ISOLDE Medicis laboratory at CERN

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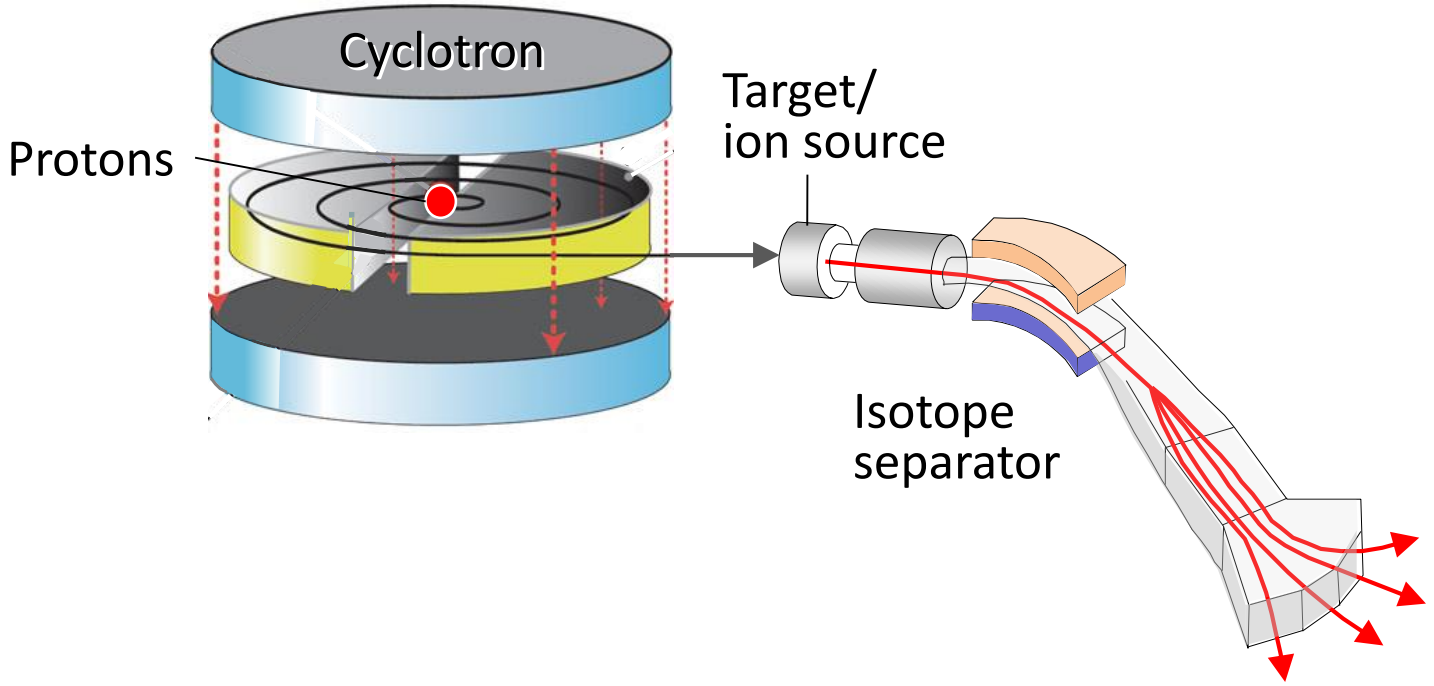
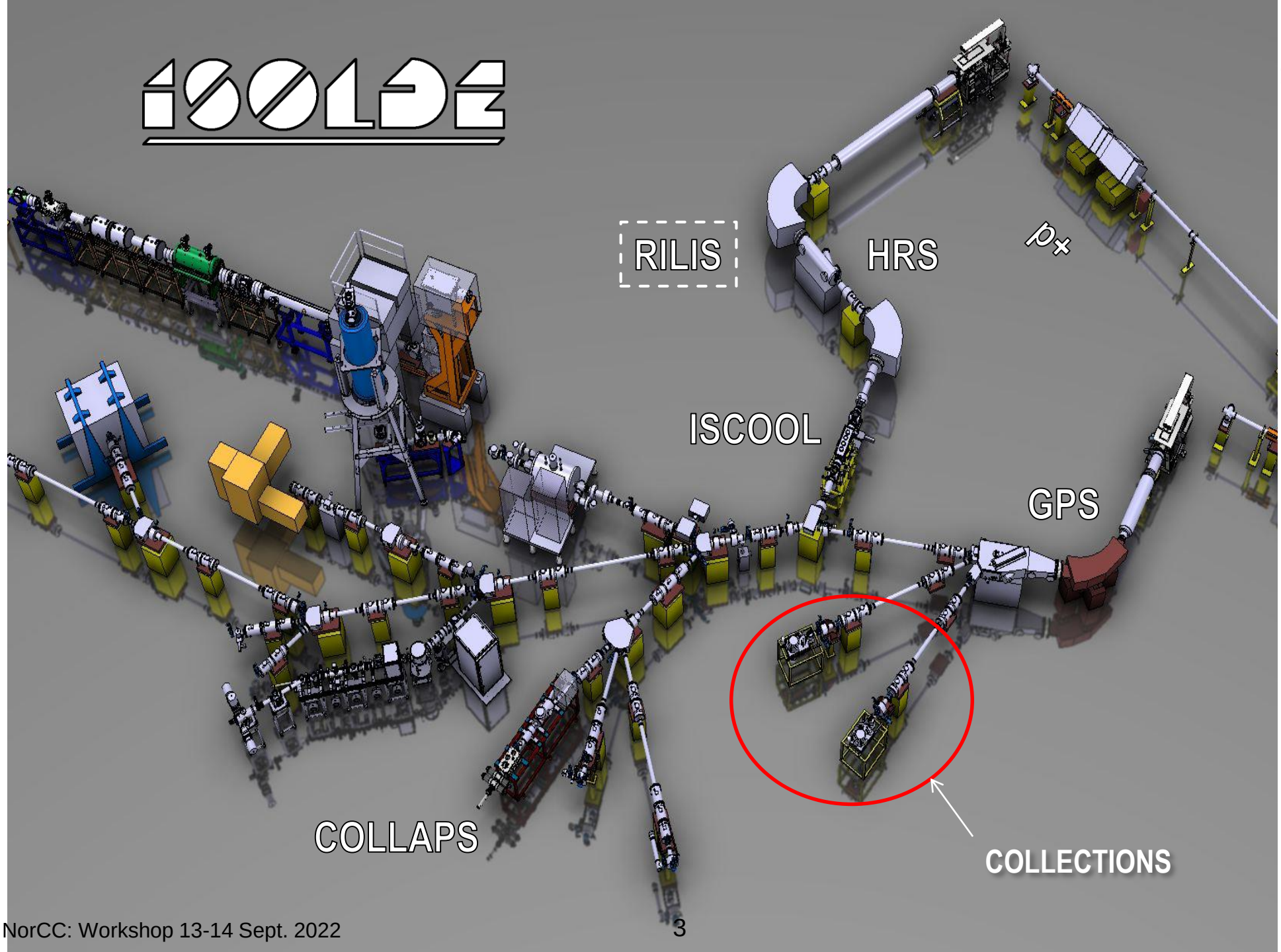
Cyclotron with EMIS

