The Besancon Galaxy Model, a Population Synthesis Tool for Galactic Structure and Evolution Studies

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Abstract

Understanding the Milky Way structure and evolution is a major objective in astrophysics. Our Galaxy is an object of highest interest for learning about galaxy formation and evolution in general. Many data of different kinds (photometry, astrometry, spectroscopy) are available for millions of stars in the Milky Way, which interpretation in terms of evolution is not easy. Stars in the Milky Way have been recognized to be part of several populations with typical characteristics and spatial distributions, such as the disc, the halo and the bulge, which shape the overall Galaxy and classify it as a barred spiral galaxy.

We present here an approach for understanding the Galaxy by simulating stars in these various populations. The population synthesis scheme is used to simulate a scenario of formation of the Galaxy. It allows to confront such scenario with real data. It is used to prepare new observations (define the best protocole of observations to answer a given question) and to interpret observations in terms of Galaxy structure and evolution. The main hypotheses to build the model are based on up-to-date knowledge on stellar evolution models, grids of atmosphere models, and galactic dynamics. Many parameters are needed, but the availability of many sources of data allow to constraint step by step theses parameters. The model produces simulations at a variety of wavelengths from X rays to mid infrared. It has been confronted to large scale surveys, ground based (Sloan Digital Sky Survey [1], 2MASS near-infrared sky survey [2], among others), and space based surveys (GALEX UV telescope, Hubble Space Telescope, etc.). It has been successfully used to constrain galactic structure parameters [3, 4], such as the disc scale length, scale heights, bar structure, halo shape, and evolution parameters such as the star formation history [5] in the solar neighborhood. It is also a useful tool to prepare future surveys, in particular the Gaia mission launched by the European Space Agency in December 2013, or further projects like PLATO and EUCLID.

The model simulator is available through a dedicated web interface, which allows the users to run the model and prepare their own simulations for direct comparisons with real data. The simulations are computed on the cluster of the Institut UTINAM and deposited on the ftp server. VOTable and ascii format are available for these simulations. Further developments are envisaged for the web service, such as a data base of simulations, and a service for bayesian stellar classification. We shall present various applications of the simulations in the different astrophysical domains.

References

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