

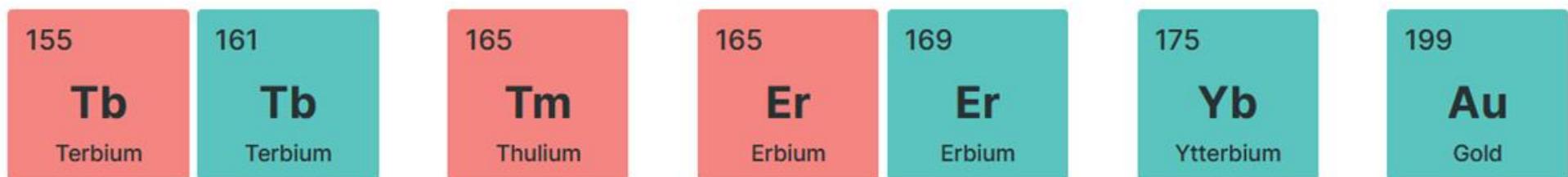


PRISMAP SERVICES FOR RADIONUCLIDE PRODUCTION AND THEIR BIOMEDICAL APPLICATION

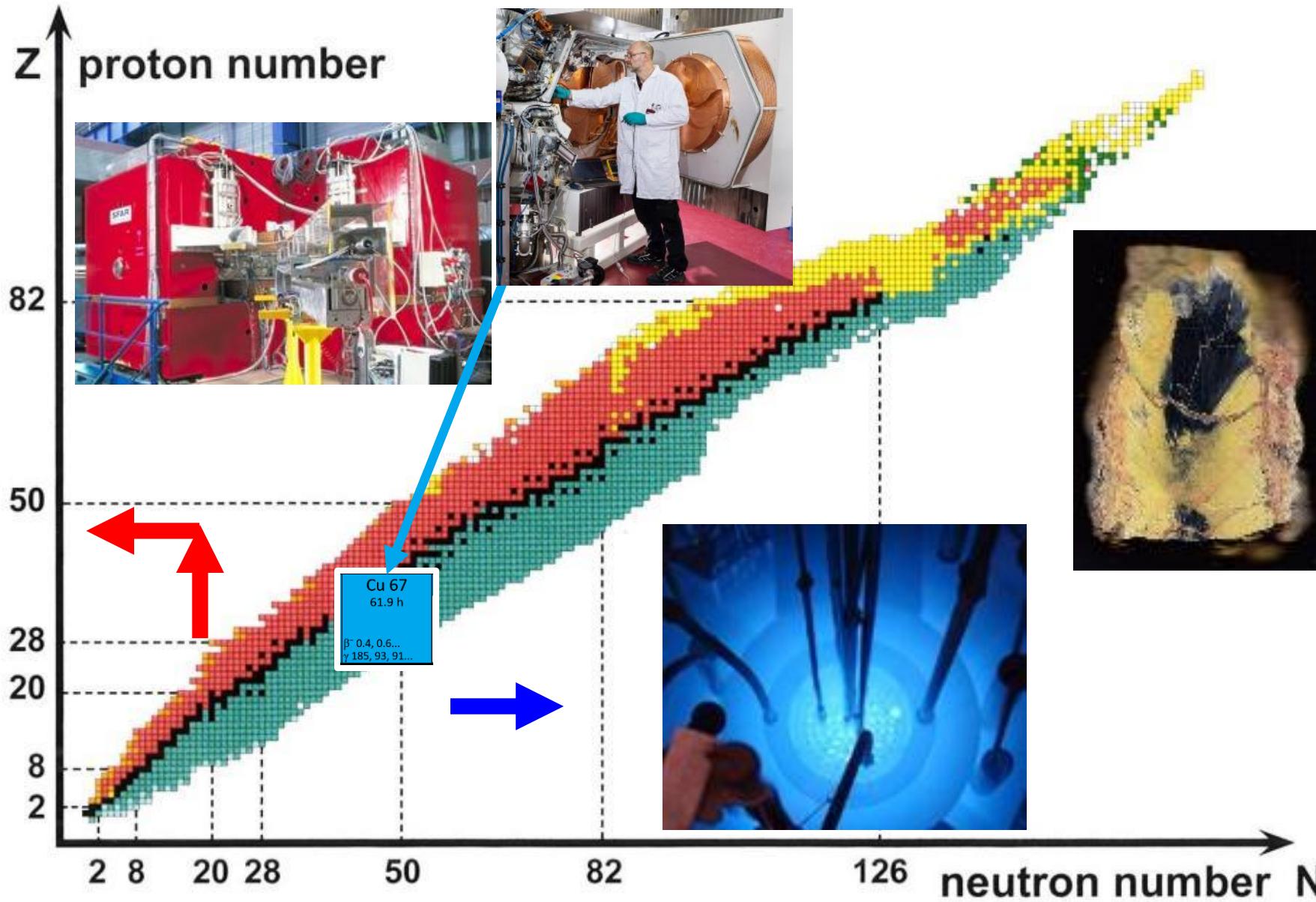
