Hubble Space Telescope

Cycle 15 AR Proposal

Modeling the Transition from Pop III to Pop II Star Formation in the Early Universe

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Total Budget Amount: $45,000

Theory: Yes

Abstract

We will study the physical conditions necessary to shift from very high-mass, population III star formation to low-mass, population II star formation. We will model the critical chemical abundances needed to enhance radiative cooling efficiency at temperatures below 10000 K. This added cooling will allow the collapsing protostar to fragment, thereby forming multiple low-mass stars, as opposed to the metal-free case where a single star of a few hundred solar masses is formed. This will be accomplished by adding the treatment of metal cooling to an established cosmological hydrodynamic simulation code. Our technique allows us freely vary abundance patterns for all elemental species up through Zinc, giving us the ability to identify the specific elements responsible for the transition to modern-day star formation. We will, then, be able to predict the initial mass function for stars formed in the wake of population III supernova, as well as the evolution to the currently observed stellar mass function. This information will be highly beneficial to those who will use the HST to study star formation at high redshift. In addition, this study will be of particular use to those who will use the JWST to observe the environment of population III stars, their supernovae, and the stars that form after their deaths. The JWST will be able to directly observe the period in the history of the universe when population II stars are formed for the very first time, verifying the predictions made by our study.

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