中華民國天文學會
The Astronomical Society of the Republic of China (Taiwan)

Contribution ID: **170** Type: **Oral**

Determining the mass of cosmic dust: the systematic errors induced by temperature-dependent opacity

Saturday, May 17, 2025 5:30 PM (15 minutes)

One of the most powerful tools in the study of galaxies is the thermal emission of interstellar dust, which dominates their spectral energy distribution (SED) at far-infrared wavelengths. Using a dust emission model such as a modified blackbody, fits to the SED reveal the dust (and interstellar medium) column density and its temperature, making the dust SED a key tracer in Galactic and extragalactic studies.
However, SED fit results depend strongly on the adopted value for dust opacity. Recent experimental findings suggest that our previously adopted values for far-infrared dust opacity, which were extrapolated from shorter wavelengths, may be systematically biased. Dust opacity appears to be higher than previously thought and, crucially, dependent on temperature: as materials get warmer, their opacity increases and its wavelength dependence becomes shallower. It is essential to understand how these findings change our interpretation of dust emission SEDs.
I will present my team's work to quantify the effect of temperature-dependent dust opacity on SED fits. This effect has been identified as a possible source of bias for some time, but has not yet been studied quantitatively. We use optical data on several candidate dust materials to model dust opacity as a function of wavelength and temperature, and we produce a grid of synthetic galaxy SEDs. By fitting these synthetic observations with a fixed-opacity model we can then recover the bias in the fit results. We find that the dust masses recovered by the fit can be underestimated or overestimated depending on the target's temperature, redshift, and choice of photometric bands.
Finally, we explore the relevance of our findings for the determination of dust abundances in the early Universe, where dust mass estimates pose a challenge to dust formation models (the so-called "dust budget crisis").

Section

Galaxy/Extragalactic

Primary author: FANCIULLO, Lapo (National Chung Hsing University)

Co-authors: Prof. KEMPER, Francisca (ICREA); Dr MARSHALL, Jonathan (ASIAA)

Presenter: FANCIULLO, Lapo (National Chung Hsing University)

Session Classification: Galaxies