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Dense Matter EoS and applications in Core Collapse SuperNovae and Neutron Stars

Lecture I: *the Equation of State of compact stars*

a) dense matter in the universe and theoretical challenges
b) modelling the EoS in the mean-field approximation
  i. density functional approaches
  ii. effective lagrangians
  iii. pairing correlations
c) constraining the parameters
d) phase transitions in dense matter
  i. from core to crust
  ii. from nucleons to quarks

Lecture II*: nuclear physics in the neutron star crust and observational consequences*

a) HFB calculations in the Wigner-Seitz cell
b) Cluster degrees of freedom
c) In-medium self-energy corrections
d) Extension to finite temperature
e) The impact of nuclear physics on compact stars
  i. Mass and radii
  ii. Crust-core transition and glitches
  iii. Symmetry energy and core cooling
  iv. Superfluidity and crust cooling
  v. Matter composition and supernova dynamics

Practical session*: an analytically solvable neutron star model*

We will develop together a back-of-the-envelope calculation of the hydrostatic equilibrium equations governing the mass and radii of neutron star. You just need a piece of paper and the calculator of your mobile. Sure we will be able to get only order-of-magnitude estimates…but you will see that basic concepts of nuclear physics are sufficient to understand many things about neutron stars!