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Coupling the dynamical and collisional evolution of dust protoplanetary and debris disk

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Abstract

Numerous observed circumstellar disks are believed to be both dynamically and collisionally active. Unfortunately planets and large bodies that could be embedded in are still difficult to observe and their putative properties are indirectly inferred from the observable dusty content. It is why constraining the size distribution coupled with dust-dynamics is so critical. Unfortunately, coupling effects such as a realistic time-dependant dynamics, fragmentation and coagulation, has been recognized as numerically challenging and almost no attempt really succeeded with a generic approach. In these disks, the dust dynamics is driven by a variety of processes (gravity, gas drag, radiation pressure, Poynting-Robertson effect etc..) inducing a size-dependant dynamics, and, at the same time collisional evolution induces a progressive change of the local size distribution. These two effects are intimately coupled because the local dynamics and size-distribution determines the local collision rates, that, in-turn, determines the size-distribution and modifies the particle's dynamics.
Here we report on a new algorithm that overcomes these difficulties by using a hybrid approach extending the work of Charnoz & Morbidelli (Icarus, 2004, 2007). We will briefly present the method and focus on : (1) gaseous protoplanetary disks either laminar or turbulent (the time dependant transport and dust evolution will be shown) and (2) post-planetary disks with or without planets in which we will map the regional size distributions of micrometer dust.
Figure 1: This is the example of an included figure.

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