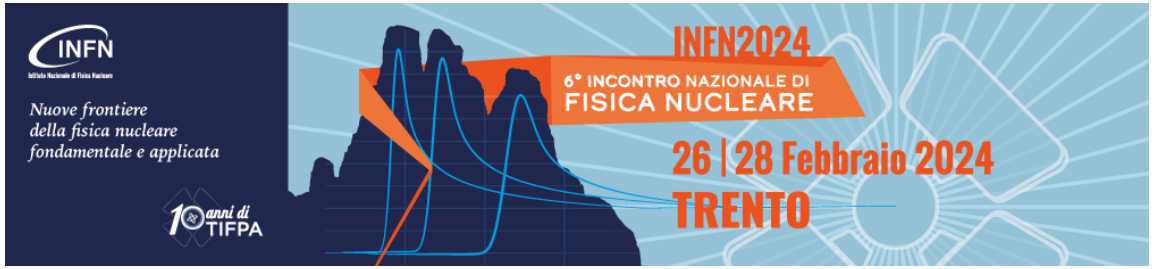
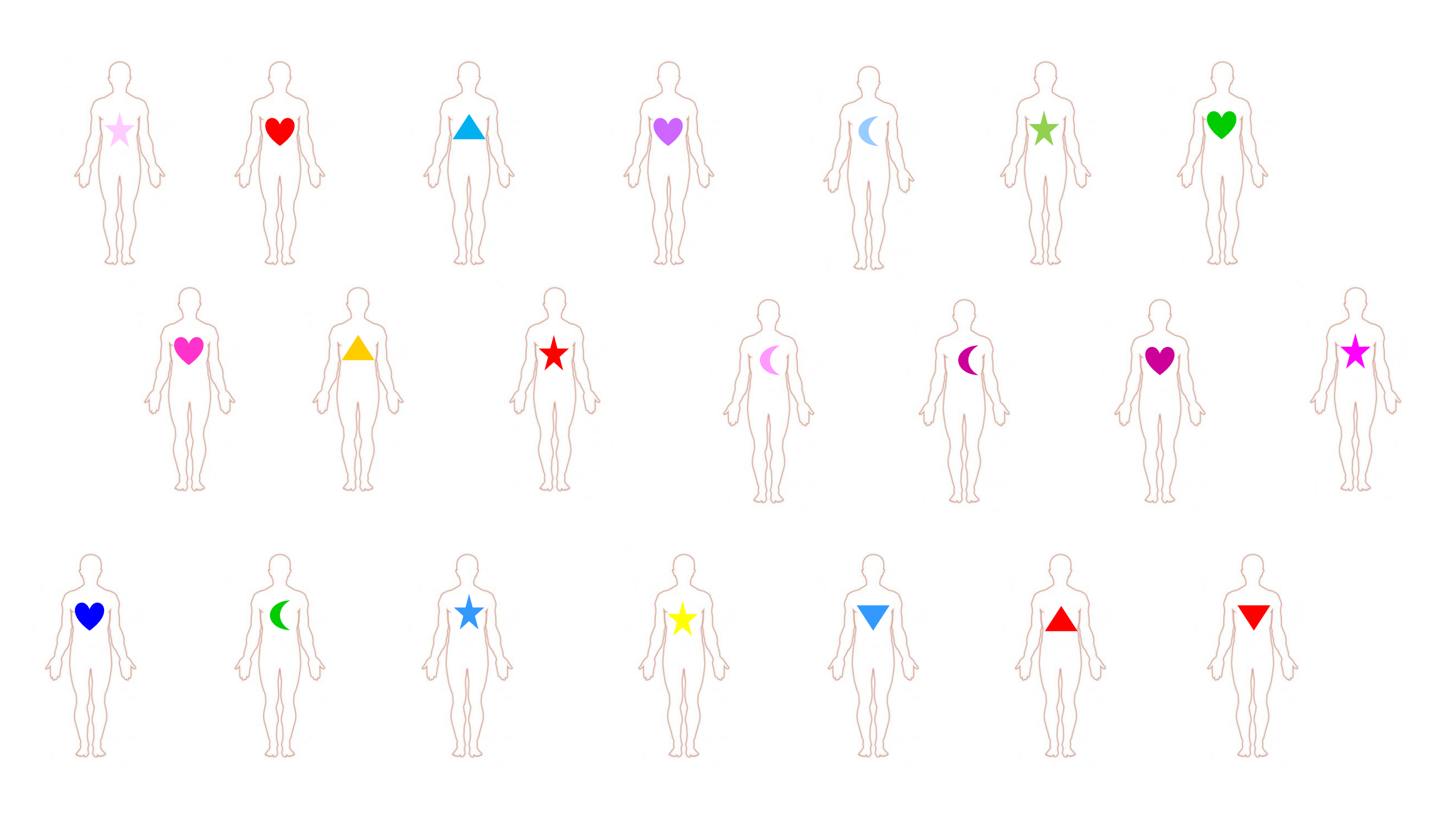


