3D models of radiatively driven colliding winds in massive O+O star binaries - II. Thermal radio to sub-mm emission

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In this work the thermal emission over cm to sub-mm wavelengths from the winds in short-period O+O-star binaries is investigated (potential non-thermal emission is presently ignored). The calculations are based on three-dimensional hydrodynamical models which incorporate gravity, the driving of the winds, orbital motion of the stars, and radiative cooling of the shocked plasma. The thermal emission arises from the stellar winds and the region where they collide. We investigate the flux and spectrum from a variety of models as a function of orbital phase and orientation of the observer, and compare to the single star case. The emission from the wind-wind collision region (WCR) is strongly dependent on its density and temperature, being optically thick in radiative systems, and optically thin in adiabatic systems. The flux from systems where the WCR is highly radiative, as investigated for the first time in this work, can be over an order of magnitude greater than the combined flux from identically typed single stars. This excess occurs over a broad range of wavelengths from cm to sub-mm. In contrast, when the WCR is largely adiabatic, a significant excess in the thermal flux occurs only below 100 GHz. Eccentric systems may show order of magnitude or greater flux variability, especially if the plasma in the WCR transitions from an adiabatic to a radiative state and vice-versa - in such cases the flux can display significant hysteresis with stellar separation. We further demonstrate that clumping can affect the variability of radio lightcurves. We investigate the spectral index of the emission, and often find indices steeper than +0.6. Our predictions are of interest to future observations with the next generation of radio and sub-mm telescopes (abridged).

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