PRISMAP Collaboration Meeting 9

Ulli Köster, ILL Grenoble

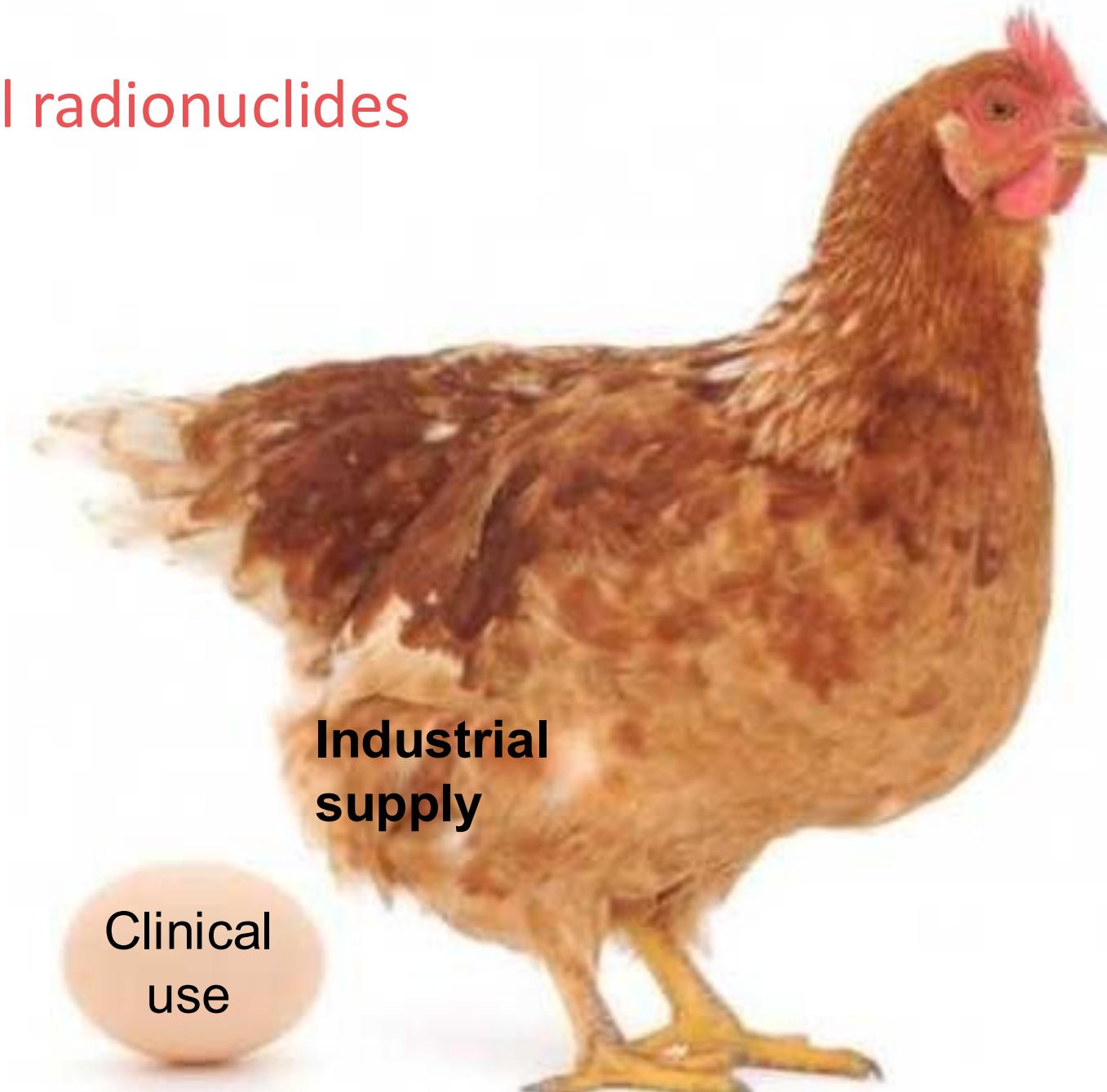
The PRISMAP radionuclide portfolio (grown by user demands)



