

Applications @ the LNL

Summary

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- Nuclear cross sections measurements and modelling for direct radionuclide production and neutron beam lines at SPES (*L. Mou*)
- ISOL and laser applications at the SPES facility (*M. Ballan*)
- Development, characterization and modifications of materials for applied nuclear physics (*M. Campostrini*)

 The **SPES facility** plays a key-role but also the **AN2000** and **CN** accelerators are essential

Medical Radionuclides production@ LNL

Production of Medical-Radio-Isotope using the ISOL technique

ISOLPHARM
SPES-exotic beams for medicine

Production of Medical-Radio-Isotope Using the direct activation

2019 molecules (INFP)

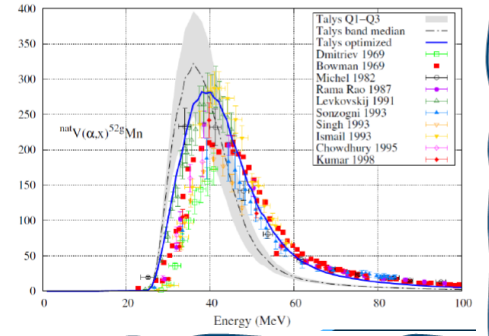
LARAMED: A Laboratory for Radioisotopes of Medical Interest

SPES
exotic beams for science

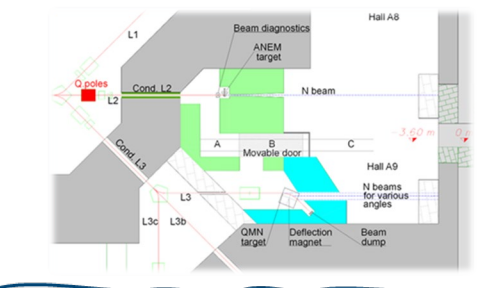
INFN

WG1. Nuclear cross sections measurements and modelling for direct radionuclide production and neutron beam lines at SPES.

- Development of emerging RNs in Nuclear Medicine (^{67}Cu , ^{47}Sc , ^{xx}Tb and future RNs: $^{117\text{m}}\text{Sn}$, ^{119}Sb , $^{133,135}\text{La}$..)
- Modeling of nuclear xs



Neutron facility @ SPES

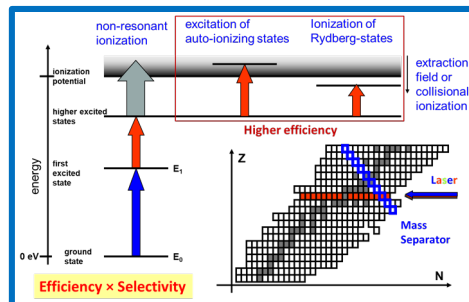
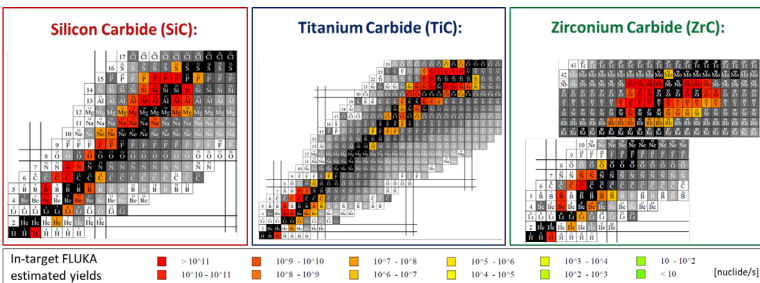


WG3. Development, characterization and modifications of materials for applied nuclear physics.

- Ion beam micro-analysis for nuclear targets development and cross section measurements for applied nuclear physics
- Ion-solid interaction and radiation damage of materials, detectors and devices
- Novel detectors development and test

