Do interactions erase the relics of galactic archeology?

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Under the gravitational influence of the Milky Way, satellite galaxies and globular clusters lose their stars along elongated stellar streams in the halo of our Galaxy. These stellar streams are then one the rare luminous objects found in galactic halo, making them unique probes of the assembly and contents of the Galaxy. Streams are relics of the highest importance in studies of galactic archeology and of the still-unknown nature of dark matter.

The number, morphologies, and properties of streams are directly affected by the details along the formation history of the Milky Way. With the advent of precise and deep astrometric surveys like Gaia, and spectroscopic programs like APOGEE, and many more to come (e.g. WEAVE, 4MOST, MOONS), we are accumulating unprecedented volumes of observational data. It is now time to translate this wealth of information into scenarios of the formation and assembly of our home Galaxy. However, this task is made complicated by the multiple degeneracies between observed features and their possible causes. Simulations are the only way to lift these degeneracies, by precisely cataloging and quantifying the observable effects of each event along the history of the Milky Way.

In the last decade, many theoretical efforts have proposed possible connections between observables in streams (e.g. morphology, kinematics) and properties of the present-day quasi-static Milky Way (e.g. the presence of a bar and of sub-halos). However, we know that galaxies in general and our Milky Way in particular grow hierarchically, by interacting with their neighbors, but the effects of these collisions on the streams remain unknown. This hinders the interpretation and the decoding of the oldest structures, and strongly truncates our understanding of the origins of our Galaxy.

The aim of this PhD project is to look for signatures of past galaxy interactions in the stream population of the Milky Way, in order to push further the reconstruction of the Galactic history. To reach this goal, the candidate will first design, run, and analyze state-of-the-art numerical simulations where a young Milky Way-like galaxy hosting a pre-existing population of streams encounters another massive galaxy. The candidate will examine how the population of streams is affected by the interloper, and which signatures of this event could be detected (for instance in the distribution of orbital angular momentum). Several interaction scenarios will be explored, for completeness. Once this task is completed, the candidate will search archival data for the signatures they would have identified numerically. It is expected that the multidimensionality of the data (morphology, kinematic, stellar ages, chemical contents) will be key to the completion of this project, and thus the candidate will use the full extent of the available surveys. Going back-and-forth between observation and theory is essential to the success of the project.

This field of research is particularly active, with Strasbourg Observatory at its forefront. The candidate will benefit from one of the best and most stimulating environments in the world to conduct this project, and to connect their research to the wider context of galaxy formation and cosmology. Supervision will be carried jointly by Renaud (expert in galaxy formation and simulations) and Martin (expert in observational detection and characterization of streams). Access to HPC resources and archival observational data is already secured.