Determining the Abundance of Visible Population III Star Clusters in Proximity to High-Redshift Quasars

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Population III (PIII) is a category of short-lived stars of near-zero metal content and high mass/luminosity. Theorized to have formed in the universe's infancy following a period where matter was homogenous and uniformly distributed, they have remained undetected by local surveys of the universe. This project aims to determine whether or not the new deep-space James Webb Space Telescope (JWST) would be able to observe high-luminosity clusters of PIII stars which formed in the proximity of deep-space quasars. Directly observing these first stars and their properties is a long-awaited milestone, one that will help refine cosmological theories and help better understand the evolution of our universe. A personal computer was used in tandem with a University of Toledo remote workstation to process results from a large-scale simulation representing the clumping and merging of dark matter in the early universe. Identifying an initial dataset of dark matter clusters ('halos') and their properties, "quasars" and "candidates–" halos hosting quasar-emitting supermassive black holes and large clouds of the Intergalactic Medium respectively–were selected using a set of conditions. The simulation produced zero candidate-quasar pairs 10-150 kpc apart, meaning it is unlikely that JWST would successfully observe PIII star clusters in proximity to deep-space quasars. The expected number of ideal pairs may be higher in scale factors greater than 0.16922, though observing later points in time risks metal contamination and pre-emptive gas collapse. This finding should caution JWST observers against searching for PIII stars near deep-space quasars until more precise findings are made.