College of Science
Department of Physics & Astronomy

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Weekly Calendar

March 7- March 12, 2016

Special Seminar

"From Fermilab to the Sun to FRIB and JLab:
Nuclear Reactions for Particle Physics, Astrophysics, and their own sake"

3:30 PM Tuesday, March 8, 2016

109 Nicholson Hall

Xilin Zhang
University of Washington

Host: Jerry Draayer/ Ed Zganjar

• Refreshments served at 3:10 PM in 232 (Library) Nicholson Hall •

Nuclear reactions are at the heart of much scientific research-and not just in nuclear physics. In this talk, I will focus on two types of reactions: neutrino-nucleus (nucleon) reactions, and light nucleus radiative capture reactions. The first involves a neutrino interacting with a composite, strongly-interacting many-body system via the weak force, while the second is a fusion process, governed by the strong force, during which a photon is emitted. I will explain why precise calculation of these reactions are crucial to the success of neutrino-oscillation measurements and improved understanding of our Sun. I will discuss how my theoretical work, combined with dedicated measurements of neutrino reaction cross sections based on modern, intense neutrino beams, and large-scale *ab initio* simulations of nuclear structure, will help achieve those outcomes. I will also show how my work leads to a deeper understanding of nucleon and nucleus themselves.

LSU Physics & Astronomy in the News

1. **Stone cold: Professor invents cooling material patented by University:** **http://bit.ly/1QpOw0l**

2. **LSU students, alumni involved in LIGO reflect on discovery**: http://bit.ly/21xvuQl

3. The next public viewing is March 12, from 9-10 P.M. CST in the Landolt Astronomical Observatory - Jupiter and moons, Sirius, Orion Nebula

Departmental Colloquia

"Understanding Fundamentals with Femtostructures"

3:30 PM Thursday, March 10, 2016

109 Nicholson Hall

Kristina Launey
Louisiana State University

Host: Jerry Draayer/ Ed Zganjar

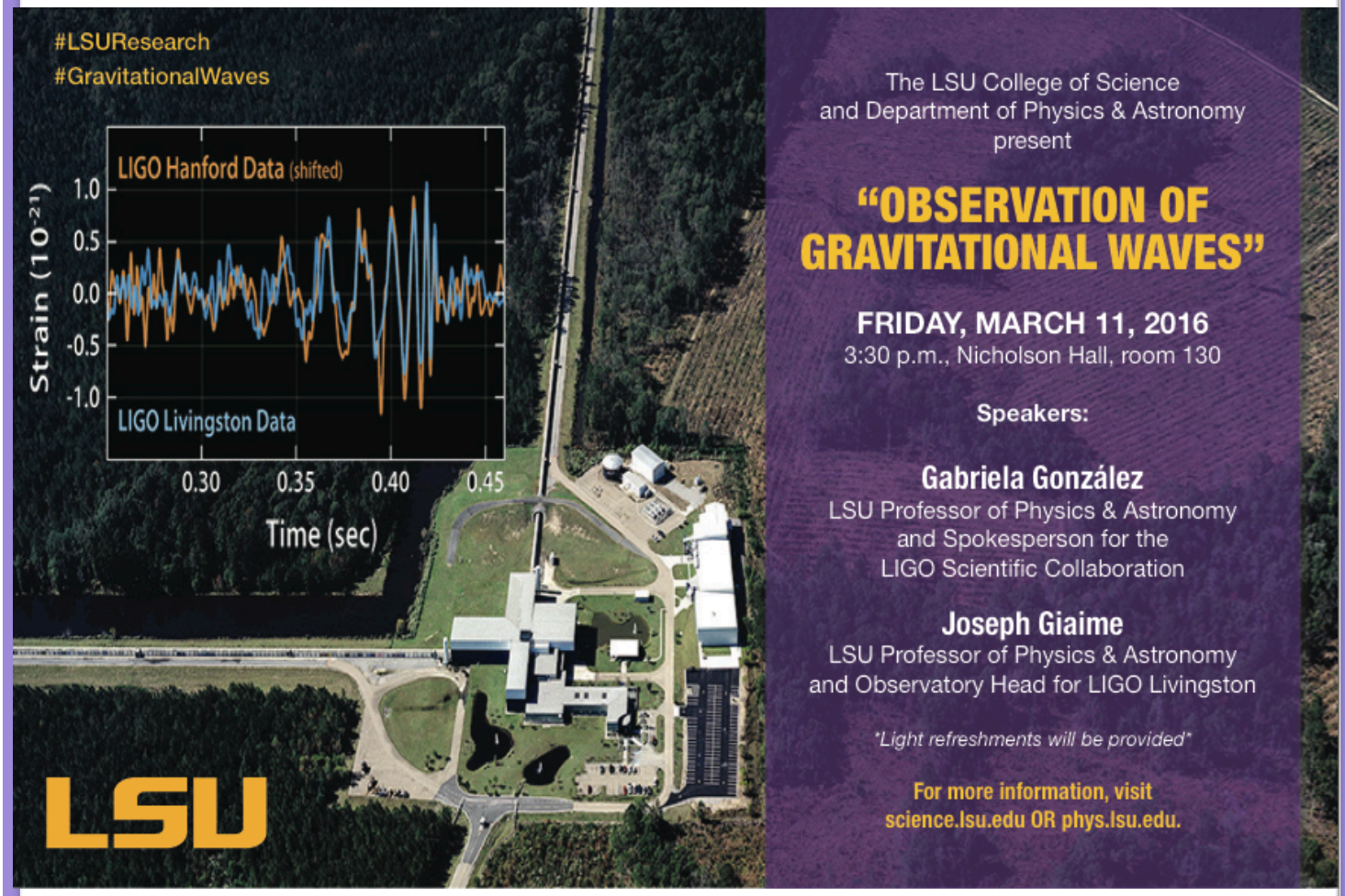
• Refreshments served at 3:10 PM in 232 (Library) Nicholson Hall •

