MW-Gaia STSM

Modelling the Milky Way using BGM and Gaia and applications for future missions

Dr. Annie Robin from Observatoire de Besançon (France) spent two weeks (7-25/03/2022) at the University of Barcelona STSM grant to collaborate with Dr. Fancesca Figueras and her collaborators. Different subjects were discussed and useful progresses were done relative to the Galaxy modelling using the Besancon Galaxy Model (hereafter BGM).

Analysis of Gaia data and the warp modelling was discussed with Merce Romero Gomez, Maria Monguio and a PhD student, considering how it is seen in different data sets, in different tracers with different ages. We noticed significant differences in the literature about how the warp shape depends on the age of the tracers, sometimes the conclusions being inconsistent. The team has undergone new studies with other tracers to solve these questions (shape of the warp, asymmetry, precessing of the line of node, etc.) using eDR3 and test particle simulations. We discussed how to take advantage of this new study to revise the BGM warp model. With Francesca Figueras and other colleagues we widely discussed a new version of the Besancon Galaxy Model with self-consistent dynamics that benefited from Gaia data. We also discussed perspectives of this new model to exploit future Gaia catalogues, by computing orbits from the new potential. The UB team is participating in the OCRE initiative (https://www.ocre-project.eu/) with the awarded project « Galactic Research in Cloud Services », that aims to provide an alternative environment for Gaia scientific exploitation that can take advantage of the scalability and configuration on-demand provided by the commercial Cloud services. One of the three pilot projects aims at running the code BGM-Fast on a cloud environment to evaluate, among others, if the star formation history in the last 6-7 Gyrs is driven by the interaction of the MW with the Sagittarius satellite galaxy (see Mor et al., 2019). The use of the BGM-Fast Galaxy Model in a Spark cluster using more than one thousand CPUs will be a good example of the scalability and the agility of Commercial Cloud Services. We discussed this project and how the BGM-Fast code should be implemented by the engineers to run both on the Microsoft cloud, and on Mare Nostrum in parallel, to validate that results are consistent on different environments. This project is just started and should continue in the coming months. The code being nearly in place, the next step, to be discussed by telecon, will be to define the data sample necessary for its scientific objectives. Barcelona team starts to be involved in the GaiaNIR project for a launch of a telescope similar to Gaia, but observing also in the near-infrared (possibly under « Voyage 2050 » ESA plan), as well as in the Euclid mission. With Eduard Masana and Francesca Figueras, we studied the way that the GOG simulator of the Gaia mission could be used for providing realistic simulations for both missions.

Description of the STSM main achievements and planned follow-up activities

During our discussions on how BGM and GOG simulations can be used for future missions, GaiaNIR and Euclid, we have identified some modifications in the simulators to allow faster simulations in the near-infrared (NIR) and at much deeper magnitude limits than Gaia. Eduard Masana already did some computations with GOG in the NIR in a few regions with different stellar densities. The CPU time appears to be much too high if using the GOG simulator for a wide part of the sky. After discussions, it appears that the BGM and its implementation in GOG could be efficiently used only if an adaptation of the computation of the Hess diagrams is done specifically for the near-infrared bands. Therefore, the plan is to study this option in the coming months. Subsequent teleconf are planned to follow the progresses in this regard. A specific requirement for Euclid concerns a realistic simulation of binaries. This is also a concern for GaiaNIR. The statistics should be revisited at the light of new Gaia data. A student is involved in analysis of binaries, both resolved and unresolved, in open clusters. Depending on the results, a modification can be done in the formula used. However, we verified that there is no need for consequent code modifications, but just a probable update of the statistics. Another important issue for this project will be the 3D extinction maps. We discussed the extinction model that has been used in GOG simulations and how to revise it. The publication this month of the new 3D map of Lallement et al (2022), based on Gaia eDR3, seems a very good opportunity for this purpose. We decided to use it, when available on line on the web site https://explore-platform.eu, or to ask directly to Rosine Lallement for a data file with the required format and spatial resolution adapted to our needs. The format will be similar from the previous Lallement et al (2019) map. Therefore, there is no significant modifications to make on the code. Specific verification tests will be necessary to validate the new map specially because the spatial resolution now depends on latitude and longitude. The Action « Revealing the Milky Way with Gaia » gave a successful contribution to our project, in relation with the working packages WG1/WG2. It allowed also significant informal discussions with master and PhD students, and active participations to seminars. To pursue our collaboration between Besnçon and Barcelona, we have planned monthly meetings (remotely) in order to follow the progresses on our projects, particularly for the OCRE European project, and for GaiaNIR and Euclid simulations.