Population III Supernovae and the elemental composition of carbon-normal and carbon-enhanced metal-poor stars

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The first supernovae to explode in the Universe start the process of metal enrichment and have a major impact on early structure formation in the Universe. The metals and dust grains released and dispersed by the first supernovae change the cooling properties of the interstellar medium out of which second generation stars form, allowing the first low-mass and long-lived stars to form. Stellar archaeology of the most metal-poor stars observed in the halo of our Galaxy and its dwarf satellites is providing strong constraints on these early star formation and chemical enrichment phases. Yet, theoretical predictions have to rely on poorly constrained physical parameters, such as the mass of Population III stars and their physical properties. Here we present a systematic investigation of the metal and dust yields released by the first supernovae with the aim to reproduce the properties of the environment out of which the most metal-poor stars have formed. We used detailed pre-supernova and supernova explosion models for metal free stellar progenitors with mass ranging between 13 to 80 solar masses developed by Limongi e Chieffi (2012). Following Bianchi e Schneider (2007) we apply a steady state nucleation theory and grain growth and we take into account the evolution of newly condensed grains and their partial destruction through the passage of the reverse shock in the supernova remnants. Dust formation calculations are performed assuming both unmixed and uniformly mixed initial composition within the He core and varying the mass cut and the explosion energies so as to reproduce the observed elemental composition of carbon normal and carbon-enhanced metal poor stars. We discuss the mass and the composition of dust yields and the role of dust-induced cooling and fragmentation in the formation of the most metal-poor stars.