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# The ISOLPHARM Radionuclide Implantation Station for medical applications at SPES

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**ISOLPHARM**  
*SPES exotic beams for medicine*

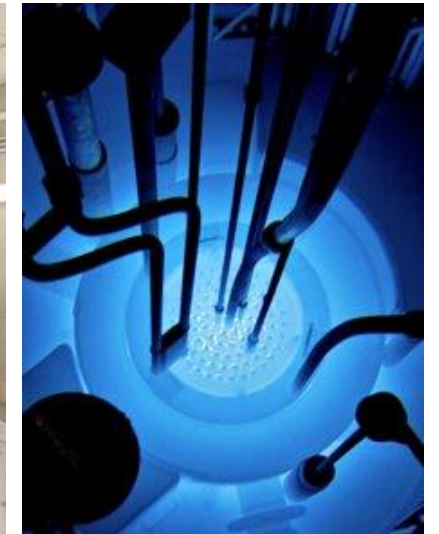
**ISOTOPIC TIME MACHINE**  
FROM CULTURAL HERITAGE  
TO SUSTAINABLE FUTURE





# Standard radionuclide production

- Medical radionuclides are commonly supplied by **cyclotrons** or by **nuclear reactors**
- The **availability** of **new** infrastructures dedicated to radionuclide production is crucial for nuclear medicine
  - **ISOL** facilities

