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Compact Radio Emission in 60 μm Peaker Galaxies

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Abstract. We present radio interferometric observations of a well defined sample of IRAS galaxies with warm far-infrared colors — 60 μm Peakers (60PKs). The core radio power of 60PKs is intermediate to that of "normal" Seyfert 2 galaxies and radio ellipticals, and follows the same relationship with respect to total radio emission as low and high power radio galaxies. This is consistent with the suggestion that 60PKs represent nascent radio elliptical galaxies.

1. Background

According to the simplest version of the unified model, the different optical spectroscopic classifications of AGN (eg. Seyfert 1 and Seyfert 2) are the result of orientation of a dusty molecular torus surrounding the AGN core (eg. Antonucci 1993; Barthel 1989). To date, about a dozen Seyfert 2 galaxies have been shown to contain broad lines typical of Seyfert 1 galaxies using spectropolarimetry.

Recently, Heisler, Lumsden, & Bailey (1997) undertook a spectropolarimetric survey of a well defined infrared-selected sample of Seyfert 2s and showed that far-infrared colors dictate our ability to detect scattered broad emission lines. The color selection criteria for 60PKs (eg. Heisler 1991) coincides with the region occupied by Seyfert 2 galaxies containing polarized broad lines (Figure 1) and so are an obvious choice for investigating unified models of AGN.

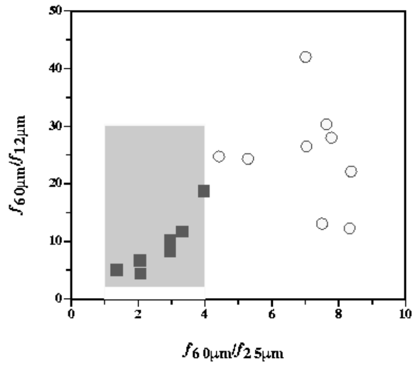

Figure 1. Far-infrared two color diagram. The shaded area outlines the region occupied by 60PKs, which coincides with that occupied by Seyfert 2 galaxies with detected polarized broad line emission (filled squares). The open circles represent Seyfert 2 galaxies for which polarized broad line emission is not observed.

The compact radio observations were obtained with the 275 km baseline Parkes-Tidbinbilla Interferometer (PTI). The PTI is sensitive to structures with brightness temperature $T_b > 10^5$ K and sizes <0.1" (see Norris et al. 1988), and thus can detect radio emission from compact sources associated with AGN, but does not see extended star formation regions which have typical $T_b < 10^4$ K.

2. Results

The distribution function of core-to-total radio fluxes for Seyfert 60PKs, *log* (P_{core}/P_{total}), has a median of -0.632 and a mean of -0.786 ± 0.174. Thus the compact radio cores contribute on average, a relatively small fraction (23%) of the total radio emission in Seyfert 60PKs.

The median power of the 2.3 GHz radio cores in Seyfert 60PKs is *log* $P_{core} = 20.9$, which is intermediate to Seyferts selected without restrictions to their far-infrared spectral energy distribution (Roy et al. 1994) and medium radio power ellipticals (Slee et al. 1994). Surprisingly, we find a strong relationship between core and total radio emission (significance probability of <0.06%), given by $P_{core} \propto P_{total}^{0.75}$. This same relationship has been found for other samples of low and high power radio galaxies (eg. Slee et al. 1994, Fabbiano et al. 1984). Thus the compact radio cores in the centers of 60PKs (due to an AGN) "know" about the total radio emission (presumably dominated by star formation).

A comparison of the far-infrared and radio flux is a useful global indicator of the dominant emission mechanism. The parameter, q, defined by Helou, Soifer, & Rowan-Robinson (1985) as $q_{6cm}(total) \equiv \log(S_{FIR}/S_{6cm})$, is an excellent indicator of the relative importance of starburst to AGN dominated activity in the nuclear heating of dust in galaxies (eg. Condon et al. 1991). The mean value of $q_{6cm}(total)$ for starburst and Seyfert 60PKs is 2.96 ± 0.06 and 1.94 ± 0.21, respectively. These results are consistent with previous findings for AGN and starburst galaxies (eg. Condon & Broderick 1991; Crawford et al. 1996).

Analogous to $q_{6cm}(total)$, we define $q_{13cm}(core)$, substituting the PTI flux density for the total radio flux. We find a strong correlation of $q_{13cm}(core)$ against $q_{6cm}(total)$ for all 60PKs and for Seyfert 60PKs, with confidence levels of <0.03% and <0.15%, respectively. Clearly, the nuclear emission is important, and will provide important constraints for understanding the underlying physics of the far-infrared–radio correlation.

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