Diamonds in Space

Kaijun Li[1], and Aigen Li[2]

1. Xiangtan University, 2. University of Missouri

Cosmic nanodiamonds were first detected in primitive carbonaceous meteorites and identified as presolar in origin based on their isotopic anomalies (Lewis et al. 1987), although their presence in the ISM was proposed almost two decades earlier by Saslaw & Gaustad (1969) to explain the interstellar UV extinction curve. Five years later, Allamandola et al. (1992) attributed the 3.47 μm absorption band seen toward a large number of protostars to the tertiary C-H stretching mode in diamond-like carbonaceous materials (this absorption feature has also been detected in the Large Magellanic Cloud; see Shimonish et al. 2016). Jones & d'Hendecourt (2000) further suggested that surface-reconstructed (to sp^2-bonded carbon) nanodiamonds could be responsible for the "unidentified infrared (UIR)" emission features, the 2175 Å extinction hump, and a part of the far-UV extinction at $\lambda^{-1} \gtrsim 7$ μm^{-1}. Circumstellar nanodiamonds were identified in the dust disks or envelopes surrounding two Herbig Ae/Be stars HD97048 and Elias 1 and one post-AGB star HR 4049, based on the 3.43 μm and 3.53 μm C-H stretching emission features expected for surface-hydrogenated nanodiamonds (Guillois et al. 1999; van Kerckhoven, Tielens, & Waelkens 2002).

Presolar meteoritic nanodiamonds were found to have a log-normal size distribution with a median radius ~ 1.3 nm (Lewis, Anders, & Draine 1989) and an abundance as much as ~ 0.1% of the total mass in some primitive meteorites, more abundant than any other presolar grains by over two orders of magnitude. In the ISM, as much as 10% of the interstellar carbon (~36 ppm) could be in the form of nanodiamonds without violating the constraints placed by the interstellar extinction curve (Lewis et al. 1989). However, a much more stringent upper limit of ~ 0.1 ppm was derived by Tielens et al. (2000) based on nondetection of the characteristic 3.43 μm and 3.53 μm C-H stretching emission features in the ISM. Of course, interstellar nanodiamonds could be more abundant if the bulk of them are not hydrogenated.

In this meeting we will report our results on an extensive study of the absorption, scattering, luminescence, and infrared emission properties of nanodiamonds in the ISM