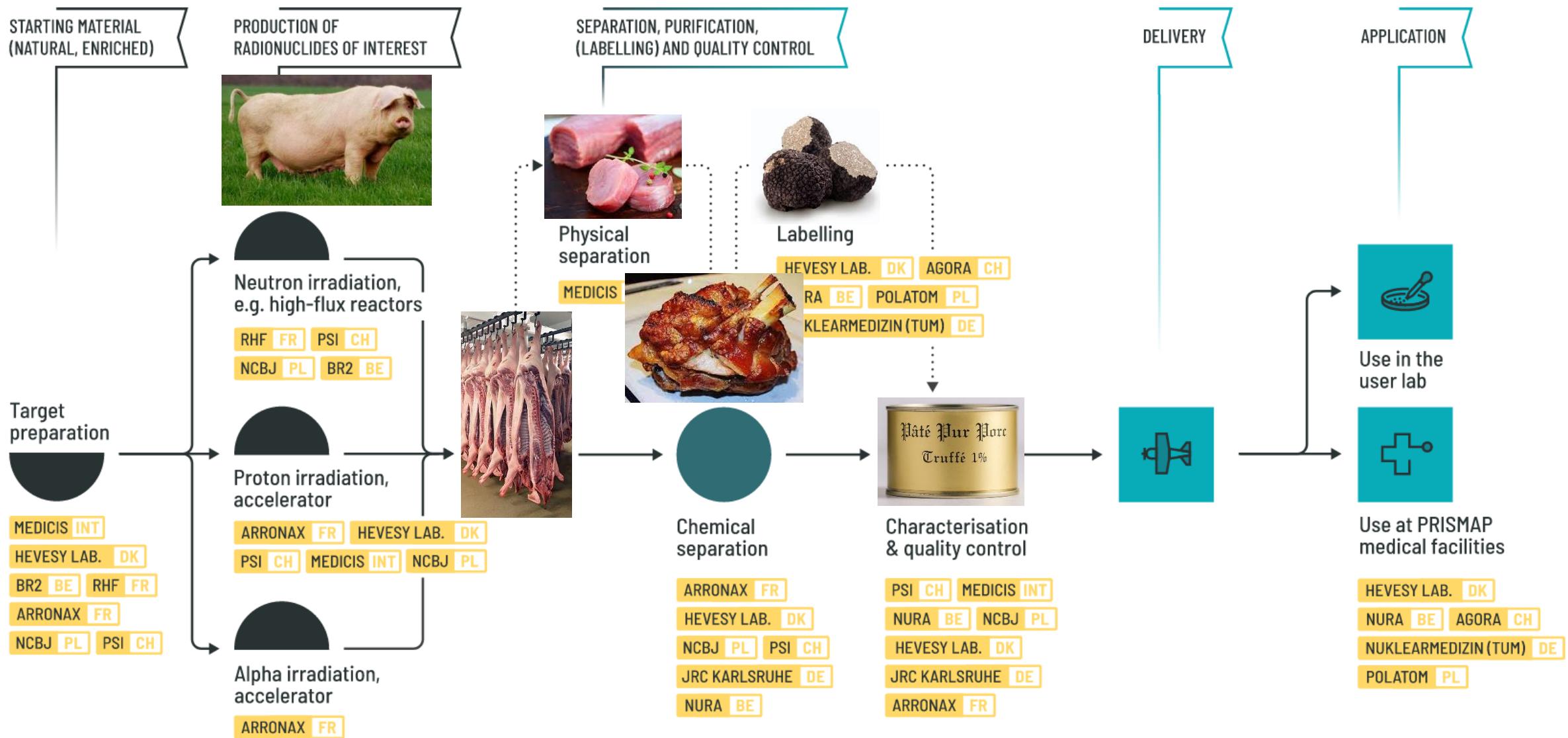
The “water divide” of radionuclide production



