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**Review of the doctoral thesis of Subhrata Dey
entitled “Panchromatic spectral energy distribution modeling of infrared bright
galaxies”**

Summary of the thesis

The thesis explores the full ultraviolet-to-radio spectral energy distributions of infrared-bright galaxies. Chapter 2 presents the data and chapter 3 and 4 present the radio-only and full SED modelling. The main results are presented in chapters 5 and 6 on luminous infrared galaxies (LIRGs) and ultraluminous infrared galaxies (ULIRGs).

Contribution to the field

The thesis presents strong evidence for a small contribution of active galactic nuclei (AGNs) to the emission of LIRGs (from the SED modelling and the infrared-to-radio ratios). The merging galaxies in the sample are also shown to have increased star formation rates placing them above the galaxy main sequence, unlike the non-merging galaxies (Figure 5.10). On the other hand, the sample of ULIRGs contains some galaxies whose emission is dominated by AGNs, showing excess radio emission and high AGN fractions from the SED modelling. This provides important input into the understanding of the nature of these galaxies.

The radio modelling also provides useful measurements for future studies analysing radio properties of different classes of galaxies.

Below I point out the weaknesses of this thesis with the aim of helping to improve the future work.

Selection criteria

The selection criteria and their impact should be discussed in more details. Chapter 5 describes the selection based on the inclusion in the 1.425 GHz Atlas of the IRAS Bright Galaxy Sample, but it is not mentioned what criteria this atlas employs. The impact of the selection is different if this is a flux-limited sample depending also on the selection wavelength, or if other selection criteria were also used.

It is also mentioned that the availability of the data from the TIFR GMRT Sky Survey was required. It would be good to mention if this means only a positional selection or that a detection was required.

Similarly, section 6.2 lists the papers from which the sample was compiled, but it should be presented what selection criteria these authors used.

Better constraint on L_{dust} using radio data

The forth result presented in section 5.5.1 and the fifth results in section 6.5 state that including the radio data resulted in one order of magnitude lower uncertainties on L_{dust} . This may only be a consequence of a low range of the allowed q_{IR} values of 2.3–2.9. i.e. less than one order of magnitude. Radio measurements typically have much higher signal-to-noise ratios than the far-infrared measurements, so if one assumed a single allowed value of q_{IR} , then the uncertainty of L_{dust} would be determined by the signal-to-noise ratio in the radio, with far-infrared measurement providing little constraints. When a narrow range of q_{IR} are allowed, then solutions with very high or very low L_{dust} are no longer allowed (unlike in the modelling with no radio data) due to strong constraints from the radio. However, if one allowed a wider range of q_{IR} values in the modelling with radio data, then such more extreme L_{dust} solutions would be allowed and consequently the uncertainties would be larger. The range assumed here is probably too narrow given Figure 5.6 and 6.3. This is especially true for radio-loud ULIRGs, which exhibit very low q_{IR} derived from 60 and 100 μm data.

Minor comments

I have several minor comments.

- Section 2.1.2 states that “[t]he dataset with the largest on-source integration time was reduced when several observations were made with the same configuration and central frequency”. A typical approach would be to combine all the data to gain sensitivity, so it would be good to justify this choice.
- In section 5.4.2 “a very careful adjustment of the fitting parameters” is mentioned. This should be explained. In general, parameters should be fit not adjusted, so I assume the allowed ranges or priors were adjusted here, but one needs to be sure that this procedure does not bias the results.
- In Section 5.5.1 q_{IR} from CIGALE and the classical formula involving FIR luminosity from 60 and 100 μm data are described to be comparable within uncertainties. However, figure 5.4 shows that most of the CIGALE measurements are 0.2-0.3 dex higher, beyond the uncertainty ranges. This is actually expected, because CIGALE defines this as a ratio of the total 8–1000 μm and radio luminosities (footnote to table 5.5), whereas the classical formula has only the far-infrared luminosity (so that sometimes this parameter is called q_{FIR} instead). Hence, it is actually surprising that four galaxies are on or below the one-to-one relation, which may be investigated further. Maybe their IR SEDs are strongly peaked, so that the FIR and IR luminosities are similar. The galaxy 0.3 dex below the one-to-one line has probably some problems with radio photometry.

Conclusion

I conclude that this thesis represents a valuable contribution to the field of galaxy evolution and star formation and therefore I recommend granting the doctoral degree to Subhrata Dey.

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