The ALMA-IMF large observational program

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The origin of stellar masses, arguably the most central question in star formation remains a major open issue in modern astrophysics (see review by, e.g., Ballesteros-Paredes et al. 2020). The main goal of the ALMA-IMF Large Program (PIs Motte, Ginsburg, Louvet, & Sanhueza) is to determine how the origin of the initial mass function (IMF) is in fact dependent on cloud characteristics or not. Thanks to its unmatched angular resolution, sensitivity, image quality, and excellent frequency coverage, we used ALMA to survey 15 massive protoclusters, covering a wide variety of Galactic environments and evolutionary stages (Motte et al. 2022).
Our pilot study and preliminary ALMA-IMF results (Motte et al. 2018a; Pouteau2022; Louvet et al. in prep.) show that the mass distribution of cores (CMFs) in these typical yet extreme environments of the Milky Way present an excess of high-mass cores with respect to the canonical IMF (e.g., Kroupa et al. 2013). A detailed study of two contiguous protoclusters, W43-MM2 and W43-MM3, which are at different evolutionary stages suggests that the CMF deviates from the canonical IMF form when and where a burst of star formation develops (Pouteau et al. subm.). The CMF would thus strongly depend on environmental parameters and may lead to non-universal stellar IMFs and heterogenous, potentially mass-segregated spatial distribution of stars. In addition, we compare the CMF of prestellar (i.e. starless) cores and protostellar (i.e. currently forming stars by gravitational collapse) cores and prove that the relationship between the CMF and IMF should be revised because, in the case of intermediate-to-high-mass star, the prestellar phase is evanescent if it exists at all (Nony et al. subm.).

The ALMA-IMF Large Program therefore has the potential to transform our understanding of the IMF origin. It also provides the community with an unprecedented database (Ginsburg et al. 2022; Cunningham et al. in prep.) with high legacy value for protocluster clouds (60 pc^2 at 2000 AU resolution), cores (about 1500 cores with 0.15-250 M_{sun} masses), many of which associated with outflows, filaments (hundreds of star-forming filaments), often tracing gas inflows, and hot cores (several tens of hot cores).

Références

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