

The Mass of Dust in the Crab Nebula: RT Models with Smooth and Clumped Dust Distributions

Patrick J. Owen (Department of Physics and Astronomy, University College London)

Michael J. Barlow (Department of Physics and Astronomy, University College London)

There has been increasing interest in core-collapse supernovae as a source of dust in galaxies, particularly at very high redshifts. Recent Herschel and Planck observations of the Crab supernova remnant have led to estimates of the mass of dust present lying between 0.10-0.24 Msun (Gomez et al. 2012). This estimate was based on simple silicate and carbon dust models that fitted the observed infrared dust continuum emission with two temperature components. Since the Crab Nebula is known to contain many dense filaments and clumps, it seems desirable to test the robustness of these dust mass estimates with more realistic modelling. Unusually for a supernova remnant, the Crab is a photoionized nebula, which has allowed us to construct a series of photoionization and dust radiative transfer models which fit the continuum energy distribution and line emission of the Crab, to enable us to provide limits on the total mass of dust present. These models utilise both smooth and clumped spatial distributions for the dust and gas, power-law grain size distributions with a range of minimum and maximum grain radii, and UV-IR optical constants for a range of grain species that are potentially present. This mass of dust is dependent on the optical constants used and the degree of clumping. The mass of dust in the Crab Nebula is found to be between 0.1-0.3 Msun for unclumped models and 0.4-0.6 Msun for clumpy models. Using the parameters taken from Temin and Dwek 2013 (arXiv:1302.5452) we were unable to obtain a reasonable fit to the observed SED.