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Modelling dust in the Nearby Evolved Star Survey (NESS) targets

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The Nearby Evolved Stars Survey (NESS) is a multi-telescope project targeting a volume-limited ($d < 2$ kpc) sample of ∼400 evolved stars, including 104 oxygen-rich stars (including ∼20 red supergiants), 8 S-type stars, and 19 carbon-rich AGB stars, as well as many post-AGB stars and planetary nebulae. NESS includes a 500-h ongoing JCMT survey of dust continuum as well as CO (2-1) and (3-2) line emission. The NESS JCMT data facilitate the determination of the circumstellar dust distribution and estimation of the mass-loss history in the circumstellar shells, including any deviations from spherical symmetry (Dharmawardena et al., in prep). Radiative transfer models of this dust must update fits to mid-infrared spectral energy distributions (SEDs) to fit the far-IR and sub-mm information, and should reproduce the results from JCMT observations.

In this poster, we present preliminary results of modelling dust in W Hya and U Ant, whose shells show complex structures that can not be fully explained by a uniform mass-loss rate model. NESS data has revealed U Ant's detached shell for the first time in the sub-mm continuum (Dharmawardena et al. in prep). We first fit the mid-IR SEDs with models from the GRAMS grid (Sargent et al., 2011; Srinivasan et al., 2011), tacitly assuming spherical symmetry. Using these models as a starting point, we use the radiative transfer code 2Dust to explore ranges of parameters that will reproduce the radial profiles as determined by Dharmawardena et al. (in prep), including any evidence of detached shells and/or variable mass-loss rates.

These models are the first step towards detailed modelling that incorporates data from optical through sub-mm SEDs and spectra, as well as other data such as interferometric visibilities. Modelling the large number of AGB stars targeted by NESS will lead to robust estimates of dust-production rates across the entire range of evolutionary stages along the AGB. Combined with modelling of the NESS CO line data, these can also be used to determine the gas-to-dust ratio throughout the circumstellar shell for the entire sample.

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Yes

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