Overcoming the barriers to planetesimal formation at low dust-to-gas ratio

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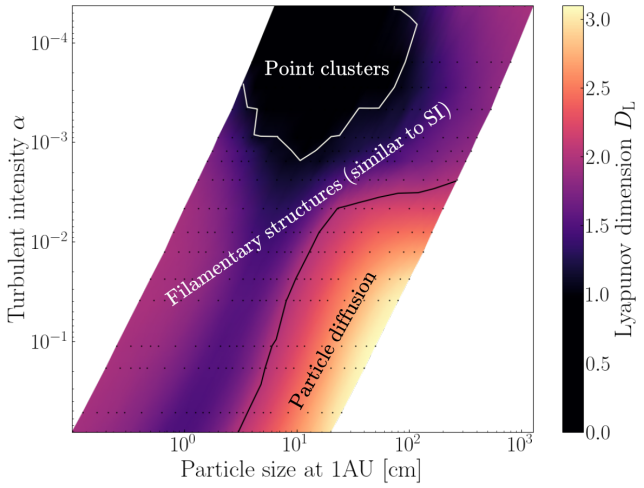
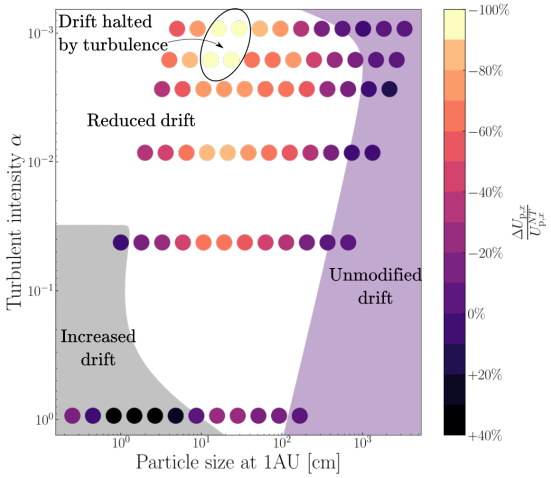
In the incremental growth model to planet formation, planetesimal formation constitutes the least understood step. The two main difficulties in this regard are the collision/fragmentation and the drift barriers. Numerous solutions have been proposed to overcome these barriers, with streaming instability (SI) being a particularly salient example. This process enables the concentration of solids up to gravitational collapse, but it does so require a high dust-to-gas ratio. In this presentation, we will share the outcomes of our 2D shearing box numerical simulations, in which we have fully captured different scales of turbulence rather than modeling it with a turbulent diffusion or turbulent viscosity parameter. Our results demonstrate that, when the turbulent cascade is taken into account, and especially in the case of weakly turbulent disks,

— the solid grains, even at arbitrary low dust-to-gas ratio, can be highly concentrated in either point or filamentary structures (left figure)
— and their radial drift can be slowed or even halted by the gas turbulent motion (right figure).

The objective of this presentation is to offer a reinterpretation of the work of Gerosa et al. (2023; 2024) highlighting its significant implications for the formation of planetesimals.





Références

Gerosa, F. A., Bec, J., Méheut, H., & Kapoor, A. U. 2024, Astronomy & Astrophysics, 685, L4

Gerosa, F. A., Meheut, H., & Bec, J. 2023, EPJPlus, 138, arXiv :2210.13147