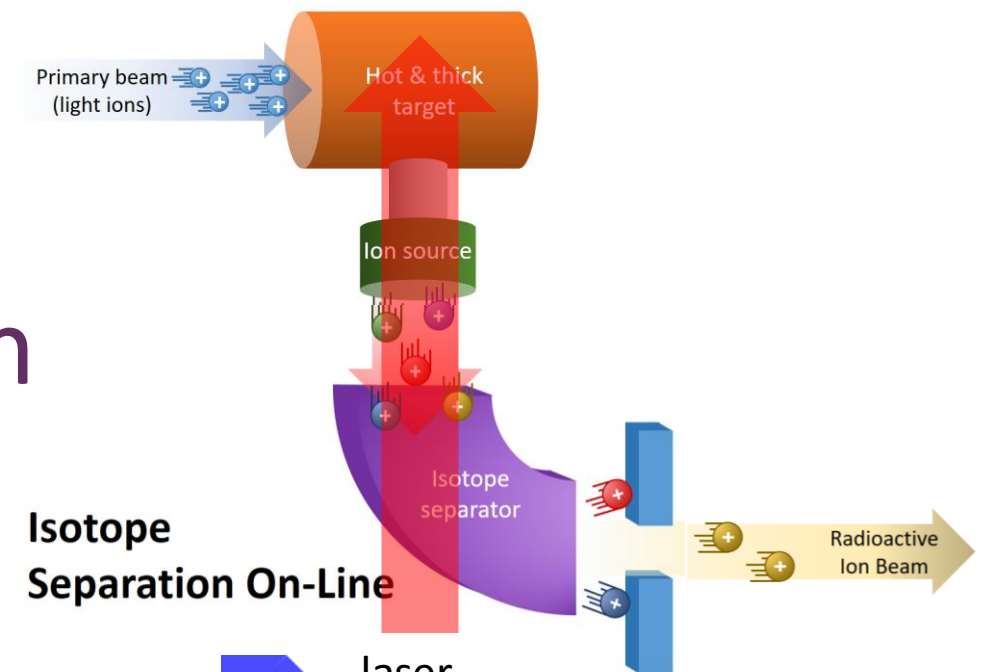


<https://lena.unipv.it/>

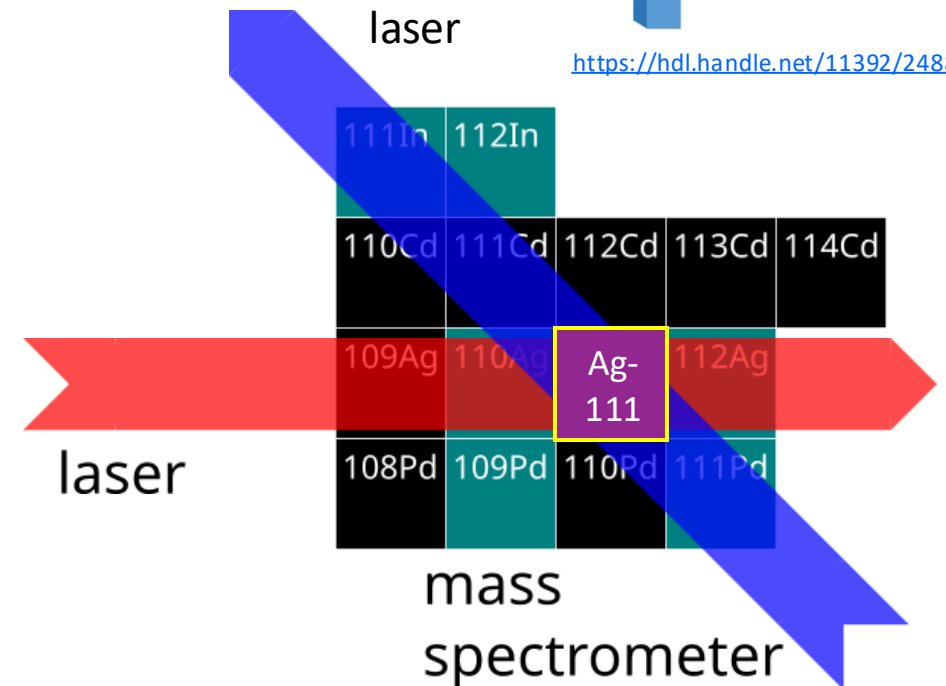


# ISOL radionuclide production

- Isotope Separation On-Line (**ISOL**) technique enables the production of very pure Radioactive Ion Beams (RIBs)
  - **Element selection** via resonant laser photoionization
  - **Mass selection** via Dipole magnet
- **SPES at INFN-LNL** will be one of the few facilities using the ISOL technique for radionuclide production, such as CERN-MEDICIS and TRIUMF-ISAC

