

Neutrinos and Nuclear Astrophysics

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- **Physics of Neutrinos** (10 h):

- The first observations of neutrinos, neutrinos in the Standard Model.
- Solar and atmospheric neutrinos and evidence of flavor fluctuations.
- Man-made neutrinos: short and long baseline experiments.
- Parameters of the oscillation matrix, direct or inverse mass hierarchy problem.
- Neutrino mass models. Dirac or Majorana neutrinos. Experiments on double beta decay. Direct mass measurements.
- What will we learn in the coming years? Tests on the possible existence of sterile neutrinos, on the mass hierarchy and the CP phase. Neutrinos as messengers from the most distant Universe or from within the Earth: neutrino relics, from supernovae, gamma ray bursts and geoneutrinos.

- **Nuclear Astrophysics** (10 h):

- Nuclear reactions in stars: energy production;
- Nuclear reactions in stars: from primordial nucleosynthesis to the synthesis of the heavier elements (Big Bang Nucleosynthesis, H, He, C, Ne, O, Si burning, explosive burning)
- What nuclear reactions can we study in the laboratory? Direct and indirect experimental methods
- The LUNA experiment at the Gran Sasso Laboratories and the new Luna-MV project.