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Dark Fires in the Sky: Model-Independent Dark Matter Detection via Kinetic Heating of Neutron Stars

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A largely model-independent probe of dark matter-nucleon interactions is proposed. Accelerated by gravity to relativistic speeds, local dark matter scattering against old neutron stars deposits kinetic energy that heats them to infrared blackbody temperatures. The resulting radiation could be detected by next generation telescopes such as James Webb, the Thirty Meter Telescope and the European Extremely Large Telescope. While underground direct detection searches are not (or poorly) sensitive to dark matter with sub-GeV masses, higher-than-weak-scale masses, scattering below neutrino floors, spin-dependent scattering well below nuclear cross-sections, pseudoscalar-mediated scattering, and inelastic scattering for inter-state transitions exceeding O(100 keV), dark kinetic heating of neutron stars advances these frontiers by orders of magnitude, and should vastly complement these searches. Popular dark matter candidates previously suspected challenging to probe, such as thermal Higgsinos, may be discovered.

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