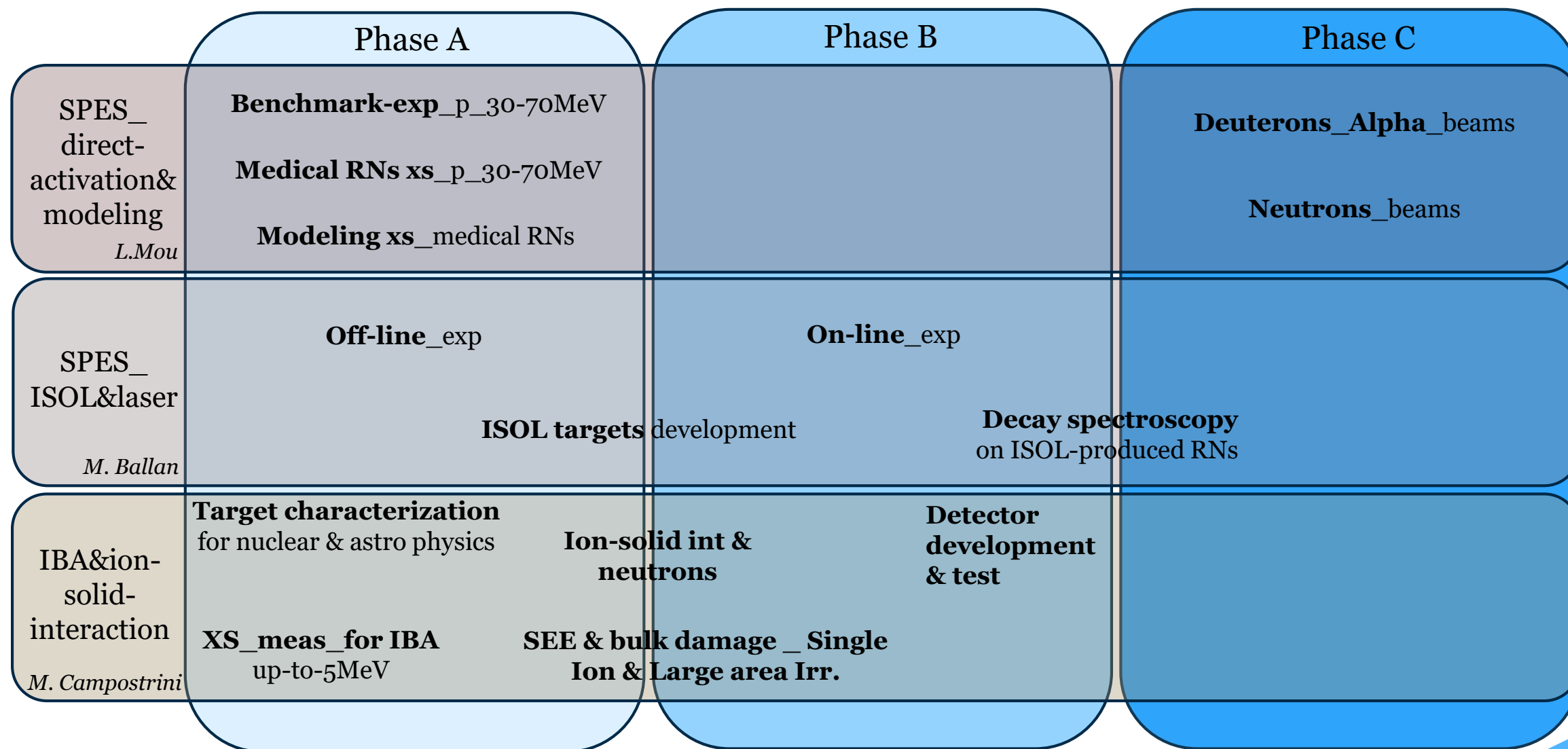
WG2. ISOL and laser applications at the SPES facility.

- Laser spectroscopy and applications
- Nuclide production with ISOL for medicine and nuclear physics
- Decay spectroscopy of nuclides of medical interest



Ion Beam Analysis

Flexible detector



Phase A: Activities ready to be performed

Phase B: Activities still requiring test and feasibility study

Phase C: Activities requiring R&D and/or infrastructures construction

Thanks Liliana, Michele, Matteo and our collaborative network..



