

Neutron stars: The journey from birth to death.

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Neutron star observations, including those from Chandra, XMM-Newton, LIGO and NICER missions, continue to provide a unique insight into the role that neutron stars (NS) play in stellar evolution and the nature of dense matter in the NS core. After being born in a core-collapse supernova explosion, the NS first minutes (as a “proto-neutron star”) are critical. It is during this brief time the NS final mass, composition, and fate are decided. Development of the NS dynamics and cooling in later times provides important clues about the first moments. NSs do not generate any light or heat on their own. Thus, over millions of years, the latent heat inherited at birth will be exhausted. Most of the NSs become cold dark objects, unless they meet another NS or a black hole to engage in a spectacular collision or they accrete mass from a binary companion and recycle into a millisecond pulsar. In my lectures, I will discuss some of these events.

In my first lecture, I will introduce the history of NSs discovery and their general structure going from the envelope through outer and inner crusts to the core. I will also survey the latest astrophysical observation and terrestrial data on the NS properties.

The second lecture will be devoted to exploration of the NS Equation of State (EoS) which is still unknown and is subject of extensive research. Among the variety of theoretical and empirical models of the EoS currently in the literature, I will describe in more detail the Quark-Meson-Coupling (QMC) Model, an effective relativistic mean-field model in which the forces between individual baryons are self-consistently mediated by exchange of virtual mesons between the valence quarks in the baryons.

The neutron star merger (BNSM) and the related gravitational waves will be subject of the final, third lecture. This topic is currently most actively explored, using novel frameworks of multimessenger technics. Advantages and disadvantages of this trend will be discussed.

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Classification de Session: Lectures