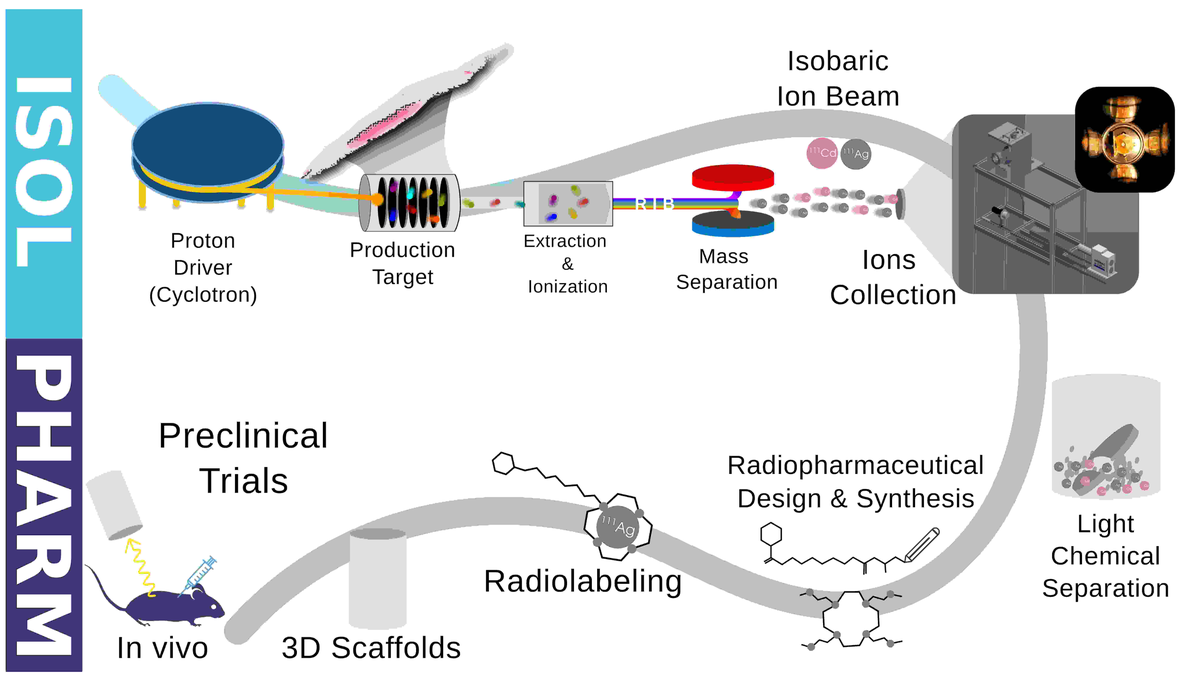
Development of a β imaging detector tailored to Ag-111 for the ISOLPHARM project

Davide Serafini[1,2,✉], Jessica Delgado[3], Vittoria Pavanello[4], Rubens Raffagnato[5], Michele Giorato[4], Marcello Lunardon[4,5], Emilio Mariotti[2,6], Alberto Andrighetto[1] and the ISOLPHARM collaboration

1) National Institute of Nuclear Physics, Legnaro National Laboratories (INFN-LNL), Legnaro (PD), Italy
2) University of Siena, Department of Physical, Geological and Environmental Sciences (UNISI-DSFTA), Siena, Italy
3) University of Ferrara, Department of Physics and Earth Science, Ferrara, Italy
4) University of Padova, Department of Physics and Astronomy (UNIPD-DFA), Padova, Italy
5) National Institute of Nuclear Physics, Padova Department (INFN-PD), Padova, Italy
6) National Institute of Nuclear Physics, Pisa Department, Siena Group (INFN-PI), Siena, Italy
✉ d.serafini@student.unisi.it

ISOLPHARM
SPES exotic beams for medicine

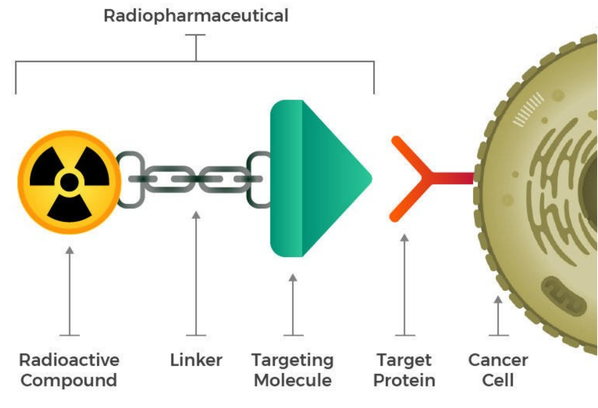
Introduction



The ISOLPHARM project (ISOL technique for radioPHARMaceuticals) is a multidisciplinary research activity focused on the production of carrier-free radionuclides for medical applications.

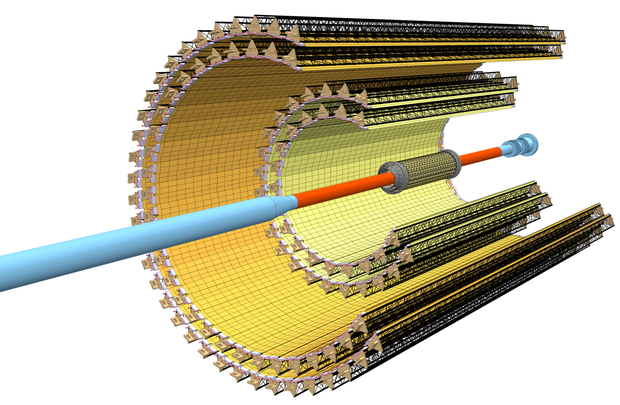
ADMIRAL
ISOLPHARM

The ongoing phase of experimentation, ADMIRAL, aims to establish the potential of the developed Ag-111 based radiopharmaceutical in both diagnostic and therapeutic contexts [1].



