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Decoding the local star formation scenario with the Besançon Galaxy Model.

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Abstract

The recent full sky large data surveys (e.g. Gaia data release 2) represents a challenge for the Galaxy modelling and requires new frameworks and tools to deal with huge amounts of data. We developed a new strategy to infer, all at once, the parameters describing the local star formation history (SFH), the initial mass function (IMF) and the density laws of the Galactic thin disc component by comparing synthetic versus observed colour-magnitude diagrams. The developed framework combines both the generation of Besançon Galaxy Model fast approximate simulations (BGM FASt; [1]) and approximate Bayesian computation methods, to obtain a posterior probability distribution function of the inferred parameters. A robust mathematical development and the adequate codification, using Apache Spark and Apache Hadoop environments, make BGM FASt about 10^4 times faster than the standard Besançon Galaxy Model and specially suited to deal with huge data sets.
From the analysis of Tycho-2 colour-apparent magnitude diagrams we want to spotlight the resulting thin disc SFH with a decreasing trend and a present rate of star formation of $1.2\pm0.2 M_{\odot}/yr$. It is known that in the colour-apparent magnitude diagrams, as the distance of the star is not taken into account, the position of giants and main sequence stars are degenerated . Additionally we estimate, using the Besançon Galaxy Model, that the position of old stars (ages$> 8Gyr$) is mixed with stars with masses larger than $1.53 M_{\odot}$. This lack of information of the intrinsic brightness of the stars is a clear handicap when aiming to derive the local IMF and SFH from the population synthesis side. Gaia parallaxes are very valuable to infer the intrinsic brightness of the stars and brake some of this degeneracies. Gaia parallaxes, colours and magnitudes represents an unprecedented opportunity to constrain the IMF and the SFH using BGM FASt. (See poster).

References

[1] Mor, R. and Robin, A. C. and Figueras, F. and Antoja, T., 2018, ArXiv e-prints, arXiv:1809.03511