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Constraining the presence of large dust grains in post-AGB disc systems using FIR and sub-mm photometry

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The final stages of the evolution of intermediate mass stars ($M \sim 1 - 8 M_{\odot}$) are characterised by the ejection of their envelope as they evolve off the Asymptotic Giant Branch (AGB), producing a spectacular planetary nebula (PN). In particular, this phase is characterised by the development of strong asymmetries in the circumstellar medium, with a large fraction of PNe and pre-PNe hosting jets, tori, rings or bipolar structures, while many AGB envelopes are broadly spherical in shape. These asymmetries are, therefore, believed to develop either in the final phase of AGB evolution or in the initial post-AGB phase. In a small fraction of cases, post-AGB stars are found to be orbited by a massive, dusty circumstellar disc. Other types of circumstellar discs, such as protoplanetary and debris discs, are typically populated by dust grains at least up to mm sizes, as probed by the spectral index in the FIR and (sub-)mm wavelength ranges. In protoplanetary discs (PPDs), the existence of these large dust grains is believed to be linked to grain-growth processes which can take place in such dense, long-lived discs. There is also evidence for the presence of grains of such sizes in the discs in post-AGBs in spite of the large difference in lifetime compared to PPDs. However, to date such studies have either been relatively small, or the samples used have combined both post-AGBs with discs with pre-PNe and other objects, making it difficult to evaluate the prevalence of grain growth. I will present the largest study to date of the FIR and sub-mm emission of post-AGB stars with discs. By exploiting archival Herschel/SPIRE photometery along with new SMA observations and literature fluxes of a sample of 45 post-AGBs with discs we show that grain-growth to at least several hundred micron is ubiquitous in these enigmatic systems. The similarity of the distribution of spectral indices to those of protoplanetary discs indicates that this is a result of in-situ grain growth, rather than the grinding of parent bodies. The relatively short lifetimes of these discs show that grain growth to these sizes is a rapid process, occurring on timescales of only a few kyr.

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Yes

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