Introducing novel radionuclides



The flowchart of PRISMAP facilities



The PRISMAP Biomedical Facilities

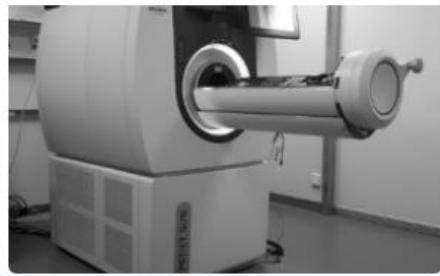
Hevesy Laboratory

Danmarks Tekniske
Universitet – DTU



AGORA

Centre hospitalier
universitaire vaudois
— CHUV



NURA

Studiecentrum voor
Kernenergie / Centre
d'étude de l'énergie
nucleaire — SCK CEN



Nuklearmedizin

Klinikum rechts der Isar der
Technischen Universität
München — TUM



POLATOM

Narodowe Centrum Badań
Jądrowych – NCBJ



Radiochemistry
Nuclear spectrosc.
Cell cultures
 μ SPECT/CT

μ PET/ μ SPECT/CT
MRI
Translational
Clinical scanners

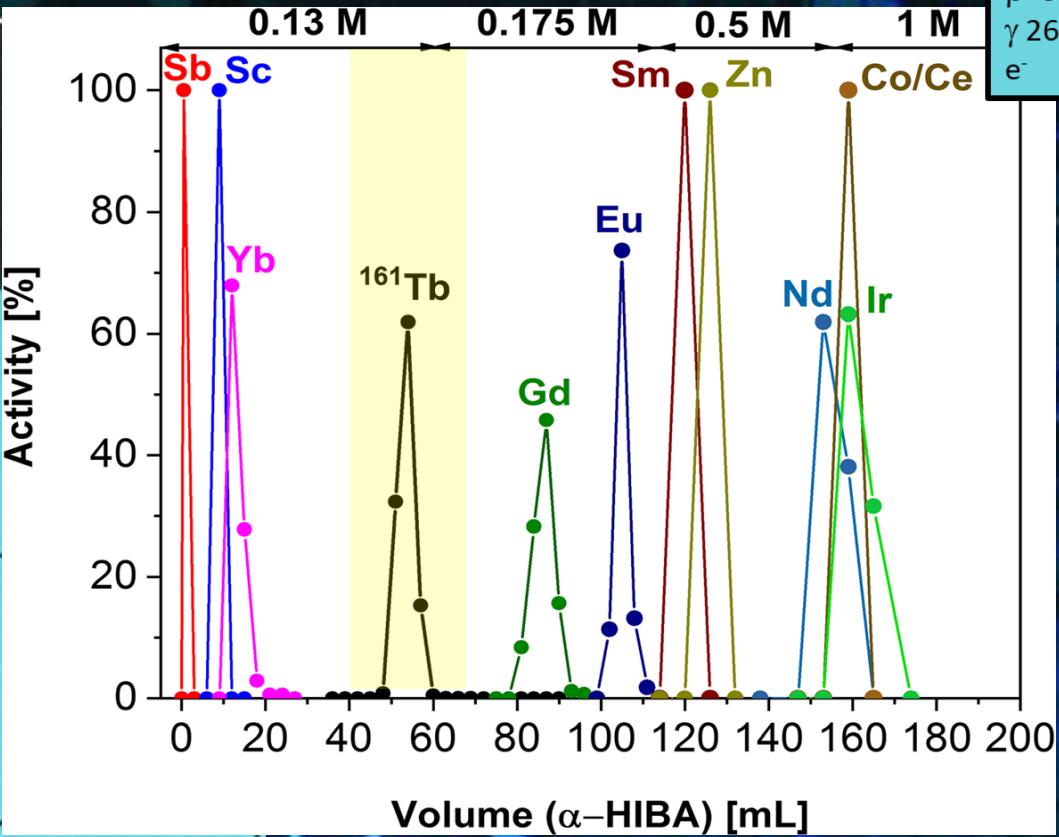
Cell cultures
 μ SPECT/CT
Longitudinal trials

μ PET/MRI
 μ SPECT/CT
GMP Radiopharm.
Clinical scanners

Radiochemistry
Cell cultures
Optical imag. (Ch.)
GMP Radiopharm.

