Parameterized Structured Wind Modelling of Massive Hot Stars with Wind3D

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We develop a new and advanced computer code for modelling the physical conditions and detailed spatial structure of the extended winds of massive stars with three-dimensional (3-D) non-LTE radiation transport calculations of important diagnostic spectral lines. The WIND3D radiative transfer code is optimized for parallel processing of advanced input models that adequately parameterize large-scale wind structures observed in these stars. Parameterized 3-D input models for WIND3D offer crucial advantages for high-performance transfer computations over ab-initio hydrodynamic input models. The acceleration of the input model calculations permits us to investigate and model a much broader range of physical 3-D wind conditions with Wind3D. We apply the new parameterization procedure to the equatorial wind-density structure of Co-rotating Interaction Regions (CIRs) and calculate the wind velocity-structure from CAK-theory for radiatively-driven rotating winds. We use the parameterized CIR models in Wind3D to compute the detailed evolution of Discrete Absorption Components (DACs) in Si IV UV resonance lines. The new method is very flexible and efficient for constraining physical properties of extended CIR wind structures (observed at various inclination angles) from best fits to DACs in massive hot stars. We compare the results with an accurate hydrodynamical model for the DACs of B0.5 Ib-supergiant HD 64760, and apply it to best fit the detailed DAC evolution observed with IUE in B0 Iab/Ib-supergiant HD 164402.