



UNIVERSITÀ
degli STUDI
di CATANIA



DIPARTIMENTO DI FISICA E ASTRONOMIA
“ETTORE MAJORANA”

DOTTORATO DI RICERCA IN FISICA
ANNO ACCADEMICO 2020/2021
CICLO XXXVI

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:

- E. Segrè, “Nuclei e Particelle”, Edited by Zanichelli.
- 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. (2019) in press, <https://doi.org/10.1016/j.pnpnp.2019.103716>
- H. Ejiri, J. Suhonen, K. Zuber, Phys. Rep. **797**, 1–102 (2019)