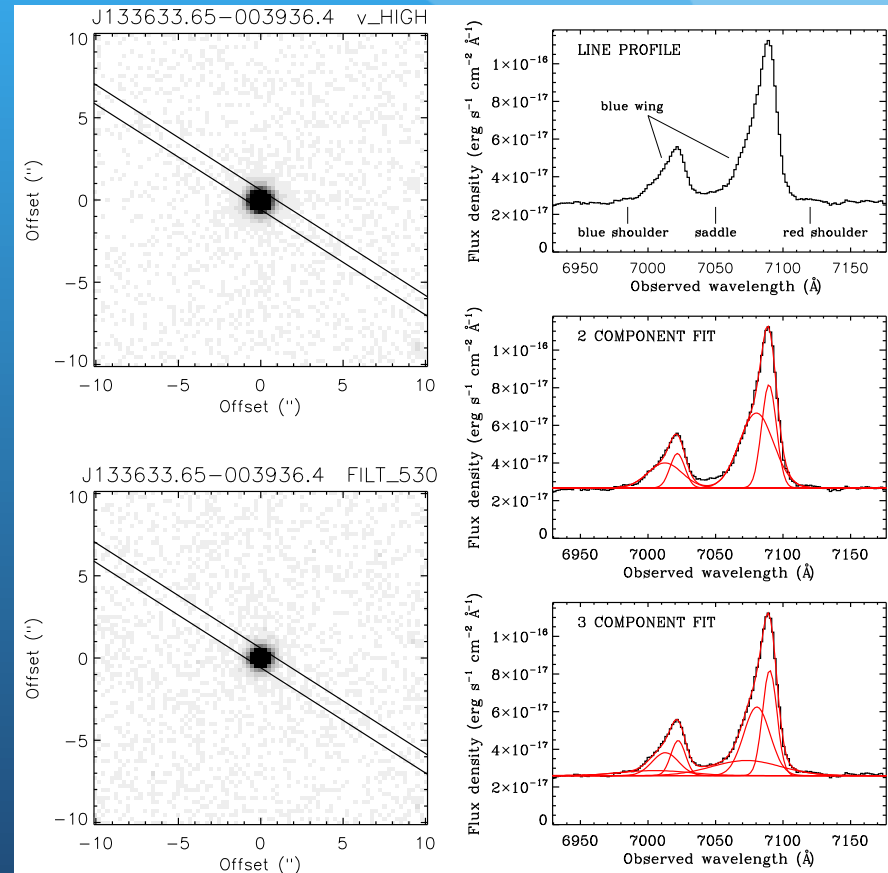
The usefulness of type 2 quasars

- Strengths
 - Obscuration of the active nucleus
 - More common than type 2 radio-loud quasars (radio galaxies)
 - Lack of radio jets simplifies interpretations
- Open questions we are particularly interested in
 - quasar induced outflows
 - what triggers the nuclear activity
 - the existence and origins of extended emission line regions

