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Understanding the mix of thermal and non-thermal emission in HII regions

The giant molecular cloud Sagittarius B2 (hereafter SgrB2) is the most massive region with ongoing high-mass star formation in the Galaxy. In the southern half of the 20-pc large envelope of SgrB2, we encounter the SgrB2(DS) region which hosts more than 60 high-mass proto-stellar cores distributed in an arc shape around an extended HII region. We use the Very Large Array in its CnB and D configurations, and in the frequency bands C (4-8 GHz) and X (8-12 GHz) to observe the whole SgrB2 complex. Continuum and radio recombination line maps are obtained. We detect radio continuum emission in SgrB2(DS) in a bubble-shaped structure. Using data from 4 to 12 GHz, we derive a spectral index between -1.2 and -0.4, indicating the presence of unexpected non-thermal emission. Moreover, the radio recombination lines in the region are found to not be in local thermodynamic equilibrium (LTE) but stimulated by non-thermal emission. The detected fraction of thermal free-free emission is likely tracing an HII region ionized by an O7 star, while the non-thermal emission is likely being generated by relativistic electrons created through first-order Fermi acceleration. Is SgrB2(DS) a peculiar case, or are there other similar HII regions in the Galaxy? Future observations could reveal new insights into the properties of HII regions, and their interaction with the surrounding medium.

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