On Graphene in Space

Xiuhui Chen¹, Jianxin Zhong¹, & Aigen Li²

1. Xiangtan University, 2. University of Missouri

ABSTRACT


Recently, the detection of C_{24} (a planar graphene) was reported in planetary nebulae (García-Hernández et al. 2011, ApJ, 737, L30). This discovery inspires us to explore whether and how much graphene would exist in the ISM and how it reveals its presence through its ultraviolet (UV) extinction and infrared (IR) emission. We examine graphene as a potential candidate for the mysterious 217.5nm extinction bump. Graphene could arise from PAHs through a complete loss of their H atoms (Bernè & Tielens, 2012, PNAS, 109, 401) or from graphite through fragmentation (grain-grain shattering). Both quantum-chemical computations and laboratory experiments have shown that the pi-pi* electronic transitions cause a strong absorption band near 217.5nm (Trevisanutto et al. 2010, Phys. Rev. B, 81, 121405; Nelson, et al. 2010, Appl. Phys. Lett., 97, 253110). We calculate the UV absorption of graphene and place an upper limit of ~7 ppm of C/H on the interstellar graphene abundance. We also model the vibrational excitation of graphene in the ISM. Graphene is stochastically heated by single photons and undergoes temperature fluctuation in the ISM. We calculate its IR emission spectra following its vibrational excitation and radiative relaxation. We also derive the abundance of graphene in the ISM by comparing the model emission spectra with that observed in the ISM.