Protons are impinging on a production target and nuclear reactions occur. Reaction pruducts are evaporated into an ion source, ionized, extracted and accelerated through an electromagnetic isotope separator dipole magnet and collected according to charge and mass in the end.




ISOLDE
RILIS
HRS
p_x
ISCOOL
GPS
COLLAPS
COLLECTIONS

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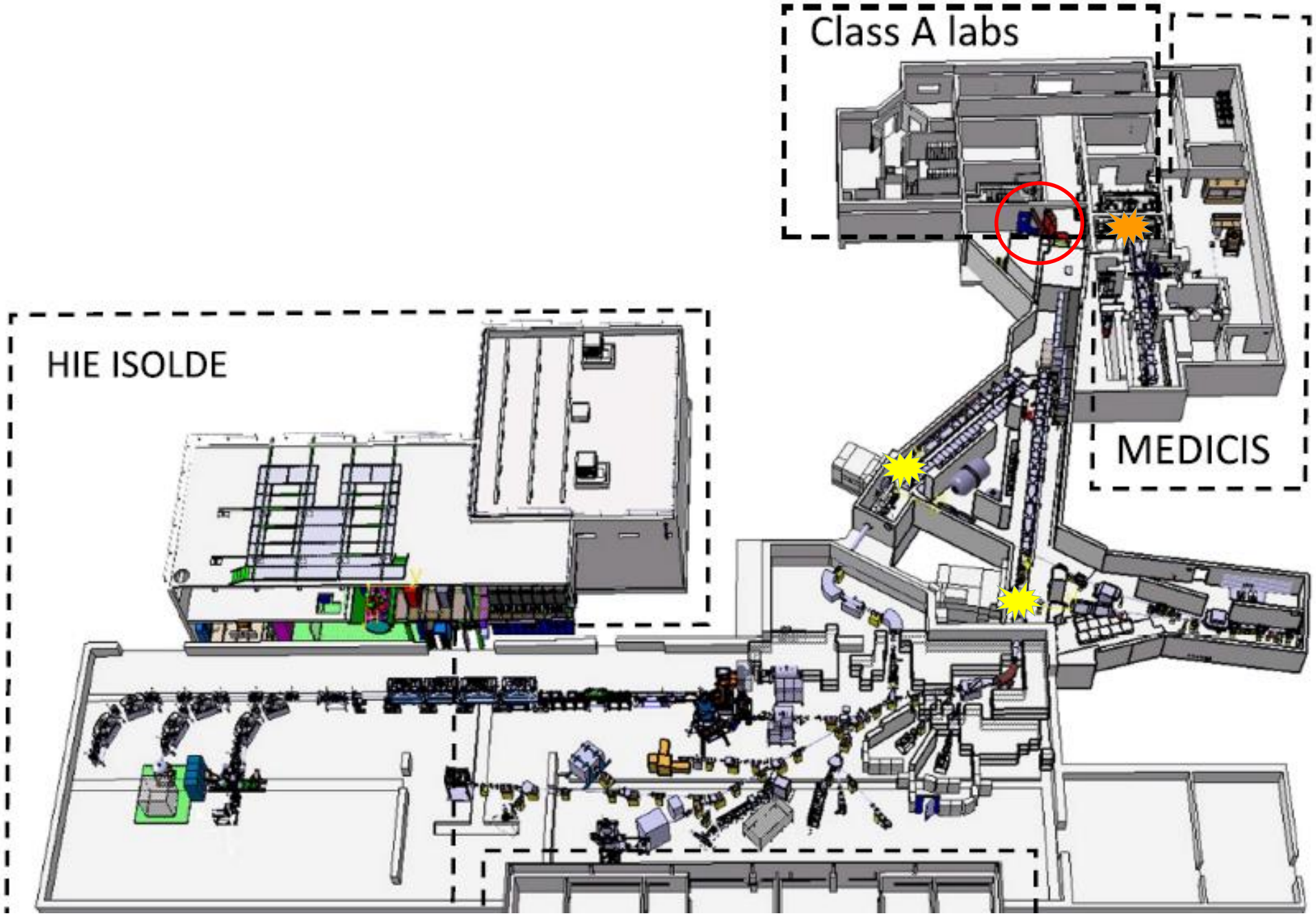
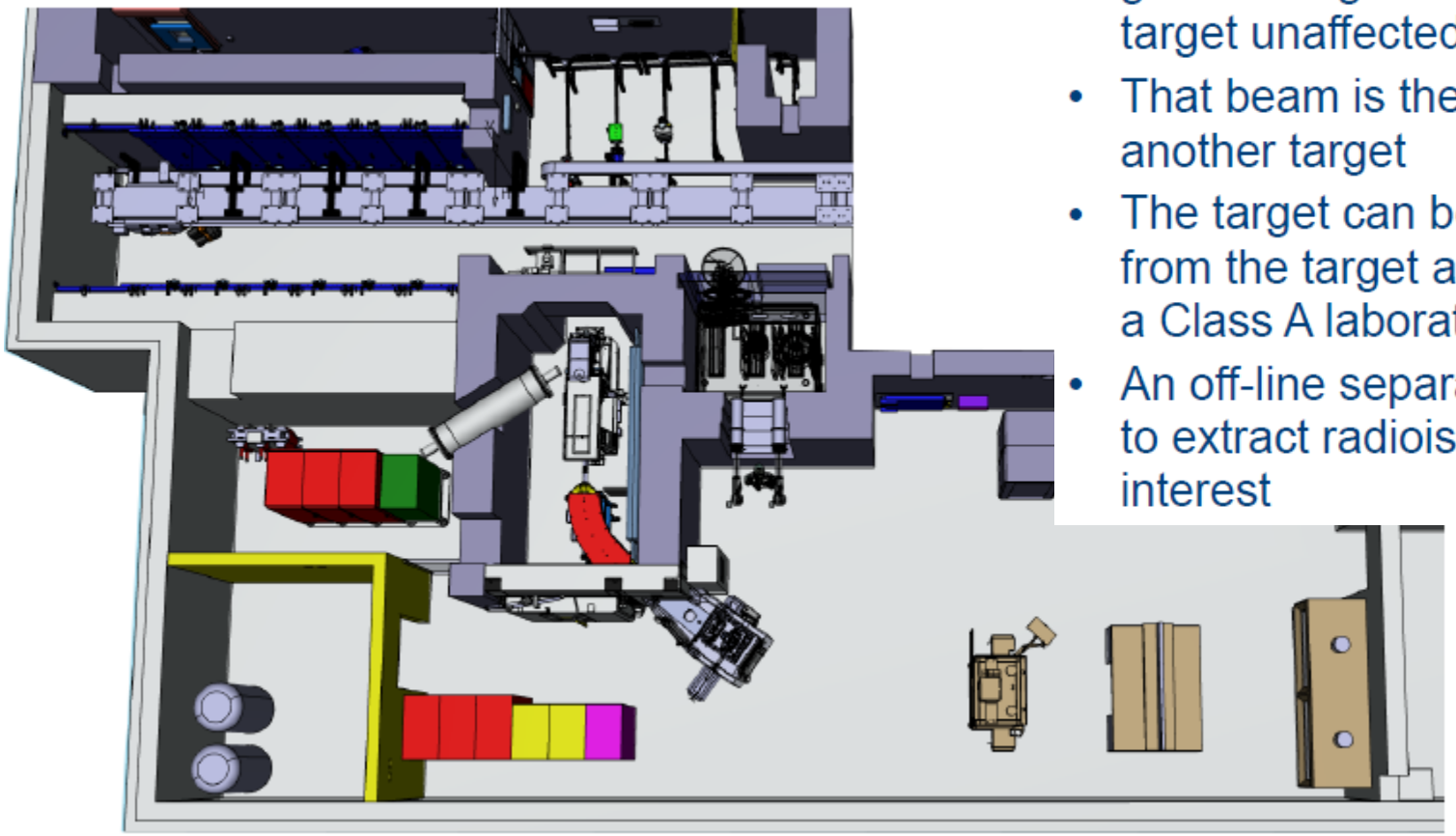
Relative positioning of ISOLDE and MEDICIS



