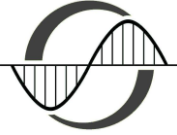




UNIVERSITÀ
degli STUDI
di CATANIA



DIPARTIMENTO DI FISICA E ASTRONOMIA
“ETTORE MAJORANA”

DOTTORATO DI RICERCA IN FISICA
CICLO XXXIX A.A. 2023/2024

SEARCH OF NEW PHYSICS BEYOND THE STANDARD MODEL IN DOUBLE BETA DECAY

2 CFU

Teaching staff

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Reception hours: Friday 15:00-17:00

Program of the course:

Dirac equations and neutral fermions. Majorana fermions and neutrinos. Overview of early experimental evidences of neutrinos and neutrino properties. The search for $\beta\beta$ -decay. Early geochemical experiments (the M.G.Inghram and J.H.Reynolds experiment). The $2\nu\beta\beta$ -decay in the laboratory (the Elliott, Hahn and Moe experiment). Overview of present search of $2\nu\beta\beta$ - and $0\nu\beta\beta$ -decays. The Italian experiments at LNGS underground laboratory. The case of the GERDA experiment. Nuclear structure aspects of the $\beta\beta$ -decays. The problem of Nuclear Matrix Elements. Surrogate nuclear reactions to study relevant nuclear response to isospin operators. Single Charge Exchange reactions and connection to single β -decay Fermi and Gamow-Teller nuclear transitions. The Double Charge Exchange reactions in connection with $\beta\beta$ -decays. The NUMEN project at the INFN-LNS laboratory.

Bibliography:

- ✓ Scientific paper and slides provided by the teacher
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- ✓ F. Avignone III, et al. Rev. Mod. Phys. **80**, 481 (2009)
- ✓ S. Elliott, et al., Rev. Mod. Phys. **87**, 187 (2015)
- ✓ F. Cappuzzello et al. Eur. Phys. J. A **54**: 72 (2018)
- ✓ H. Lenske, F. Cappuzzello, M. Cavallaro and M. Colonna, Prog. in Part. and Nucl. Phys. 109 (2019) 103716
- ✓ F. Cappuzzello et al. Prog. in Part. and Nucl. Phys. 128 (2023) 103999
- ✓ H. Ejiri, J. Suhonen, K. Zuber, Phys. Rep. **797**, 1–102 (2019)