USING NARROW EMISSION LINES TO TEST PHYSICAL MODELS UNIFYING AGNs

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We contend that *quantitative* measurements of nuclear narrow emission line strength can strongly constrain models that unify AGNs. The reasons for the importance of narrow-line luminosity L_{NLR} are:

a) The lines normally arise via photoionisation by the integrated UV/soft X-ray luminosity L_{PHOT} of the central source. Thus L_{NLR} is directly linked to a physical quantity intimately connected with the central engine but not observable from the ground. For constant covering factor we expect an approximate proportionality between L_{NLR} and L_{PHOT}; this has been confirmed observationally for AGNs by estimating L_{PHOT} from either optical non-stellar luminosity[1] or effective ionisation parameter[2,3].
b) NLRs are far enough from the photoionising source to avoid the excessive obscuration that appears able to attenuate broad-line and continuum emission [4]. Narrow-lines are radiated isotropically unlike, eg, the radio core which may be Doppler boosted. Their variability timescale of 10^{3-4} years is intermediate between those of L_{PHOT} and any large-scale radio emission.

We now illustrate our contention with three examples. Note that all the results are based on complete, flux-limited samples of objects; in the Figures *all* the sample objects are plotted.

1. <u>The fuelling of classical double radiosources</u>. By analysis of spectrophotometric, radio and environmental data for a 3CR-based sample of classical doubles with $z<0.5$ we have discovered an approximate proportionality (see Fig. 1) between L_{NLR} (accretion rate?) and the invisible bulk kinetic power Q piped along the jets to make the lobes[5]. Prima facie, this link - together with the observation that the nuclear radiation seems to peak in the UV - supports a "simple" accretion-driven jet model with jet power proportional to current accretion rate. But the attractive features (high efficiency and funnel formation) of the ion torus model[6] may be salvageable if, eg, sub-Eddington accretion is itself driven by extraction of black hole rotational energy. However, the key point is

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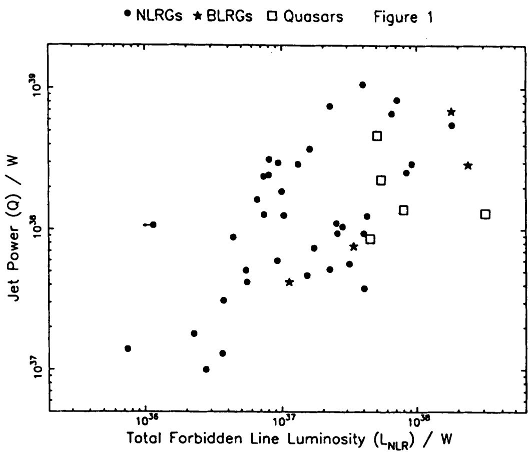
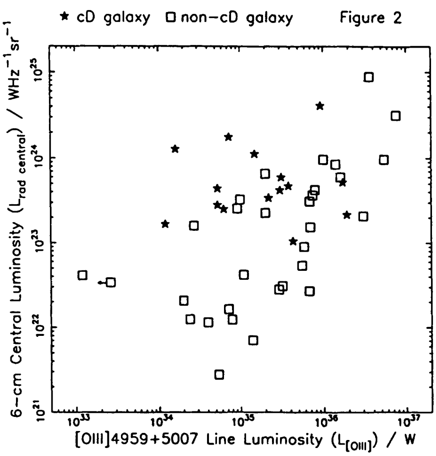
that Fig. 1 is the first quantitative link between radiated power and collimated bulk power and ***any AGN model must take account of it.***

2. Radiogalaxies, radioquasars and radio-quiet quasars. Fig. 1 indicates that BLRGs and quasars have a similar L_{NLR} versus Q relation to NLRGs. This suggests that the dichotomy between radiogalaxies and radioquasars is due to the orientation and/or variability effects mentioned in b) above. Regarding the RQQs, they populate a distinct region in the lower right part of Fig. 1 and are thus physically dissimilar to radio-loud objects. We are attempting to determine which parameters of the host galaxy are responsible for radio-loudness by spectrophotometry and radio observation of a complete optically selected sample of quasars.

3. Influence of the host galaxy. Models of nuclear jets suggest a dissipation of jet bulk power (and an increase in the central component radio luminosity $L_{rad\ central}$) due to interactions with the ISM. We indeed find supporting evidence from Fig 2: the cD galaxies - those with the deepest potential wells and the most ISM - have enhanced $L_{rad\ central}$ at constant $L_{[OIII]}$, ie constant jet bulk power.

References. 1 Yee, 1980, *Ap J* **241**, 894. 2 Robinson et al., 1987, *MNRAS* **227**, 97. 3 Saunders et al., in preparation. 4 Antonucci, 1984, *Ap J* **278**, 499. 5 Rawlings & Saunders, 1987, *MRAO Cavendish preprint no.* 1294. 6 Rees et al, 1982, *Nature* **295**, 17.





DISCUSSION

GOPAL-KRISHNA Since the beam power used in your correlation is an average over the lifetime of the source, while the [O III] line luminosity is related to the nuclear activity over a much shorter time scale, does the correlation between the two parameters suggest that the beam power remains essentially constant over the source's lifetime?

RAWLINGS Yes. Indeed, for the same complete sample, we find a strong correlation between jet (beam) kinetic power and hotspot luminosity that reinforces the picture of an essentially stable jet power over intermediate time scales ($\sim 10^{3-5}$ yr). On shorter time scales the situation is less certain: correlations between jet power and radio central component luminosity are, we believe, strongly influenced by jet environment.

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