Public Abstract

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Title: Extremely extended dust shells around evolved intermediate mass stars, tracing the history of mass loss and stellar evolution.

Intermediate mass stars enter the Asymptotic giant branch (AGB) phase and suffer mass loss which leads to the formation of a circumstellar shell of gas and dust. At the end of the AGB phase, a star develops a superwind that leads to the exhaustion of the outer stellar envelope. Then the star evolves off the AGB and becomes a protoplanetary nebula (PPN) for short time ~ 1000 years.

At this stage the mass-loss has significantly decreased or stopped, and the circumstellar shell begins to drift away from the star. When the stellar core evolves to high enough effective temperatures to produce photo-ionizing radiation, the circumstellar dust shell gets ejected (to the interstellar medium) and the star becomes a planetary nebula (PN). If the velocity of the AGB wind has been relatively constant, then dust furthest from the star represents the oldest mass loss, while material closer to the star represents more recent mass loss. Hence, the history of mass loss during the AGB phase is imprinted on the dust shells of AGB and post-AGB envelopes.

We studied the distribution of matter using the analysis of linear map scans derived from far infrared image observations taken from space observations in the far infrared using ISOPHOT (Infrared Space Observatory Photo-polarimetry PHTC 32 camera) in order to determine a) the history of mass loss, and b) to measure the total mass of the circumstellar dust. From our results, we determined the lower limit to the initial mass of the progenitor star.

The results indicate intermediate mass stars (like our Sun) will form very large dusty shells ($\sim$ radius from the sun to Jupiter) that is critical in driving the mass loss from the star. The dust masses are very small compared to the gas, however this dust subsequently causes the star to lose more than 40% of its mass. The time scales of the mass loss since these stars began losing mass on the AGB phase are within approximately $\sim 10\,000$ of years.

Studying thermal emission from circumstellar dust in this thesis, allowed us to compare our results with those of theories of stellar evolution. As a result we achieved a better understanding of mass loss and the re-cycling of material to the galactic environments where new generations of star and planets are formed.