Course unit English denomination	Nuclear Astrophysics
SS	02/A1
Teacher in charge (if defined)	Antonio Caciolli
Teaching Hours	24
Number of ECTS credits allocated	3
Course period	March – June 2026
Course delivery method	☒ In presence ☐ Remotely ☐ Blended
Language of instruction	English
Mandatory attendance	☒ Yes (50% minimum of presence) ☐ No
Course unit contents	Over the course of 24 hours in this comprehensive Ph.D. program, participants will explore the fundamental principles of stellar nucleosynthesis. The course is organized into four distinct segments: 1. Introduction to Nuclear Astrophysics and Nucleosynthesis of Elements (6 hours): Laying the foundation by exploring the fundamental concepts of nuclear astrophysics and the element nucleosynthesis. 2. Cross section extrapolations at Stellar Energies through R-Matrix Calculations (6 hours): a brief theoretical introduction of the R-Matrix approach will be followed by practical exercises, using the 12C+p and 13C+p systems as example. 3. Indirect Methods for Nuclear Astrophysics (6 hours): An introduction of indirect methodologies, highlighted by a practical exercise that employs the Trojan Horse method. 4. Practical Tools (6 hours): Equipping students with essential practical skills, covering topics such as the efficiency of high-purity germanium detectors across a wide energy range (from 500 keV to 10 MeV) and the use of resonance scans as a powerful method to unveil the characteristics of target materials.
Learning goals	Introduce to experimental techniques designed to study stellar processes in terrestrial laboratories. This includes both direct and indirect methodologies, each offering a different perspective on this field of research. Introduce students to practical, hands-on procedures for data analysis at

	various stages of experimental work. This will encompass critical aspects such as detector efficiency calibration, analysis of target scans, and the design of future experimental setups through simulation exercises. Write experimental proposal, a crucial skill for researchers in nuclear physics experiments.
Teaching methods	Lectures and a dedicated section, spanning approximately 6 hours, will be allocated to the R-Matrix analysis, coupled with practical applications employing the Azure2 code.
Course on transversal, interdisciplinary, transdisciplinary skills	☐ Yes ☒ No
Available for PhD students from other courses	☒ Yes ☐ No
Prerequisites (not mandatory)	
Examination methods (if applicable)	The final evaluation will center in developing and presenting an experiment proposals, either individually or collaboratively.
Suggested readings	
Additional information	