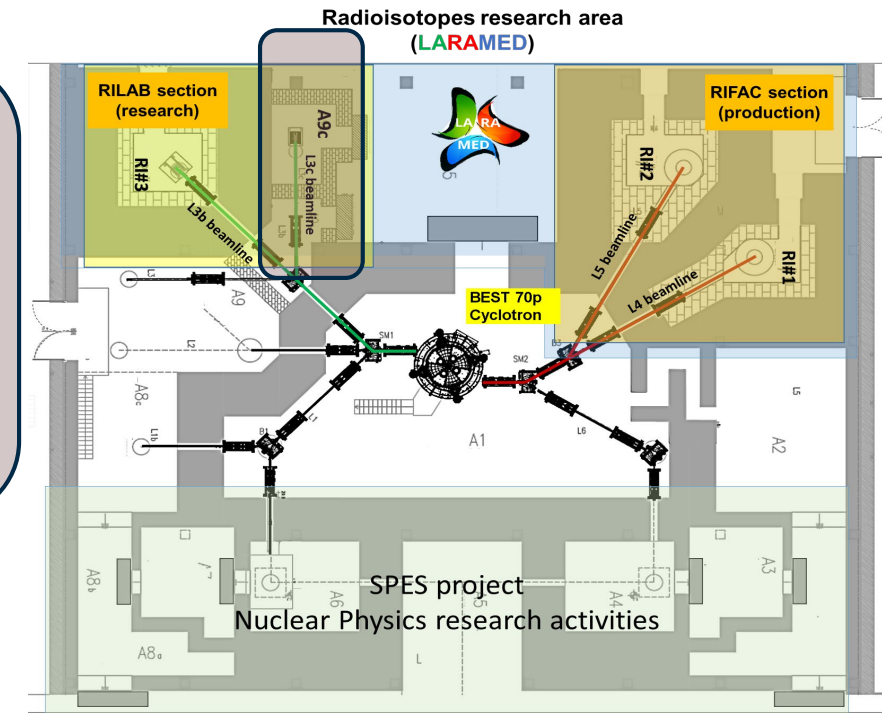
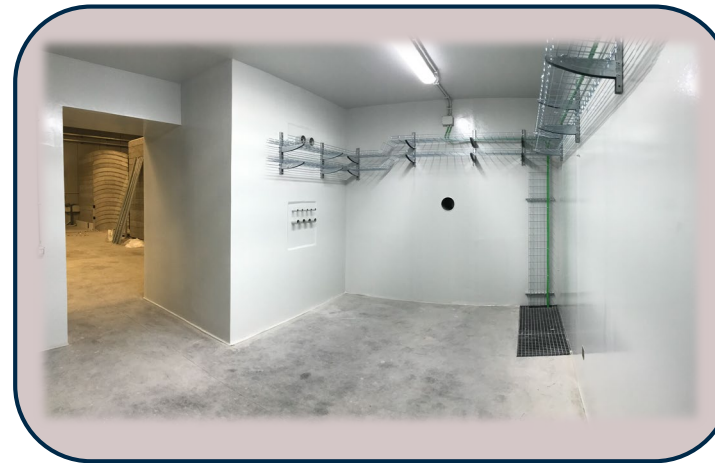
.. and You for the attention!



Nuclear cross sections measurements and modelling for direct radionuclide production and neutron beam lines at SPES (*L. Mou*)

➤ Proton-induced nuclear cross sections measurements for medical RNs:

- **Benchmark experiments** for beam-line characterization with IAEA recommended xs
- **Development of emerging RNs in Nuclear Medicine** (^{67}Cu , ^{47}Sc , ^{xx}Tb and future RNs: $^{117\text{m}}\text{Sn}$, ^{119}Sb , $^{133,135}\text{La}$, etc.)



➤ Possible future use of deuterons & alpha beams!

..Importance of co-produced RNs..

