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INFRARED WEAK QUASARS

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ABSTRACT

We present some examples of quasars with anomalously weak infrared emission, and discuss the effects of starlight subtraction on estimates of the ultraviolet and infrared component strengths.

INTRODUCTION

The energy distributions of most quasars (e.g. Neugebauer et al 1987, Sanders et al 1989) have a prominent inflection at about 1.5 microns, where the 'ultraviolet bump' component meets an infrared component. The nature of the infrared component remains unclear. Original suggestions that it was a nonthermal power law have been largely supplanted in recent years by the idea of thermal dust emission. Since the two decade wide infrared component often contains comparable luminosity to the observable decade of the ultraviolet component, this implies that *in at least some directions* a substantial fraction of the bump component is being reprocessed. If the UV all gets out on one axis and is progressively more obscured as one looks towards the plane of an obscuring torus, one might expect an anticorrelation of the observed UV slope and the IR component strength relative to the inflection point (or 'baseline IR luminosity', Carleton et al 1987). However, for our sample (Fig. 1., Elvis et al 1992, in preparation) we observe no significant correlation of this kind.

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However, we do notice three objects with unusually weak infrared emission. The energy distributions of these quasars are plotted in Fig. 2; it may be seen that although the near IR inflection is present, the rise towards longer wavelengths is abortive and most of the infrared energy distribution lies below the inflection baseline (a horizontal line drawn on the plots through the near IR local minimum in the energy distribution). This is is sharp contrast to the case for most quasars (Sanders et al 1989) where the IR energy above the inflection baseline is comparable to the observed energy in the ultraviolet bump. We note the good agreement between Einstein and Exosat estimates of PG0026+129's power law spectrum, which is typical for radio-quiet quasars, and the very unusual (Wilkes and Elvis 1987) hard x-ray spectrum of the radio-quiet quasar Kaz 102. Barvainis (1990) pointed out the sharp IR cutoff of PG0026+129; however his comparison of it with PG1358+043 is misleading, since the latter has a perfectly normal value of L_{IR}/L_{Base}.

The third object, PG0844+349, is included as a cautionary note; its energy distribution is rather similar to the first two objects, but it is known to be in a bright host galaxy (Hutchings and Neff 1991). Subtraction of a starlight template (which peaks near 1 micron) from the energy distribution gives colors within the normal envelope for quasars. Measurements of the host galaxy luminosities for PG0026+129 and Kaz 102 suggest that starlight contamination is not important in those objects, a conclusion supported by the fact that their ultraviolet bumps are of normal strength and so unlikely to be diluted by starlight. A fourth quasar, PG1116+215, was missed by IRAS, but ground based 10 and 20 micron observations suggest it may fall in the same category; PHL 658 is another candidate.

The 'ultraviolet bumps' of these infrared weak quasars are normal, and

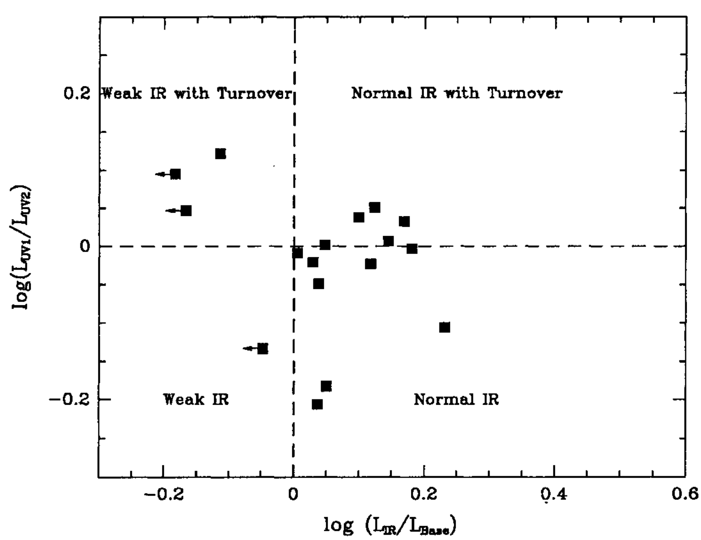

Figure 1: Ultraviolet shape versus infrared strength. The UV shape is determined from the ratio of the continuum flux in two bands in the far UV (1000 – 2000Å). The IR strength compares the total IR luminosity to the luminosity at the near IR inflection. Data for quasars with both IUE and IRAS data is from Elvis et al (1992).

flatten out in the far UV. If the turnover in these quasars were due to internal reddening, we would expect the energy to be reemitted in the infrared; the lack of infrared emission strongly implies that in these objects the ultraviolet turnover is in fact intrinsic. (The total luminosity of the 1-100 micron region is about 1.2 times the luminosity missing from the observed 2000-1000A region of the spectrum assuming an extrapolation of the 8000-1500A slope; any reasonable extrapolation

