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The Promise of Nuclear Astrophysics[1]

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The field of nuclear astrophysics stands at the intersection of some of the most exciting thrusts in nuclear theory and experiment, many-body physics, neutrino and particle physics, gravitation and astronomy. In fact, key facilities like FRIB for studying nuclear properties and reactions, JLAB and RHIC for uncovering fundamental aspects of QCD, and a variety of neutrino experiments are poised to leverage the fruits of a coming expansion of observational astrophysics capabilities. This will allow unprecedented insights into grand questions: Where do the nuclei come from?; How did the structures we see form?; What can the extreme conditions of the early universe, massive stars and violent stellar collapse/explosion and compact object mergers tell us about the nature of strongly interacting matter and neutrino physics?; What is the nature of Dark Matter? I will argue here that the advent of 30m-class optical telescopes, high precision cosmic microwave background polarization experiments, next generation orbiting X-ray and gamma-ray observatories, and gravitational wave astronomy (e.g., Advanced LIGO observations of compact object in-spiral events), combined with advances in nuclear theory and experiment, promises an intriguing future.

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