Monte Carlo simulation of the ISOLPHARM gamma camera for Ag-111 imaging

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ISOLPHARM SPES exotic beams for medicine
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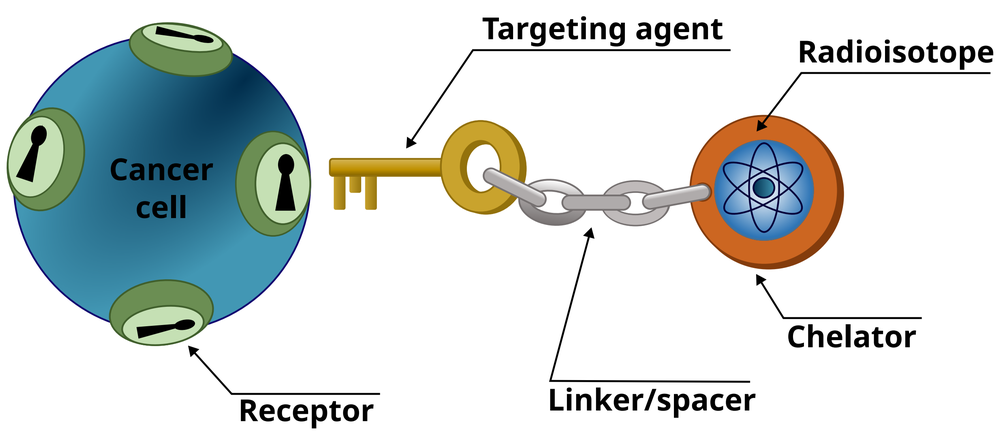
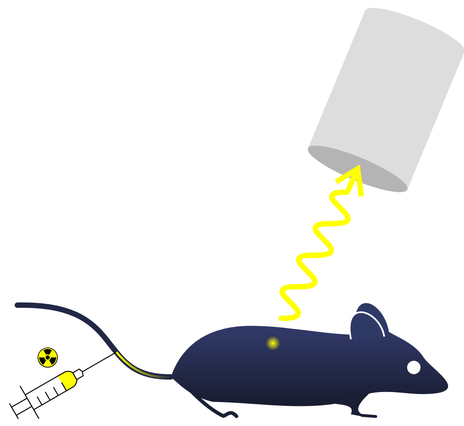
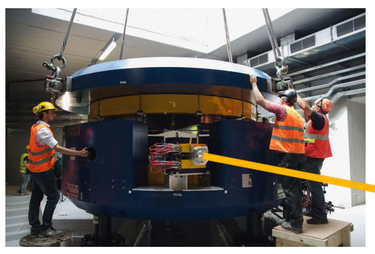
Introduction

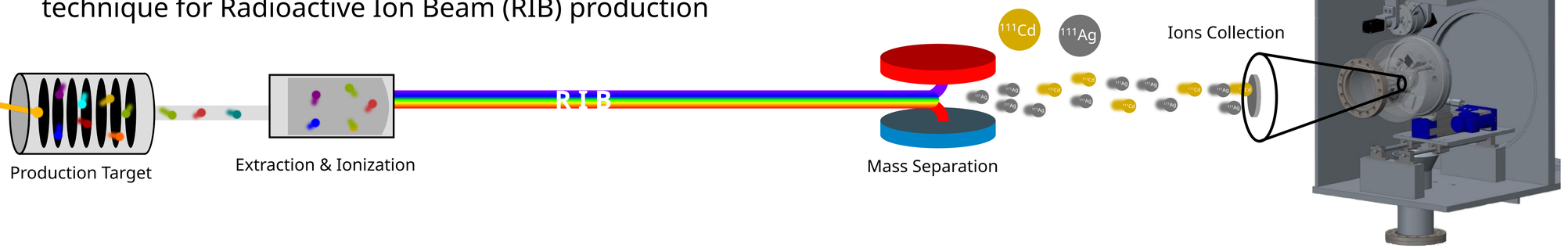
- One consolidated technique for the treatment of cancer is Targeted Radionuclide Therapy (TRT)
- With this technique, radionuclides are attached to a specific drug that is able to bring them to the target tumor site [1]
- The ISOLPHARM project is currently developing a radiopharmaceutical for TRT based on Ag-111, an innovative radionuclide [2] [3]





