

NUCLEAR ASTROPHYSICS (6 ECTS)

The subject will be taught in 18 sessions of 1.5 hours. It includes tutorial sessions to discuss proposed exercises, questions about the contents of the lectures, etc.

Lectures:

- A.1. Brief history of the Universe. Life cycle of a star. Hertzsprung-Russell diagram
- A.2. Hydrostatic equilibrium. Star formation. The Sun: density, pressure and temperature
- A.3. Primordial nucleosynthesis
- A.4. Stellar nucleosynthesis
- A.5. Explosive nucleosynthesis
- B.1. Equation of state of an ideal gas: electrons and photons
- B.2. Phenomenological models of nuclear matter: Skyrme interactions
- B.3. Equation of state of symmetric, asymmetric and β -stable matter
- C.1. Astroparticle physics and nuclei: direct detection of dark matter
- C.2. White dwarfs: mass and size
- C.3. Neutron stars: general characteristics
- C.4. Neutron stars: crust and cooling
- C.5. Neutron star mergers: gravitational waves
- D.1. Numerical applications (I): nuclear equation of state
- D.2. Numerical applications (II): white dwarfs and neutron stars

Basic Bibliography:

- 1) "The Physics of Stars", A. C. Phillips, John Wiley & Sons, 2004.
- 2) "Particle Astrophysics", D. H. Perkins, Oxford University Press, 2003.
- 3) "Fundamentals in Nuclear Physics: from Nuclear Structure to Cosmology", J. L. Basdevant, J. Rich, M. Spiro, Springer, 2004.
- 4) "Introductory Nuclear Physics", P. E. Hodgson, E. Gadioli, E. Gadioli Erba, Oxford University Press, 2003.
- 5) "An Introduction to Particle Dark Matter", S. Profumo, World Scientific, 2017.

Timetable and teachers

WEEK 1	Monday 15-04 Online	Tuesday 16-04 Online	Wednesday 17-04 Free	Thursday 18-04 Online	Friday 19-04 Online
9:30 – 11:00	C.1 J. Menéndez			C.2 A. Ríos	
11:30 – 13:00	A.1 M. Centelles			A.3 M. Centelles	
15:00 – 16:30		B.1 A. Ríos			B.2 J. Menéndez
17:00 – 18:30		A.2 M. Centelles			

WEEK 2	Monday 22-04 Classroom	Tuesday 23-04 Classroom	Wednesday 24-04 Classroom	Thursday 25-04 Classroom	Friday 26-04 Classroom
9:30 – 11:00	C.4 J. Menéndez	C.5 J. Menéndez	D.1 / Tutorial J. Menéndez	D.2 / Tutorial A. Ríos	Tutorial J. Menéndez
11:30 – 13:00	A.4 M. Centelles	B.3 A. Ríos	A.5 / Tutorial M. Centelles	Tutorial M. Centelles	Tutorial A. Ríos
13:15 – 14:45	C.3 A. Ríos				

The lectures of the first week will take place online. The lectures of the second week will be given in the classroom at the Faculty of Physics of the University of Barcelona.

Examination: the examination will be based on the solution of a few proposed exercises, to be submitted by the student before May 24, 2024.