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Sergio Molinari - Galaxy-wide star formation: zooming in from panoramic Galactic Plane surveys to 1000au-scale with ALMA (Review Invited)

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The process of star formation is governed by the interplay of often competing physical agents such as gravity, turbulence, magnetic fields, and radiation. The ISM is organized in a hierarchy of scales, that connect the disk of the Milky Way as a whole, through filamentary atomic/molecular star-forming clouds to dense and fragmenting clumps, and eventually to cores and protoplanetary disks. At the same time, the momentum and energy input from stars, in form of radiation, winds and supernovae, creates highly non-linear feedback loops that strongly influence the behavior of the system across the entire cascade of scales. This depicts the Milky Way as a complex ecosystem where dramatically different environments coexist and where varying conditions are found for star and planet formation, and ultimately for life. Exploring and understanding our Galactic ecosystem as well as the physical processes that govern its evolution is the primary research goal of the ECOGAL Project, in which observations and numerical simulations come together to address fundamental questions about: i) how the different phases of the ISM form and evolve, ii) identify the processes that govern the build-up and fragmentations of dense filamentary clouds, iii) what are the agents responsible to drive the mass flow through spatial scales onto the dense parsec-scale clumps, and finally iv) what are the physical processes governing the clump-to-core fragmentation, how do cores gain their mass and how they evolve with time. In a zoom-in view from the Galactic disk, down to the 1000au scale where dense cores are resolved, I will present an overview of the preliminary results that ECOGAL is obtaining by joining forces between large-scale atomic, molecular lines and far-infrared Galactic single-dish surveys, with statistically significant ALMA surveys. In particular I will present a first overview of the results of the ALMAGAL large project, a “statistical” survey of 1000 dense ($> 0.1 \text{ g/cm}^2$) and massive ($M > 500 M_{\text{sun}}$) parsec-scale clumps resolved at a minimum linear scale of 1000au, sampling the full evolutionary path from IRDCs to UCHII regions from the tip of the Galactic Bar to the Solar circle and beyond. I will conclude with some perspectives about ongoing numerical modelling campaigns and possible future surveys with MeerKAT/SKA, proposed balloon-borne far-infrared polarimetry and more.

Session Classification: Milky Way