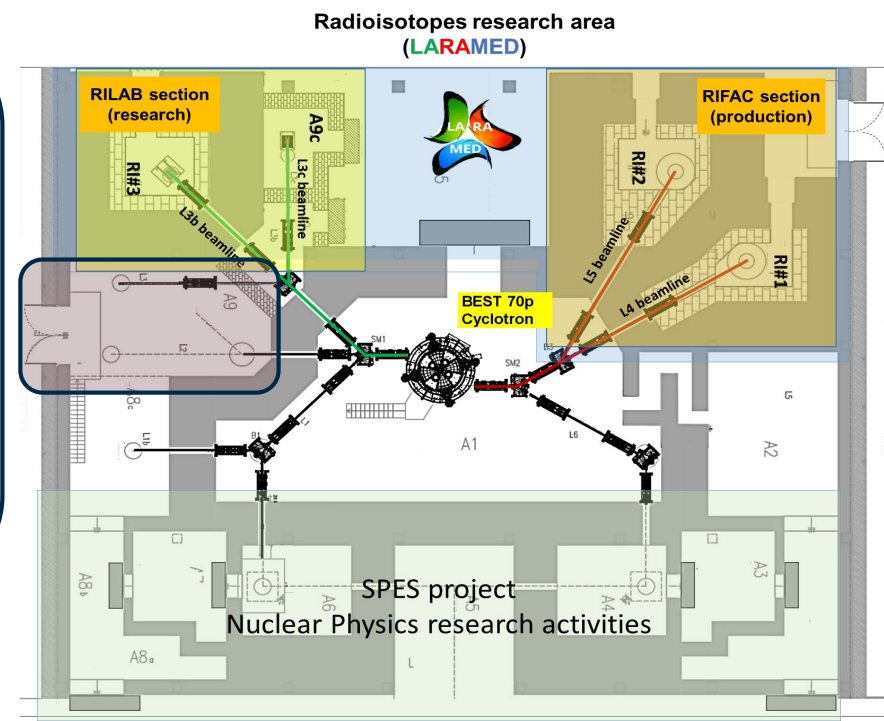
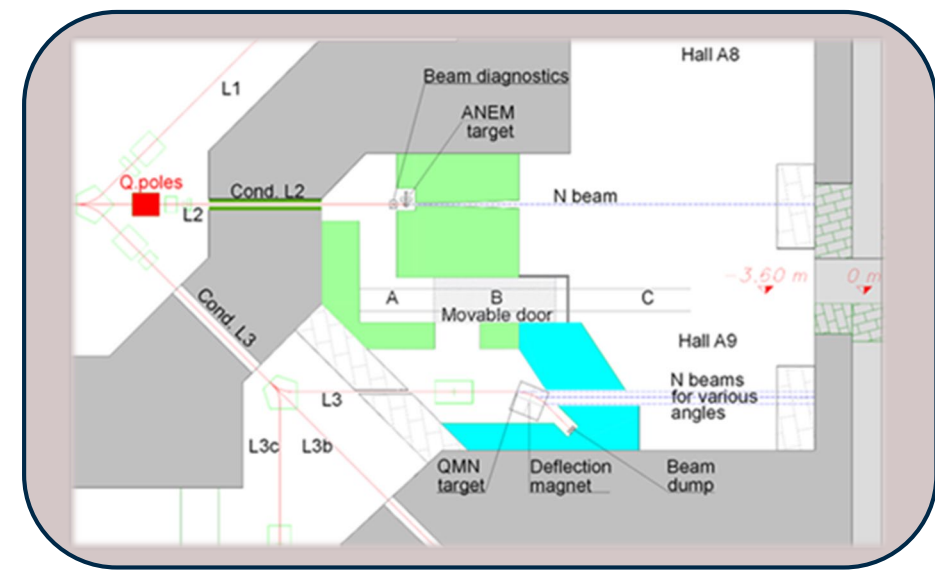
➤ Modelling of charged particle-induced nuclear cross sections for medical RNs



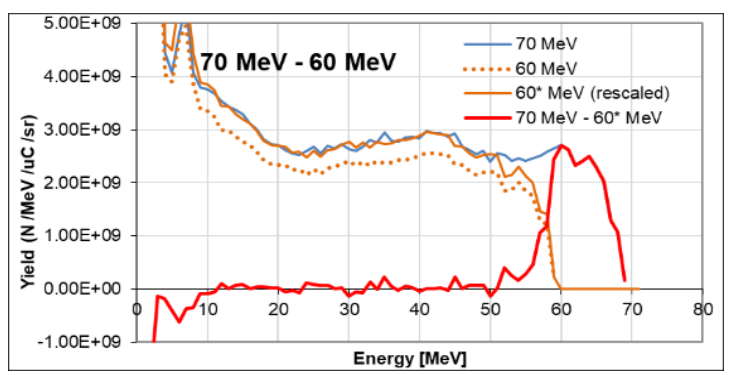
Nuclear cross sections measurements and modelling for direct radionuclide production and neutron beam lines at SPES (*L. Mou*)

