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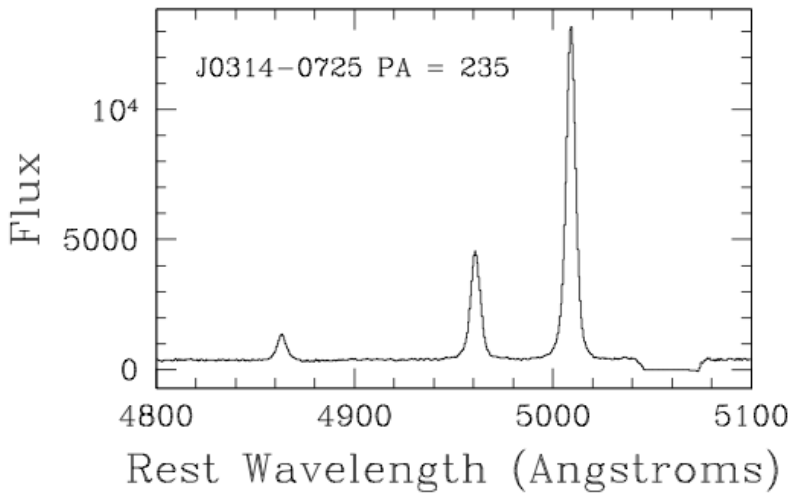
SALT Spectroscopy of Obscured Quasars

Kevin Hainline & Ryan Hickox

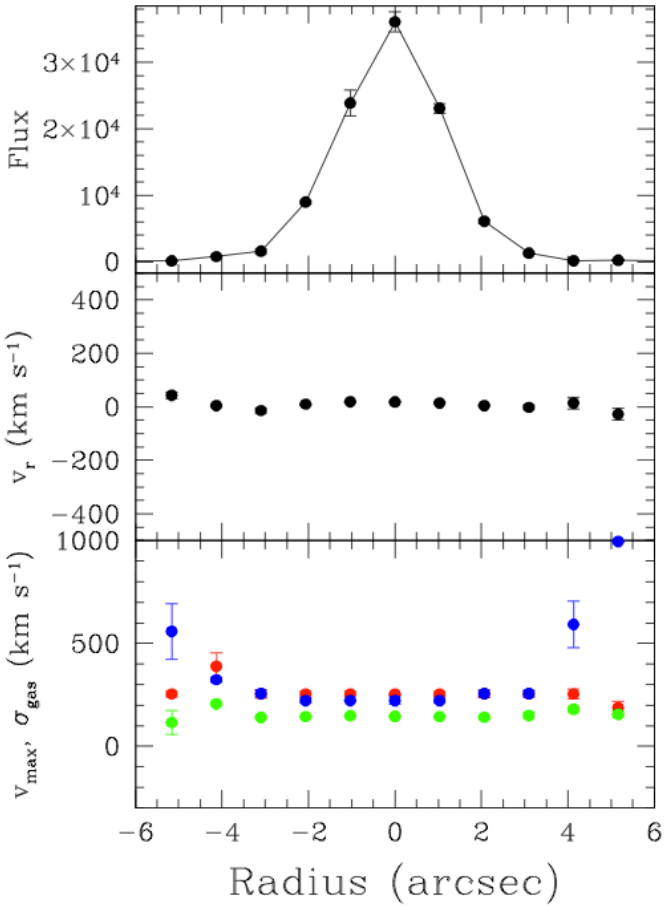
- Observed a sample of 8 Type II radio quiet quasars with RSS to study the extent of their narrow line region
- In a Type II quasar, an obscuring medium is thought to block the UV/optical emission near the black hole, making them ideal targets for studying the extent and kinematics of the narrow line region
- Observations obtained from November 2011 to April 2012 using the PG1300 grating and a 1’’.25 slit for a spectral resolution of 3.2 Å
- Typical seeing was 2’’, and exposure times ranged from 20 to 50 minutes each

Sample Spectra



Central 1'' spectrum, arbitrarily normalized
(2566 second exposure on this g=18.8 quasar)

Spatially Resolved [OIII]λ5007 line



Top: total flux as a function of radius
Middle: Radial velocity curve
Bottom: Velocity dispersion (green); max. velocity on red and blue side of line center

