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511 keV line constraints on feebly interacting particles from supernovae

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Feebly interacting particles (FIPs), such as axion-like particles, sterile neutrinos and dark photons, with masses $O(10-100)$ MeV can be efficiently produced in core-collapse supernovae and escape the supernova envelope. During propagation in the interstellar medium, these particles may decay into electron-positron pairs, generating a positron flux. Such positrons would annihilate with electrons in the Galactic medium and contribute to the photon flux in the 511 keV line. Using the spectrometer on INTEGRAL observation of this line improves the bounds on the couplings for these particles by several orders of magnitude below what is already excluded by the SN 1987A energy-loss argument.

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