A Near-Infrared Spectroscopic Analysis of Galactic Mergers: Revealing Obscured Accretion

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Motivations

- Galaxy interactions are vital and ubiquitous
  - Gas inflows trigger accretion

- Constrain true frequency of dual AGNs

- Dual AGNs as precursors to SMBH mergers
  - Source of intense gravitational waves

Problems

- Strong theoretical evidence for dual AGN
  - Despite decades of searching only a few have been found

- Traditional surveys have used optical wavelengths
  - Ambiguous
  - Easily attenuated by dust
    - Heavily obscured galaxies show higher fraction of merger signatures than less obscured galaxies

Sample Selection

WISE Color-Color Diagram
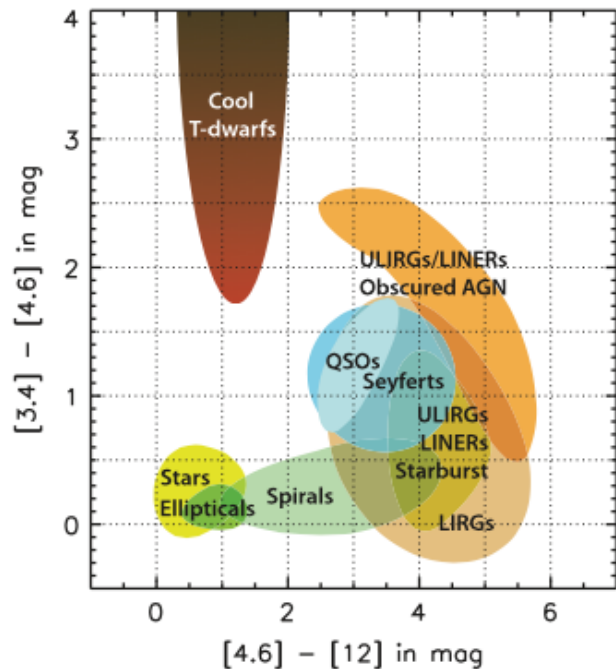
(Wright et al. 2010)

- Both galaxies exhibit red mid-IR colors
  - Indicative of obscured accretion

- Optically quiescent

- Less than 10 kpc separation
  - Very few dual AGNs found at this distance

- X-ray data available
  - Multi-wavelength analyses are crucial

Hidden Clues in Near-IR

- Near-IR is less affected by dust extinction than optical wavelengths

- Broadened Paschen alpha emission line

- Coronal Lines
  - Large ionization energies

- Emission line ratios
  - Constrain dominant excitation mechanism

- Age dependent features
  - Constrain age of underlying stellar population

Observations

Large Binocular Telescope (LBT)

http://www.nasa.gov/topics/universe/features/
lbti20101206-i.html#.VvWOp2MbCjg

- LUCI – LBT Near Infrared Spectroscopic Utility with Camera Instruments.

- The total integration time for each object was ~20 minutes.

- Ten observations fully reduced and analyzed.
  - Two coalesced objects and four galaxy pairs.

- Six more galaxy centers currently being reduced.

- Exposure times range between 10 and 30 minutes.

SDSSJ1036+0221

- Plethora of high S/N emission and absorption features
  - Coronal Lines
  - CO bandhead

