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Inferring Dark Matter Properties from Tidal Deformability Measurements of Binary Neutron Stars DIVYA SINGH, Pennsylvania State University, ANURADHA GUPTA, University of Mississipi, B. SATHYAPRAKASH, Pennsylvania State University, SANJAY REDDY, University of Washington, EMANUELE BERTI, Johns Hopkins University — We explore the capability of future gravitational-wave detectors like the proposed US Cosmic Explorer and the European Einstein Telescope to distinguish between populations of black-holes formed through dark-matter induced implosions of neutron stars and neutron stars using tidal deformability measurements. The tidal deformability parameter is inferred by the equation of state of the neutron star, and can inform if and how much dark matter has accumulated inside the star. For a neutron star to implode and form a black-hole, dark matter particles must get captured in its core and thermalize forming a self-gravitating mass that exceeds the Chandrasekhar mass forming a mini black-hole. If this mini black-hole is large enough to overcome Hawking radiation, it continues to accrete till it consumes the neutron star completely. The timescales over which these processes occur determine the relative rates and population densities of 3 compact binary populations in the mass range 1-3 solar masses - binary neutron stars, binary black-holes, or neutron star-black hole binaries. We use tidal deformability measurements of these binaries to constrain dark matter particle mass and interaction cross-section, which determine the rate of capture of dark matter inside neutron star cores.

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