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## Observable signatures of dark photons from supernovae

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A dark photon is a well-motivated new particle which, as a component of an associated dark sector, could explain dark matter. One strong limit on dark photons arises from excessive cooling of supernovae. We point out that even at couplings where too few dark photons are produced in supernovae to violate the cooling bound, they can be observed directly through their decays. Supernovae produce dark photons which decay to positrons, giving a signal in the 511 keV annihilation line observed by SPI/INTEGRAL. Further, prompt gamma-ray emission by these decaying dark photons gives a signal for gamma-ray telescopes. Existing GRS observations of SN1987a already constrain this, and a future nearby SN could provide a detection. Finally, dark photon decays from extragalactic SN would produce a diffuse flux of gamma rays observable by detectors such as SMM and HEAO-1. Together these observations can probe dark photon couplings several orders of magnitude beyond current constraints for masses of roughly 1 - 100 MeV.

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