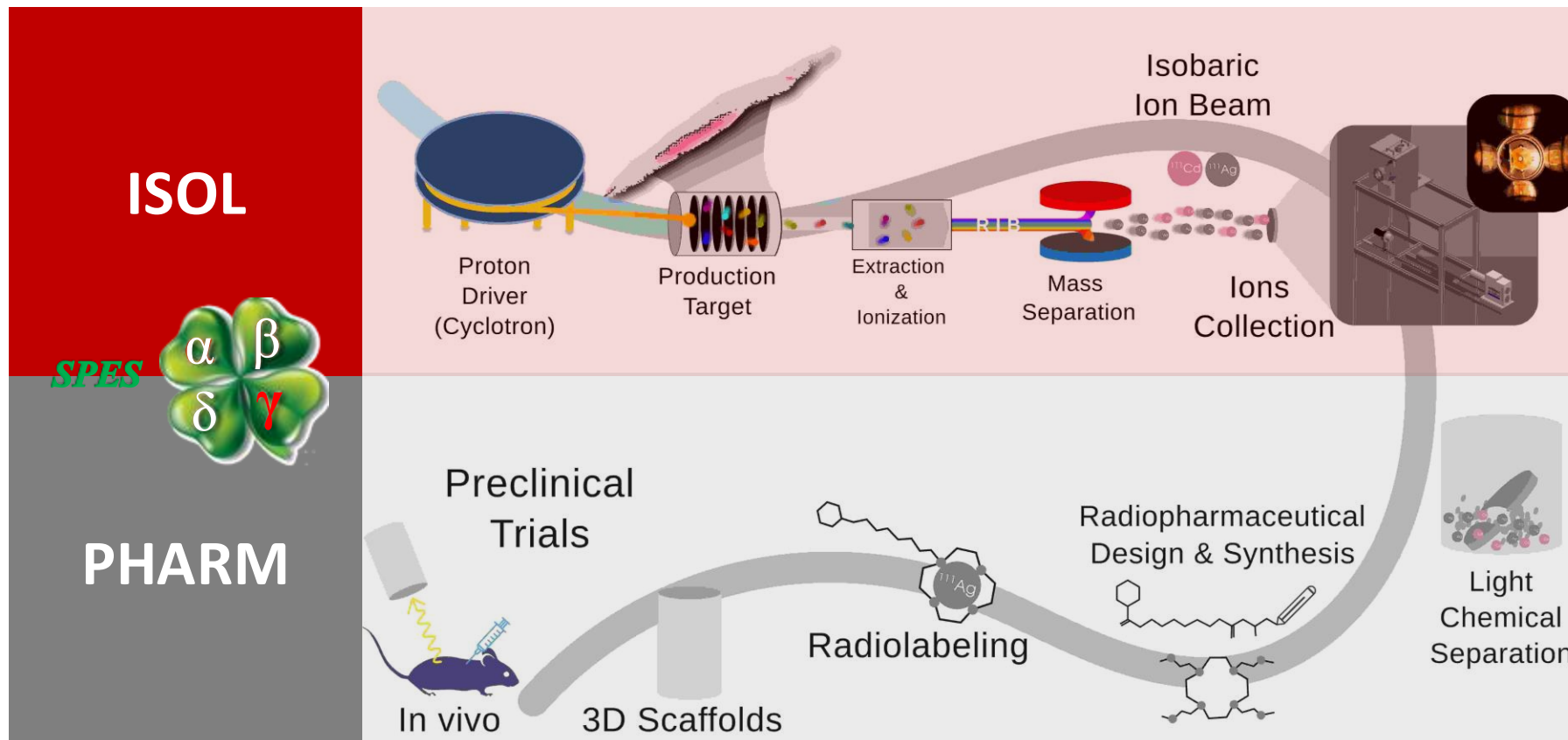


<https://hdl.handle.net/11392/2488258>





# The ISOLPHARM project

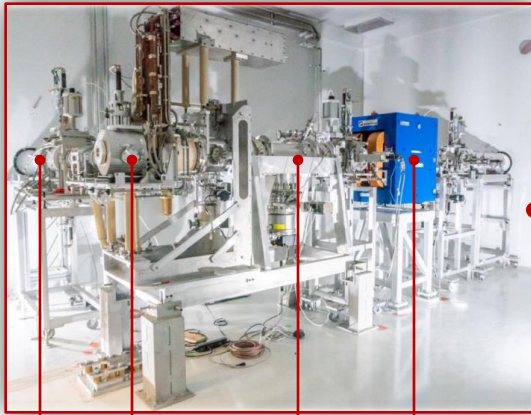


- SPES-produced radionuclides will be employed for **innovative radiopharmaceuticals** studies
- **<sup>111</sup>Ag** is a promising candidate for therapy
  - The maximum energy of its  $\beta^-$ -rays is 1 MeV
  - The main  $\gamma$ -rays has 342 keV and 7% intensity
  - Silver features **diagnostics isotopes**, in particular <sup>103</sup>Ag

