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Predicting the UV Escape Fraction of the First Galaxies in the Renaissance Simulations with Machine Learning

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Published November 2023 • © 2023. The Author(s). Published by the American Astronomical Society.

Research Notes of the AAS, Volume 7, Number 11

Citation Ben C. Sherwin *et al* 2023 *Res. Notes AAS* **7** 242

DOI 10.3847/2515-5172/ad0cc5

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1. Received October 2023
2. Revised October 2023
3. Accepted November 2023
4. Published November 2023

Galaxy formation; Reionization; High-redshift galaxies

Abstract

Cosmic reionization is likely driven by UV starlight emanating from the first generations of galaxies. A galaxy's UV escape fraction, or the fraction of photons escaping from the galaxy, is useful to quantify its contribution to reionization. However, the UV escape fraction is notoriously difficult to predict due to local environment dependency and variability over time. Using data from the Renaissance Simulations, we attempt to make predictions about the impact of the first stars and galaxies on their environments. We present a time-independent classification model using a general artificial neural network architecture to predict the UV escape fraction given other galaxy properties—namely halo mass, stellar mass, redshift, star formation rate, lookback time, and gas fraction. We find our validation accuracy to be approximately 50%–65%, depending on the data set size from each zoom-in region of the Renaissance Simulations.

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Acknowledgments