The role of Type Ia supernovae on the second generation formation in globular clusters

From both spectroscopic and photometric observations, it has been revealed that a fraction of globular clusters (GCs) host stars that show anomalous chemical composition with respect to field stars, which hints at the presence of multiple stellar populations (MPs). These anomalies are mainly seen when light elements are concerned and stars showing them are now assumed to be formed later than 'normal' stars. They are, therefore, labelled as second generation stars (SG). The origin of MPs in GCs is one of the most puzzling issues of stellar astrophysics. Many attempts have been done both from observational and theoretical studies to unveil the enigma of their formation but, so far, a clear picture is still lacking. In the upcoming years, new data will be available from ongoing surveys but also from new facilities such as James Webb Space Telescope. We will have access with unprecedented detail to the high-z Universe, where recent studies have detected systems likely being proto-GCs. By means of 3D hydrodynamic simulations, we study, for the first time, how the formation and the chemical properties of SG stars in a massive proto-GC are affected by Type Ia supernovae (SN) explosions, one likely cause for the quenching of star formation in these systems. Our work is one of the first wind-tunnel experiments where stellar feedback is taken into account and the first which studies the very early phases of GC formation. The role of Type Ia SNe in MPs formation is still a much debated topic given the large uncertainties on the timing of their explosion. In our model, the formation of SG stars starts 40 Myr after the cluster birth and is due to the retention of the fresh ejecta of first generation asymptotic giant branch stars plus accretion of cold, pristine gas. At the same time, Type Ia SNe start exploding, carving hot and tenuous bubbles in the interstellar medium. In this talk, I will focus on SNe Ia effects on the iron and helium abundances and study the role of various parameters in regulating the efficiency of Type Ia SN feedback. Finally, I'll discuss a possible avenue for the formation of Type II GCs, an anomalous sub-category of GCs known to exhibit an internal iron spread. HPC resources have been fundamental to perform all the simulation at high resolution. We have relied on a national call exploiting almost 2M core/hrs to perform all the runs. This work will be followed up by a broader series of simulations, which will be crucial to interpret the available observational data and to drive future observational studies. The understanding of the origin of MPs is, indeed, of great importance for many astrophysical issues. It will allow to put constraints on stellar evolution and nucleosynthesis, to understand how star formation works in the dense early universe, to unveil the role of stellar dynamics on the formation of exotic stellar objects like binary black holes responsible for the emission of gravitational waves,and to shed light on the role of proto-GCs in the cosmic reionization and in galaxy formation.