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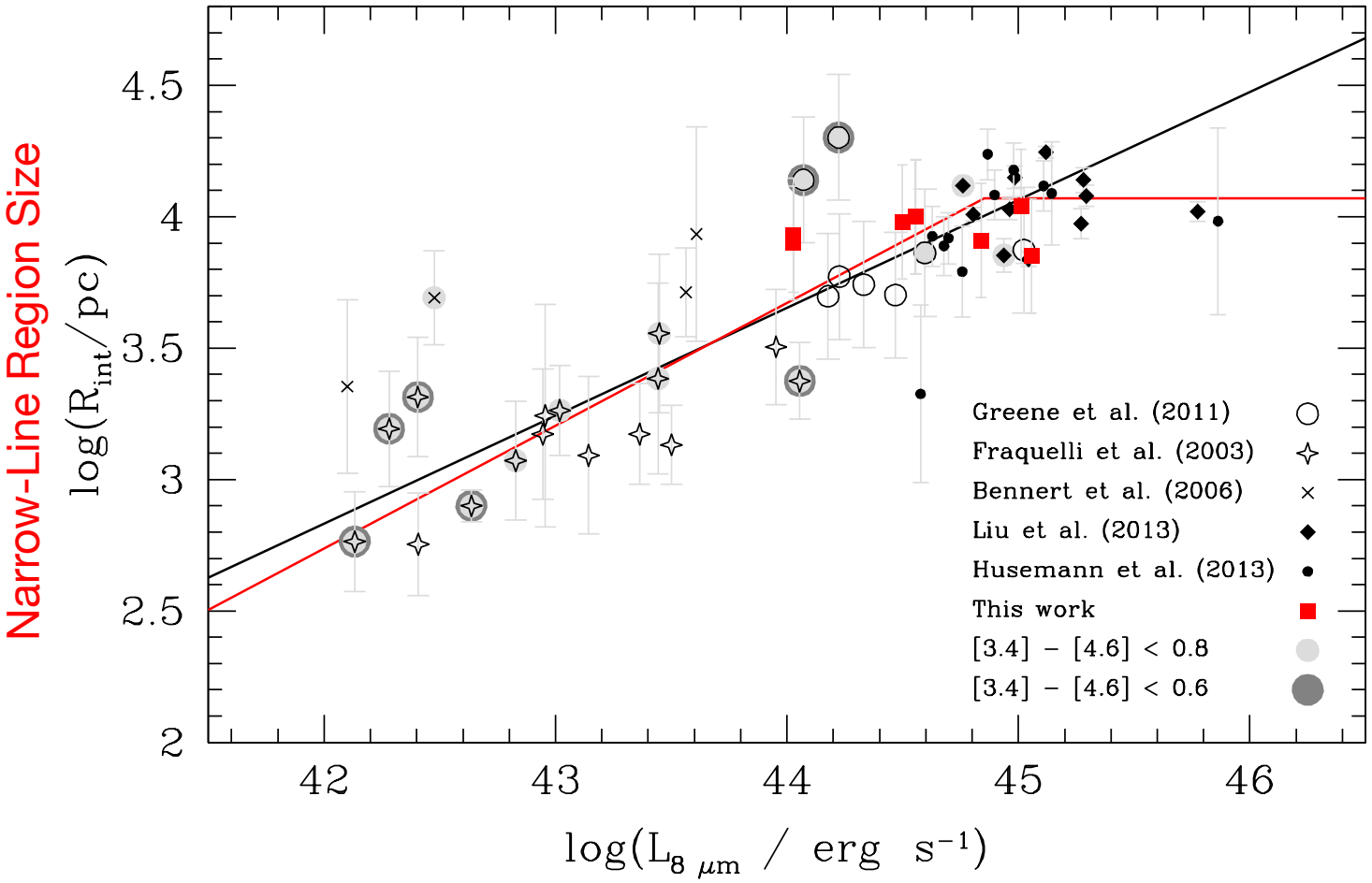

Size of NLR is related to nuclear luminosity: $R_{NLR} \propto L^{1/2}$ (predicted by theory)
Results point to a turnover in this relationship such that the size of powerful AGNs is limited by the availability of gas in the galaxy, rather than AGN strength (Hainline et al. ApJ submitted

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SALT LONG-SLIT SPECTROSCOPY OF LUMINOUS OBSCURED QUASARS: AN UPPER LIMIT ON THE SIZE OF THE NARROW-LINE REGION?