Optical imaging and spectroscopy: a work in progress

[OIII] 4959,5007

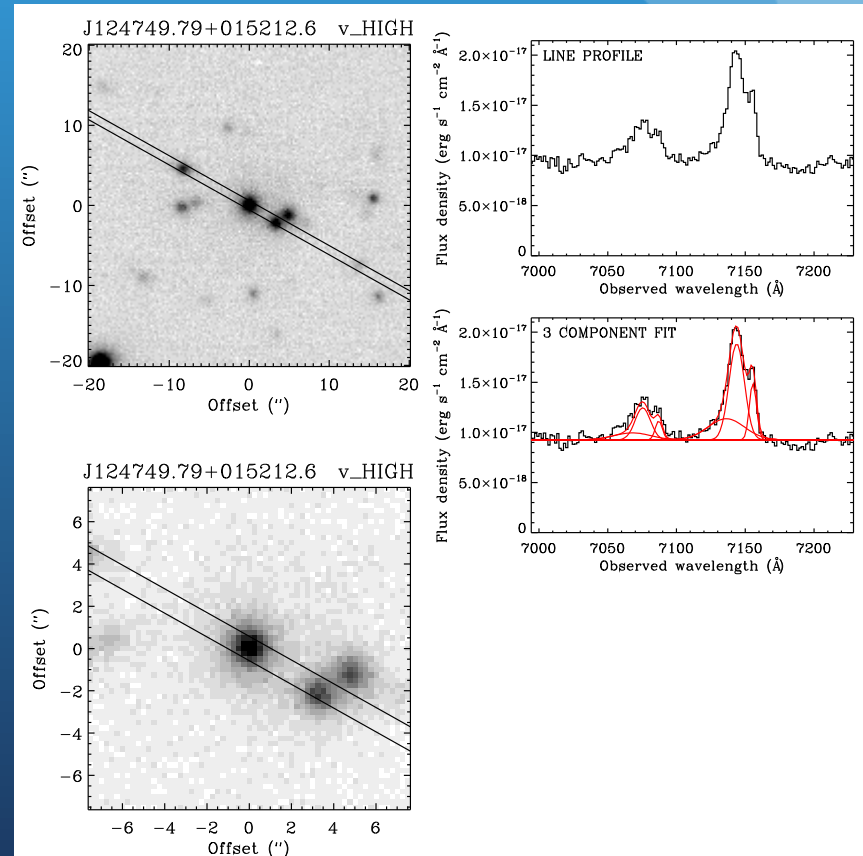
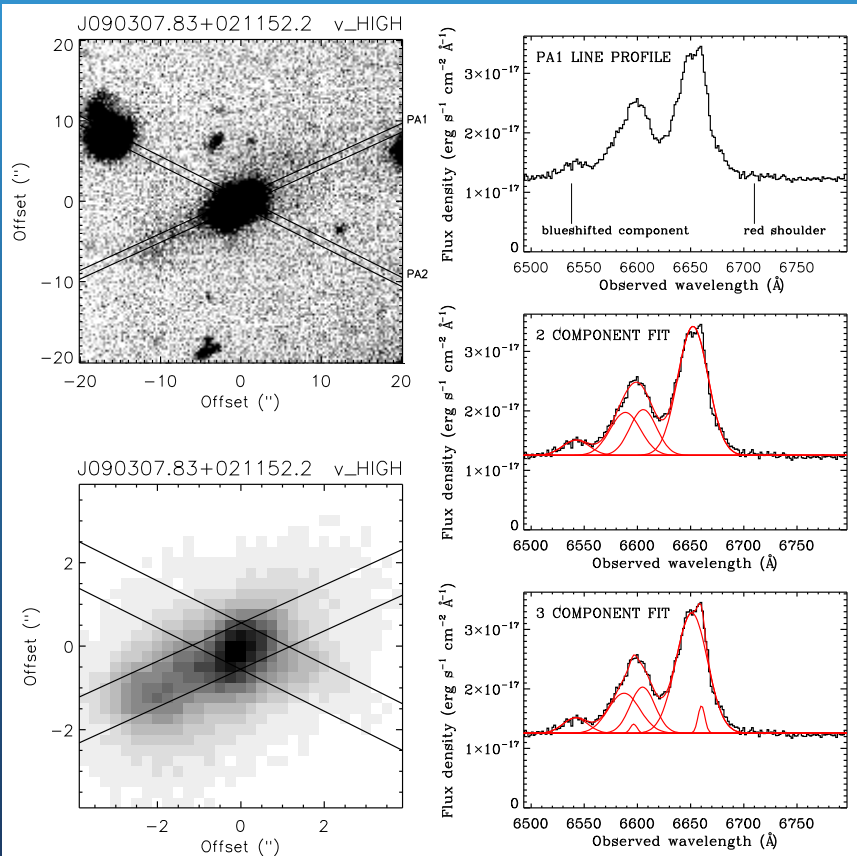
- VLT FORS2 BB and NB/IB images and long-slit spectra
 - 9 radio quiet type 2 quasars at $z=0.3-0.6$
 - selected for their asymmetrical [OIII] 5007 velocity profiles
 - usually enhanced blue wing
- Aim to investigate ionized outflows and AGN triggering
- Preliminary results...



Correlations between morphology and [OIII] kinematics?

