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Probing The First Stars and their Effects on the Universe

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Abstract The formation of the first stars marks the transformation of the universe from its smooth initial state to its clumpy current state. In popular cosmological models, the first stars began to form at a redshift ~ 20 . The large-scale polarization anisotropies of the microwave background measured recently by the WMAP satellite imply that these stars ionized a significant fraction of the cosmic hydrogen only 200 million years after the big bang. If feedback regulates star formation in early dwarf galaxies as observed in present-day dwarfs, then this early re-ionization requires that the first generation of metal-free stars have a top-heavy (rather than Salpeter) mass function. Despite its importance, there is currently very limited theoretical understanding of the radiative and hydrodynamics feedback of the first stars on their host galaxies. I will describe observational methods to directly probe these effects. In particular, I will show why gamma-ray bursts are much better sources than quasars for probing the first stars and their cosmic habitat.