Observing substructure in circumstellar discs around massive young stellar objects

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Simulations of massive star formation predict the formation of discs with significant substructure, such as spiral arms and clumps due to fragmentation. Here we present a semi-analytic framework for producing synthetic observations of discs with substructure, in order to determine their observability in interferometric observations. Unlike post-processing of hydrodynamical models, the speed inherent to our approach permits us to explore a large parameter space of star and disc parameters, and thus constrain properties for real observations. We compute synthetic dust continuum and molecular line observations probing different disc masses, distances, inclinations, thermal structures, dust distributions, and number and orientation of spirals and fragments. With appropriate spatial and kinematic filtering applied, our models predict that ALMA observations of massive YSOs at <5 kpc distances should detect spirals in both gas and dust in strongly self-gravitating discs (i.e. discs with up to two spiral arms and strong kinematic perturbations). Detecting spirals will be possible in discs of arbitrary inclination, either by directly spatially resolving them for more face-on discs (inclinations up to ~50 degrees), or through a kinematic signature otherwise. Clumps resulting from disc fragmentation should be detectable in the continuum, if the clump is sufficiently hotter than the surrounding disc material.

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