Layout of MEDICIS central separator area



- 80% of the proton beam goes through the ISOLDE target unaffected
- That beam is then sent onto another target
- The target can be removed from the target area towards a Class A laboratory
- An off-line separator is used to extract radioisotopes of interest

MEDICIS target robot picks targets from storage cupboards

MEDICIS-Promed target robot

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ISOLDE MEDICIS-Promed target

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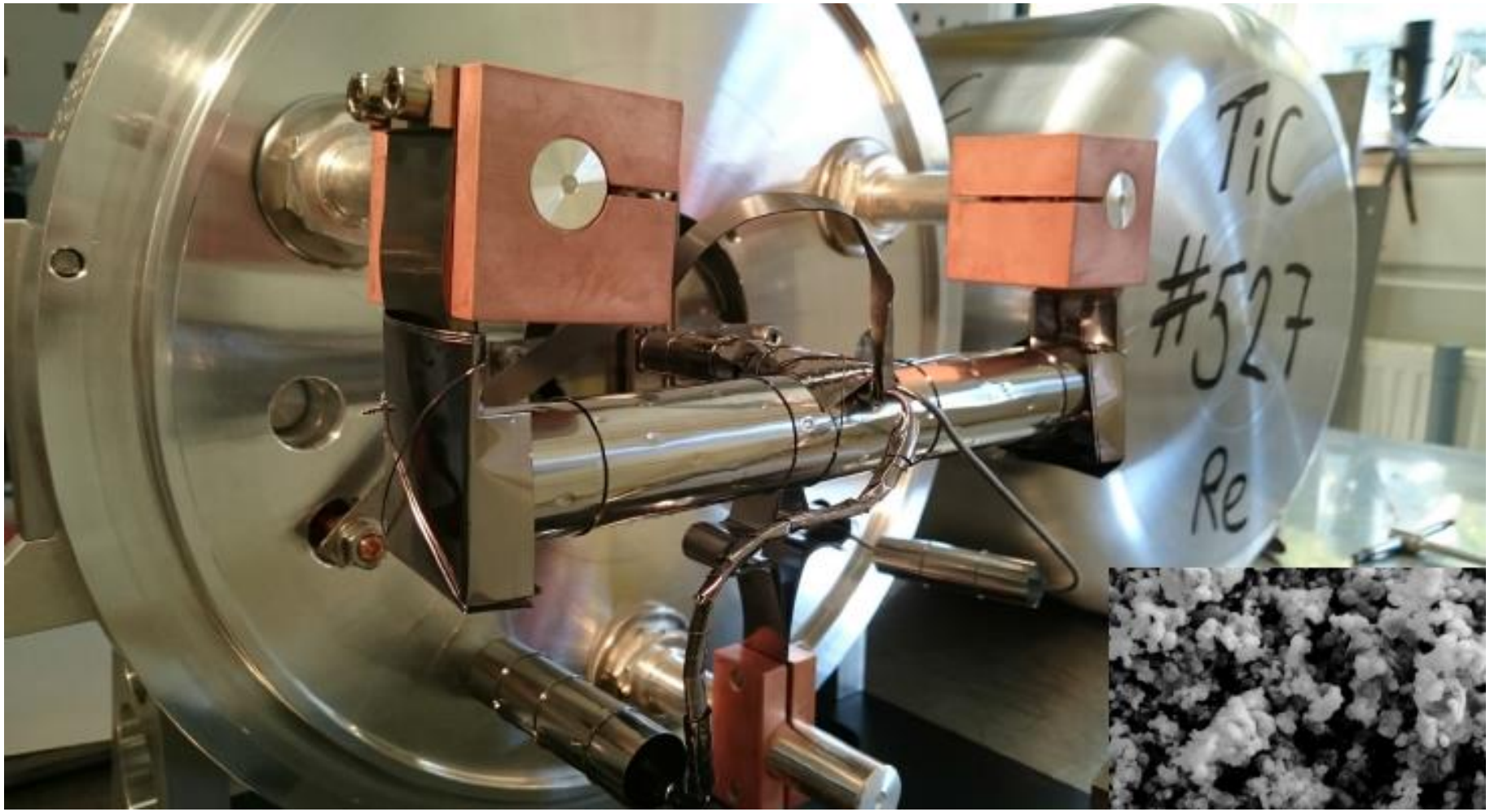
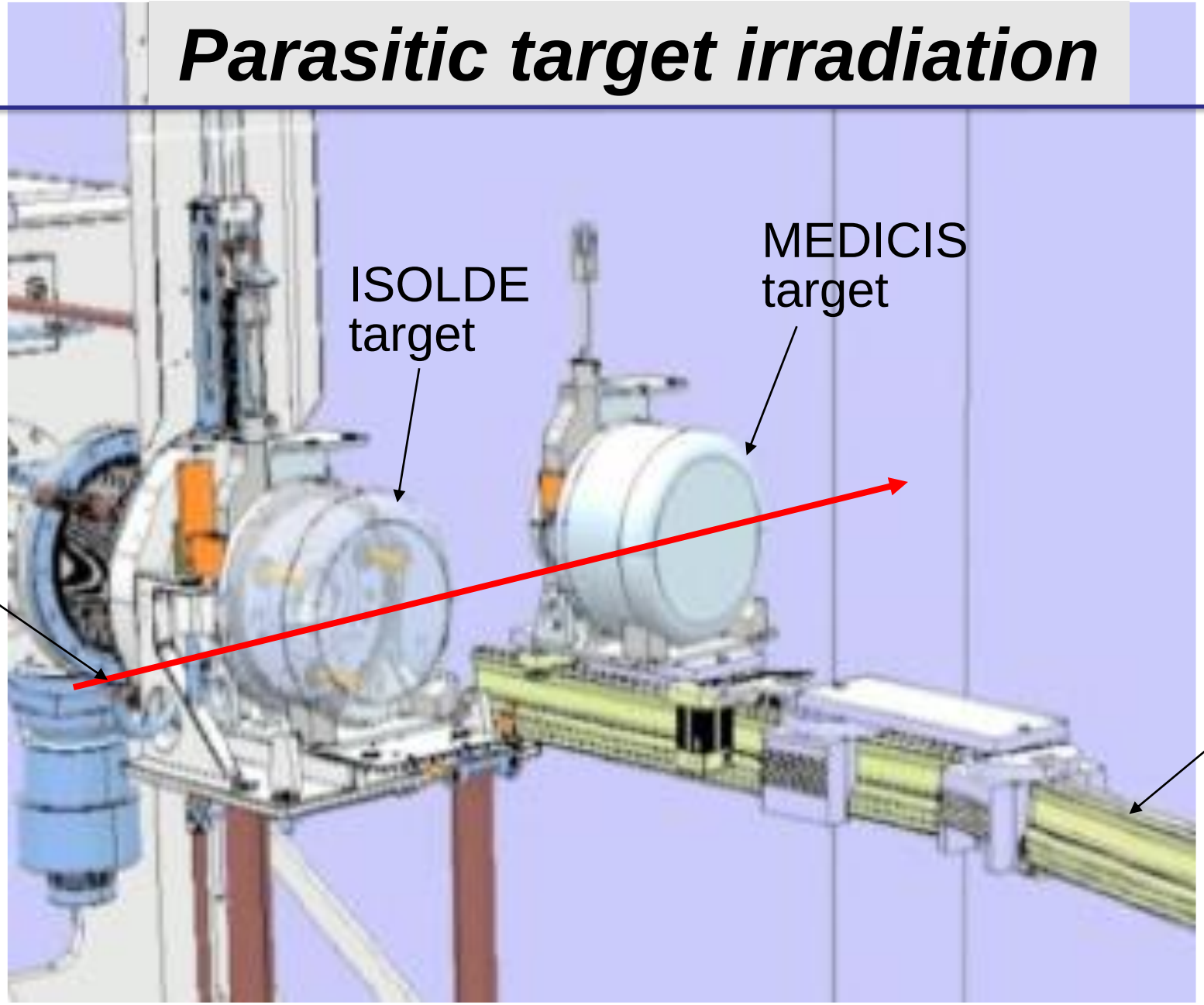
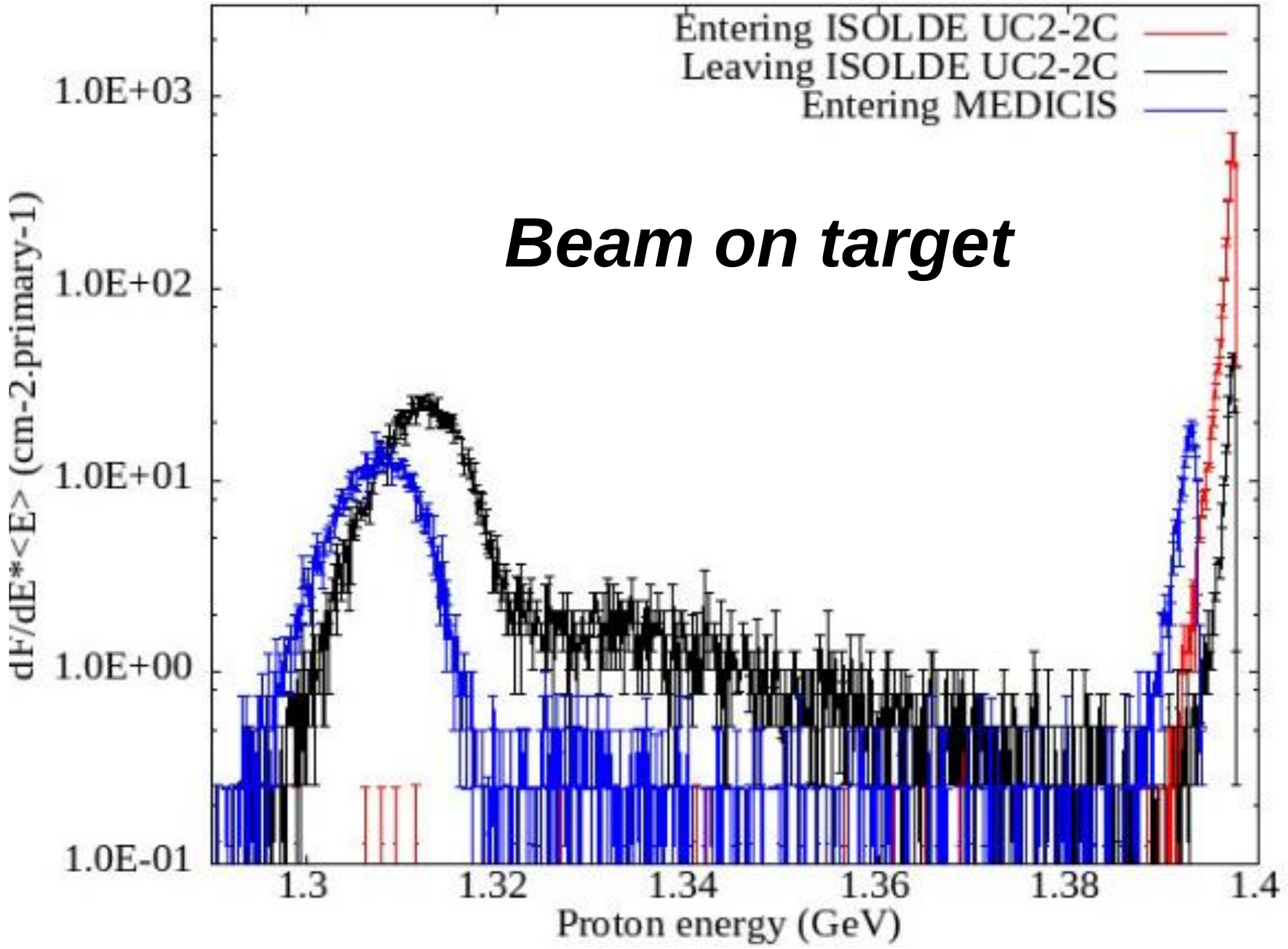