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ABSTRACT

We present spatially resolved long-slit spectroscopy from the Southern African Large Telescope (SALT) to examine the spatial extent and kinematics of the narrow-line regions (NLRs) of a sample of 8 luminous obscured quasars at $0.10 < z < 0.43$. Our results confirm the shallow slope in the relationship between NLR size and [OIII] luminosity, which has been interpreted to indicate that NLR size is limited by the density and ionization state of the NLR gas rather than the availability of ionizing photons. We also explore how the NLR size scales with a more direct measure of instantaneous AGN power using mid-IR photometry from WISE, which probes warm to hot dust near the central black hole and so, unlike [OIII], does not depend on the properties of the NLR. Using our results as well as samples from the literature, we obtain a power-law relationship between NLR size and 8 micron luminosity that is significantly steeper than that observed for NLR size and $L_{[\mathrm{OIII}]}$. We find that the size of the NLR goes approximately as $L_{8\mu\mathrm{m}}^{1/2}$, as expected from the simple scenario of constant-density clouds illuminated by a central ionizing source. We further see tentative evidence for a turnover at the high luminosity end of the relationship between NLR size and $L_{8\mu\mathrm{m}}$, and propose that we are seeing a limiting NLR size of $10-20$ kpc, beyond which the availability of gas to ionize becomes too low. We find that $L_{[\mathrm{OIII}]} \sim L_{8\mu\mathrm{m}}^{1.4}$, consistent with a picture in which the [OIII] luminosity is dependent on the volume of the NLR. We also examine the kinematics of the NLR gas as a function of spatial position of the galaxy. Similar to other studies, we find no evidence for large line-of-sight velocity offsets, but we do observe broad [OIII] linewidths ($\sim 500-1000$ km s^{-1}) across the host galaxy, indicating that the central quasar is disturbing gas out to large distances. Together, these results indicate that high-luminosity quasars have a strong effect both in ionizing and creating turbulence throughout the available gas in a galaxy.

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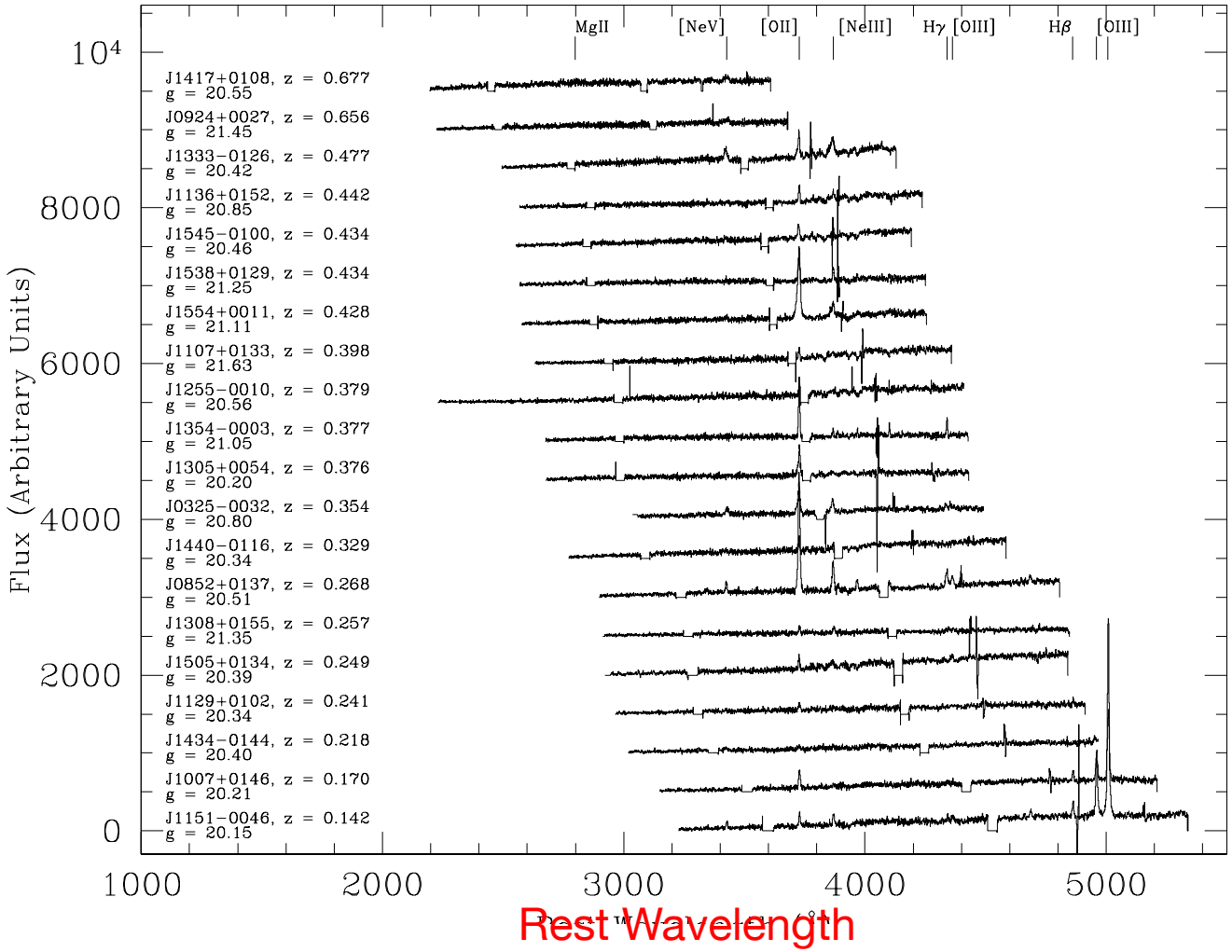

