Uncovering Early Galaxy Evolution in the ALMA and JWST Era
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A VLT/MUSE analysis of HeIIλ1640 emitters at $z = 2 - 4$

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Abstract. In the quest to study early star-formation physics in the universe, one of the most sought after tracers is HeIIλ1640, with its presence in the lack of other metal emission/absorption lines generally being interpreted as evidence for metal-poor stellar populations. HeII ionizing photons are produced via sources of hard ionizing radiation and requires photons with energies $\geqslant$54.4eV, however, traditional stellar population models lack sufficient ionising photons to match with current observations. Our analysis of $z = 2 - 4$ HeIIλ1640 emitters from deep 10-30h pointings from MUSE has shown that ISM properties inferred from multiple rest-UV diagnostics are not compatible with requirements necessary to reproduce HeIIλ1640 equivalent-widths. Thus, we have used latest generation of single, rotational, and binary stellar population models with realistic dust physics to explore rest-UV emission line diagnostics and link with H and He^+ ionisation photon production efficiencies ($\xi_{\rm ion}$(H,He^+)) in a variety of stellar/gas metallicities and star-formation histories. I will discus our latest results and show that including 'exotic' stellar phenomena such as extreme low-metallicity binary stars, X-ray binaries, and dust dissociation physics may be necessary to lessen the tension between models and observations.