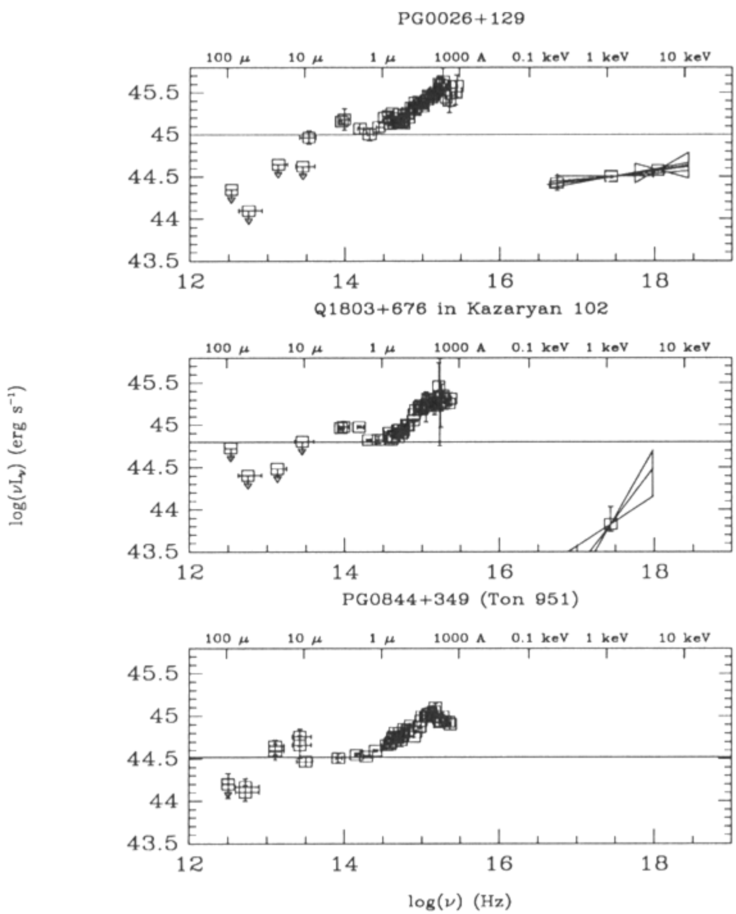

Figure 2: Infrared weak quasars. Plot shows logarithm of energy per unit logarithmic frequency from far infrared to x-ray for three radio-quiet quasars whose infrared emission is unusually weak relative to the optical and ultraviolet. A horizontal line is drawn through the near infrared inflection point to guide the eye.

of the continuum into the unobserved EUV would give missing energy in excess of this total infrared luminosity). We suggest these unusual objects may be suitable candidates for detailed modelling.

DISCUSSION

If we are to test accretion disk models of the quasar continuum, we must be able to compare the models with the observations. Inferred model parameters are very sensitive to the position of the peak of the ultraviolet energy distribution (assumed to represent the disk emission). In many low redshift objects the peak is not seen; even in those objects where the turnover is clear, the concern exists that the turnover may not be intrinsic but instead due to reddening within the quasar host galaxy. Although several lines of argument, most forcefully the low hydrogen columns inferred from x-ray spectral observations, suggest that typical quasars have little line-of-sight reddening, many Seyfert galaxies have a UV continuum that is clearly reddened, and the suggested interpretation of the quasar infrared continuum as emission from dust gives the reddening question renewed importance. The small number of unusual quasars with weak infrared emission will serve as a useful probe of the the quasar phenomenon in the absence of dominant dust reprocessing.

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REFERENCES

Barvainis, R., 1990. Ap.J., **419**, 432.

Carleton, N.P., Elvis, M., Fabbiano, G., Lawrence, A., Ward, M.J., and Willner, S.P., 1987. Ap J., **318**, 595.

Elvis, M., Wilkes, B., McDowell, J.C., Green, R.F., Bechtold, J., Willner, S.P., Oey, M.S., and Polomski, E., 1992, in preparation.

Hutchings, J., and Neff, S., 1991. A.J. **101**, 434.

Neugebauer, G., Green, R.F., Matthews, K., Schmidt, M., Soifer, B.T. and Bennett, J., 1987. Ap J.Supp., **63**, 615

Sanders, D.B., Sofier, B.T., Elias, J.H., Madore, B.F., Neugebauer, G., and Scoville, N.Z., 1989. Ap J., **347**, 29.

Wilkes and Elvis, 1987. Ap.J., **323**, 343.