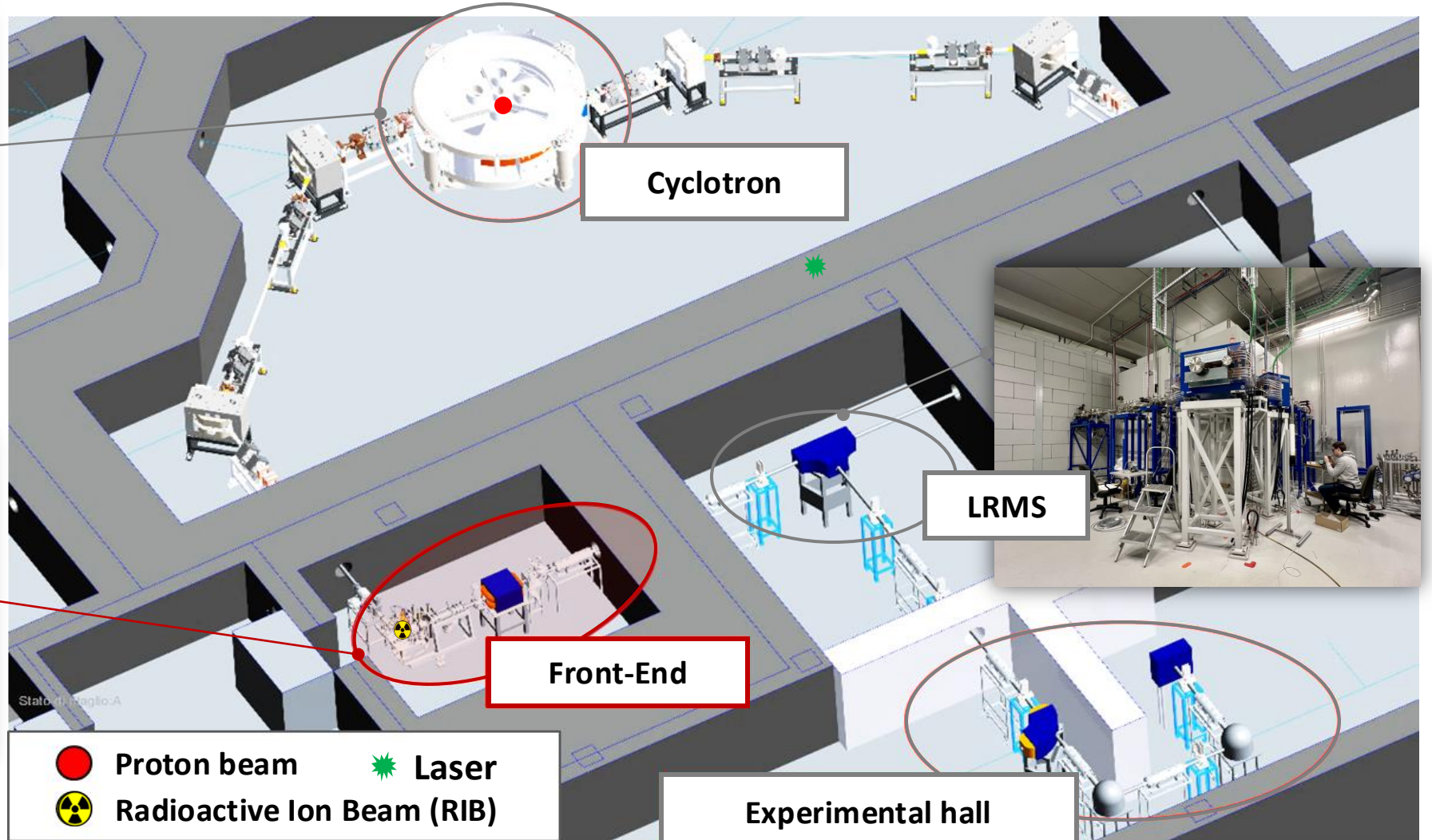
Courtesy of D. Chen



**Up to 40 MeV @ 200  $\mu$ A**



**PPB TIS RIB WF**





# A system for the collection of radionuclides?

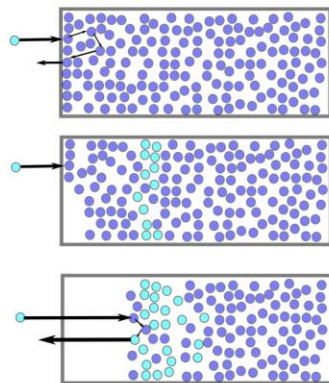
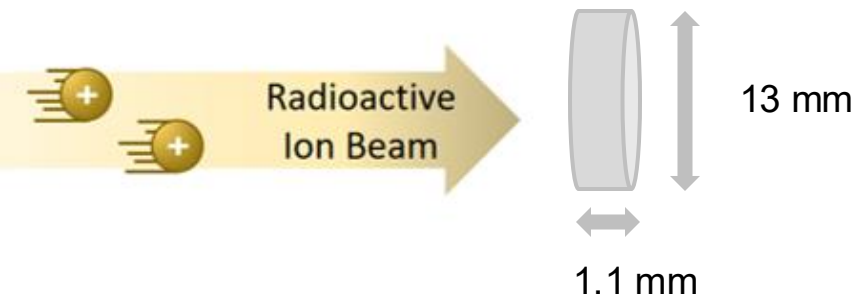


- The ISOL-produced Radioactive Ion Beam needs to be **stopped** on a suitable material
- The radioactive sample needs to be **characterized** (activity quantification)
- The radioactive sample needs to be **safely stored** and **accessible** for users



<https://doi.org/10.1016/j.apradiso.2021.109795>

# Implantation substrate



- The ISOL-produced Radioactive Ion Beam needs to be **stopped** on a suitable material → **organic tablets**
- The radioactive sample needs to be **characterized** (activity quantification)
- The radioactive sample needs to be **safely stored** and **accessible** for users

