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Using SOFIA ionised carbon data as a probe for sub-GeV cosmic rays in young Supernova Remnants

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Supernova remnants (SNRs) have long been proposed as potential sources of galactic cosmic rays. However, current gamma-ray observations at GeV energies lack the angular resolution required to effectively trace low-energy cosmic rays. Ionised gas tracers such as the 1.9 THz fine-structure line of carbon ([C II]) offer arc-minute resolution and thus a promising probe of cosmic rays in the GeV range.

In this contribution, we present analysis of SOFIA [C II] observations of several SNRs—including RXJ1713.7–3946, RCW86, and Vela Jr.—focusing on the gas associated with and surrounding the remnants. Data from the SOFIA, Nanten, and Parkes+ATCA telescopes were used to measure the ratios of [C II] intensity to H₂ and HI emission toward each remnant, in an attempt to discern the origin of the [C II] emission. However, the contribution of UV photons to [C II] emission was also modelled using the photoionisation code CLOUDY. Model results suggest that UV photons can be an important source of [C II] emission in the SNRs we studied, providing challenges to use [C II] emission as a tracer of GeV cosmic rays.

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