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"Milky Way dynamics and evolution with Gaia"

Thanks to the large amount of data delivered by the Gaia satellite and their excellent precision, in the recent years we have experienced a vertiginous progress in the studies of our Galaxy. I will talk about how the exploration of the positions and velocities of stars (phase space) is helping us to unravel the dynamics and evolution of the Milky Way. One of the most interesting findings is the discovery of the phase-spiral in the stars around the Sun, which indicates that the disc was perturbed around 300-900 Myr ago, matching current estimations of the previous pericentric passage of the Sagittarius dwarf galaxy. This finding challenges the most basic premise of stellar dynamics of dynamical equilibrium. Most likely, our Galaxy is being perturbed both by internal mechanisms such as the bar and the spiral arms, and the interaction with its companion galaxies such as Sagittarius. These recent Gaia results mark the start of a new era when, by modelling the richness of phase space, we can determine the gravitational potential of the Galaxy, its time evolution and the characteristics of the perturbers that have most influenced our home in the Universe. But at the same time, the complexity of the processes involved require that we progress much faster in our dynamical modelling considering disequilibria and self-gravity.