HK 1: Tutorial Physics of Neutron Stars (joint session AKjDPG/HK)

Zeit: Sonntag 16:00–18:00 Raum: HS 1

Tutorium HK 1.1 So 16:00 HS 1

Birth and Death of Neutron Stars — •Hans-Thomas Janka — Max Planck Institute for Astrophysics, Garching, Germany

Neutron stars are born in catastrophic explosions of massive stars as supernovae, and they can get destroyed during the violent collision with a companion star in a close binary system. Such events belong to the most energetic phenomena in the universe, and they are among the brightest cosmic sources of electromagnetic radiation, neutrinos, and gravitational waves. Therefore they are prime targets in the new era of multi-messenger astronomy, which has received an enormous boost by the recent first measurement of gravitational waves from the late inspiral phase of two neutron stars, followed moments afterwards by the detection of a short gamma-ray burst and the discovery of the kilonova emission from a radioactively heated cloud of ejecta. Such events offer unique possibilities to probe regimes of extreme gravitational, particle, nuclear, and plasma physics that are hardly accessible by laboratory experiments. Our understanding of the complex processes taking place in the astrophysical sources and of their interplay on microscopic and macroscopic scales heavily relies on numerical simulations, which are indispensable to make quantitative predictions of observables and to interpret the measured signals. The tutorial will discuss recent progress of three-dimensional computational modeling in this fast-advancing field.

Tutorium HK 1.2 So 17:00 HS 1

Introduction to nuclear physics of neutron stars — •Ingo Tews — Theoretical Division (T-2), Los Alamos National Laboratory, Los Alamos, NM 87545

Neutron stars are fascinating stellar objects born in core-collapse supernovae. Their masses reach up to two solar masses but their radii are of the order of only 10 km. Due to these extremely high densities, up to 10^{15} g/cm^3 in their cores, neutron stars represent ideal laboratories for fundamental physics. In particular, neutron stars probe nuclear physics at densities far beyond the regime accessible in terrestrial experiments.

In this presentation, I will give an introduction to the nuclear physics relevant for the structure of neutron stars. I will present current state-of-the-art results for the equation of state of neutron-star matter and neutron-star properties, and discuss current observational limits.