Formation and saturation of non-axisymmetric features in protoplanetary discs

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Young class II discs are known to host favourable conditions for the formation of disc substructures. Indeed, they are often massive enough that gravitational instability (GI) is triggered. However, this instability usually saturates to a marginally stable state, with Toomre criterion $Q \approx 1$. However, even discs stable to the GI with $Q > 1$, remain unstable to non-axisymmetric perturbations under their own gravity, leading to the creation of structures like spirals. These spirals shocks contribute to angular momentum transport and accretion in the disc, and depending on the local cooling they may also collapse to denser substructure, eventually leading to planet formation. Here I use the GPU-accelerated finite-volume code Idefix to probe at very high resolution the local properties of the transition to a spiral dominated protoplanetary disc and the saturation phase from an initially stable axisymmetric disc.