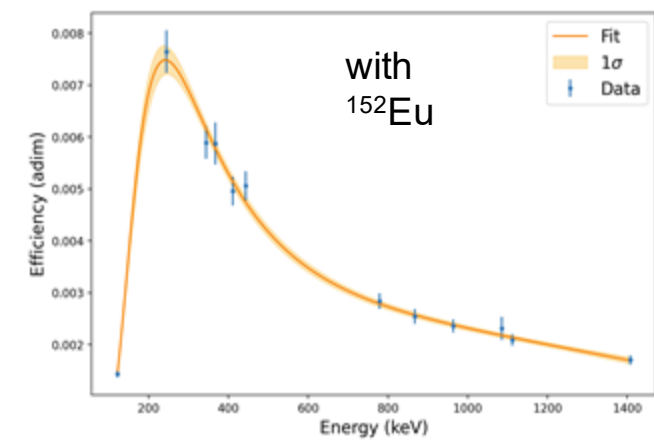
High mechanical resistance

Minimum self-sputtering

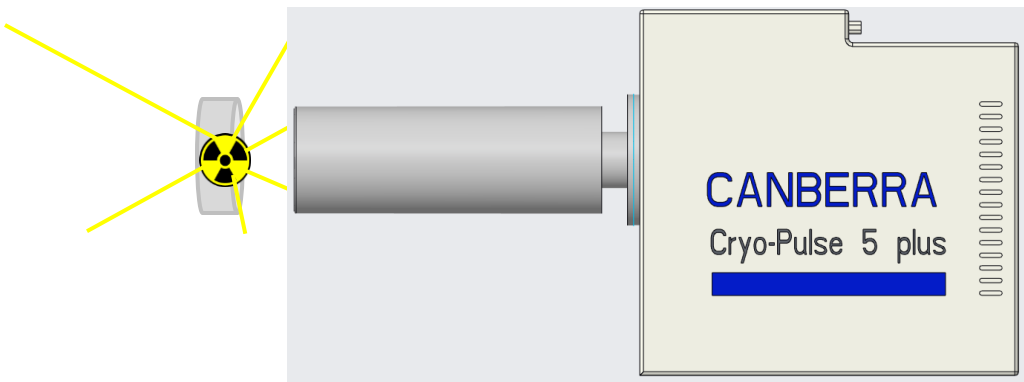
Fast dissolution and ion-deposition release

<https://repository.cern/records/16ja0-2at43>

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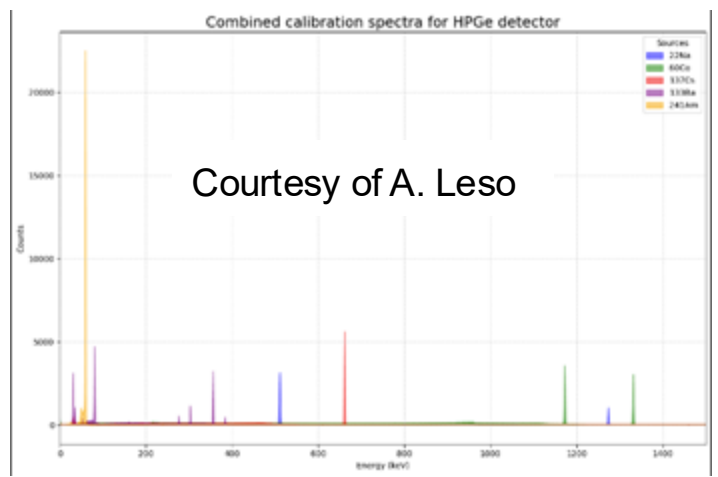


