

Public Abstract

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Graduation Term:SS 2016

Department:Physics

Degree:PhD

Title:A STUDY OF COSMIC DUST IN THE GALACTIC ENVIRONMENT

The mysterious "21 micron" emission feature seen almost exclusively in the short-lived protoplanetary nebula (PPN) phase of stellar evolution remains unidentified since its discovery two decades ago. This feature is always accompanied by the equally mysterious, unidentified "30 micron" feature and the so-called "unidentified infrared" (UIR) features at 3.3, 6.2, 7.7, 8.6, and 11.3 micron which are generally attributed to polycyclic aromatic hydrocarbon (PAH) molecules.

We explore the interrelations among the mysterious 21 micron, 30 micron, and UIR features of the 21 micron sources. We find that none of these spectral features correlate with each other. This argues against a common carrier (e.g., thiourea) for both the 21 micron feature and the 30 micron feature. This also does not support large PAH clusters as a possible carrier for the 21 micron feature.

We also derive the stellar mass loss rates of these 21 micron sources from their dust infrared (IR) emission, using the "2-DUST" radiative transfer code for axisymmetric dusty systems and examine the correlation between mass loss rate of AGB phase or mass loss rate of superwind phase with that of fluxes emitted from 21 and 30 micron features.

In addition, we probe the role of carbon in the ultraviolet (UV) extinction by examining the relations between the amount of carbon required to be locked up in dust with the 2175 Angstrom extinction bump and the far-UV extinction rise, based on an analysis of the extinction curves along 16 Galactic sightlines.

We derive abundances of carbon from the model-independent Kramers-Kronig relation which relates the wavelength-integrated extinction to the total dust volume and is less model-dependent. We also derive carbon abundance from fitting the observed UV/optical/near infrared extinction with a mixture of amorphous silicate and graphite. We find that the carbon depletion tends to correlate with the strength of the 2175 Angstrom bump, while the abundance of silicon depleted in dust shows no correlation with the 2175 Angstrom bump. This supports graphite or polycyclic aromatic hydrocarbon (PAH) molecules as the possible carrier of the 2175 Angstrom bump. We also see that carbon abundance shows a trend of correlating with  $1/R(V)$  where  $R(V)$  is the total-to-selective extinction ratio, suggesting that the far-UV extinction is more likely produced by small carbon dust than by small silicate dust.

Finally, we model the infrared emission of 120 Galactic high latitude clouds and 81 Diffuse Infrared (DIR) excess clouds using silicate-graphite-PAH model. They exhibit notable cloud-to-cloud variations in the mid-infrared, with the ratio of the IRAS 12 micron intensity to the IRAS 25 micron intensity varying by up to one order of magnitude. We find that hydrogen column density strongly correlates with the far-infrared emission, this indicates the presence of large grains of similar properties and abundances. Also, we find that all clouds are rich in PAHs as traced by the IRAS 12 micron data. They are heated by the local interstellar radiation field, but with the radiation intensity reduced by a factor of about 2 to 3.