

Fall 2018 Colloquium

Department of Physics & Astronomy, TAMU-Commerce

Nov 15, Thursday, 4-5 PM in Science Building 127

(coffee and cookies will be served at 3:50 PM)

Nuclear Physics, Astrophysics

Constraints on the Nuclear Equation of State and r-Process Nucleosynthesis from the Multi-Messenger Detection of a Binary Neutron-Star Merger

Dr. Grant Mathews

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Dr. Mathews earned a BS (1972) degree in Chemical Physics at Michigan State University, and a Ph.D. degree (1977) in Nuclear Chemistry at the University of Maryland. His Ph.D. He worked as a postdoctoral researcher at the University of Maryland, and a research scientist at Lawrence Berkeley Laboratory, California Institute of Technology-W. K. Kellogg Radiation Laboratory, Lawrence Livermore National Laboratory. He taught as an adjunct professor (1992-1994) in Physics and Astronomy Department at University of California, Davis. In 1994, Dr. Mathews began his appointment as an assistant professor at University of Notre Dame, where he is currently doing research in Nuclear astrophysics.

More information about his research can be found at

<https://physics.nd.edu/people/faculty/grant-j-mathews/>

Abstract

The first detection of gravitational waves a binary neutron star merger GW170817 by the LIGO-Virgo Collaboration and the associated kilonova GRB170817A has provided fundamental new insights into the astrophysical site for rapid-neutron-capture (r-process) nucleosynthesis and on the nature of dense neutron-star matter. The detected gravitational wave signal depends upon the tidal distortion of the neutron stars as they approach merger. We numerical simulations highlighting the sensitivity of the detected “chirp” to the adopted equation of state. This places new constraints on the properties of nuclear matter and suggests a new dilemma in our understanding of neutron stars. The detected evidence of heavy-element nucleosynthesis also provides insight into the nature of the rapid-neutron-capture (r-process) and the fission properties of the heaviest nuclei. Parametrically, one can divide models for the r-process into three scenarios roughly

characterized by the number of neutron captures per seed nucleus (n/s). In addition to neutron-star mergers, these include magneto-hydrodynamic jets from supernovae and the neutrino heated wind above the proto neutron star in core-collapse supernovae. Insight from GW170817 allows one to better quantify the termination of the r-process in the neutron-star merger environment.