Theoretical simulations for innovative nuclear medicine applications: cyclotron production of the theranostic radionuclides ^{47}Sc and ^{155}Tb

Francesca Barbaro

Istituto Nazionale di Fisica Nucleare

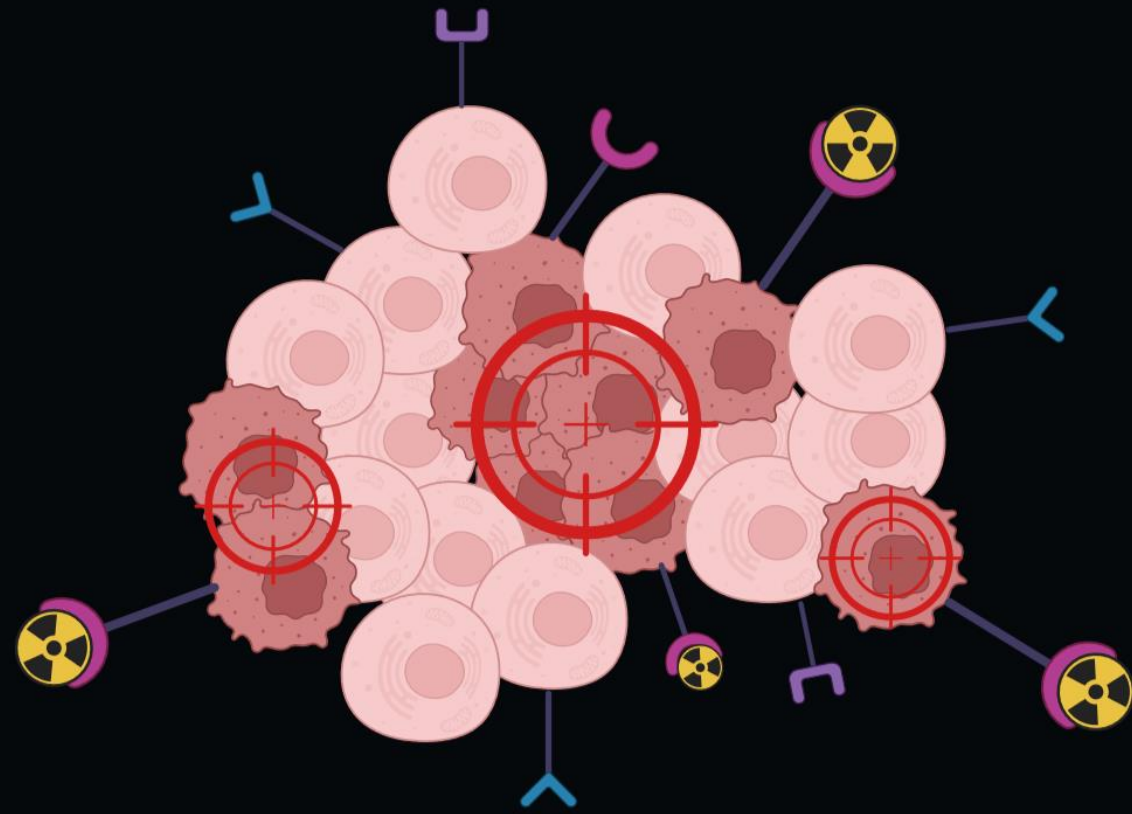
NUCSYS - CSN4 REMIX - CSN5 SPES_MED - CSN3



THERANOSTICS

therapy + diagnosis

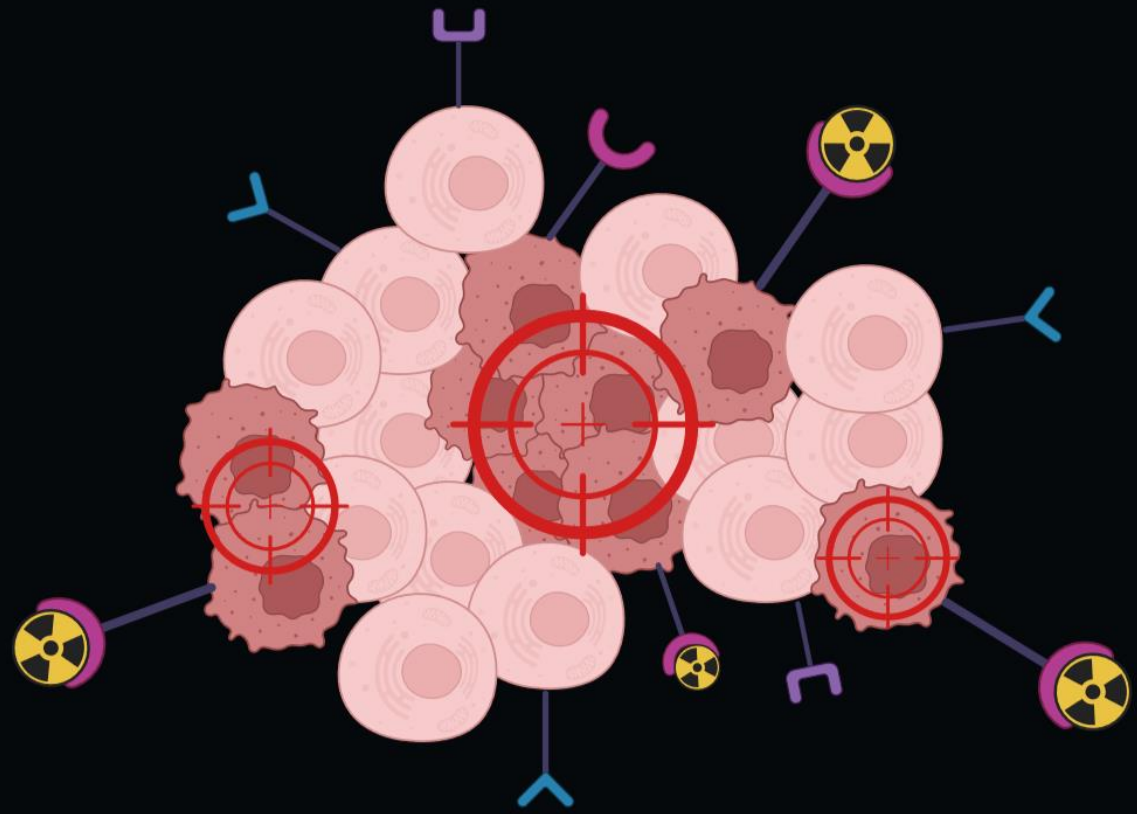
What we see is what we treat = personalized treatment



What type of radionuclides are interesting for medical purposes?

half-life & decay mode

quantity & quality (medical standards)



feasible production routes for ^{47}**Sc** and ^{155}**Tb**

Theoretical calculations

Radionuclidic purity

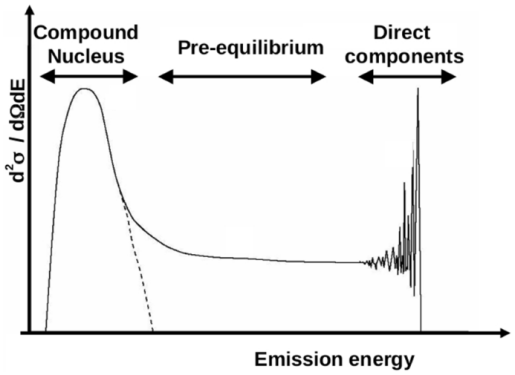
$$RNP = \frac{A_{47\mathrm{Sc}}(t)}{\sum_{xx} A_{xx\mathrm{Sc}}(t)}$$

