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### **The Nuclear and Particle Physics of Neutrinoless Double Beta Decay<sup>1</sup>**

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Fortuitous properties of nuclei allow us to isolate and study the rare second-order weak process of double beta decay. In particular, the decay channel in which a final state of two electrons and no neutrinos is produced – neutrinoless double beta decay – provides our best test of lepton number conservation and the Majorana mass of the electron neutrino. I will describe the connections between this process and the charge conjugation properties of the neutrino, including the possibility that the presence of both Dirac and Majorana masses accounts for the anomalous scale of neutrino masses. The extraordinary progress made over the past two decades has prepared the way for next-generation experiments that will probe Majorana masses at levels where nonzero rates may be found, given what we now know about neutrino mass splittings. I will describe some of the heroic efforts underway to develop detectors of unprecedented size, radiopurity, depth, and thus sensitivity.

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