Production of non-carrier-added Tb-161

Dy 160 2.329	Dy 161 18.889	Dy 162 25.475	Dy 163 24.896
σ_{60} $\sigma_{n, \alpha} < 0.0003$	σ_{600} $\sigma_{n, \alpha} < 1E-6$	σ_{170}	σ_{120} $\sigma_{n, \alpha} < 2E-5$
Tb 159 100	Tb 160 72.3 d β^- 0.6; 1.7... γ 879; 299; 966... σ 570	Tb 161 6.90 d β^- 0.5; 0... γ 26; 49; 5... e^-	Tb 162 7.76 m β^- 1.4; 2.4... γ 260; 808; 888...
Gd 158 24.84	Gd 159 18.48 h β^- 1.0... γ 364; 58...	Gd 160 21.86 σ 1.5	Gd 161 3.66 m β^- 1.6; 1.7... γ 361; 315; 102... σ 20000



Tb-161: \approx 30% of PRISMAP deliveries

1 Tb-161 atom in \sim 10⁴ Gd atoms

Irradiation in high flux reactor, then radiochemical separation

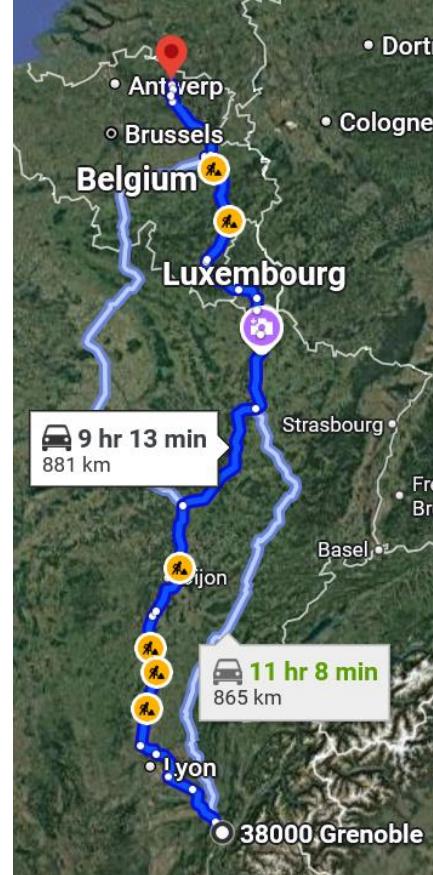
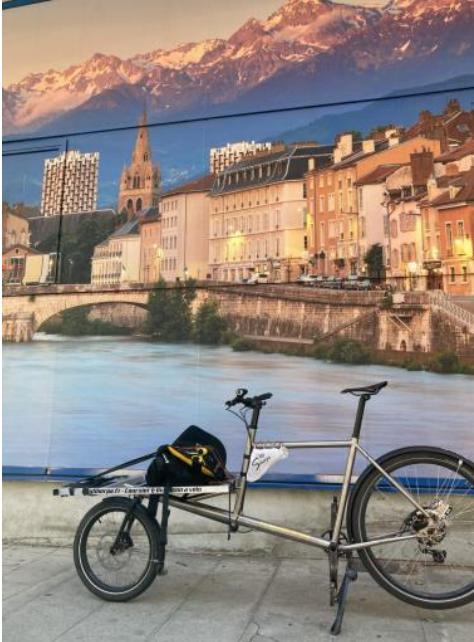
N. Gracheva et al., EJNMMI Radiopharm Chem 2019;4:12.

