MONTANA STATE UNIVERSITY | College of LETTERS & SCIENCE

Physics Colloquium

NOTE: Special Day, Special Time, & Special Location

Thursday, February 15, 2018

3:10 – 4:00 PM

Roberts Hall 310

Testing relativity with past and future supernova explosions

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Abstract:

Although Solar System and binary-pulsar experiments test General Relativity to remarkable accuracy, the highly dynamical, strong-field regime of the theory is still untested and lies in the realm of gravitational-wave astronomy. One of the simplest and most famous alternative models is scalar-tensor theory, where the spacetime metric is coupled to one or more scalar fields. Scalar-tensor theory admits a propagating monopole gravitational-wave mode, which may constitute smoking gun evidence for strong-field modifications of General Relativity. Here I present the first fully nonlinear numerical-relativity simulations of core collapse and compact-object formation in massless and massive scalar-tensor theories. The presence of a non-perturbative effect called “spontaneous scalarization” (somewhat similar to spontaneous magnetization in ferromagnets) makes the dynamics of the collapse and the formation of neutron stars and black holes qualitatively different from General Relativity, thus providing an ideal way to constrain the parameters of the theory. If the scalar field is massive, neutron stars might "hyper scalarize" after collapse. The emitted signal has the peculiar structure of a long-lived "inverse chirp" which can be targeted by existing gravitational-wave searches. More on arXiv:1602.06952,1708.03651.

Host: Nico Yunes

**** Refreshments served in the Barnard (EPS) second floor atrium at 3:45 ****