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GROUND-BASED FOLLOW UP OF IRAS GALAXIES

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We have undertaken optical, near-infrared, radio-continuum and HI observations of the galaxies identified with IRAS sources in a few fields roughly of the size of a sky survey plate. We present here results from two fields at galactic latitude $+27^{\circ}$ and $+43^{\circ}$ over a total area of 100 square degrees (see also Dennefeld et al. 1986).These regions contained 115 IRAS point sources, out of which 26 were identified with stars and 81 with faint galaxies, 10 of which were difficult to recognize on the Schmidt plates. A further 8 sources could not be identified with any object down to the limit of the Palomar or ESO Sky Survey Plates. As judged from the Cirrus Flags, at most 3 could be spurious sources. The surface density of galaxies lies between 0.6 and 0.9 galaxies per square degree, in accordance with other determinations (Helou, 1986). Our value is however of little statistical significance,especially because the field at $b = +27^{\circ}$ seems to contain a group of faint galaxies.

Spectroscopy was obtained with the ESO telescopes at a resolution of about 10Å. The vast majority of galaxies have low excitation spectra dominated by low-ionization lines. These spectra are typical of HII-region type galaxies, however of much lower excitation (typically $[OIII]/H\beta < 1$) than other starburst galaxies such as those described by Balzano 1983). Similar results have been found independently by Allen, Roche and Norris (1985) and Elston, Cornell and Lebofsky (1985). We stress here the importance of the reddening as determined from the $H\alpha/H\beta$ ratio: the visual absorption A_V ranges from 2 to 6 magnitudes and as a consequence the corrected L_{IR}/L_B ratios are considerably reduced if those reddenings apply to the whole galaxy. Indeed J-H, H-K colours can be reconcilied with those of "normal" galaxies when such reddening corrections are applied. In some cases, a substantial K-L excess remains, indicating a dust contribution even at short wavelengths. The strong Na absorption line seen in some spectra is also partly attributed to dust, in absence of any other late-type stellar feature.

Velocities up to 60000 km/s, resulting in large infrared luminosities, have been found. Several objects have L_{IR} of a few 10^{12} solar luminosities, similar to the ones of Arp 220 or NGC 6240, which are thus not exceptional anymore. If our numbers are representative, more than a thousand of such objects should exist all over the sky. Star formation activity is believed to be the source for this enormous IR emission. Evidence for this comes from the correlation between IR and $H\alpha$ luminosities (Dennefeld et al. 1986) or from the strong Balmer absorption lines seen in the spectra. Radio-continuum observations of these extreme objects (Karoji et al. 1986) show that the star-formation activity is located in

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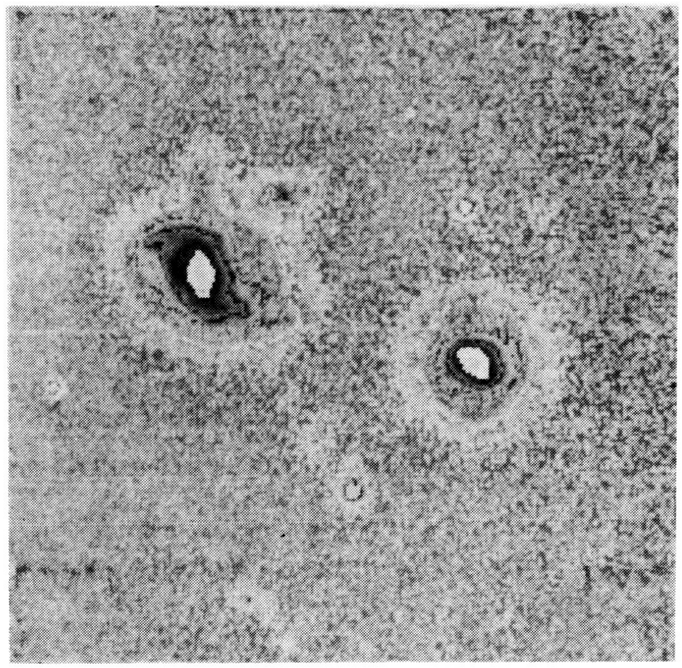


Figure 1a - A CCD picture in r (Gunn) of A 09111-1007 obtained at ESO. The eastern galaxy with two companions is not the IRAS source.