Local production versus centralized production

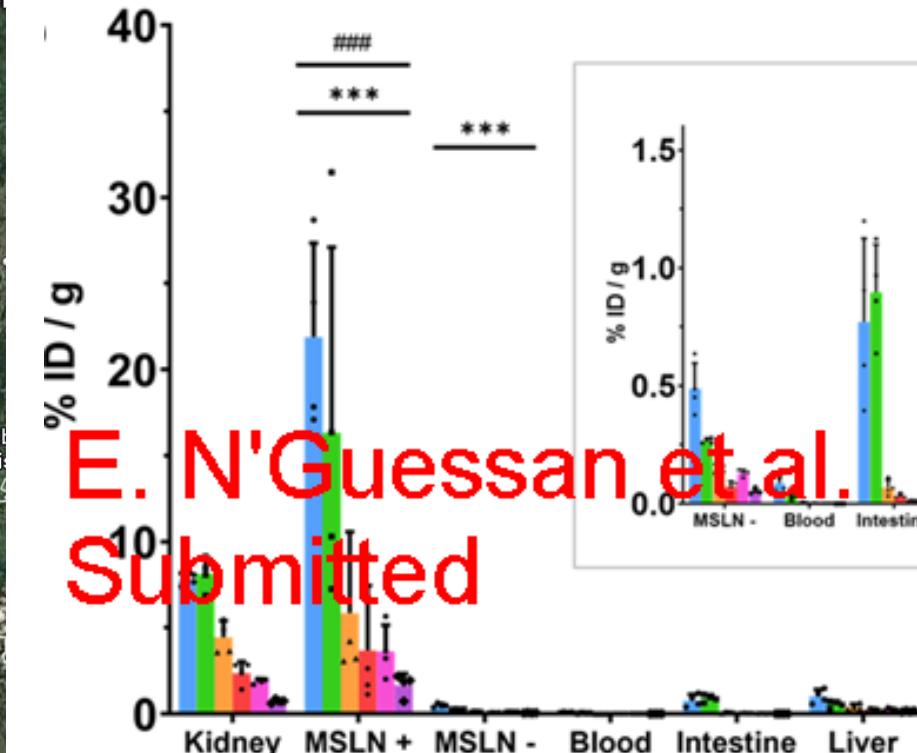
Project P14 = INCA_16111 project, Alexis Broisat et al.

Development and preclinical evaluation of a mesothelin-targeting theranostic agent