- No broadened Paschen alpha emission found
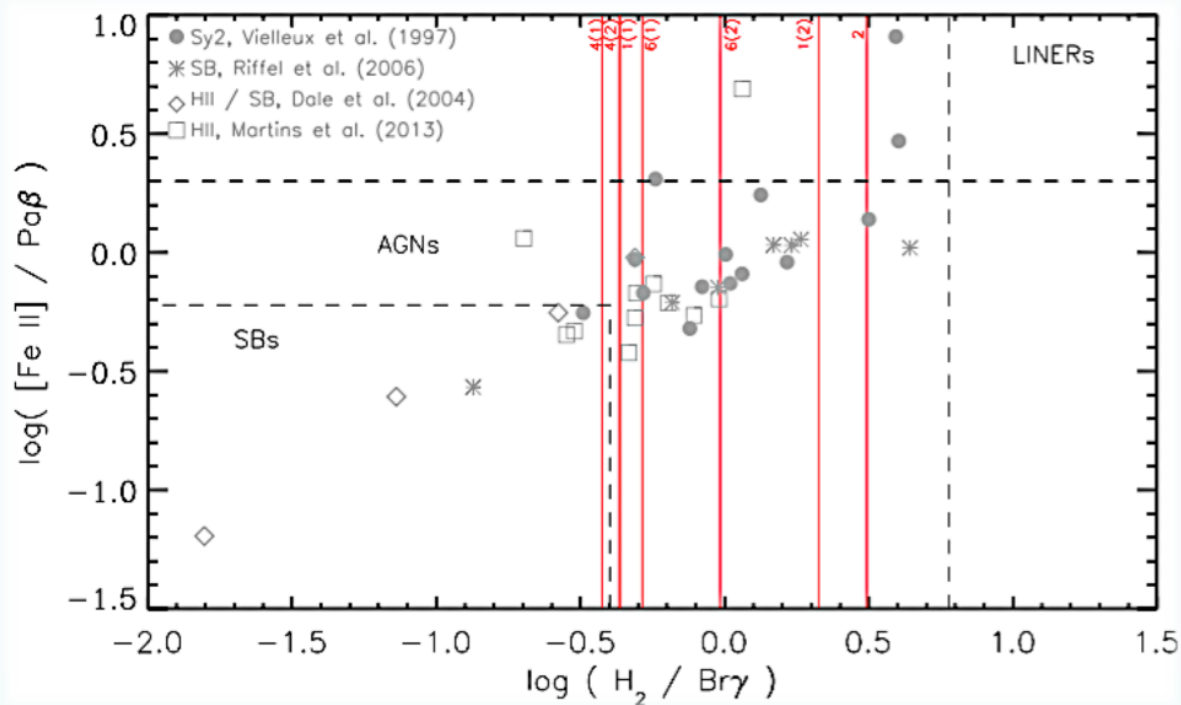 - Orientation
  - Wings

SDSS image for SDSSJ1036+0221.
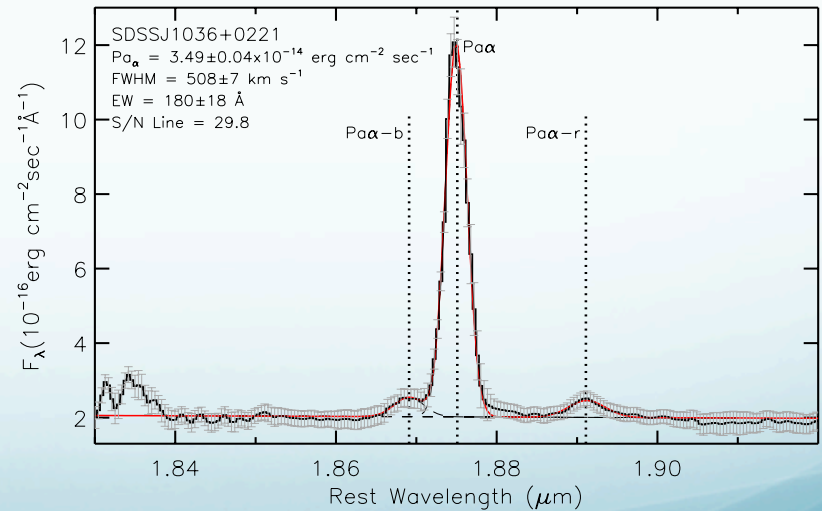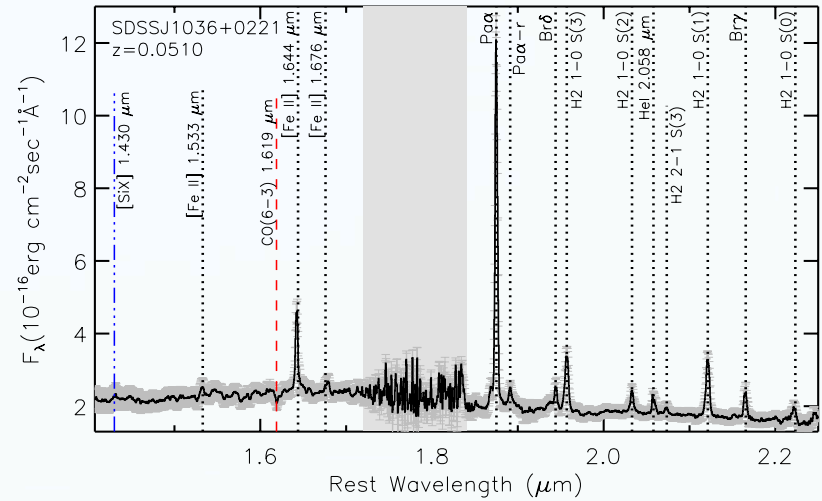
Above: Full near-IR spectrum for SDSSJ1036+0221.
Below: Close up of Paschen Alpha emission line.

