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COLD DUST IN GALAXIES: SUB-MM OBSERVATIONS WITH THE HEINRICH-HERTZ-TELESCOPE

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We have studied the cold dust component of a sample of nearby galaxies via its thermal continuum emission at 870 μm wavelength.

Dust grains are an important constituent of the interstellar matter in galaxies. While the total mass of the interstellar dust is small (about 1 % of the gas), it plays an important role in the energy balance and the chemical composition of the ISM. High-energy radiation is absorbed through dust, molecules are formed on dust grains, and the shielding of molecular clouds from the interstellar radiation is important for the formation of stars and therefore for the overall star formation history and the evolution of galaxies.

This interstellar dust can be observed directly in the infrared to mm wavelength range due to its thermal radiation. The FIR emission which was detected by the IRAS or ISO satellites traces the existing warm or hot dust, but these instruments were unable to detect the gross amount of dust at low and moderate temperatures.

We observed a sample of nearby galaxies at a wavelength of 870 μm, using the MPIfR 19-channel bolometer array installed at the Heinrich-Hertz-Telescope (Baars et al. 1999) on Mt. Graham, Arizona. These observations were performed during several periods between March 2000 and January 2002. The sample included a total of nine galaxies: NGC 253, NGC 278, NGC 2146, M 82, NGC 3079, NGC 3628, NGC 4565, NGC 4631, and NGC 5907. All galaxies were detected; examples of the obtained continuum maps are shown in Fig. 1.

After subtraction of the contributions from synchrotron- and free-free emission and the – mainly CO(3–2) – line emission which falls into the bandpass of the broad-band bolometer, we were able to determine flux densities due to the thermal dust radiation alone. After combination of our results with flux densities at other wavelengths (between 25 μm and 1.2 mm) we fitted a two-component modified blackbody curve to the galaxy spectra and found that the flux densities of most objects can be well fitted under the assumption of a dust absorption coefficient of $\beta = 2$, leading to dust temperatures of $50 - 55$ K and $20 - 25$ K for these two components. For the starburst galaxy M 82 higher temperatures are required (70 K and 35 K, respectively), and for the interacting galaxies NGC 3628 and NGC 4631 no satisfactory fit was possible. Here either a different dust absorption coefficient ($\beta < 1.5$) is required, or a third component of very cold dust with temperatures of < 12 K for NGC 3628 and < 6 K for NGC 4631. This latter possibility would lead to a gas-to-dust ratio of about 20 in NGC 4631, far below galactic values.

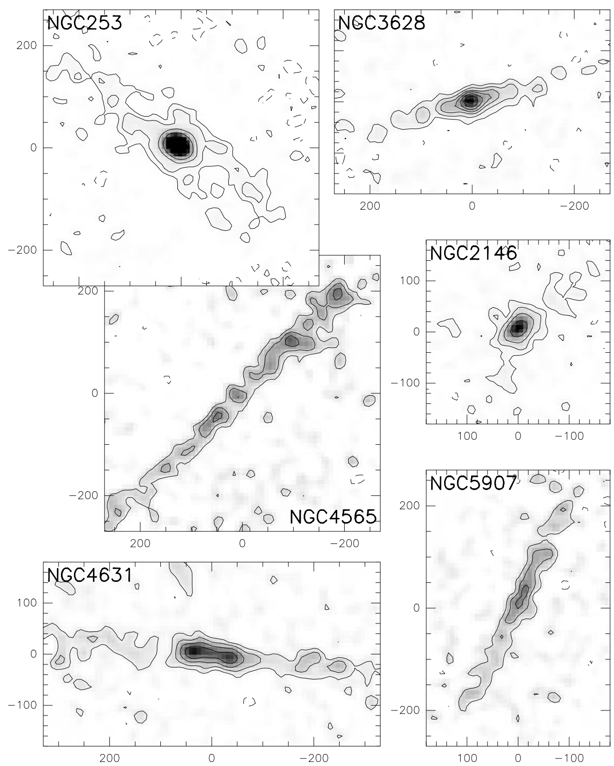

Fig. 1. Continuum maps at λ 870 μm of selected nearby galaxies included in the sample observed with the Heinrich-Hertz-Telescope. Grey scale intensities and contour levels are different for each galaxy depending on the maximum in the map.

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