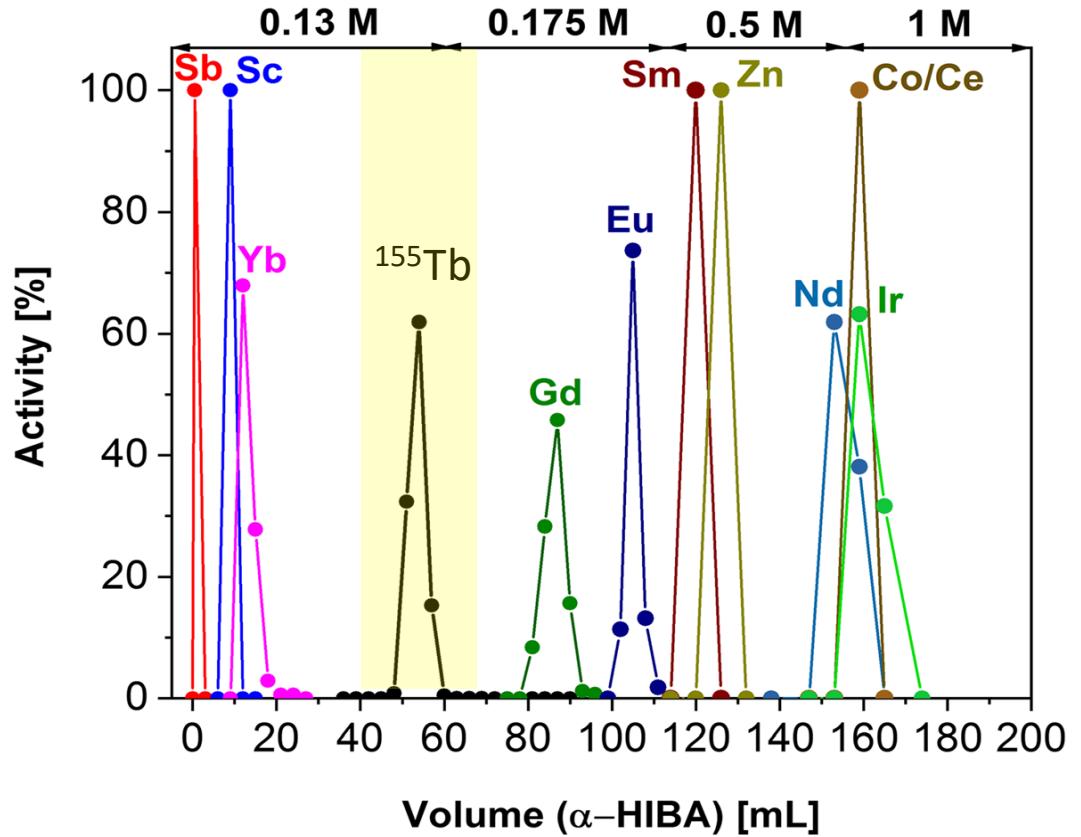
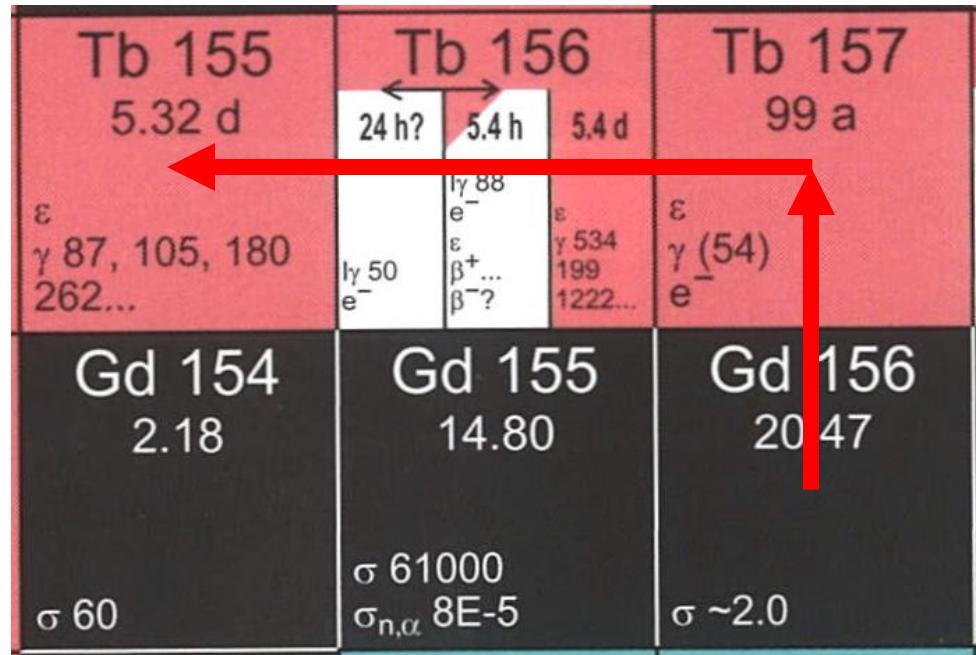
Tb 161
6.96 d
 β^- 0.5; 0.6
 γ 26; 49; 75...
 e^-



Centralized production favorable
for long-lived radionuclides !



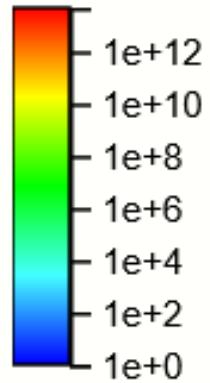
Production of non-carrier-added Tb-155 at PSI



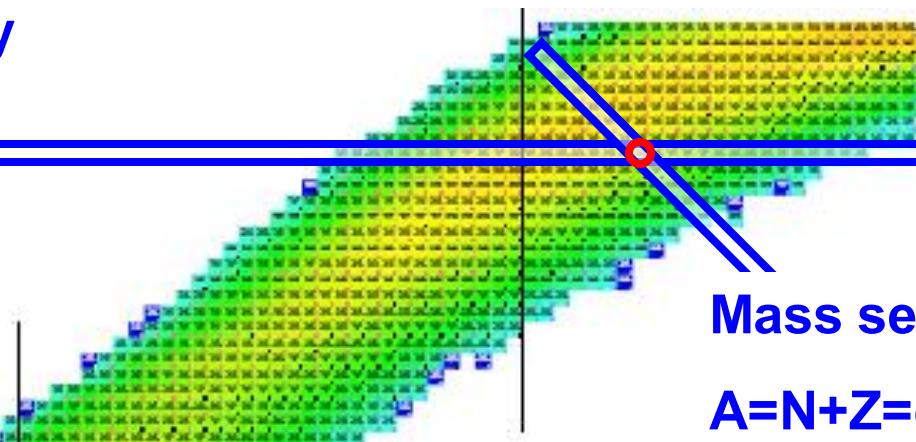
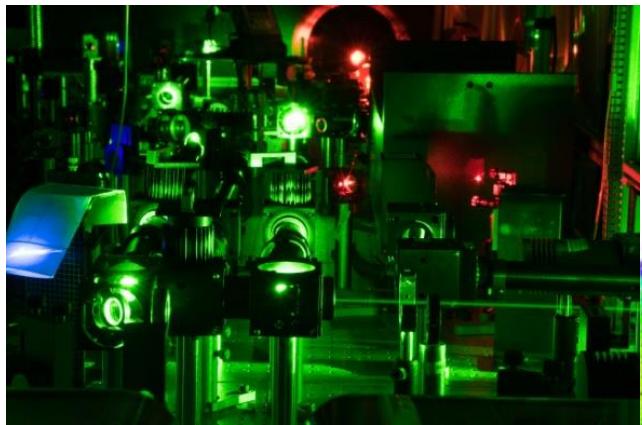
1 Tb-161 atom in $\sim 10^5$ - 10^6 Gd atoms