Hainline & Hickox have also been using SALT RSS spectroscopy to explore the redshift distribution for a sample of luminous obscured quasars with red mid-IR colors selected using WISE photometry. Using strong emission lines, we calculate these objects to have an average redshift of $z = 0.365$.

SA's have been very helpful (Encarni in particular) in setting up this program.

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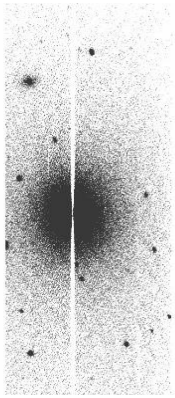
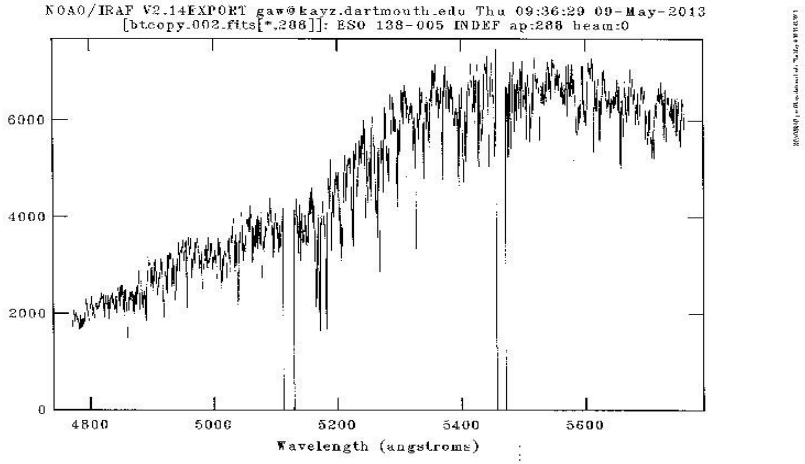
LONG SLIT SPECTRA OF EARLY-TYPE GALAXIES

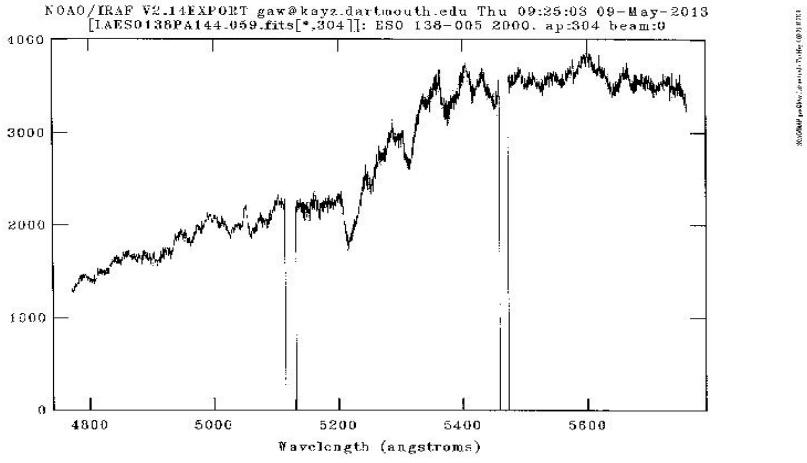
G. A. Wegner

Long slit spectra are made with the SALT by placing the slit through the centres of the galaxies using different position angles to map the velocities and velocity dispersions on the projection of the galaxy. Combined with imaging of the galaxy, this map can be used to determine the galaxy's dynamics and to determine the distributions of the luminous and dark matter in the galaxy as well as stellar ages and metal abundances.





SALT spectrum of a star of spectral type similar to That of the galaxies, showing the same unbroadened Spectral lines, notably Mgb near λ5170.



SALT spectrum of a galaxy at the same wavelength as the star spectrum showing the broadening of the lines from the motions of the stars in the galaxy.