Project Title: The source of CO in debris disks

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Project Description:

Recent observations of many debris disks around main-sequence stars point out the presence of a CO gas cloud embedding faint dust disks. The ages of the central stars suggest that all the pristine gas and dust has been already dissipated by the stellar winds and drag forces. One of the current explanations is that the observed CO is a signature of cometary activity, occurring while comets are undergoing collisions with forming planetesimals, thus refurbishing the disk of the debris products of the collisions. However, recent models of cometary activity, based on the data collected by the Rosetta mission at comet 67P, suggest that the lifetime of just-formed comets is much shorter than the collisional lifetimes at the star distances where CO is observed. The only way for a comet to survive is to be stored in Oort-like clouds at distances >85au from a Sun-like central star, where collisions become negligible and the erosion of the nucleus driven by CO is inhibited by the CO pressure at the nucleus surface lower than the cohesive forces bonding the material making-up planetesimals. In this context, the observed CO would be a fossil gas cloud embedding the disk and slowly dissipating in time. The CO and debris production (via cometary CO-driven erosion) to the disk dust would then be limited to distances of 85au from a Sun-like central star and to the first 50 kyr after the protoplanetary disk became transparent to stellar UV radiation. The proposed PhD thesis should check if the features observed in the CO-rich debris disk are consistent with this scenario, comparing the outcomes of collisional models with those of CO fossil disks, to be yet modeled in detail. As a first step, CO-rich disks with a structure inconsistent with input of collisional debris (e.g. without evidence of formed Neptune-like planets, which excite orbits of comets and

Plutos, thus triggering collisions) may be preferred, for which fossil CO may be the only actual input consistent with observations. The project is being carried on in collaboration with Prof. F. Marzari (Padova Univ.) and Dr. Maria Teresa Capria (INAF-IAPS).