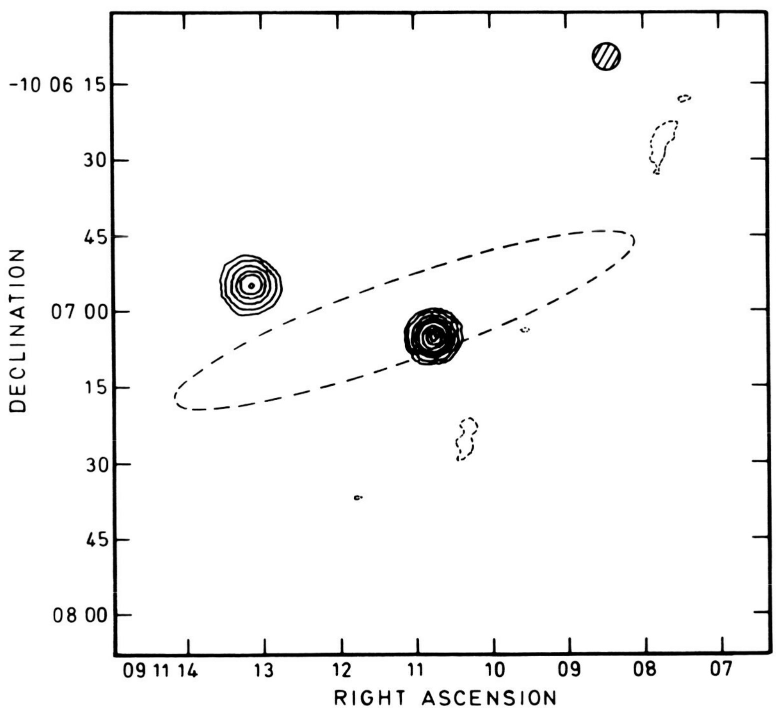


Figure 1b - A VLA map of A 09111-1007 at 20 cm. Peak brightness is 22 mJy/beam. This figure is taken from Karoji et al. (1986).

