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Modeling Nonthermal Emission in a Stellar Bubble

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Recently, massive stars have been suggested as important sources of Galactic cosmic rays. These stars have intense stellar winds that can accelerate particles up to relativistic energies. It is expected that these stellar winds make a substantial contribution to the production of galactic cosmic rays, albeit less than that from supernova remnants. In 2019, the first detection of non-thermal radio emission from a stellar bubble, G2.4+1.4, associated with a Wolf-Rayet star WO2, was reported. In this work we study and model the recently detected emission in this bubble, which is consistent with synchrotron radiation produced by a population of relativistic electrons. The high-energy particles responsible for the synchrotron, also produce non-thermal emission at other wavelengths, with the most significant occurring in the gamma-ray range. At radio frequencies, a competition between Bremsstrahlung and synchrotron mechanisms occurs. Simultaneously, as the bubble covers an extended region of the interstellar medium, the contribution from the background (i.e., from cosmic rays) is expected to be significant. Finally, we analyze the observability of the gamma-ray flux obtained with our model by current and future high-energy detectors.

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