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An Ultraluminous IRAS Galaxy with an Extremely Soft X-Ray Spectrum [1]

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Redshift surveys of the extragalactic *IRAS* sources have revealed a class of galaxies, ultraluminous infrared galaxies (ULIRGs), that radiate an enormous amount of energy in the far-infrared (Soifer et al. 1986), typically $L_{\rm IR} \geq 10^{12} L_{\odot}$, which is comparable to the luminosities of quasars. The energy source for most ULIRGs is believed to be massive nuclear starbursts triggered by galaxy interactions or mergers (Rigopoulou et al. 1996, Crawford et al. 1996). There is much debate about the evolution of ULIRGs. Sanders et al. (1988) suggested that ULIRGs are forming QSOs. However, it is not clear how merging galaxies evolve to QSOs. Meanwhile, observations and N-body simulations show that mergers between disk galaxies can form ellipticals. Some ULIRGs, such as Arp 220 and NGC 6240, do have elliptical characteristics. What is the evolutionary connection between QSOs and elliptical galaxies? About 10% of ULIRGs are IR QSOs or Seyfert 1 galaxies, on the basis of their optical spectra and appearance. Some of them are hosted in ellipticals (Hutchings et al. 1988, Lipari et al. 1994). Also, most of them are strong Fe II emitters. Studying this subsample of ULIRGs in detail may give some clues to understanding the evolutionary process mentioned above.

We have performed a cross identification of 131 ULIRGs compiled from the QDOT *IRAS* redshift survey with the *ROSAT* all-sky survey (RASS). Among the identified sources is *IRAS* 10026+4347, which is a Seyfert 1 galaxy or IR QSO according to its optical image, luminosity, and spectrum. Its optical spectrum shows that it is a strong Fe II emitter. Figure 1 shows the infrared color-color diagram. We can see from Fig. 1 that *IRAS* 10026+4347 is located above the power-law line. For this source, 394 X-ray photons have been detected by the RASS during a total the exposure time of 508 seconds. The redshift of *IRAS* 10026+4347 is $z = 0.178$, so its soft X-ray luminosity is 2×10^{45} ergs s^{-1}. The analysis of *ROSAT* all-sky survey data shows that it is a point-like source, although it is possible that there exists a soft X-ray halo around it. However the spectrum is *extremely* soft; the RASS data show that *IRAS* 10026+4347 emits more than 70% of its flux below 0.5 keV and there are no photons above 1.1 keV, as shown in Fig. 2. 'Supersoft' AGNs have been found in the *ROSAT*

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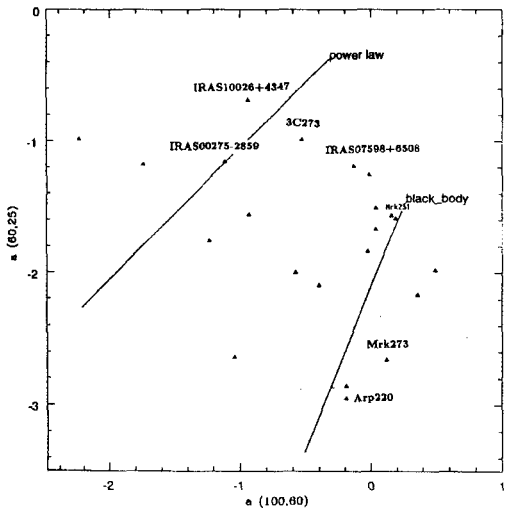

Figure 1. The infrared color-color diagram for 22 ULIRGs identified with *ROSAT* RASS and pointed-observation sources. *IRAS* 10026+4347 is above the power-law line.

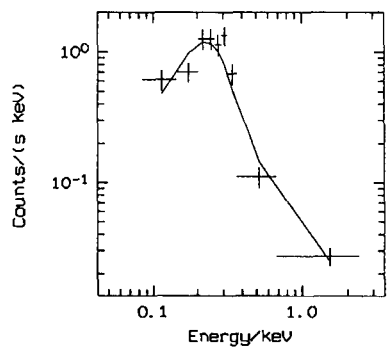

Figure 2. The soft X-ray spectrum of *IRAS* 10026+4347

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pointed catalog (Singh et al. 1995), but these AGNs are not as bright in the soft X-ray band as *IRAS* 10026+4347. From its optical and infrared properties and soft X-ray luminosity, *IRAS* 10026+4347 is more like normal QSOs than IR QSOs such as *IRAS* 00275−2859 and *IRAS* 07598+6508. However its soft X-ray spectrum is extremely soft, and therefore, this ultraluminous IR QSO is a very special and interesting object to be studied.

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