Parasitic target irradiation



Courtesy: K. Kershaw et al., Presentation, HOTLAB 2017, Mito, Japan 17-22 September 2017

Beam on target



Courtesy: T. Stora
11th Int. Particle Acc. Conf. IPAC2020, Caen, France JACoW Publishing
ISBN: 978-3-95450-213-4

Treatment range in soft tissue

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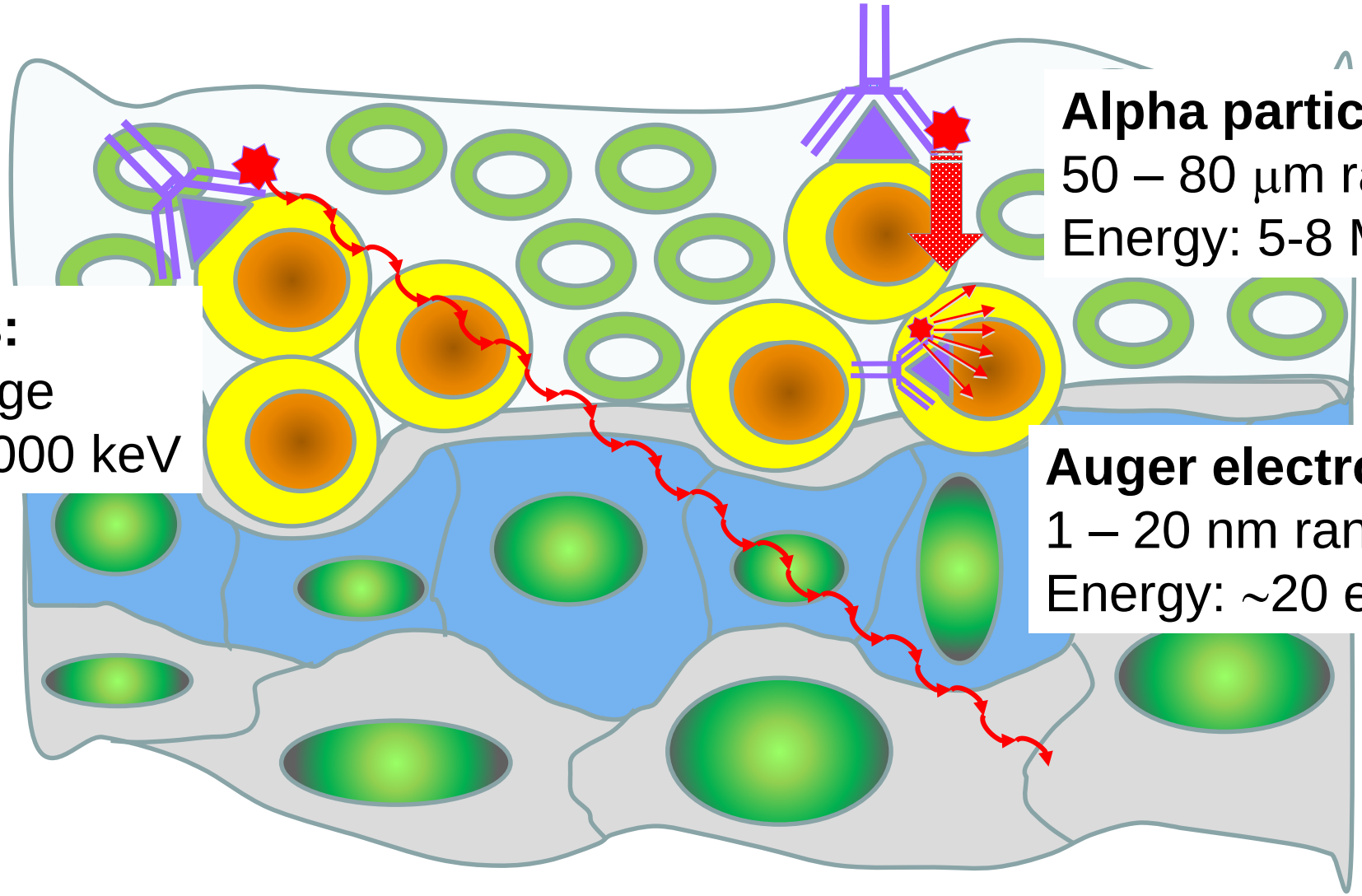
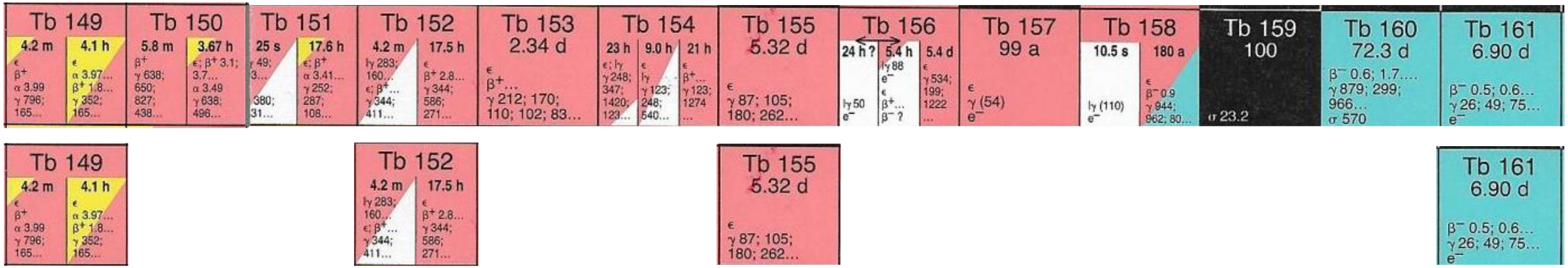