activity

Bateman eq

rate

cross section



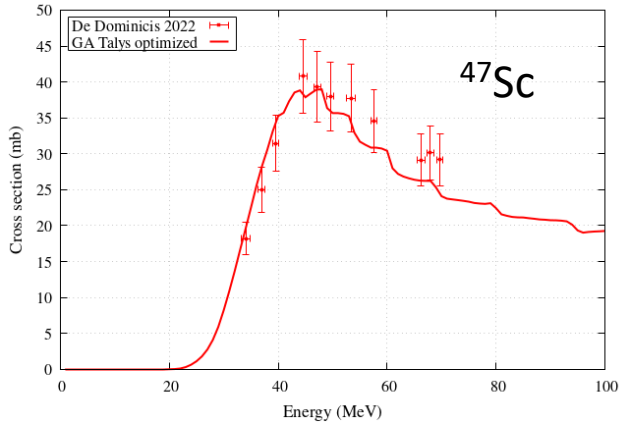
TALYS code

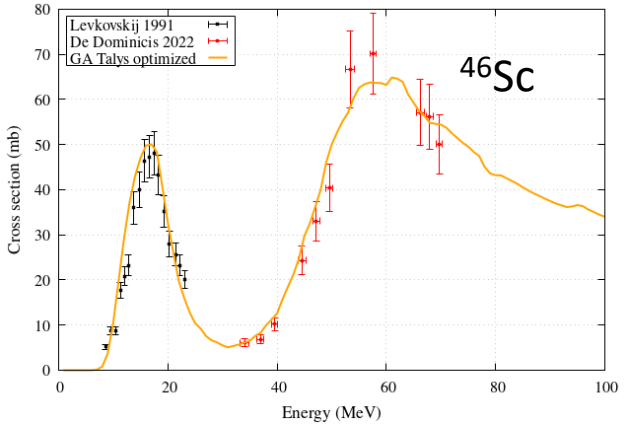
MAIN ISSUE:

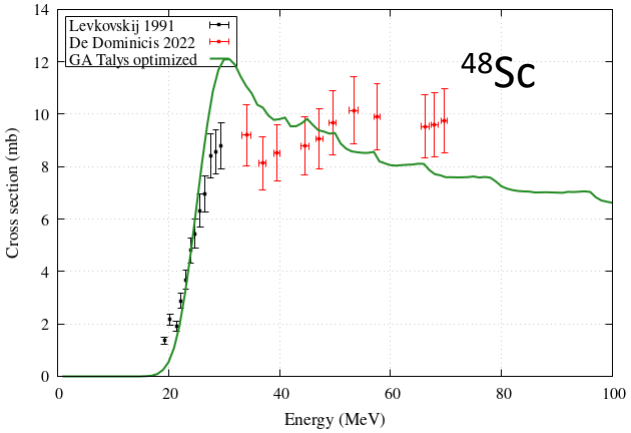
CONTAMINANTS, radioisotopes that affect the purity

