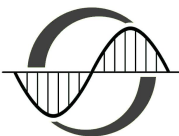




UNIVERSITÀ  
degli STUDI  
di CATANIA



DIPARTIMENTO DI FISICA E ASTRONOMIA  
“ETTORE MAJORANA”

DOTTORATO DI RICERCA IN FISICA  
CICLO XLI A.A. 2025/2026

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## Quark Matter at Finite Temperature and Density

3 CFU

### Teaching staff

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## Program of the course:

Basic ideas and concepts of Strong Interactions: asymptotic freedom and confinement. Quantum ChromoDynamics (QCD) a general overview: perturbative and non-perturbative regimes. Chiral symmetry phase transition. Proton-Proton Collision and Parton model: distribution functions and basic properties.

QCD phase diagram of nuclear matter at finite density and temperature. Relativistic gas and bag models. Equation of State of the quark-gluon plasma and its transport coefficients. Basic thermodynamics and fluid dynamics of the phase transition from hadronic matter to the Quark-Gluon Plasma (QGP). Applications to Early Universe and Neutron stars. Impact of the QGP in the expansion of the Early Universe and in the evolution of ultra-relativistic collisions. Relativistic pp, pA, AA collisions at ultra-relativistic energy and the properties of the QGP.

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## Bibliography:

- “An Introduction to Quark and Gluons”, F. E. Close, Academic Press London, 1979.
- “Handbook of Perturbative QCD”, G. Sterman et al., Review of Modern Physics 67 (1995) 158.
- “Quark-Gluon Plasma”, K.Yagi, T. Hatsuda and Y Miake, Cambridge University Press, 2005.