Blake Miller, Physics and Mathematics

Year in School: Senior
Faculty Mentor: Dr. Angela Speck, Physics

Episodic mass loss on the timescale of thermal pulses: Radiative transfer modeling

Using far-infrared observations obtained from the Infared Space Observatory (ISO), we have discovered extremely large dust shells around two post-AGB stars (AFGL 2688 and AFGL 618; Speck, Mexiner & Knapp 2001). These circumstellar shells contain the fossil record of their previous AGB mass loss. The radial profiles of these dust shells suggest that episodic mass loss has occurred with mass-loss enhancements on timescales corresponding to theoretical predictions of thermal pulses on the AGB. By modeling the dust emission, we can constrain how the mass-loss varies as stars evolve on the AGB, which will constrain the mass-loss mechanisms. Furthermore this modeling allows the determination of the density distribution of the dust around the protoplanetary nebulae as a function of radius. By assuming spherical symmetry we calculate the total mass of the dust envelope and using a canonical dust-to-gas ratio we estimate the total mass lost by the stars and thus get a lower limit for the mass of the progenitor star. However, modeling such large dust shells is not trivial. Previous studies of very large circumstellar shells (e.g. Young, Phillips & Knapp 1993; Gillett et al. 1986) showed that most of the outer shell is heated by the interstellar radiation field rather than the central star. Therefore using radiative transfer models with only the central star heating the dust in unrealistic. We present preliminary results of modeling these very large dust shells using a version of the 1-d radiative transfer code DUSTY which includes external heating by the interstellar radiation field.