cross section OPTIMIZATION by GENETIC ALGORITHM

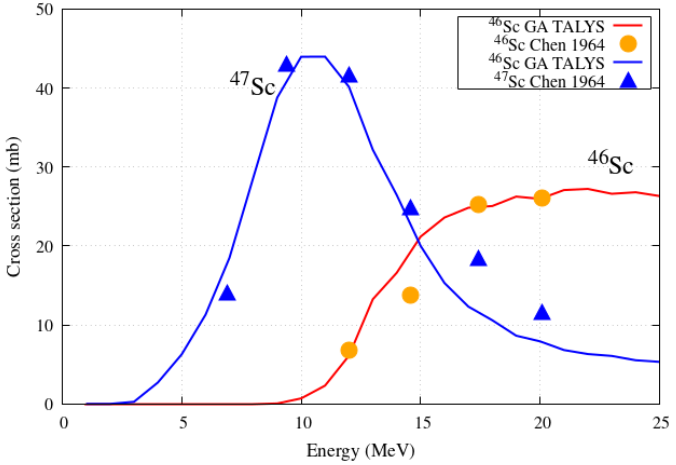
p-^{49}Ti



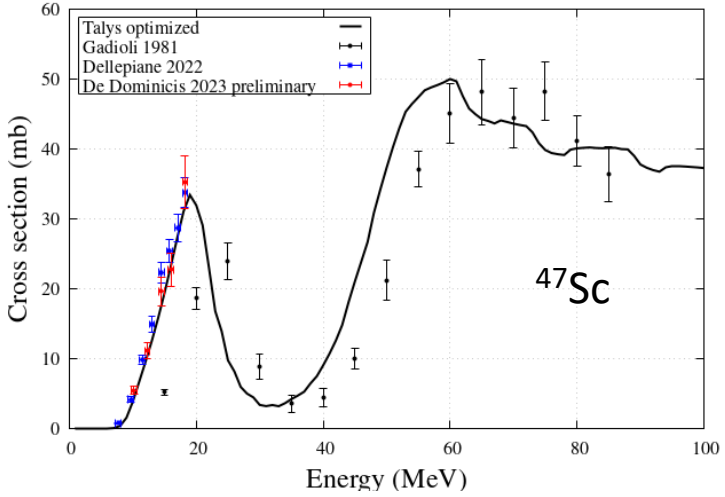


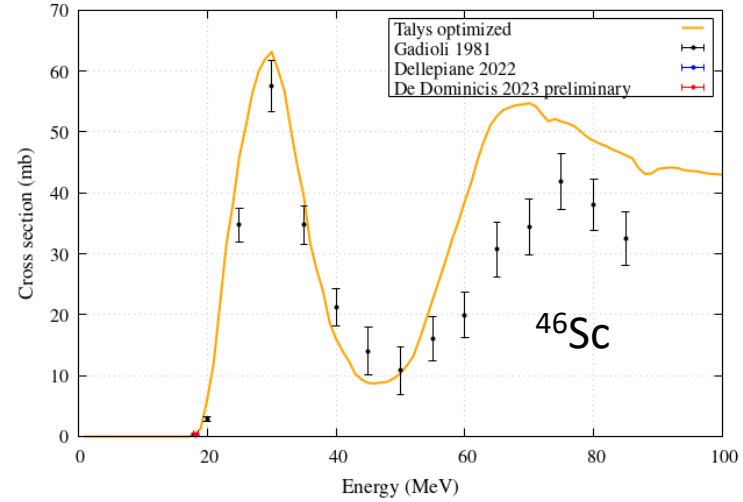


d-^{49}Ti