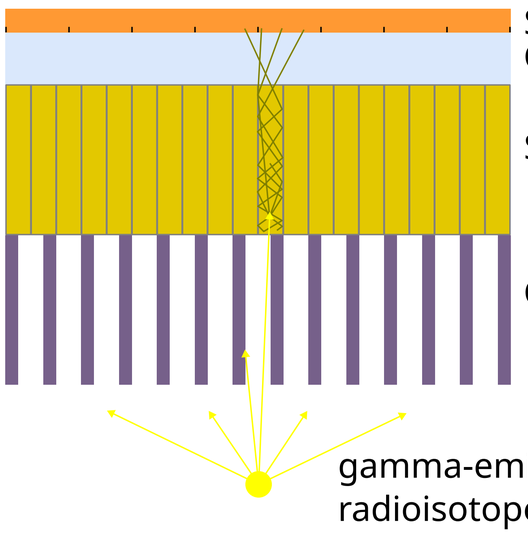

SPES Proton Driver (Cyclotron)

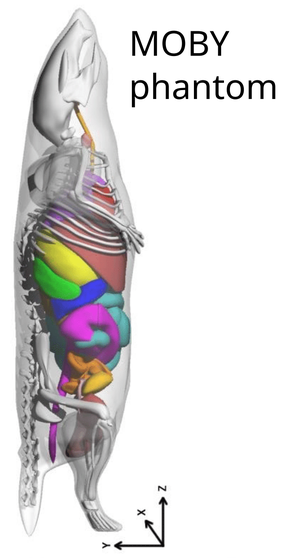
- Ag-111 will be produced at the SPES facility at INFN-LNL using the ISOL technique for Radioactive Ion Beam (RIB) production



Material and Methods

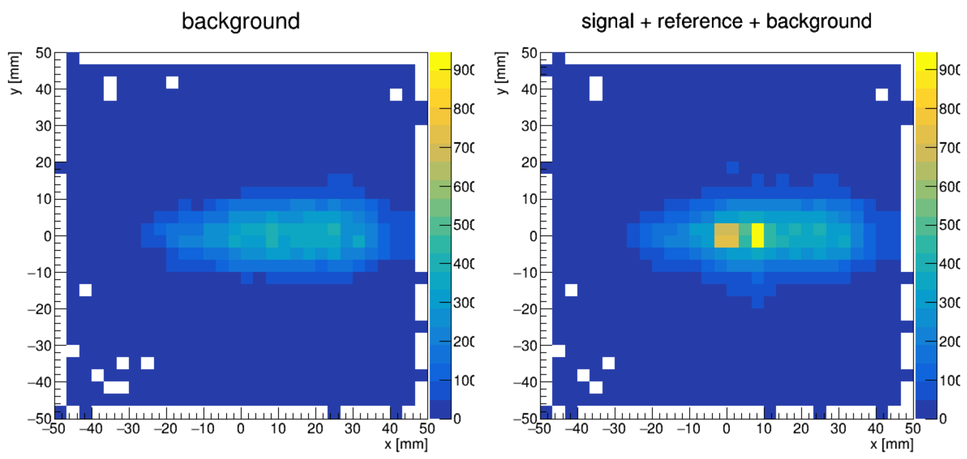
- Ag-111 has a half-life of 7.45 days and decays emitting both beta-rays, Auger electrons and gamma-rays (245 keV and 342 keV)
- The emission of gamma-rays allows the Ag-111 nuclei to be visualized through the use of a gamma camera
- The gamma camera will be composed of: tungsten collimator, GaGG(Ce) scintillator, 64 channel SiPM, readout electronics
- A Monte Carlo simulation of the device was realized in Geant4 [4]
- The MOBY mouse model was used to simulate an experimental condition with a real tumor [5]





GEANT4 A SIMULATION TOOLKIT

Results



- The physics lists used are G4EmStandardPhysics_option3 and G4OpticalPhysics
- The scintillator is simulated with yield 42k optical photons per MeV, refractive index 1.9 and absorption length 645 mm
- Two sources (spheres of 1 mm diameter) were simulated inside a mouse model with uniform activity
- The centre of the sources is placed at 10 mm from the collimator
- Sources separated by at least 8 mm could be resolved

Conclusions

- The SPES ISOL facility at INFN-LNL will be used to produce radionuclides of medical interest within the ISOLPHARM project
- The most promising radionuclide is a teranostic candidate: Ag-111
- With the ISOLPHARM ADMIRAL experiment, Ag-111 imaging with a gamma camera is being investigated
- A Monte Carlo simulation of such gamma camera was built with Geant4 toolkit
- From the results of the simulations, we expect to be able to resolve tumors in mice model that are at least 8 mm apart

References

[1] S. J. Goldsmith (2020). Seminars in Nuclear Medicine, 50, 87-97
[2] S. Corradetti et al (2020). Impact and Applications, 30, 33-36
[3] L. Morselli et al (2023). Applied Radiation and Isotopes, 197, 110798
[4] J. Allison et al (2016). Nucl. Inst. Methods. Phys. Res. A, 835, 186-255
[5] E. Larsson et al (2007). Cancer Biotherapy & Radiopharma., 22, 3

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