Testing the Emission Mechanism of the Quasar Infrared Component

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This is a report on work in progress. We are attempting to determine the nature of the infrared component in radio quiet quasars. Our first method is observation of the long-wavelength spectral cutoffs. Based on data from IRAS, the NRAO 12-m, the FCRAO 14-m, and the Maxwell 15-m telescopes, we find that the cutoffs are sharp, and that they occur in the submillimeter region. They are reminiscent of those in dust sources such as IRAS galaxies. Our ultimate goal (delayed by weather) is determination of the slopes of the cutoffs. Nonthermal sources must have slopes less that 2.5, while all known thermal dust sources have slopes steeper than this.

If the quasar far IR sources are really analogous to those in IRAS galaxies, they should show CO in emission at a roughly predictable level. Our NRAO 12-m and FCRAO 14-m limits cannot rule this out, but our July 1988 IRAM data should address the question definitively. I hope to present the IRAM data at this meeting.

The above abstract contains up-to-date information on our continuing study of the submillimeter cutoffs in the spectra of radio quiet quasars and luminous Seyfert 1's. The details may be found in Barvainis and Antonucci 1988 (Ap.J., submitted). We will use this space to give the results of our recent CO detection run at the new IRAM 30-m telescope.

We successfully obtained CO spectra of the M(V) = -23.8 (for Ho = 50) quasar I Zw 1 in both the J=1-0 and J=2-1 lines (Fig 1 shows 1-0). The J=1-0 CO spectrum resembles the 21-cm H I spectrum of Condon et al 1985 (A J 90, 1642). The observed J=2-1 line luminosity (in the smaller J=2-1 beam) is much less than that of the J=1-0 line, which is virtually impossible for compact sources. Assuming that the lines are optically thick and thermalized, as in Galactic molecular clouds, this implies that the CO is extended over ~30 kpc. If so, the far IR source may be very large as well, possibly being powered by young stars in a luminous host galaxy. Imaging studies have in fact shown a large and luminous host (e.g. Smith et al 1986, Ap.J. 306, 64) The infrared spectral energy distribution looks normal for radio quiet quasars, without any obvious sign of thermal emission.

Fig. 2 shows the relationship between 100-micron luminosity and CO luminosity for IRAS galaxies and luminous Seyfert 1's. The open triangles are IRAS galaxies from Sanders et al 1986 (Ap J Lett 305, L45); the filled triangle is Arp 220 (Sanders and Mirabel 1985, Ap J Lett 298, L31); the open diamond is Mrk 231 (Sanders et al 1987, Ap J Lett 312, L5); the filled circles are NRAO 12-m and FCRAO 14-m upper limits for radio quiet quasars and Seyfert 1's (Barvainis and Antonucci 1988); and finally the hand drawn stars are the new IRAM data, including the detection of I Zw 1 and a limit for Mrk 817.

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This is an interpretable plot because both axes are relatively insensitive to obscuration and orientation effects. I Zw 1 does have as much CO as IRAS galaxies of comparable far IR luminosity. However, the CO profile connotes a rotating disk, unlike those of the luminous IRAS galaxies. Mrk 817 is undetected in CO, but it may still have as high a CO/100-micron luminosity ratio as many thermal sources.

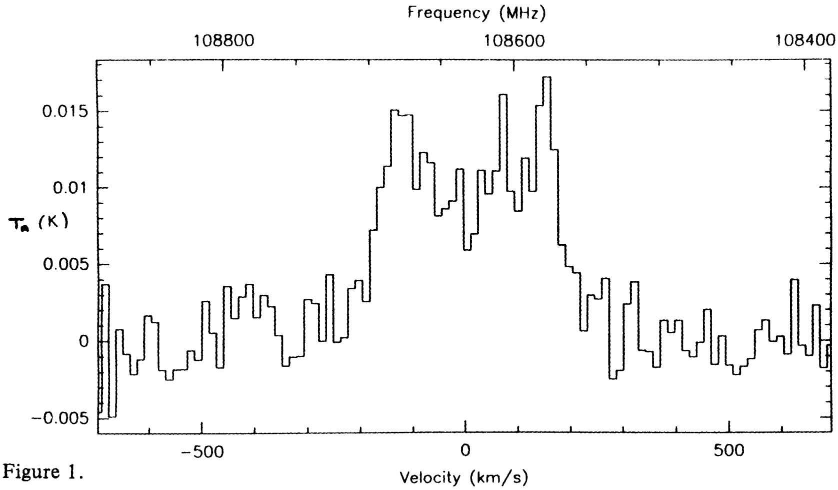

Figure 1.

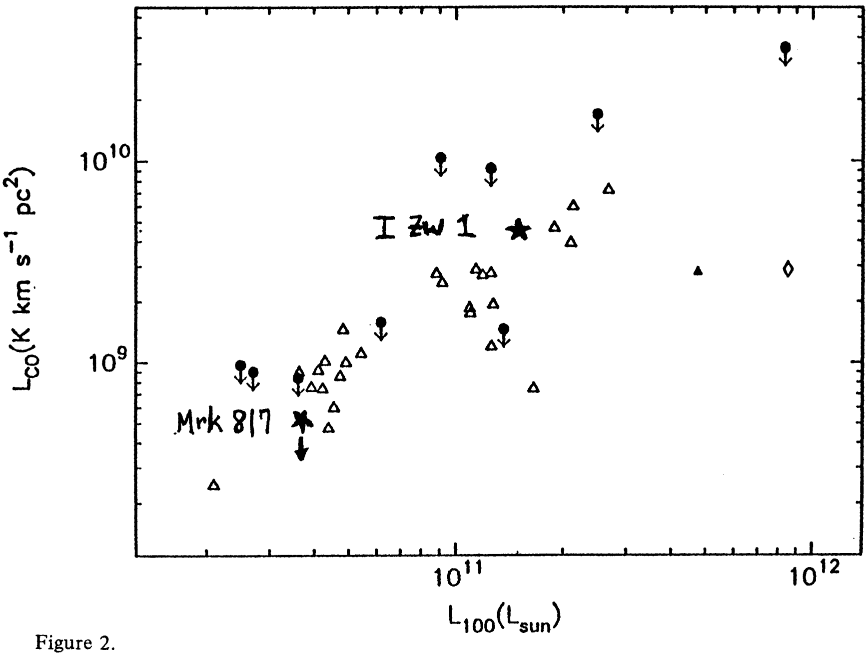

Figure 2.

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