Line-Ratio Diagnostics
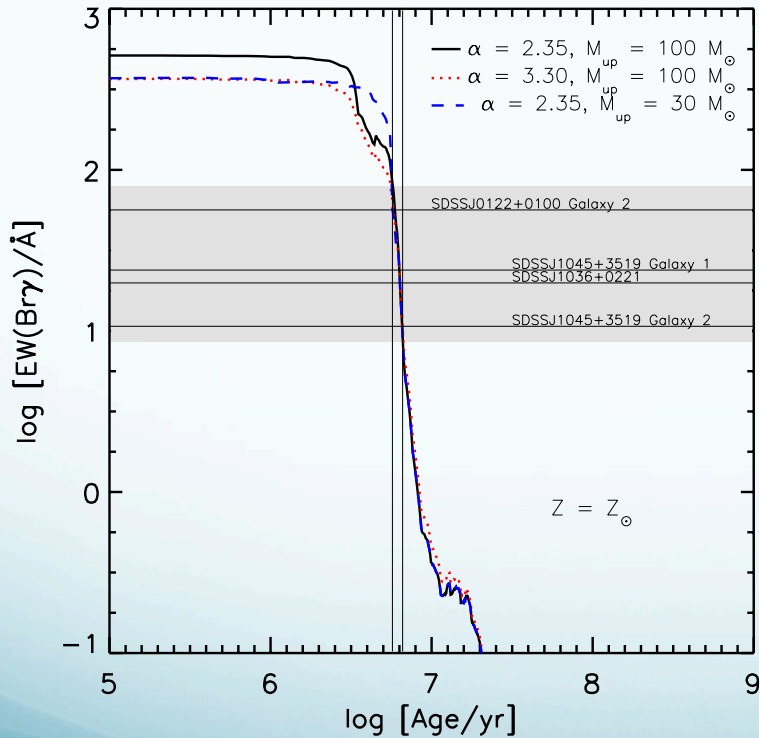

- The $H_2/Br\gamma$ line flux ratio can help distinguish between Starburst galaxies (SBs), AGNs, and Low Ionization Nuclear Emission Regions (LINERs) (Larkin et al 1998).

- Our data do not cover the $Pa\beta$ emission, however the $H_2/Br\gamma$ line flux ratio is measured in seven individual galaxies (red lines).
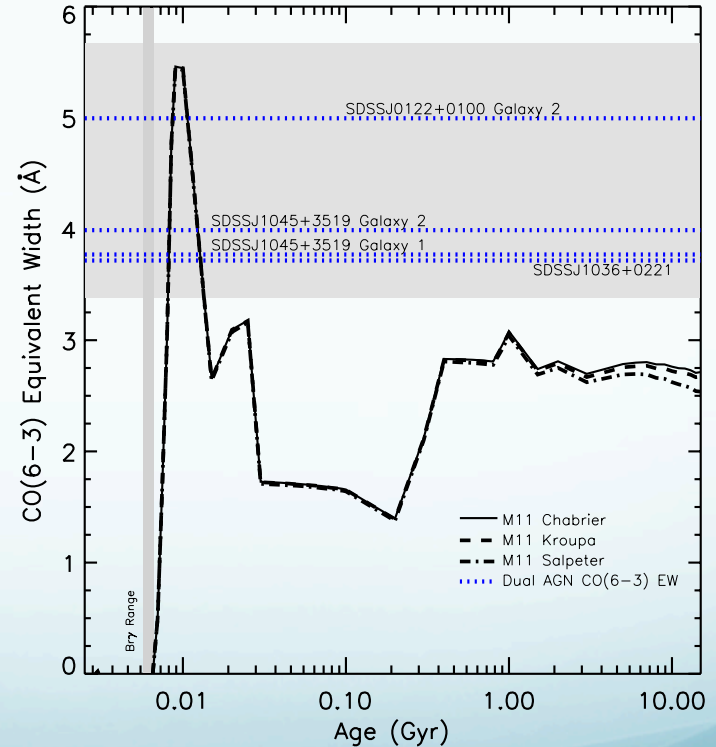
Age of Stellar Population

Compare simulated stellar spectra to observed spectra

~ 8 Myr

< 20 Myr

Conclusions

- Four out of six galaxies have evidence supporting the galaxy pair hosts dual AGNS
  - Remaining two galaxies are single coalesced AGNs

- WISE pre-selection technique is promising
  - Need more observations for real statistics

Future work

- Finish reducing / analyzing newest observations

- Simulate spectral energy distribution created by stellar populations 10-20 Myr old
  - Subtract from observed spectrum

- FWHM vs. IP

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