Alpha particles:
50 – 80 μm range
Energy: 5-8 MeV

Beta particles:
1 – 10 mm range
Energy: 100-1000 keV

Auger electrons:
1 – 20 nm range
Energy: ~20 eV – 1 keV

Tb-isotopes for diagnostics and therapy

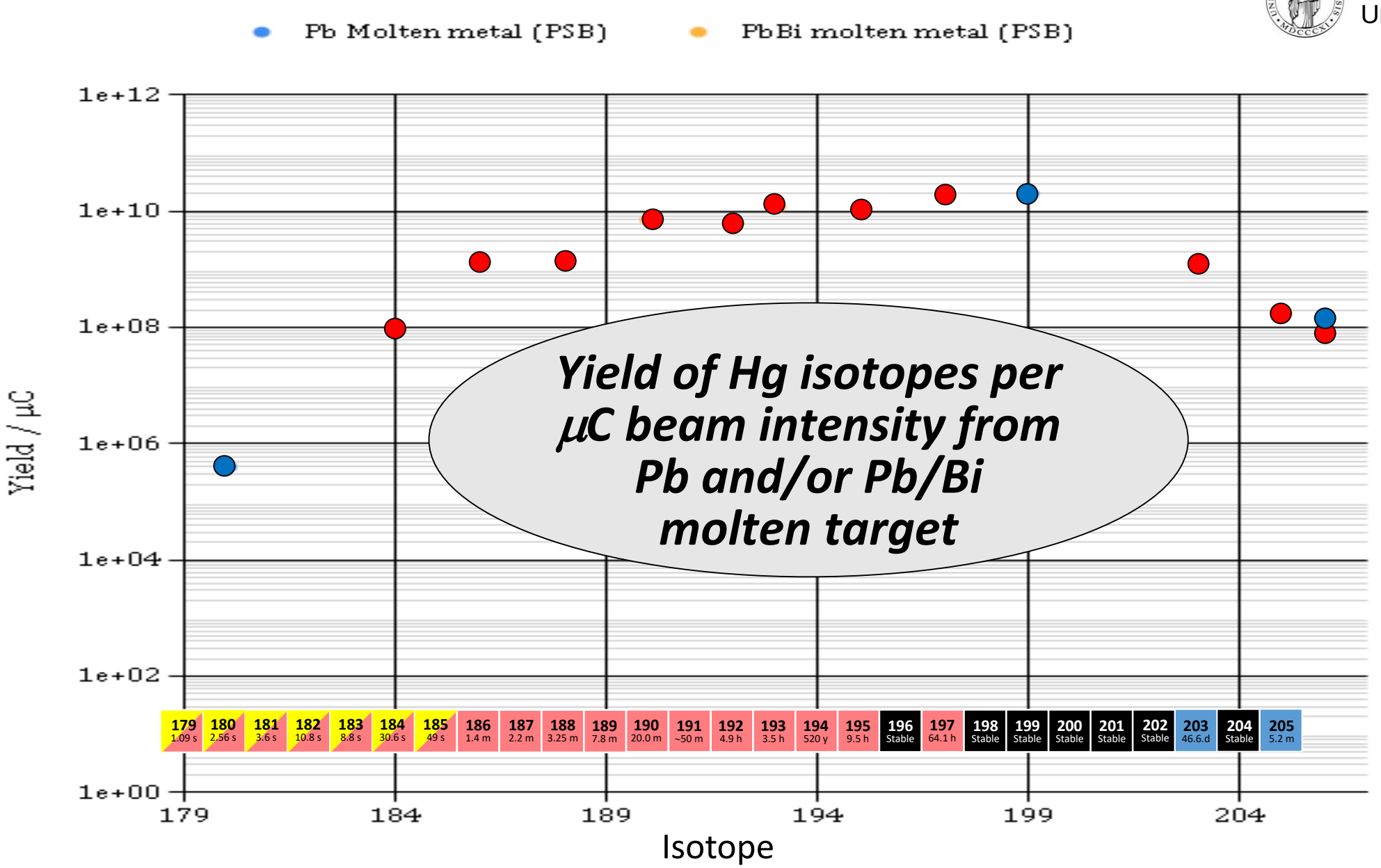


Low-energy gamma emitter for SPECT-based diagnostics

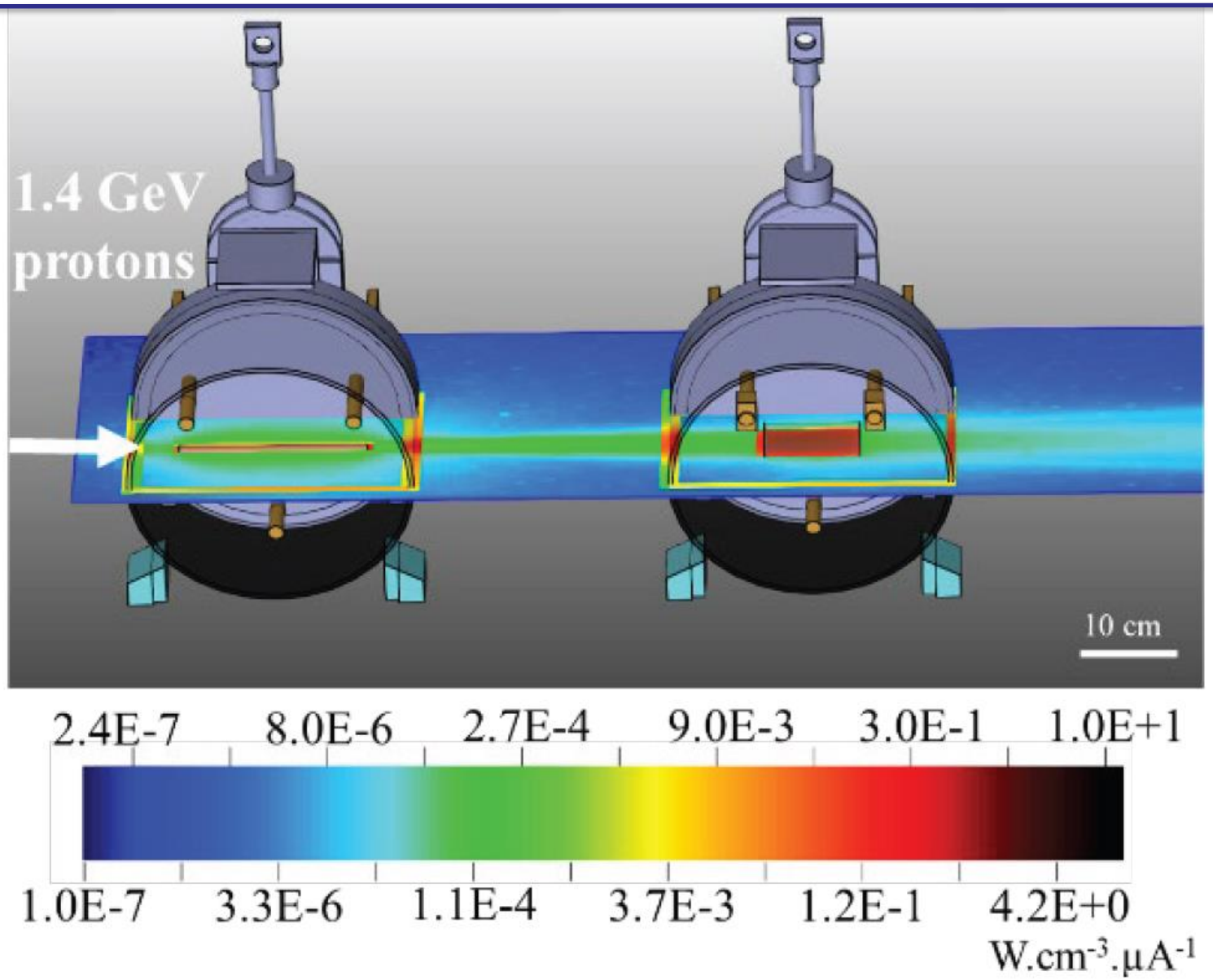
Low energy beta and conversion electron emitter for therapy

