Contribution ID: **14** Type: **Poster**

Dust evolution in prestellar dense cores

Dust grains plays an essential role in many fields of astrophysics. In particular, they are the main charge carriers during the protostellar collapse and as such, control the evolution of angular momentum [1,2]. In addition, they are the fondamental bricks for the formation of planetesimals and planets [3].

Firstly, we perform single-zone simulations including a complex chemical network to study the collapse of a dense core accounting for dust coagulation and fragmentation. We find that magnetic resistivities are highly sensitive to the population of small grains, which are rapidly depleted via ambipolar drift. This results in a very high ambipolar resistivity producing large protoplanetary disks as magnetic braking is rendered inefficient. Since disks are observed to be rather small in size [4], we identify two mechanisms to preserve the small grains and thus alleviate this tension: grain-grain electrostatic repulsion and erosion [5].
Secondly, we perform 1D simulations of magnetized dust in a turbulent magnetized medium reproducing dense core environments, making a full treatment of both the gas and dust dynamics. Turbulence is driven on large scales. We use a sophisticated non-ideal MHD approach including charged dust grains, neutral gas and ions. We observe high levels of dust concentration driven by magnetic effects. The parametric instability [6] is triggered in the dust in shocked regions, producing long-lived dust clumps and dust density enhancements of a factor of 10 to more than 100 [7]. Those clumps persist over time owing to the cold and pressureless nature of dust. This has interesting implications for dust growth in prestellar envelopes. Recent observations suggest the presence of $100\ \mu\mathrm{m}$ grains in such environments [8]. Using an analytical model for dust growth, we find it to possible to form in-situ large grains by pure means of coagulation in a reasonable amount of time provided that the local dust-to-gas ratio $\epsilon \geq 10\%$. Such dust density enhancements are achieved via the novel mechanism previously mentioned.

References :

[1] Zhao B., Caselli P., Li Z.-Y., Krasnopolsky R., Shang H., Nakamura F., 2016, MNRAS.

[2] Hennebelle P., Commerc¸on B., Lee Y.-N., Charnoz S., 2020, A&A.

[3] Testi L., et al., 2014, in Beuther H., Klessen R. S., Dullemond C. P., Henning T., eds, Protostars and Planets VI. p. 339.

[4] Maury, A. J., André, P., Testi, L., et al. 2019, A&A, 621, A76.

[5] Vallucci-Goy, V., Lebreuilly, U., and Hennebelle P., 2024, A&A, 690, A23.

[6] Del Zanna, L., Velli, M. and Londrillo, P., 2001, A&A, 367.

[7] Vallucci-Goy V., Hennebelle P., Lebreuilly U. and Verrier G., A&A submitted.

[8] Galametz, M., Maury, A. J., Valdivia, V., et al. 2019, A&A, 632, A5.

Primary author: VALLUCCI-GOY, Valentin (CEA Saclay)

Presenter: VALLUCCI-GOY, Valentin (CEA Saclay)

Session Classification: Session 1a