Testing the predicted mass-loss bi-stability jump at radio wavelengths

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Massive stars play a dominant role in the Universe, but one of the main drivers for their evolution, their mass loss, remains poorly understood. In this study, we test the theoretically predicted mass-loss behaviour as a function of stellar effective temperature across the so-called `bi-stability' jump. We observe OB supergiants in the spectral range O8-B3 at radio wavelengths to measure their thermal radio flux densities, and complement these measurements with data from the literature. We derive the radio mass-loss rates and wind efficiencies, and compare our results with Halpha mass-loss rates and predictions based on radiation-driven wind models. The wind efficiency shows the possible presence of a local maximum around an effective temperature of 21~000 K - in qualitative agreement with predictions. Furthermore, we find that the absolute values of the radio mass-loss rates show good agreement with empirical Halpha rates derived assuming homogeneous winds - for the spectral range under consideration. However, the empirical mass-loss rates are larger (by a factor of a few) than the predicted rates from radiation-driven wind theory for objects above the bi-stability jump (BSJ) temperature, whilst they are smaller (by a factor of a few) for stars below the BSJ temperature. The reason for these discrepancies remains as yet unresolved. A new wind momenta-luminosity relation (WLR) for O8-B0 stars has been derived using the radio observations. The validity of the WLR as a function of the fitting parameter related to the force multiplier alpha(eff) (Kudritzki & Puls 2000) is discussed. Our most interesting finding is that the qualitative behaviour of the empirical wind efficiencies with effective temperature is in line with the predicted behaviour, and this presents the first hint of empirical evidence for the predicted mass-loss bi-stability jump. However, a larger sample of stars around the BSJ needs to be observed to confirm this finding.

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