➤ Neutron facility at SPES

- NEPIR-1 facility:
 - ANEM
 - SEE
 - QMN
 - SPARE
 - JUNO
 - SEE
 - n-XS



NEPIR-0: Pseudo monochromatic *n*-beam

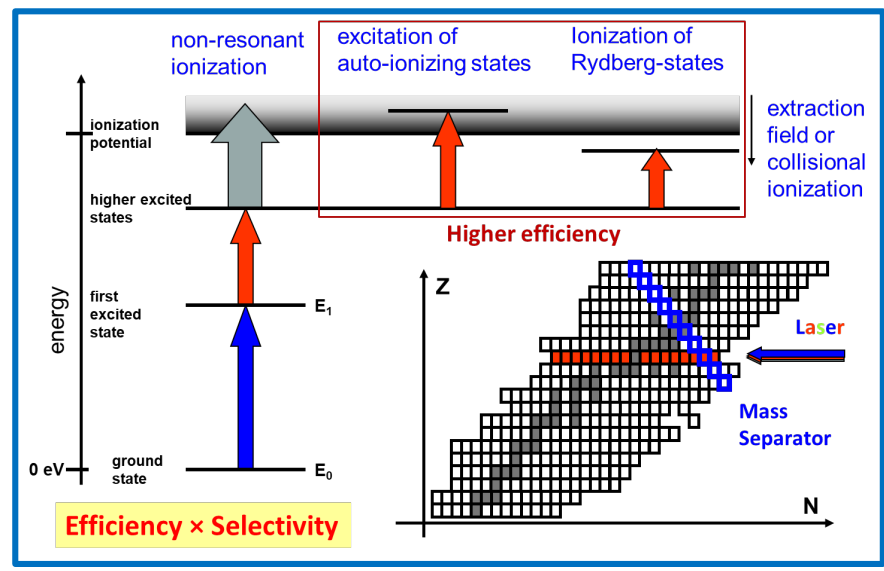


Large & various communities are interested in *n*-induced nuclear physics experiments & applications

ISOL and laser applications at the SPES facility (M. Ballan)

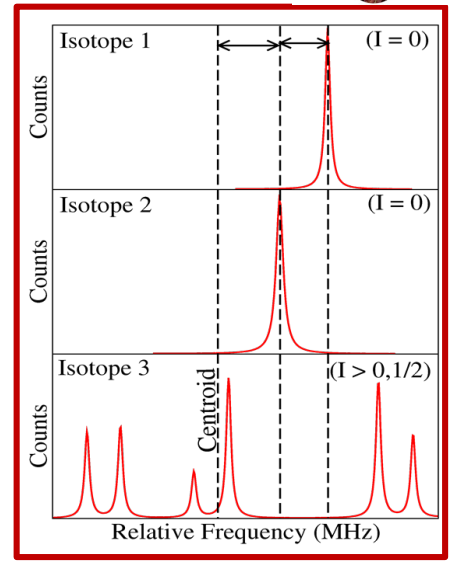


Laser spectroscopy and applications:



Photoionization combined with mass separation could provide isotopically pure RIBs

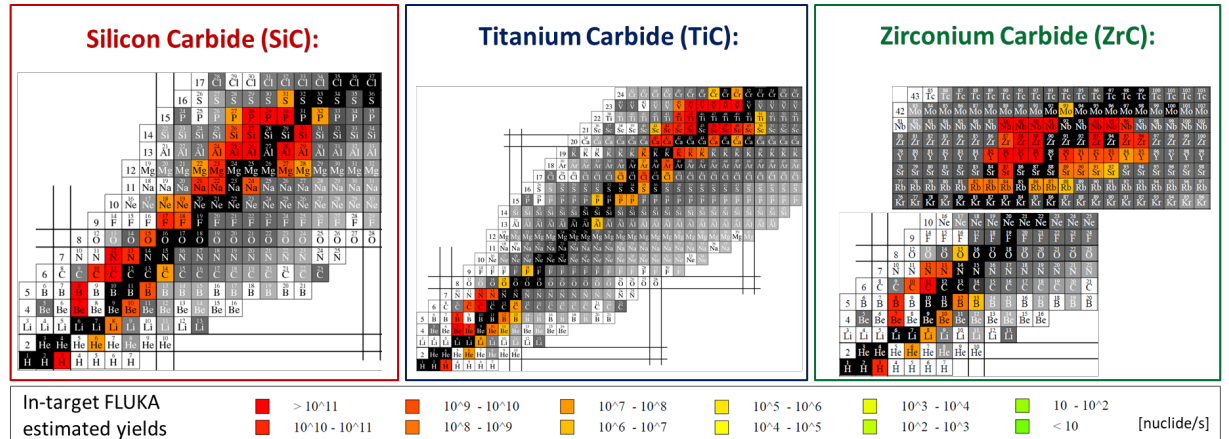
Several photoionization schemes are unknown, but can be studied with the available set-ups at SPES (and collaborating institutes)