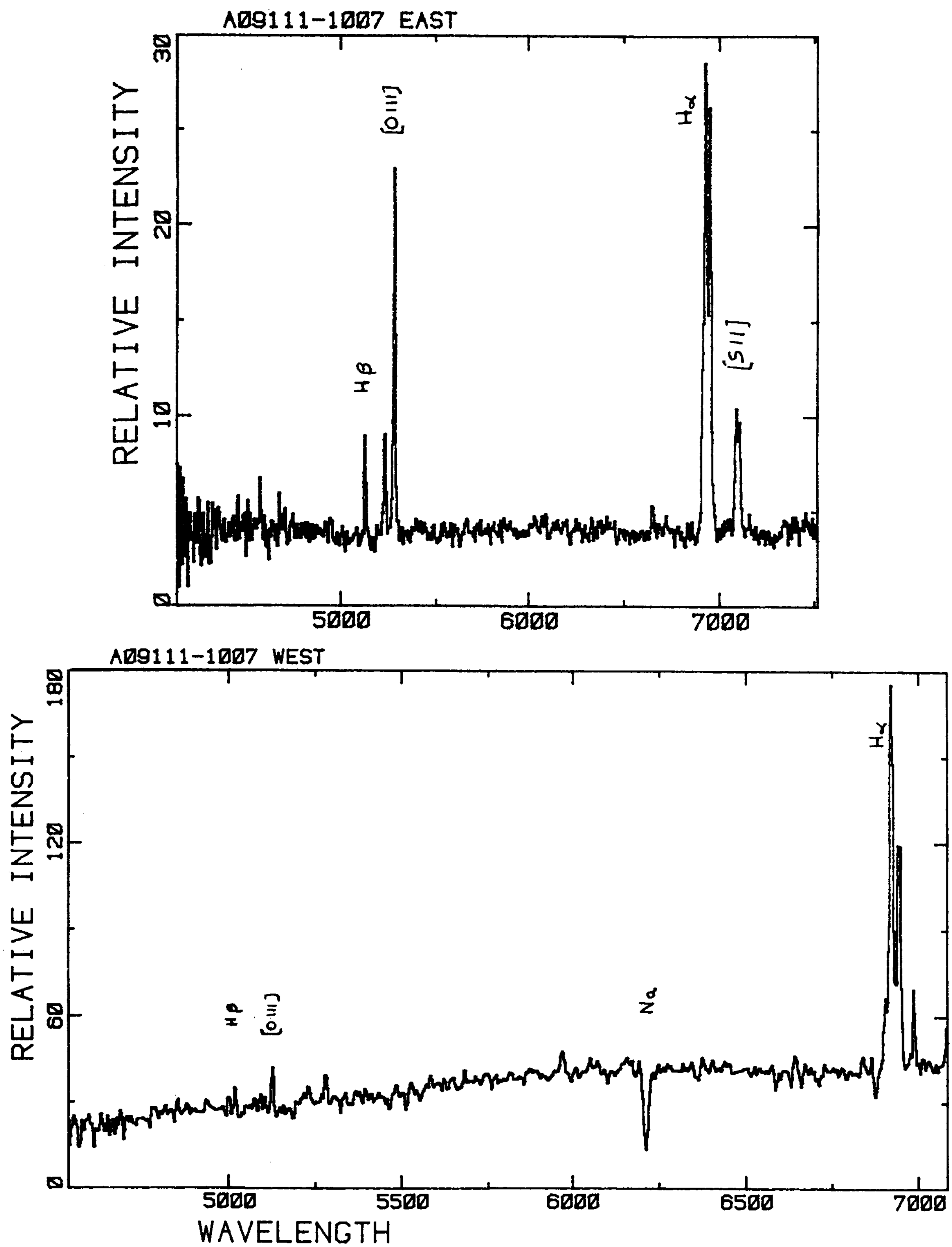
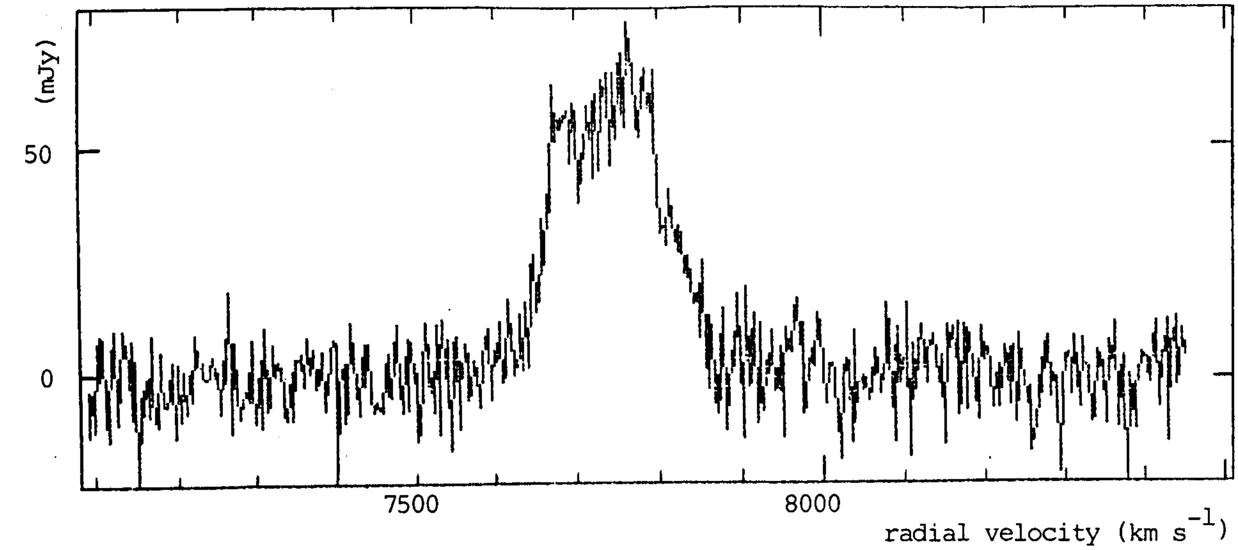
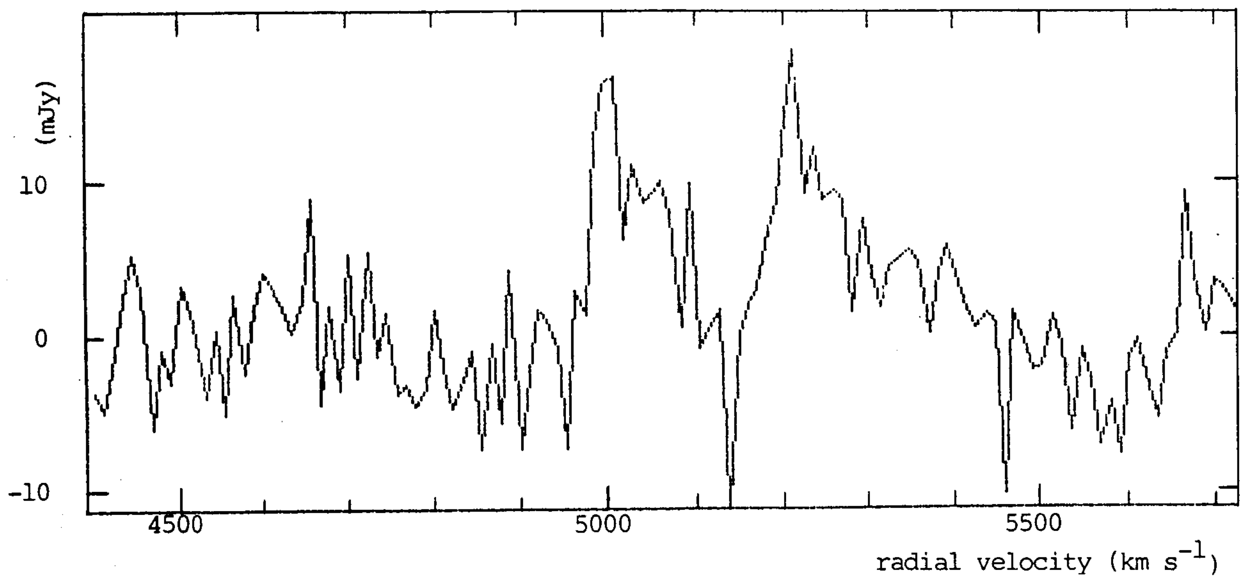


