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Search for Gamma-ray Production in Supernovae located in a dense interstellar medium with Fermi LAT

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Supernovae (SNe) exploding in a dense circumstellar medium (CSM) are hypothesized to accelerate cosmic rays in collisionless shocks and emit GeV gamma rays and TeV neutrinos on a time scale of several months. We perform the first systematic search for gamma-ray emission in Fermi LAT data in the energy range from 100 MeV to 300 GeV from the ensemble of SNe exploding in dense CSM. We study a sample of 147 SNe Type II_n and search for a gamma-ray excess at each SNe location using the maximum likelihood method for each source in a one year time window. In order to enhance a possible weak signal, we simultaneously study the closest and optically brightest sources of our sample in a joint likelihood analysis in three different time windows (1 year, 6 months and 3 months). We do not find a significant excess in gamma rays for any individual source nor for the combined sources and provide flux upper limits at 95% confidence level (CL) for both cases. We calculate model independent limits on the gamma-ray flux for individual sources as well as the combined source sample. In addition, we derive limits on the gamma-ray luminosity and the ratio of gamma-ray to optical luminosity as a function of the index of the proton injection spectrum assuming a generic gamma-ray production model.

Collaboration

FERMI

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Primary author: FRANCKOWIAK, Anna (SLAC)**Presenter:** FRANCKOWIAK, Anna (SLAC)**Session Classification:** Poster 1 GA**Track Classification:** GA-EX