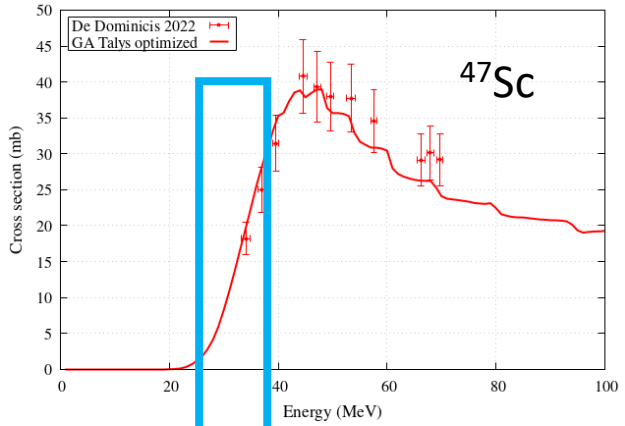
p-^{50}Ti

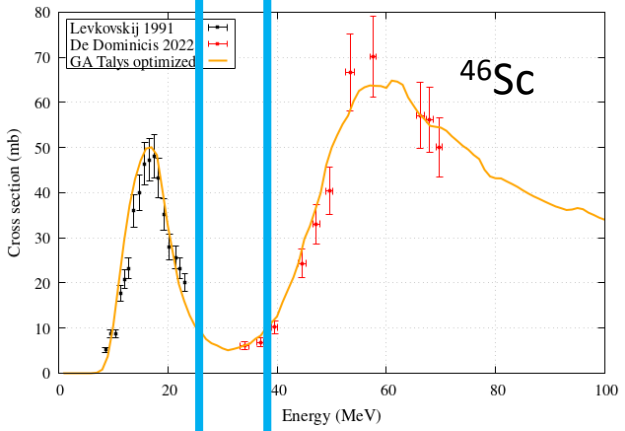


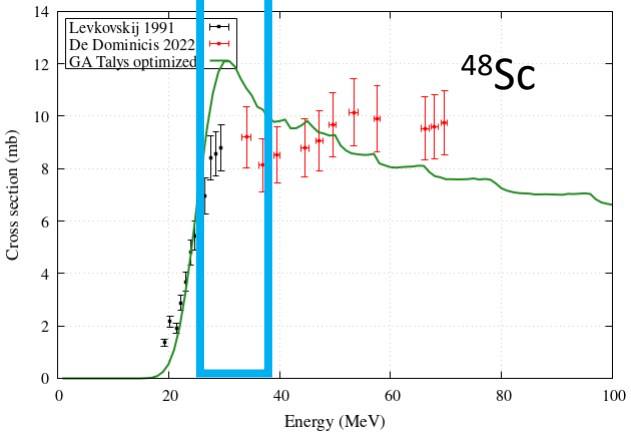


MAXIMIZE ^{47}Sc
MINIMIZE contaminants

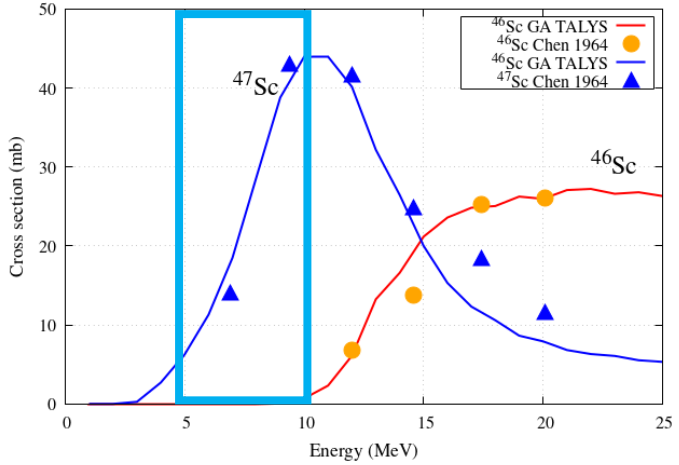
p-^{49}Ti