Radiopharmaceutical from National Cancer Institute.

Methods

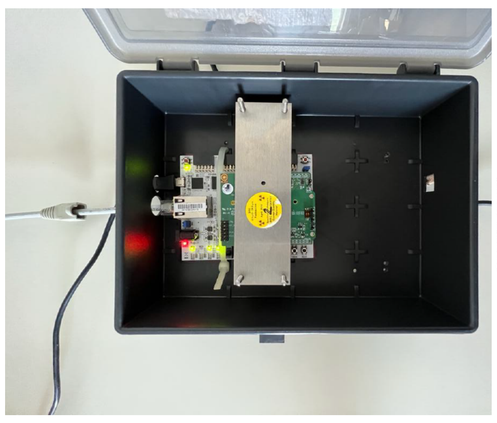


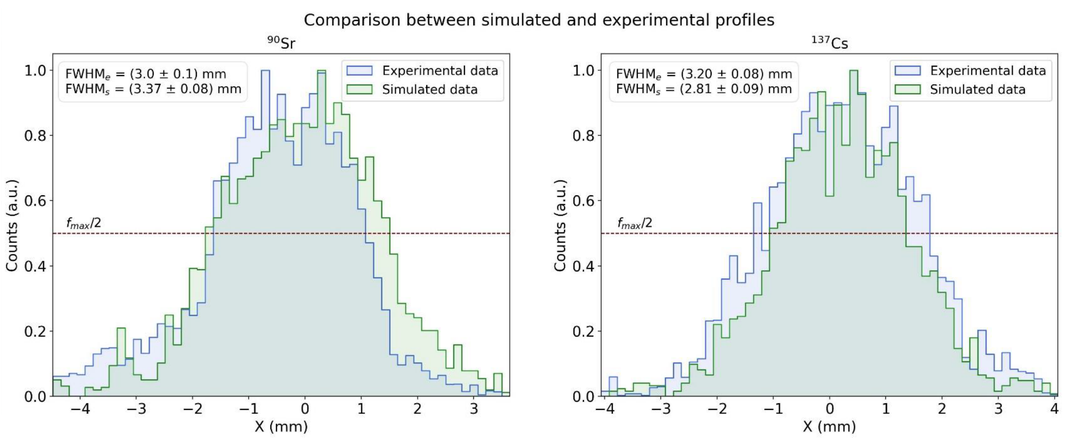
In order to assess the cellular uptake of radiopharmaceutical, a possibility is to use Monolithic Active Pixel Sensors (MAPS) namely the ALice PIxel DEtector (ALPIDE) chips [2,3].

GEANT4
A SIMULATION TOOLKIT

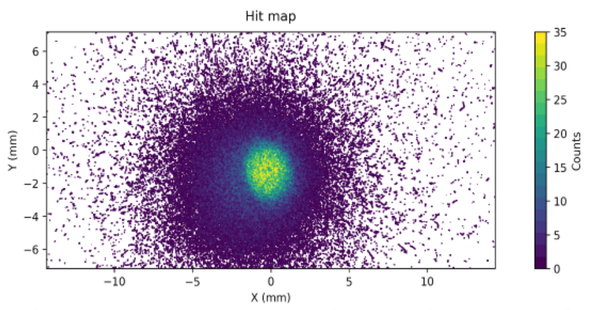
A Monte Carlo simulation model of the detector system was developed using the Geant4 toolkit.

Results



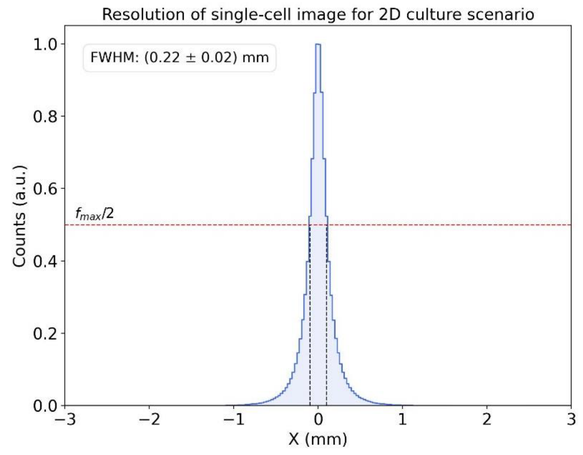


A preliminary acquisition with Sr-90 was carried out to test the system and to evaluate the Geant4 simulation.



The intrinsic spatial resolution of the ALPIDE is about 10 µm. However, in the case of a cellular uptake experiment, the practical spatial resolution decreases [1]:

· 0.2 mm for 2D cultures
· from 0.2 mm to 1 mm for hydrogel-based cultures



Conclusions

Preliminary experiments with Sr-90 and the β detector were conducted to validate a Monte Carlo simulation of the system.
The designed simulations successfully described the β detector performance and confirmed that it is suitable for the following in-vitro uptake experiments.

References

[1] V. Pavanello, Performance study of a novel 2D imaging beta detector for medical applications, M. Sc. Thesis, University of Padova, 2023
[2] B. Abelev et al and (The ALICE Collaboration) 2014 *Journal of Physics G: Nuclear and Particle Physics* 41 087002
[3] M. Suljic, Study of Monolithic Active Pixel Sensors for the Upgrade of the ALICE Inner Tracking System, PhD Thesis, University of Trieste, 2017

INFN Istituto Nazionale di Fisica Nucleare
UNIVERSITÀ DI SIENA 1240
Dipartimento di Fisica e Astronomia Galileo Galilei