# Activity quantification



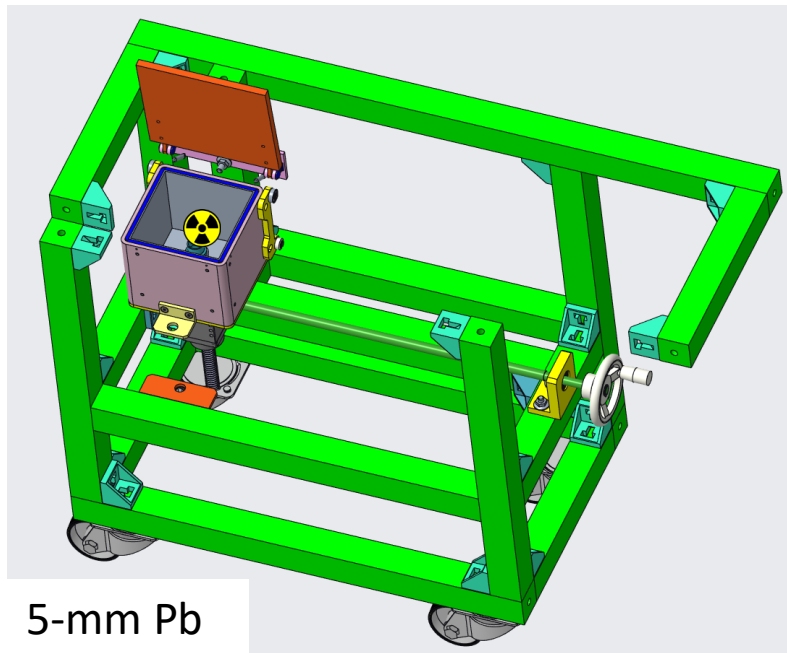
- The ISOL-produced Radioactive Ion Beam needs to be **stopped** on a suitable material
- The radioactive sample needs to be **characterized** (activity quantification) →  $\gamma$ -ray spectrometry
- The radioactive sample needs to be **safely stored** and **accessible** for users

$$A = \frac{N_{\text{photopeak}}}{\Delta t \cdot \epsilon_{\text{abs}} \cdot \Gamma}$$





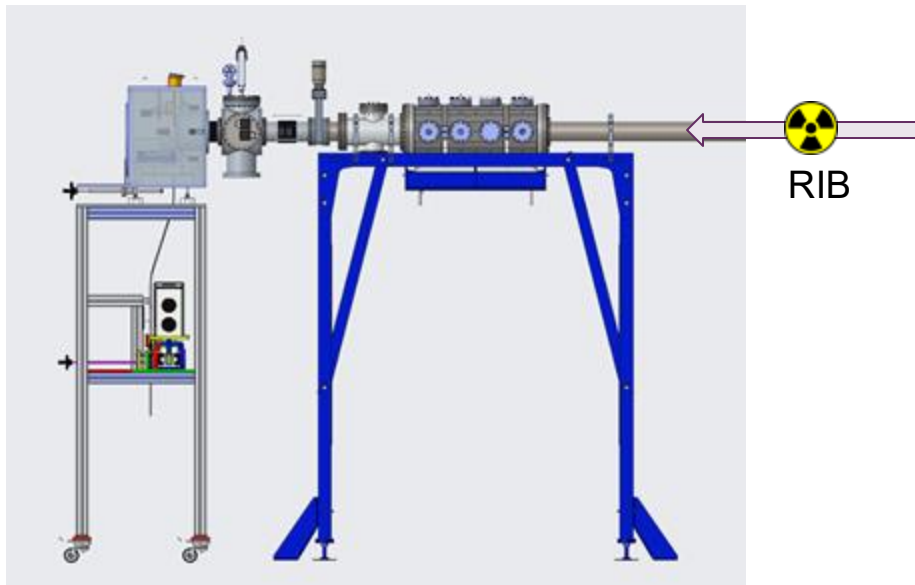
# Radioactive tablet movement



- The ISOL-produced Radioactive Ion Beam needs to be **stopped** on a suitable material
- The radioactive sample needs to be **characterized** (activity quantification)
- The radioactive sample needs to be **safely stored** and **accessible** for users → shielded trolley



# ISOLPHARM Radionuclide Implantation Station (IRIS)



- An experimental setup named **IRIS** was designed to:
  - Perform the **radionuclides collection** on the implantation substrates
  - Host the  $\gamma$ -ray detectors for the **activity quantification**
  - Dock the shielded trolley to **safely store and move** the radioactive sample