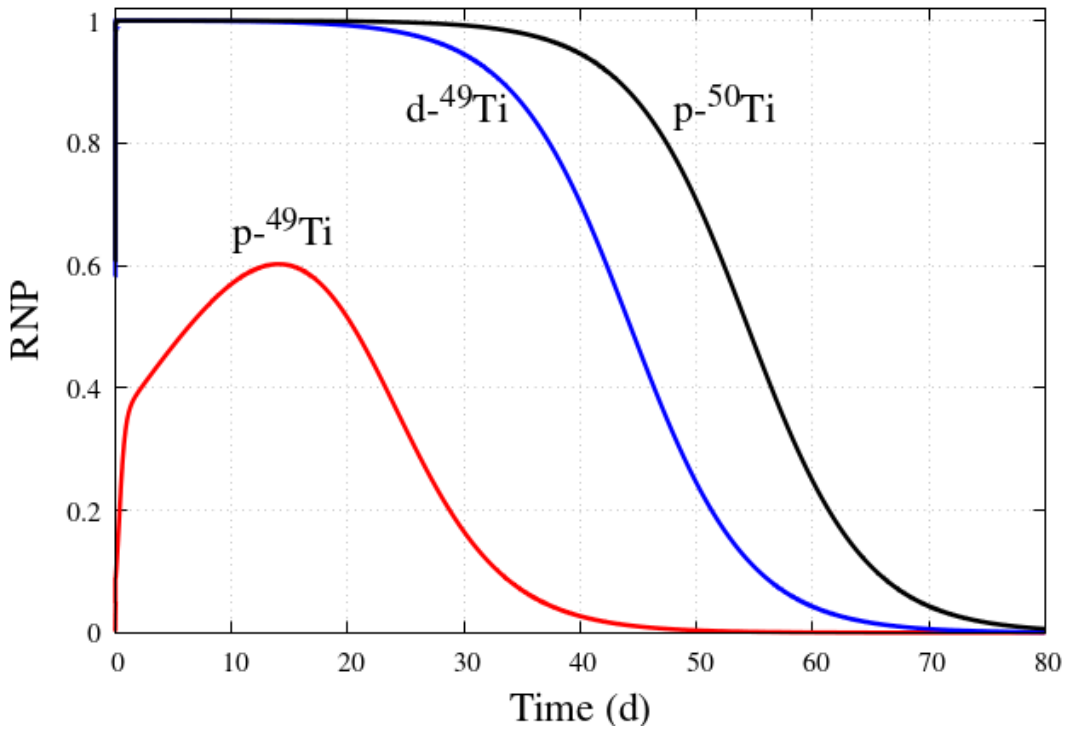




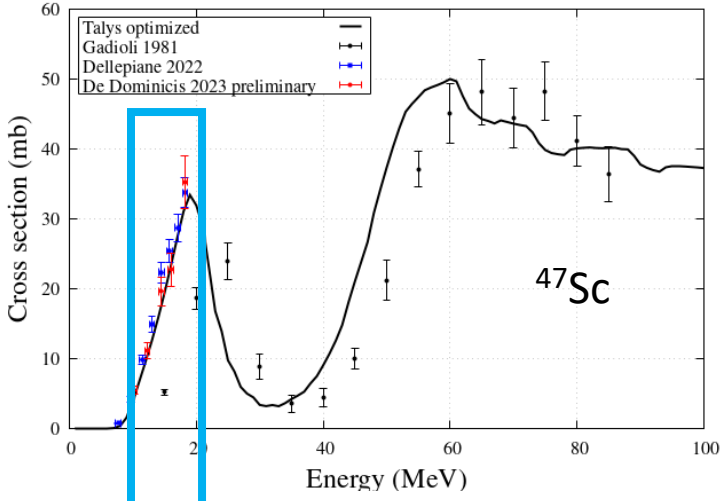
d-^{49}Ti

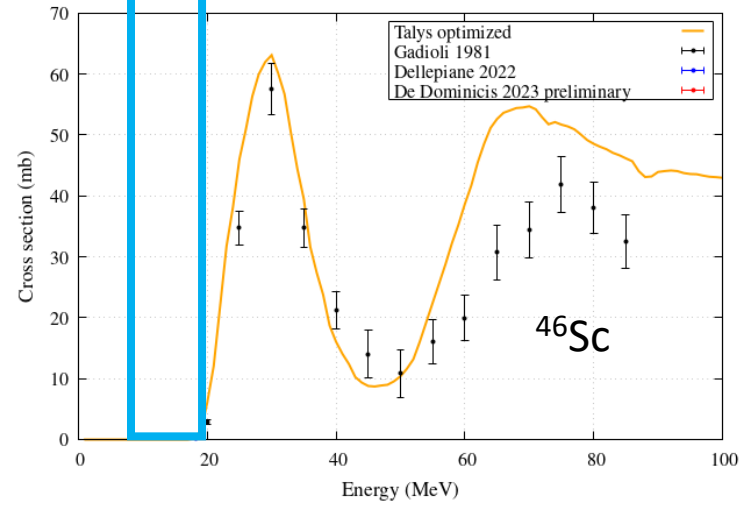


Radionuclidic Purity



p-^{50}Ti





MAXIMIZE ^{47}Sc
MINIMIZE contaminants