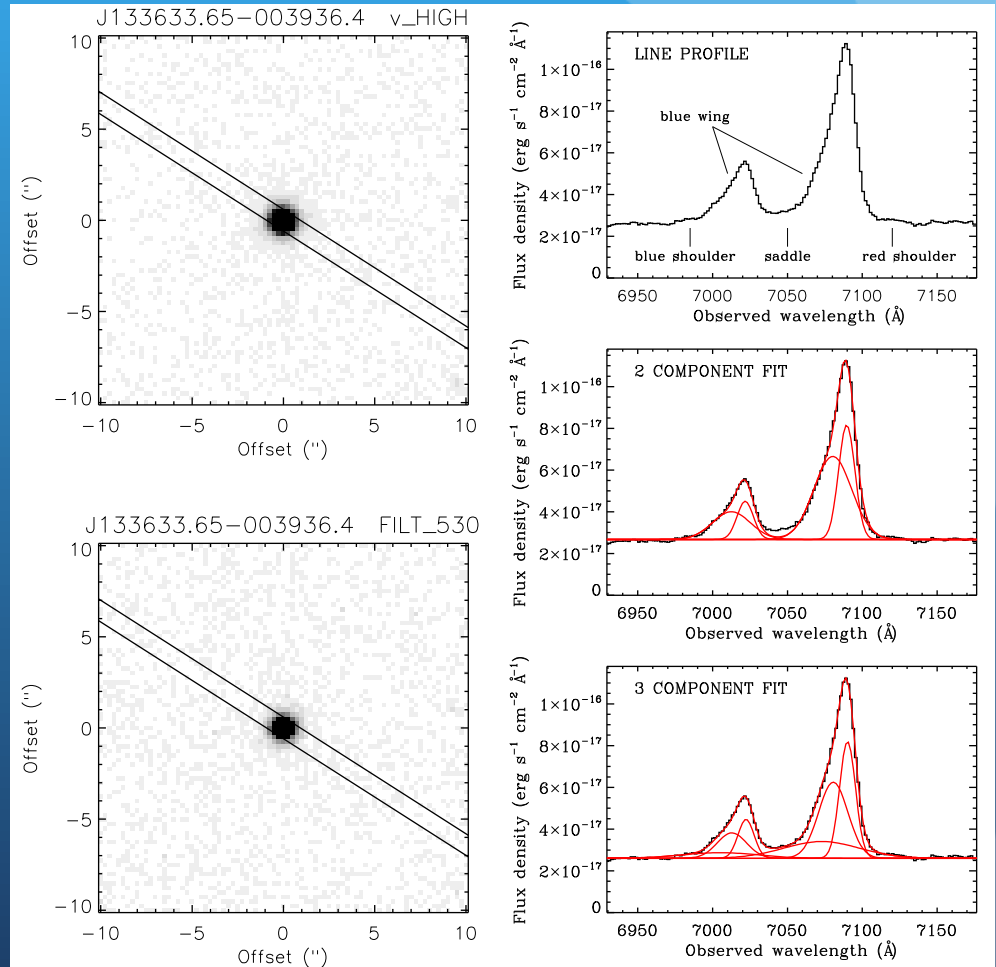
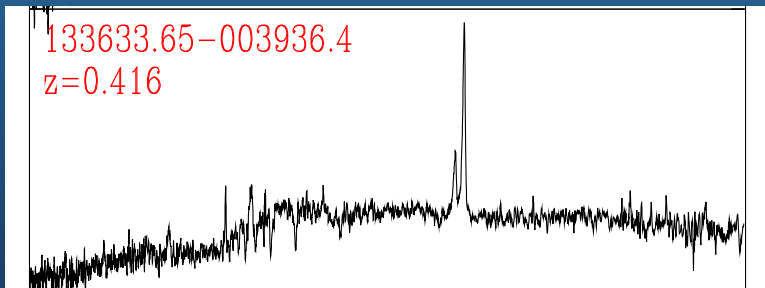
Cometary, multi-knot (3)
Highly blueshifted component.
Outflows or double nuclei?

Merging, less disturbed, faint tail (4)
Redshifted component (3/4)
Inflow of gas (and outflows)?



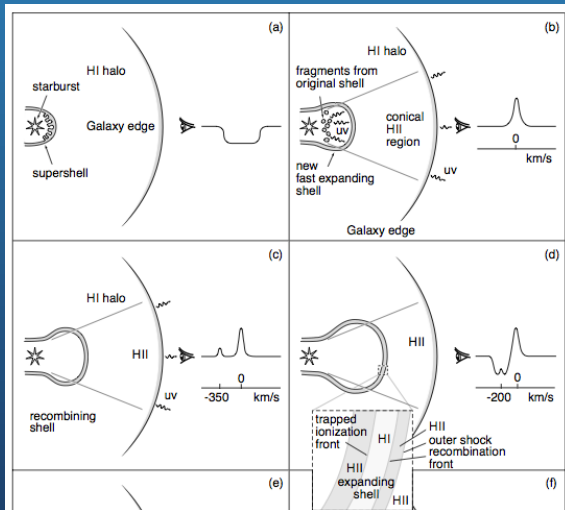
Not all show evidence for mergers

- Unremarkable elliptical morphology
 - isolated
 - no tails / knots
- strong excess in blue wing \rightarrow outflow
- post-starburst optical spectrum? (starlight)