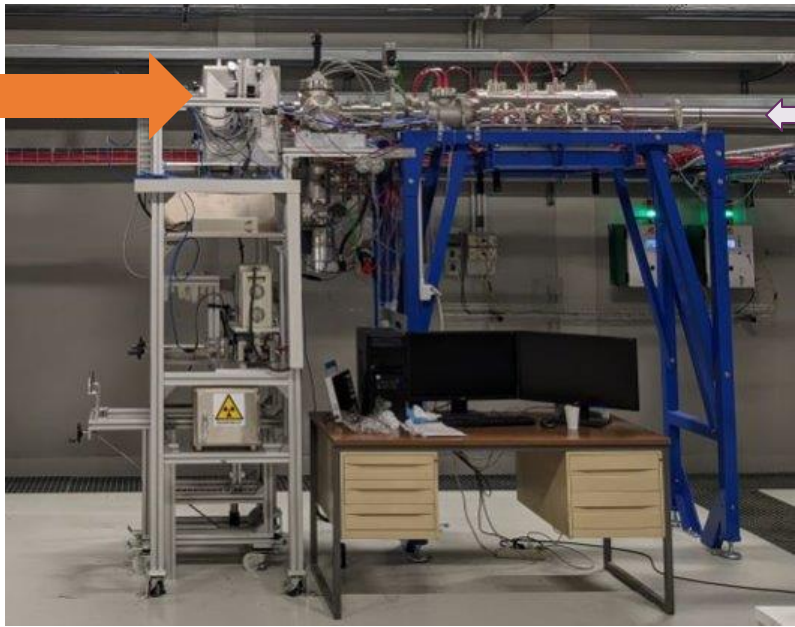
# ISOLPHARM Radionuclide Implantation Station (IRIS)



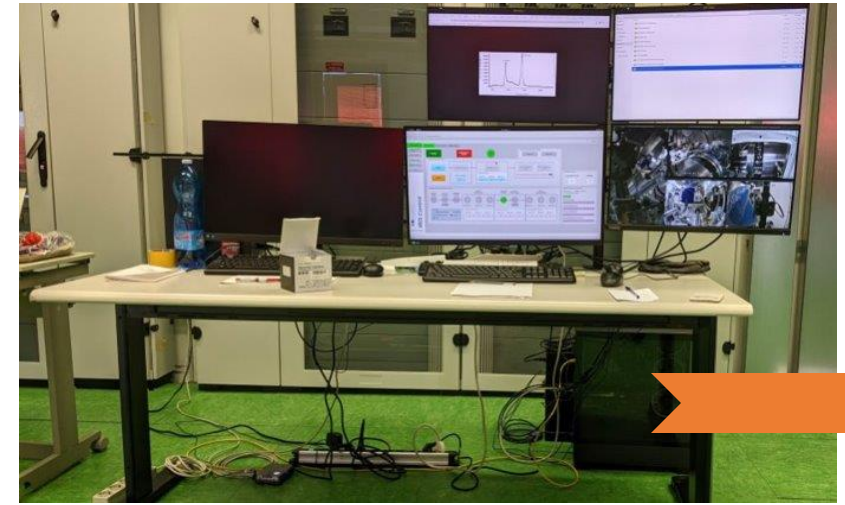
- IRIS setup was **installed** at SPES in 2025
- The operational **workflow** was tested offline to ensure the routine reliability:
  - Tablets loading
  - Beamline coupling
  - Radionuclide collection
  - Beamline decoupling
  - Gamma-ray spectrometry
  - Tablets in trolley