Figure 1c - Spectra obtained at ESO for the two galaxies seen in fig. 1a. The high-excitation eastern galaxy (Sey2) is not an IRAS source. The western one has a typical spectrum of IRAS galaxies with low excitation, high reddening and interstellar absorption lines



HI LINE PROFILE WITH A VELOCITY RESOLUTION OF 2.6 KM S^{-1}. RADIAL VELOCITIES ARE GIVEN IN TERMS OF HELIOCENTRIC OPTICAL REDSHIFT $C\Delta\lambda/\lambda_0$.



HI LINE PROFILE WITH A VELOCITY RESOLUTION OF 10.6 KM S^{-1}. RADIAL VELOCITIES ARE GIVEN IN TERMS OF HELIOCENTRIC OPTICAL REDSHIFT $C\Delta\lambda/\lambda_0$.
NOTE THE ABSORPTION FEATURE AT ABOUT 5140 KM S^{-1}.

Figure 2 - HI profiles of IRAS galaxies obtained at Nançay
Upper image is A12488-2051, lower one is A09234-1146

the central regions (unresolved at 6 kpc diameter for our far-outlying galaxies) and that the radio/IR flux density ratio is typical of star-burst activity rather than Seyfert 1 Indeed, very few Seyfert galaxies or Liners have been found in our survey (see fig.1 for an illustration). It has been suggested that interactions between galaxies are more frequent within IRAS galaxies than elsewhere (Lonsdale et al. 1984) and that this could represent the triggering mechanism for star formation. About 25% of our galaxies have neighbours within 2' but we still need more analysis (velocities and imaging) to distinguish interactions from simple clustering. At least the fuel for star formation is available: about half the objects have been detected in HI and have hydrogen masses in the range 10^9-10^{10} M_0. Large central column densities are sometimes present (see fig.2) as expected for these highly reddened objects. But it should be stressed that high star formation rates are required (larger than 100 M_0 per year) to explain the large IR luminosities unless truncated mass functions are assumed (see the accompanying paper by Belfort, Mochkovitch and Dennefeld, this volume).

It seems therefore that the overall characteristics of faint IRAS galaxies are now well established from the spectral point of view. Enough so to distinguish from spectra alone an IRAS candidate from another (see fig.1) One particularity is the high reddening which no doubt explains why these fairly numerous objects with strong Hα emission line were not discovered in the objective prism surveys mostly conducted in the blue !

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