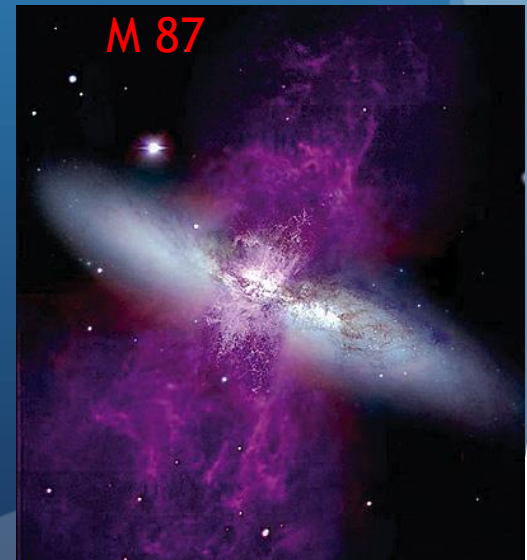


No blueshifted absorption lines

- Low covering factor? (<0.1)
 - small area or porous?
- Matter bounded (high-ionization) clouds?
 - Extreme [OIII] / $H\beta$ ratios in blue wings of some targets

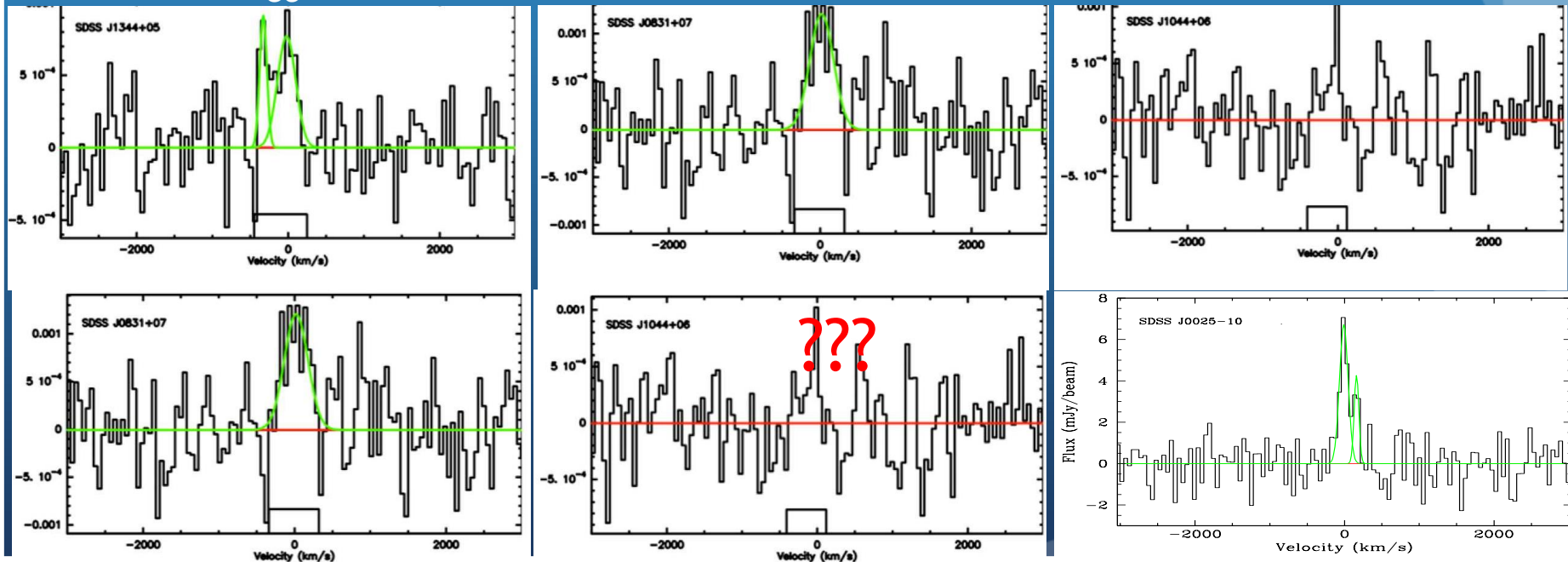


From Tenorio-Tagle et al. (1999)



CO Observations of type 2 quasars

- CO (1-0) spectroscopy of 10 type 2 quasars at $z=0.2-0.3$
 - IRAM 30 m (8) and ATCA (2)
- 5 detections (+1 tentative detection) gives 50% det. rate
 - $L'_{\text{CO}} \sim \text{several } 10^9 \text{ K km s}^{-1} \text{ pc}^2$



CO Observations of type 2 quasars

- Adopting conversion $a=0.8 M_{\text{sol}} (\text{K km s}^{-1} \text{pc}^2)^{-1}$
 - Molecular gas mass ranges from $< 4 \times 10^8$ to $5 \times 10^9 M_{\text{sun}}$
- No significant difference to type 1 quasars at the same L_{IR}
- CO is usually narrower than [OIII] 5007 (up to factor of 2)
 - different spatial locations of molecular and ionized gas
 - gravitational motion (CO) vs. outflows ([OIII])

