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Formation and interaction of nano dust in planetary debris discs

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The circum-stellar planetary debris discs are typically observed by thermal emission in mid-infrared and located at large distance from the star, comparable to the solar system's Kuiper belt. They are produced by fragmentation of small objects and dust-dust collisions, but with higher rates and the dust clouds are denser than in the solar system. Most of the small dust particles are pushed away from the vicinity of the star by radiation pressure. Some stars, however, reveal thermal emission spectra that suggest the existence of dust relatively close to the star, denoted as hot debris discs (Absil *et al.* 2013; Su *et al.* 2013, 2016). To explain the observations, some authors consider trapping of nanodust by the stellar magnetic field (Su *et al.* 2016), a process that we previously found for the dust in the vicinity of the Sun (Czechowski & Mann 2010).

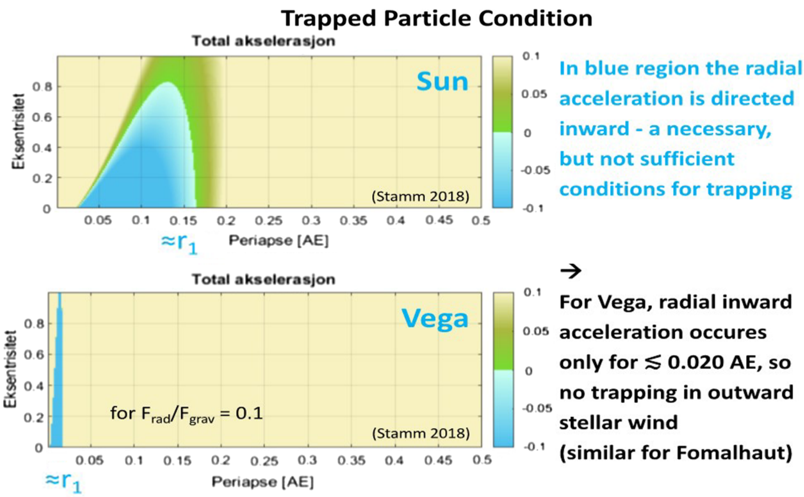

Figure 1. Comparison of the nanodust trapping for Sun and Vega. The blue area in the eccentricity-periapsis plot indicates orbital parameters where trapping is possible (from Stamm 2018).

We here discuss the cases of Vega and Fomalhaut. From trajectory calculations we find that the trapping conditions are different from the case of the Sun and that a hypothetical trapping zone would only occur for a small range of orbital parameters in the very close vicinity of the star (see Fig. 1). Our estimate is based on applying a Parker-type magnetic field model (Stamm 2018) to the conditions of Vega and Fomalhaut, as well as radiation pressure force which for both stars is larger than gravity. Other groups find trapping based on a different magnetic field model. We also consider the thermal emission brightness that was brought up as another argument to support the existence of nm-sized dust. We find that the brightness observations can be explained with a dust component within 1 AU around the stars and with dust sizes below micrometer (Myrvang 2018).

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