

**X33a Hell emission in JWST sources: A quest for clues to Population III star formation**

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In the quest to observe the elusive Population III stars – representing the first generation of chemically pristine stars – identifying their sources is a crucial goal. Despite their theoretical importance, these primordial objects have proven challenging to detect, leaving us with unanswered questions about their formation in the early universe. In this study, we examine sources identified with JWST that exhibit a noteworthy detection of HeII  $\lambda 1640$ , a crucial emission line for diagnosing the presence of Population III stars as proposed in theoretical frameworks (Schaerer 2003, Inoue 2011, Nakajima & Maiolino 2022). Our objective is to characterize the stellar and interstellar medium properties of these sources. Leveraging a substantial JWST/NIRSpec sample compiled from early release science, DDT and GTO observations, we discuss 10 objects identified with HeII emission at  $z = 5.1\text{--}10.6$ , encompassing 9 isolated objects and an intriguing clump nearby a bright galaxy, GN-z11 (Maiolino et al. 2023). Our comparison of their nebular emission line strengths with photo-ionization models reveals that all 9 isolated objects fall below the criteria indicative of galaxies hosting Population III stars. This suggests that these isolated galaxies, primarily continuum-selected from blank fields, may be biased toward evolved or enriched systems. In our discussion, we highlight the unique characteristics of the clump near GN-z11 that shows a possible signature of Population III stars (Maiolino et al.) based on our re-analysis to discuss the implications of our findings for the formation of Population III stars and their surrounding environment.