Fragmentation in Kinematically Cold Disks

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Gravity is scale free. Thus gravity may form similar structures in self-gravitating systems on different scales. Indeed, observations of the interstellar medium, spiral disks and cosmic structures, reveal similar characteristics. The structures in these systems are very lumpy and inhomogeneous. Moreover some of these structures do not seem to be of random nature, but obey certain power laws.
Models of slightly dissipative self-gravitating disks show how such inhomogeneous structures can be maintained over several galaxy rotations. The basic physical processes in these models are self-gravity, dissipation and differential rotation. In order to explore the structures resulting from these processes on the kpc scale, local simulation of self-gravitating disks are performed in 2D and 3D. The third dimension becomes important as soon as a strong matter clumping causes a tight coupling of the 3D equations of motion.
In order to assess the general relevance of the underlying physical processes we check if they can account for self-similarity. We observe persistent patterns, formed by transient structures, whose intensity and morphological characteristic depend on the dissipation rate. Moreover some of our simulations reveal first signs of power-law relations.