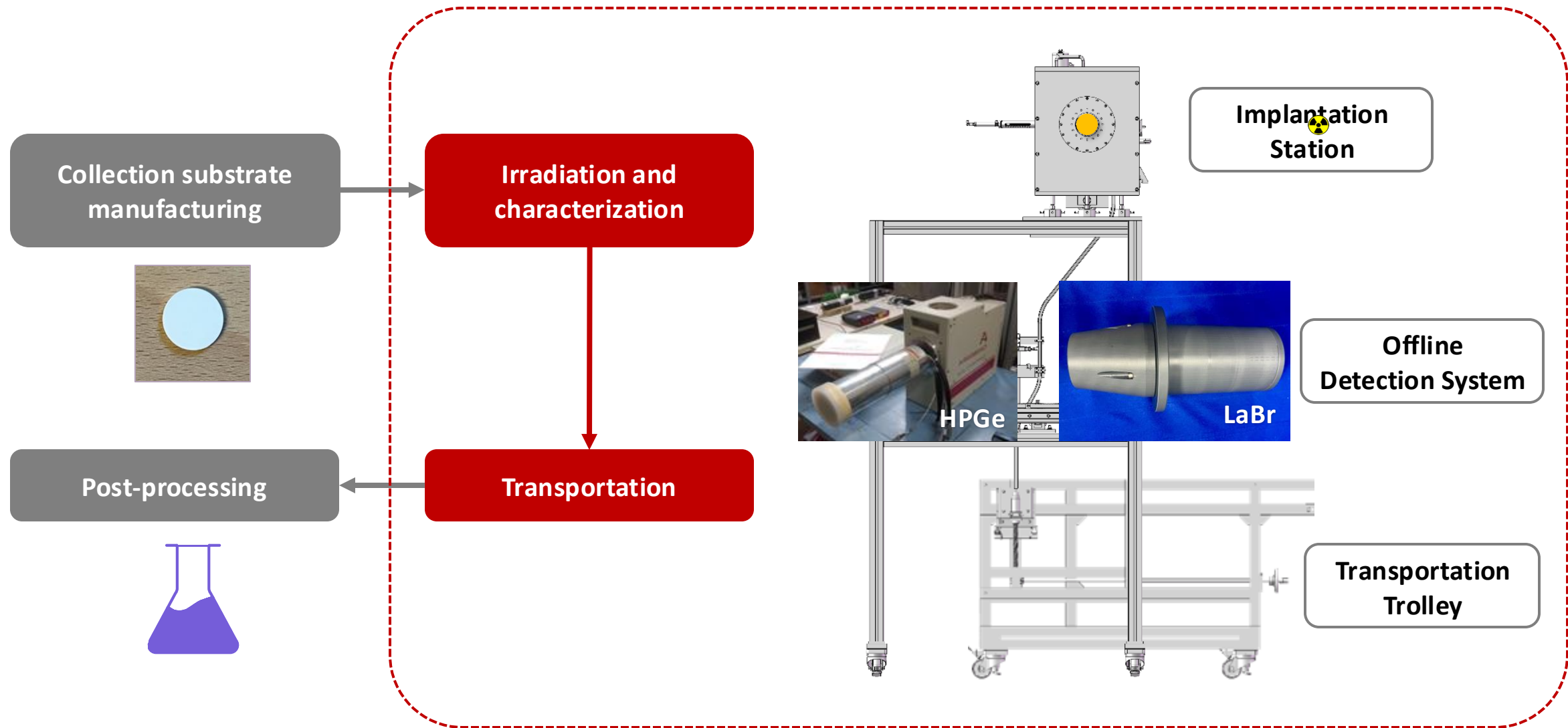


# ISOLPHARM Radionuclide Implantation Station (IRIS)



- A **workstation** in the SPES control room allows a **user** to manage the irradiation + characterization routine in an **automated** fashion







# Conclusions

- The **SPES** facility at INFN-LNL plans to produce innovative radionuclides of medical interest, such as  $^{111}\text{Ag}$
- The ISOLPHARM Radionuclide Implantation Station (IRIS) was recently **installed** at SPES
- The **collection** and **activity-quantification** workflows have been tested **offline**
- Tests with **stable beam** at SPES are planned in the next months
- Innovative **substrate materials** for the deposition tablets will be tested in the offline front-end





# The ISOLPHARM project

- The ISOLPHARM collaboration will present PHARM activities in two talks:
  - On Wednesday at 12:10 in Europa room (Wed\_S1\_C) [Radiobiology experiments with  \$^{111}\text{Ag}\$](#)  by A. Leso
  - On Wednesday at 16:00 in Pacifico room (Wed\_S2\_D) [Geant4 image-based cellular dosimetry for in-vitro  \$^{111}\text{Ag}\$ -irradiated LNCaP cells](#) by G. S. Valli
- And ISOL activities in another talk:
  - On Wednesday at 18:15 in Asia room (Wed\_S3\_B) [A theoretical framework for isotope production at the SPES ISOL facility: Magnesium-28 as a case-study](#) by A. Arzenton



# Thanks



The ISOLPHARM collaboration

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DIPARTIMENTO DI  
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SPES  MED

ADMIRAL  
 ISOLPHARM



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