Large timescale simulations of embedded protoplanetary discs

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Résumé

Protoplanetary discs are expected to be the birthplace of planets around forming protostars. In the early class 0/I stages of their evolution, they are embedded in an infalling envelope, remnant of the collapse phase, that makes them difficult to observe. They are therefore poorly constrained compared to the late class II stage, where the envelope is mostly depleted. However, with the latest generation of instruments, we are now able to probe earlier and earlier on the evolutionary track of protoplanetary discs, thus raising new questions.
For instance, the detection of potential planets in young discs suggests that their formation is triggered during earlier stages, eventually when the disc is still embedded. On the other hand, the observation of outflowing material that exhibits a conical morphology questions about the outcome of the interaction between this outflow and the infalling envelope. Finally, the magnetic field being a suitable ingredient for the launching mechanisms, its secular evolution might considerably affect the disc.

So much perspectives that make it crucial to understand how the disc is shaped by its surrounding during this primitive phase where interactions are likely to be the strongest. While observations of class 0 systems are still lacking to provide answers, serious models of core collapse simulations have already contributed to the comprehension of this hidden stage. In this talk, I will present recent 3D simulations of embedded protoplanetary discs, starting from the collapse stage and designed for a large timescale integration. I will first discuss my implementation of an iterative self-gravity solver in the new finite volume, GPU-accelerated code *Idefix*, and I will then introduce the secular evolution properties of the models I have computed.

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