IRAS Galaxies: Near-infrared Colours and Starformation

Albertus C. van den Broek
Astronomical Institute Anton Pannekoek, University of Amsterdam
Roetersstraat 15, 1018 WB Amsterdam, The Netherlands

INTRODUCTION

IRAS made it possible for the first time to study infrared complete samples of galaxies. On the average these galaxies appear to emit most of their energy in the infrared in contrast to optical selected galaxies. The so-called minisurvey is the first infrared completem sample studied and additional observations in the optical, near-infrared and radio have already been done for these galaxies. The interpretation of these observations has not yet led to a clear and uniform picture of the astrophysical processes in these galaxies. The question whether these galaxies are highly obscured by dust or whether these galaxies experience starbursts is not yet satisfactory answered.
Studying published data we found a correlation between the near- and far-infrared luminosities. This is surprising because normally the far-infrared luminosity is considered to originate from young stars embedded by dust while the near-infrared luminosity is due to old stars. We argue here that a young stellar population recently formed in a starburst can also be responsible for the near-infrared luminosity, which can explain the found correlations.

DO WE UNDERSTAND THE NEAR-INFRARED COLOURS?

Renzini and Buzzoni (1986) have made models for population synthesis in which they include late stages of stellar evolution. One of the results is that light from evolved stars on the asymtotic giant branch can contribute significantly to the total light. AGB stars with a Teff of 3000 K will emit most of their energy in the near infrared. Therefore especially JHK photometry is suited to study these stars.

Galaxies, like those in the minisurvey, which experience a period of constant enhanced starformation (starburst) would after 50-100 million years have a young stellar population which emits 20-30% of its light through AGB stars (Renzini and Buzzoni 1986). On the other hand an old population with constant starformation and a life time of 10 billion years would emit about 30% of its light through AGB stars and 30% light through red giants.

On the average the minisurvey galaxies emit 3-4 times as much energy in the far-infrared than in the blue (LFIR/LB~3-4; Soifer et al 1984). In galaxies where dense dust clouds are restricted to starforming regions the far-infrared luminosity is mainly due to young stars embedded in dust clouds, while hardly any dust is heated by the old population. Therefore a high LFIR/LB luminosity ratio implies that the luminosity of the young population dominates

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the luminosity of the old population by about a factor of LFIR/LB or more. Hence, in the minisurvey galaxies, we would expect a considerable emission in the near-infrared from AGB stars belonging to the young population. If this is the case, the presence of AGB stars will certainly be seen in the H-K, J-H colours of starburst galaxies which indeed resemble those of AGB stars and are quite different from those of 'normal' galaxies. Futhermore we also can understand the correlation between the near-infrared and far-infrared luminosities, which both turn out to be a measure of (past and present) starforming activity.

The argument (Moorwood et al 1985, 1986) that in these galaxies no enhanched starformation took place but that high extinction by dust may be responsible for the displacement between the minisurvey galaxies and 'normal' galaxies in the H-K, J-H colour diagram, cannot explain the correlations between the near- and far-infrared luminosities. In this case the near-infrared luminosity, diminished by absorption, would originate from the old population and would not necessarely correlate with the far-infrared luminosity.

Although hot dust might be present in the most extreme infrared galaxies (Carico et al 1988) it could also not explain the observed near-infrared correlations, especially in the J-band, since this would indicate improbably high dust temperatures.

CONCLUSION

We show that both the correlations between the near- and far-infrared luminosities and the H-K, J-H colours of the minisurvey galaxies can be explained by assuming a period of enhanced starformation which started typically 50-100 million years ago.

References

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