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Radiation-driven winds of hot luminous stars. XVI. Expanding atmospheres of massive and very massive stars and the evolution of dense stellar clusters

A. W. A. Pauldrach, D. Vanbeveren, T. L. Hoffmann

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Context: Starbursts, and particularly their high-mass stars, play an essential role in the evolution of galaxies. The winds of massive stars not only significantly influence their surroundings, but the mass loss also profoundly affects the evolution of the stars themselves. In addition to the evolution of each star, the evolution of the dense cores of massive starburst clusters is affected by N-body interactions, and the formation of very massive stars via mergers may be decisive for the evolution of the cluster.
Aims: To introduce an advanced diagnostic method of O-type stellar atmospheres with winds, including an assessment of the accuracy of the determinations of abundances, stellar and wind parameters.
Methods: We combine consistent models of expanding atmospheres with detailed stellar evolutionary calculations of massive and very massive single stars with regard to the evolution of dense stellar clusters. Accurate predictions of the mass loss rates of very massive stars requires a highly consistent treatment of the statistical equilibrium and the hydrodynamic and radiative processes in the expanding atmospheres.
Results: We present computed mass loss rates, terminal wind velocities, and spectral energy distributions of massive and very massive stars of different metallicities, calculated from atmospheric models with an improved level of consistency.
Conclusions: Stellar evolutionary calculations using our computed mass loss rates show that low-metallicity very massive stars lose only a very small amount of their mass, making it unlikely that very massive population III stars cause a significant helium enrichment of the interstellar medium. Solar-metallicity stars have higher mass-loss rates, but these are not so high to exclude very massive stars formed by mergers in dense clusters from ending their life massive enough to form intermediate-mass black holes.

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