



UNIVERSITÀ  
degli STUDI  
di CATANIA



DIPARTIMENTO DI **FISICA E ASTRONOMIA**  
“**ETTORE MAJORANA**”

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

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# **ADVANCED TOPICS IN NUCLEAR DYNAMICS AND REACTION MECHANISMS WITH STABLE AND RADIOACTIVE BEAMS**

## **2 CFU**

### **Teaching staff:**

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**Reception hours:** Monday 15-17

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### **Program of the course:**

#### **1-Production techniques of RIBS (radioactive ion beams)**

- a) Isol and in-flight methods
- b) from the beam production to the tagging

#### **2-HI nuclear reactions mechanism from low to intermediate energy**

- a) physics case (complete and incomplete fusion, multifragmentation, equation of state, symmetry energy, isospin effects)
- b) experimental methods to select reaction mechanism
- c) experimental devices

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### **Bibliography:**

#### **1 - Production techniques of RIBS (radioactive ion beams)**

- Blumenfeld Y, Nilsson T and Van Duppen P, Facilities and methods for radioactive ion beam production, 2013 Phys. Scr, T152 014023
- Lombardo et al. Use of Large Surface MicroChannel Plates for the Tagging of Intermediate Energy Exotic Beams, Nuc. Phys. B - Proceedings Supplements 215 (2011), 272-274,

<https://doi.org/10.1016/j.nuclphysbps.2011.04.028>.

- Nuclear Physics Mid Term Plan @LNS and LNL – EPJ accepted for publication

## 2- HI nuclear reactions mechanism from low to intermediate energy

- S. Pirrone, G. Politi, **B. Gnoffo**, ..., et al.: "isospin influence on fragments production in  $^{78}\text{Kr}+^{40}\text{Ca}$  and  $^{86}\text{Kr}+^{48}\text{Ca}$  collisions at 10 MeV/nucleon", *EPJ A* 55, 22, (2019) [10.1140/epja/i2019-12695-4](https://doi.org/10.1140/epja/i2019-12695-4)
- Russotto, P., Cozma, M.D., De Filippo, E. *et al.* Studies of the equation-of-state of nuclear matter by heavy-ion collisions at intermediate energy in the multi-messenger era. *Riv. Nuovo Cim.* **46**, 1–70 (2023). <https://doi.org/10.1007/s40766-023-00039-4>
- E. De Filippo, A. Pagano, P. Russotto et al., Correlations between emission timescale of fragments and isospin dynamics in  $^{124}\text{Sn}+^{64}\text{Ni}$  and  $^{112}\text{Sn}+^{58}\text{Ni}$  reactions at 35 A MeV. *Phys. Rev. C* 86, 014610 (2012). <https://doi.org/10.1103/PhysRevC.86.014610>
- P. Eudes, Z. Basrak, F. Sébille, V. de la Mota, and G. Royer Comprehensive analysis of fusion data well above the barrier, *Phys. Rev. C* **90**, 034609 – Published 12 September 2014, <https://doi.org/10.1103/PhysRevC.90.034609>