Identifying the Source of Ultraviolet Emission Powering He II Lines in Metal-Poor Dwarf Galaxies

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Recent observations from the JWST have found surprisingly mature galaxies in the early Universe, calling into question our current understanding of galactic star formation processes and evolution. Nearby low-metallicity high star formation rate galaxies present themselves as promising analogs to understand and study their early-universe counterparts. A subset of such Blue Compact Dwarf Galaxies has been observed to exhibit strong and narrow nebular He II λ4686 emission lines that require a substantial continuum of extreme ultraviolet (EUV) photons with energies from 54 to ~300 eV. Often, this EUV continuum can be explained by Wolf-Rayet stars where a strong wind exposes the hotter inner layers of a star. However, a further subset of these galaxies do not have spectroscopic signatures from these stars, leaving the explanation as to the stellar-origin of this nebular emission a mystery. We seek to use stellar population synthesis modeling to resolve the star formation histories of metal-poor star-forming galaxies, in conjunction with multiwavelength X-ray observations, to investigate the plausibility of accreting compact objects sources within these galaxies (both present and in the past), being the primary sources of He II ionization. We present Chandra X-ray observations for 7 of these galaxies and analyze archival data for 16 more, alongside updated star formation histories for 12 of our galaxies derived from stellar population synthesis modeling utilizing SDSS spectra and photometric data. We show that although the luminosity of concurrent X-ray sources aligns with expectations based on their host's star formation rates and metallicities, these sources still fail to account for the excess EUV ionization. Our findings suggest that although unable to explain the He II line at the present time, short-timescale bursts of star formation could explain its presence in the past, justifying the continued study of the holistic time-resolved star formation history and high-energy ionizing output of these galaxies.