Photoionization could be selective to isomers!

Nuclide production with ISOL for medicine and nuclear physics:

Different solid target materials could be used at SPES ensuring the availability of a wide set of RIBs for both nuclear physics studies and nuclear medicine applications, following to the users' community requests

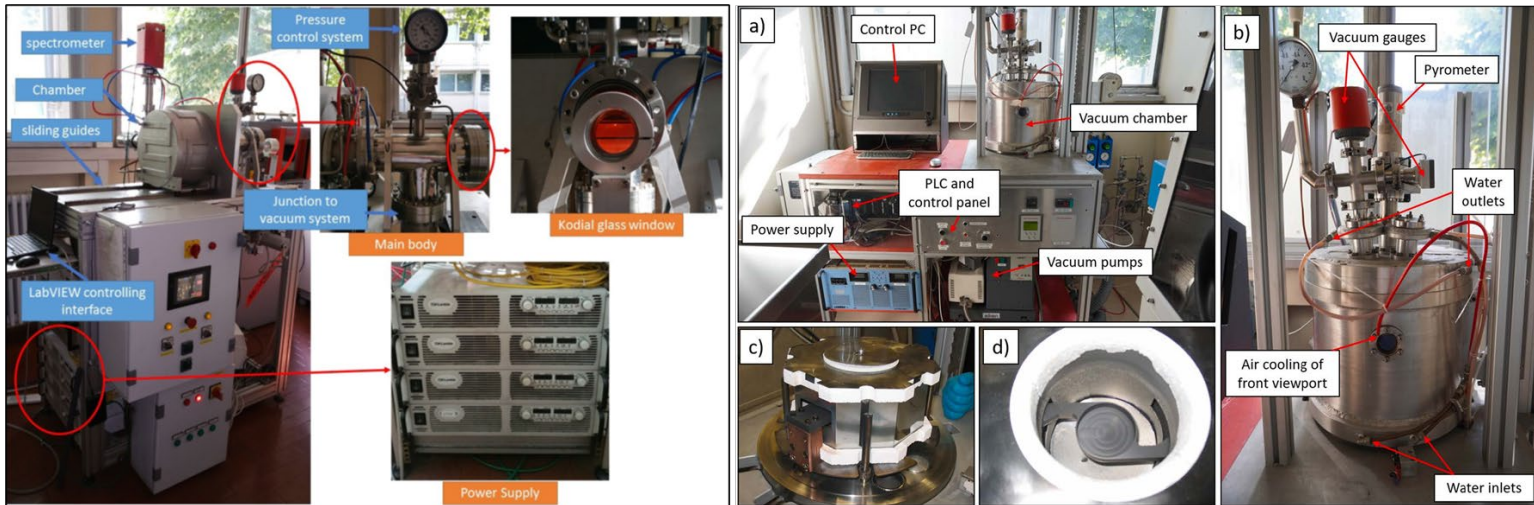




ISOL targets development:

The target development process requires several competences and technologies, available at LNL and at the ISOL facility community.