Positron emitter for PET-based diagnostics

Alpha emitter for therapy


Pb Molten metal (PSB)
PbBi molten metal (PSB)
Yield / µC
1e+12
1e+10
1e+08
1e+06
1e+04
1e+02
1e+00
179
184
189
194
199
204
Isotope
Yield of Hg isotopes per µC beam intensity from Pb and/or Pb/Bi molten target
179 1.09 s
180 2.56 s
181 3.6 s
182 10.8 s
183 8.8 s
184 30.6 s
185 49 s
186 1.4 m
187 2.2 m
188 3.25 m
189 7.8 m
190 20.0 m
191 ~50 m
192 4.9 h
193 3.5 h
194 520 y
195 9.5 h
196 Stable
197 64.1 h
198 Stable
199 Stable
200 Stable
201 Stable
202 Stable
203 46.6 d
204 Stable
205 5.2 m

Generated irradiation heat in target



Courtesy: T. Stora
11th Int. Particle Acc. Conf. IPAC2020, Caen, France JACoW Publishing
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Examples of mass resolution for Xe-isotopes

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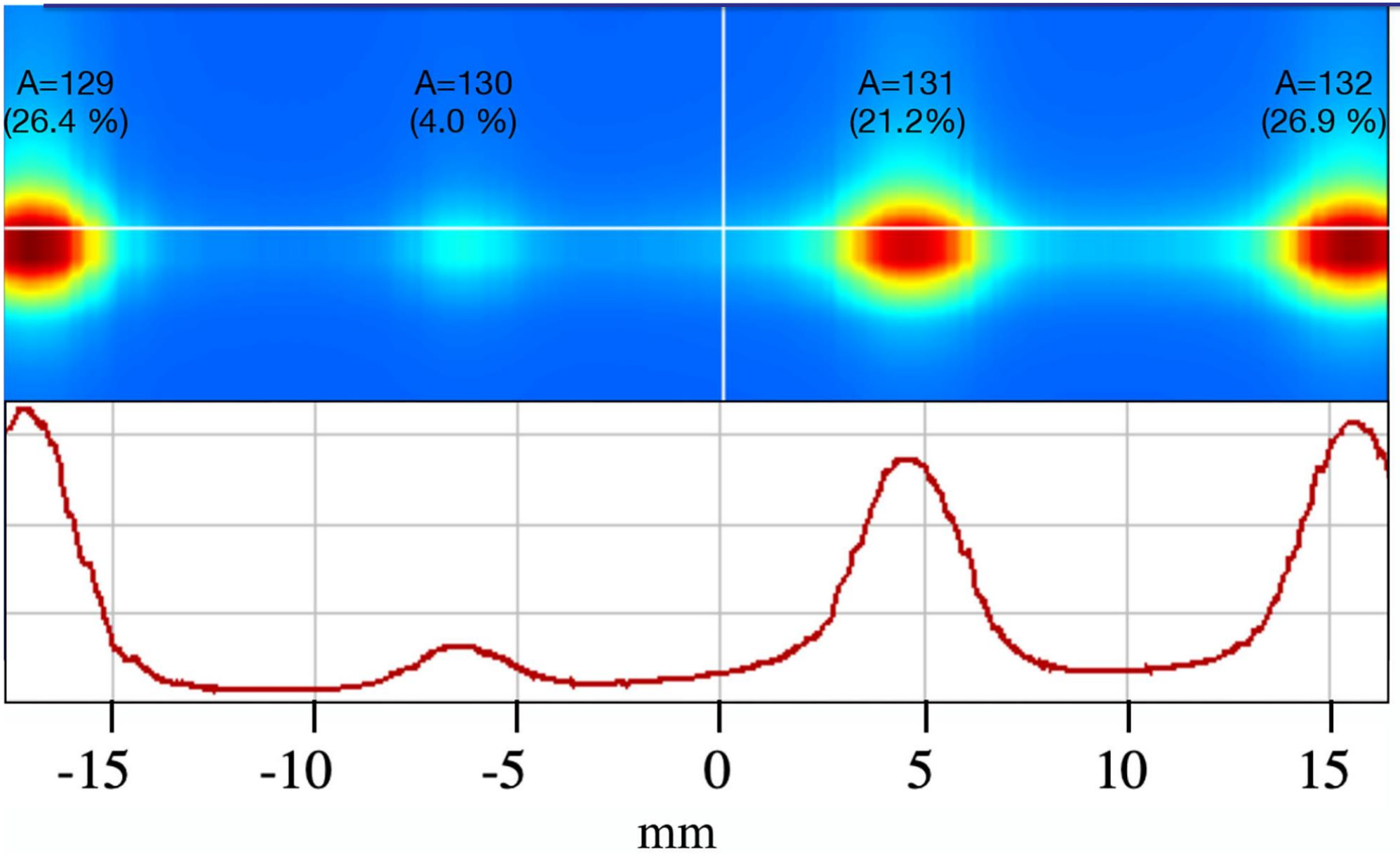

Courtesy: Y. Martinez Palenzuela et al., Frontiers in Medicine, Sept. 2021, Vol.8, Article 689281

A few concluding facts….

- **MEDICIS** was initiated in 2010 by CERN, using contributions from the CERN Knowledge Transfer Fund, private foundations and partner institutes
- Since December 2017, it has been entirely dedicated to the production of unconventional radionuclides whose properties are useful to enhance the precision of both patient diagnostics and therapy.
- **MEDICIS** is part of the project **PRISMAP** – the European medical isotope programme, supported by the European Commission.
- This consortium of 23 institutes works to produce high purity radionuclides by mass separation.
- This EU project is approved for funding by the Research Infrastructures program INFRA-2-2020 of Horizon 2020 of the European Commission.

Medicis video…

https://videos.cern.ch/record/2288144

https://www.youtube.com/watch?v=2etyZ3PeFNE

Examples of Consortium participants so far….

GIP ARRONAX (France), **CHUV** (Switzerland), **EANM** (Europe), **FABIS** (Spain), **HUG** (Switzerland), **ILL** (France), I**ST** (Portugal), **JGU** Mainz (Germany), **JRC** Karlsruhe (Germany), **KU Leuven** (Belgium), **NPL** (UK), **PSI** (Switzerland), **PAEC** (Pakistan), **RTULU** (Latvia).