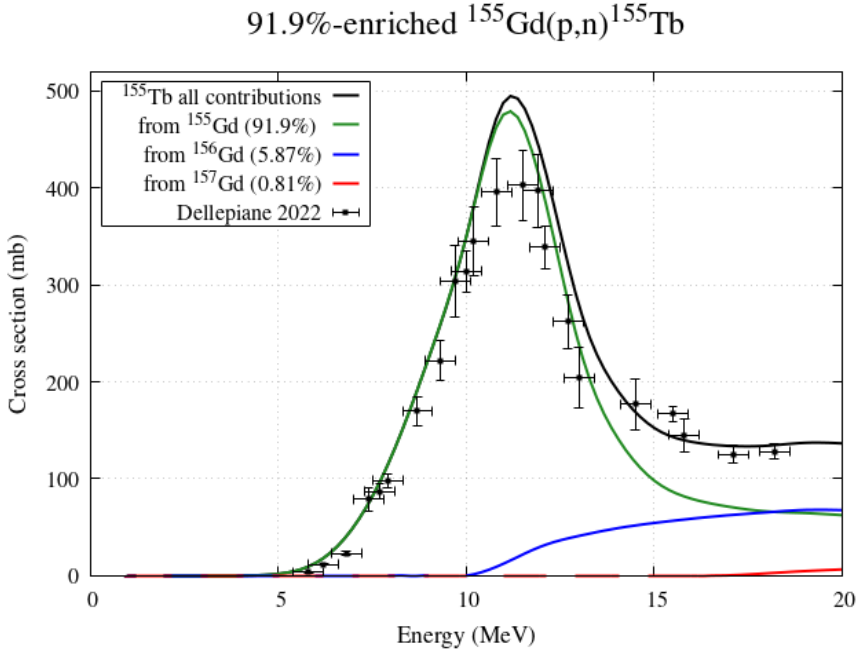
PATENT

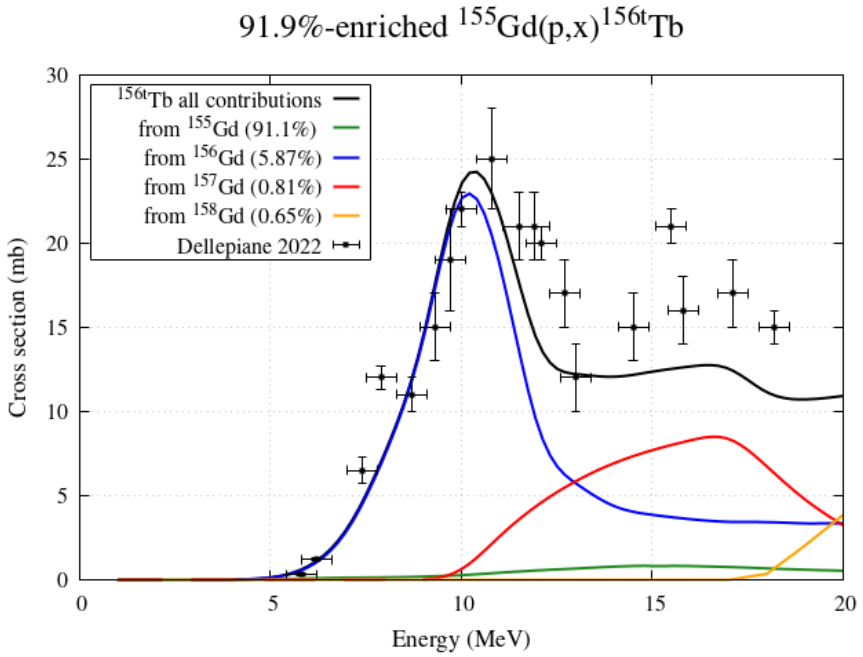
*"Metodo per produzione di **Sc-47** ad alta purezza con ciclotroni ad energie intermedie (35 MeV) attraverso un **bersaglio multistrato**"*