Atomic nuclei - tiny femtoscale systems of protons and neutrons bound by the strong force - are key to understanding processes in extreme environments, from stellar explosions to the interior of nuclear reactors and fusion capsules. In this talk, I will discuss two central questions in nuclear physics, namely, understanding and predicting diverse nuclear properties from first principles or "*ab initio*" (tied to the underlying physics of quarks and gluons), and the origin of emergent orderly patterns in the intricate nuclear dynamics. In particular, I will talk about the multi-facet challenges of a large-scale first-principle nuclear modeling and the way an innovative symmetry-guided framework, recently developed at LSU, has significantly expanded the reach of *ab initio* theories. This is based on a discovery, within this framework, of a new fundamental (and surprisingly simple) feature common to all nuclei. This, empowered by petascale computing facilities, opens up a new region of nuclear isotopes for study and prediction, providing complementary theory efforts to planned and future experimental research at radioactive beam facilities, such as FRIB, FAIR, TRIUMF, and RIKEN, as well as the National Ignition Facility. These studies are important for advancing our knowledge about the formation of elements and other astrophysical phenomena, fundamental symmetries in nature, neutrino physics, applied research for nuclear energy, and related processes from fusion to fission.

Publications

1. Jianting Ji, Anmin Zhang, Jiahe Fan, Yuesheng Li, Xiaoqun Wang, Jiandi Zhang, E. W. Plummer, and Qingming Zhang. Giant magneto-optical Raman effect in a layered transition metal compound. *PNAS,* **113**, 9 (2016).

Special Event



The Laser Interferometer Gravitational- wave Observatory (LIGO) detectors in Livingston, Louisiana and Hanford, Washington, have observed gravitational waves from the inspiral and coalescence of a binary pair of black holes hundreds of millions of parsecs from the Earth. The signal carries with it information about this highly relativistic and dynamic astrophysical system. Our observation was made about a century after publication Albert Einstein's theory of general relativity and his prediction of such waves; and after half a century of work by several generations of experimentalists to measure the minuscule effects from the waves. At LSU, such an effort has spanned 45 years. After reviewing the basic properties of gravitational waves, we will present an overview of the detector design, give an overview of the various scientific results from the detection, and speak a bit about the field's future.