The Nuclear and Extended Infrared Emission of the Seyfert Galaxy NGC 2992 and the Interacting System Arp 245

Ismael García-Bernete1,2, Cristina Ramos Almeida1,3, Jose Acosta-Pulido1,2, et al.
1 Instituto de Astrofísica de Canarias, C/ Vía Láctea, 1, La Laguna, Tenerife, Spain
2 Departamento de Astrofísica, Universidad de La Laguna, La Laguna, Tenerife, Spain
3 Observatorio Astronómico Nacional

ABSTRACT

We present subarcsecond resolution infrared (IR) imaging and mid-IR (MIR) spectroscopic observations of the Seyfert 1.9 galaxy NGC 2992. The data were obtained using the Gran Telescopio CANARIAS (GTC). In the H-band, the galaxy was observed with a spatial resolution of 0.32'' (55 pc) and the imaging data reveal faint extended emission out to about 3 kpc, with a surface brightness of 4.8 mJy/arcsec². By comparing the MIR spectra of the nuclear and extended emission of the galaxy, we conclude that the origin of the extended emission is likely dust in the inner galaxy disk, with wome contribution from star formation. We also report arcsecond resolution MIR and far-IR (FIR) imaging of the interacting system Arp 245 (NGC 2992, NGC 2993 and Arp 245 North), taken with the Spitzer Space Telescope and Herschel Space Observatory. For NGC 2992, we obtained Spitzer MIR and Herschel FIR nuclear fluxes using different methods and compared them with the subarcsecond resolution data. Using imaging data, we find that we can only resolve the nuclear fluxes obtained from NGC 2992 at high angular resolution due to 20-25 µm, whereas the MIR fluxes come from the AGN dominate. We fitted the nuclear IR spectral energy distribution (SED) of NGC 2992, including the 7.5-13 µm GTC/CanariCam (CC) nuclear spectrum, with clumpy torus models. We then used the best-fitting torus model to decompose the 5-30 µm Spitzer/IRS spectrum (~330 pc) in AGN and starburst (SB) components, using different SB templates. We find that, whereas at shorter wavelengths the SB component dominates the MIR emission, with 64% contribution at 6 µm, the AGN component reaches 90% at 20 µm. Finally, we reproduced the dust emission of the Arp 245 system using a set of modified blackbodies, from which we derived dust temperatures, star formation rates (SFRs) and dust masses.

Conclusions.

- The comparison between the GTC/CC spectrum of NGC 2992, which probes the central ~60 pc of the galaxy, and the Spitzer/IRS spectrum (~640 pc) reveals absent/suppressed PAH emission in central parsecs.
- We can reproduce the nuclear IR SED of NGC 2992 with a clumpy torus model of 1.2 pc radius and containing a mass of $M_{torus}=9x10^4 M_\odot$. The column density of the obscuring material is compatible with being Compton-thick, in agreement with X-ray observations (Weaver et al. 1996).
- Using low angular resolution photometry from Spitzer and Herschel, we can only recover the nuclear IR emission of NGC 2992 at 20-25 µm, where the torus emission dominates.
- By decomposing the Spitzer/IRS spectrum in AGN and SB component, we can recover the nuclear information provided by the GTC/CC spectrum.
- From the spectral decomposition of the Spitzer/IRS spectrum we find that, whereas the SB component dominates the MIR emission at x<15 µm, with 60-70% contribution at 6 µm, the AGN component reaches 95% at 20 µm.
- We reproduced the dust emission in the Arp 245 system using a set of modified blackbodies and derived similar SFRs and dust masses for the two spiral galaxies and significantly smaller for Arp 245 North, in agreement with Duc et al. (2000).

Physical parameters of the circumnuclear dust emission.

Dust grains are heated mainly by SF and nuclear activity, and this radiation is re-emitted in the IR range. We fitted the circumnuclear and disk IR emission with modified blackbodies and we derived the dust temperatures, star formation rates (SFRs) and dust masses of the different components in the interacting system Arp 245. For the spiral galaxies, we find temperatures of ~38 K for the circumnuclear dust, typical of star-forming regions. On the other hand, the dust in the galaxy disk can be reproduced with a geometry of 5-23 kpc, characteristic of dust heated by the interstellar radiation field (see Fig. 8).