Cooperation with other new facilities (i.e. SCK CEN) can boost the target development process

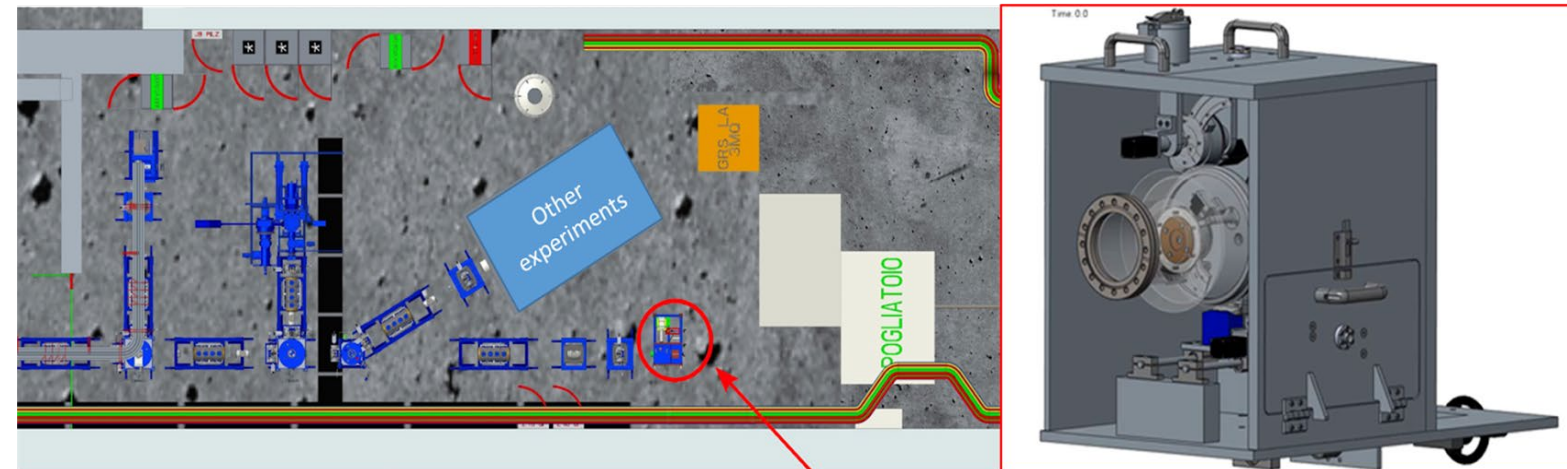


Decay spectroscopy of nuclides of medical interest:

The IRIS system will allow:

- Collection of RNs on appropriate substrates
- Quality control and characterization of the collected RNs

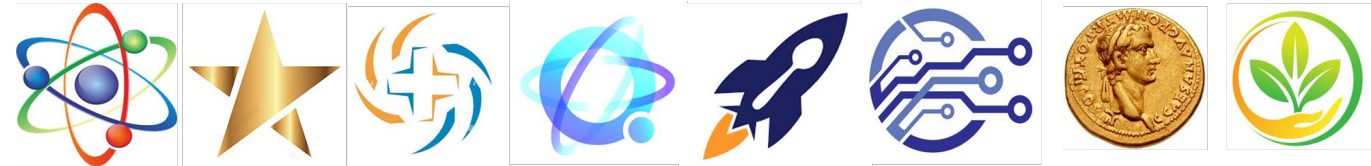
It could also be used to produce extremely pure radioactive sources



Development, characterization and modifications of materials for applied nuclear physics

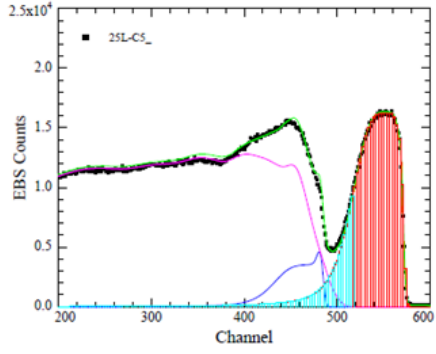
(M. Campostrini)

