“NUCLEAR PHYSICS OF STARS”

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"We are star stuff”. This famous quote by Carl Sagan refers to the fact that almost all elements were synthesized and “cooked” by nuclear reactions in stars. The elements are released during or at the end of a star’s lifetime, and are subsequently incorporated into a new generation of stars, into planets that form around stars, and into life forms that originate on the planets. Moreover, the energy we depend on for life originates in nuclear reactions that occur at the center of the Sun. Synthesis of the elements and energy production in stars are at the heart of nuclear astrophysics research. Our understanding of nuclear reactions in stars has seen extraordinary progress. Today, nuclear astrophysics constitutes a multidisciplinary crucible of knowledge addressing key questions in fundamental research, ranging from the age of the Universe to the origin of cosmic rays, from supernova explosion mechanisms to the origin of the solar system. This series of four presentations will provide an introduction to nuclear astrophysics. The topics that will be covered are listed below.

Lecture #1: "Nuclear and Thermonuclear Reactions"
Discussion of nuclear physics concepts to understand stellar burning. Topics: potential models of nuclear reactions, tunnel effect, Gamow factor, astrophysical S-factors, Gamow peak, narrow and broad resonances, Breit-Wigner equation, partial widths, reaction rates, reaction rate equilibria,

Lecture #2: "Non-Explosive Stellar Burning"
Discussion of hydrostatic burning stages. Topics: main sequence stars, red giants, AGB stars, massive stars, pp chains, CNO cycles, helium burning, carbon burning, neon burning, oxygen burning, silicon burning, nuclear statistical equilibrium, pre-supernova evolution.

Lecture #3: "Explosive Stellar Burning"
Discussion of explosive burning stages. Topics: massive stars, core collapse, explosive silicon, oxygen, carbon, neon burning, binary stars; classical novae, hot CNO cycles, type I x-ray bursts, waiting point nuclei, rp-process, type Ia supernovae.

For more information, see: "Nuclear Physics of Stars", C. Iliadis, 2nd Edition (Wiley-VCH, Weinheim, 2015).