Patent application No. 102023000018477, deposited on 08/09/2023. Patent owner: INFN (Istituto Nazionale di Fisica Nucleare), inventors: Luciano Canton, Francesca Barbaro, Lucia De Dominicis, Liliana Mou, Gaia Pupillo

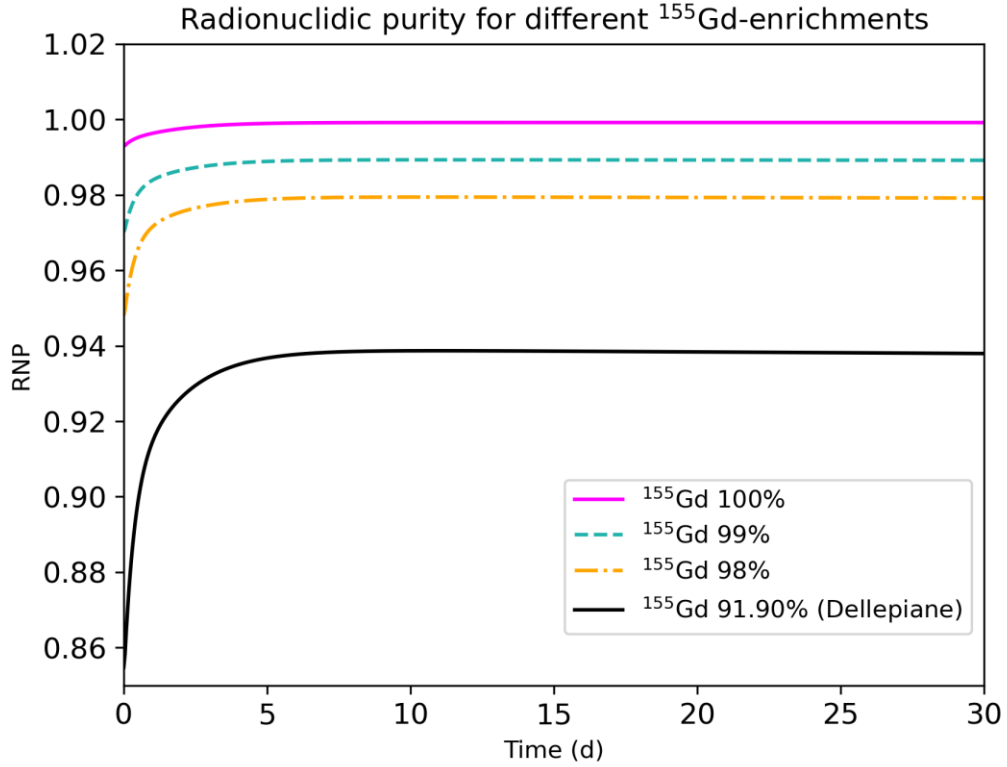
Proton-induced production of the theranostic ^{47}Sc radionuclide: nuclear cross-section measurements and dosimetric analysis

Poster by Lucia De Dominicis





4 levels of ^{155}Gd-enrichments: 91.9%, 98%, 99%, 100%



A **maximum 2% content of ^{156}Gd** in the target guarantees a **RNP** in compliance with the clinical standards

Projects:

REMIX
METRICS
CUPRUM-TTD
NUCSYS
SPES_MED
APHRODITE-155 (PRIN)
CLOUDVENETO COMPUTING

Thanks to:

L. Canton (INFN PD)
Y. Lashko (INFN PD)
L. Zangrando (INFN PD)
L. De Nardo (UNIPD – INFN PD)
L. Meléndez-Alafort (IOV)
G. Pupillo (INFN LNL)
L. Mou (INFN LNL)
L. De Dominicis (UNIPD – INFN LNL)