Several researcher communities interact with same purpose

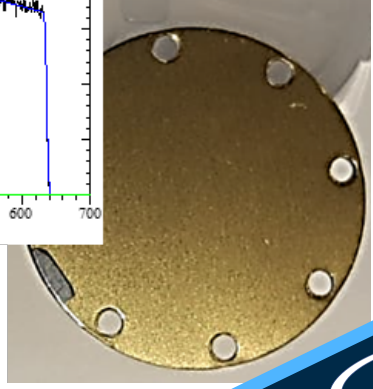
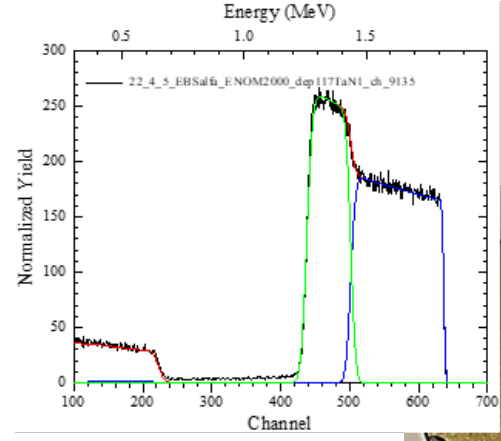
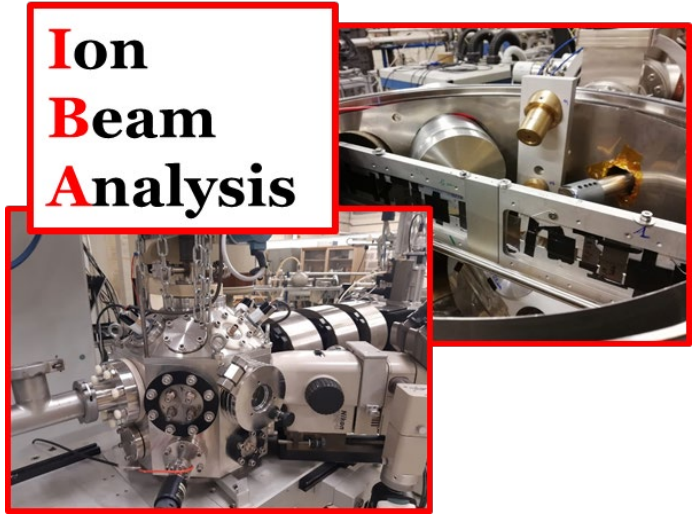


Ion beam micro-analysis for nuclear targets development and cross section measurements for applied nuclear physics

IBA quantitative analysis are **essential** for nuclear cross sections measurement



IBA **drive** the nuclear target production process



IBA quantitative analysis are **fundamental** for develop new materials and new concept of target for nuclear physics

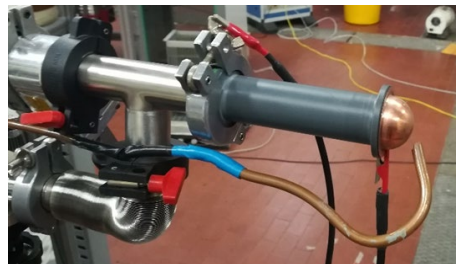


Ion-solid interaction and radiation damage of materials, detectors and devices:

Specific irradiation facilities are now or will be available soon @ LNL



High quality Neutron Beam Source are available @ LNL



All these facilities are involved in several physics experiments:

- Devices Radiation damage
- Material modification
- Detector tests
- Quantum technology
- Materials study

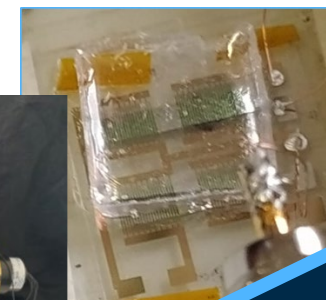


Novel detectors development and test:

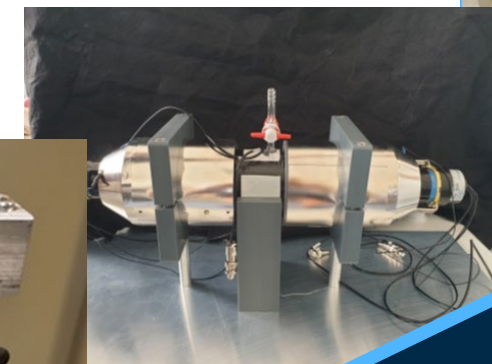
The technological research in new detector development and test is part of LNL background and will be carried on in next years.

The detectors developed and tested at LNL are a cutting-edge technology in X-ray, γ -rays, charge particles and neutrons detection

Flexible detector



Liquide scintillatore



Next generation HPGe detectors