Production of non-carrier-added Tb-155 at CERN

Production (μC^{-1})

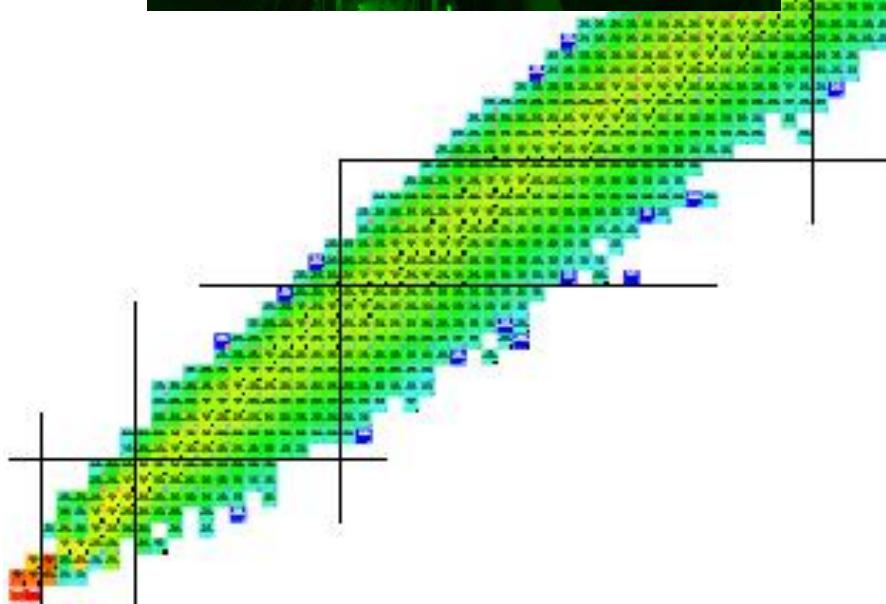


**Z selection by chemically
selective ionization**

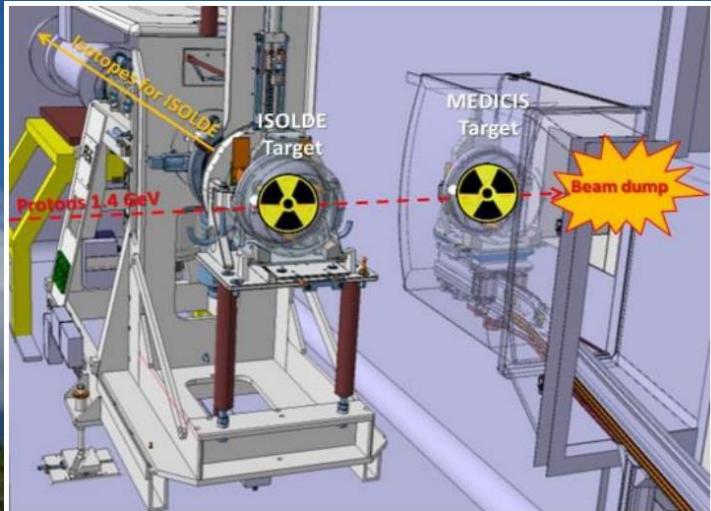


Mass separation
 $A=N+Z=\text{const.}$

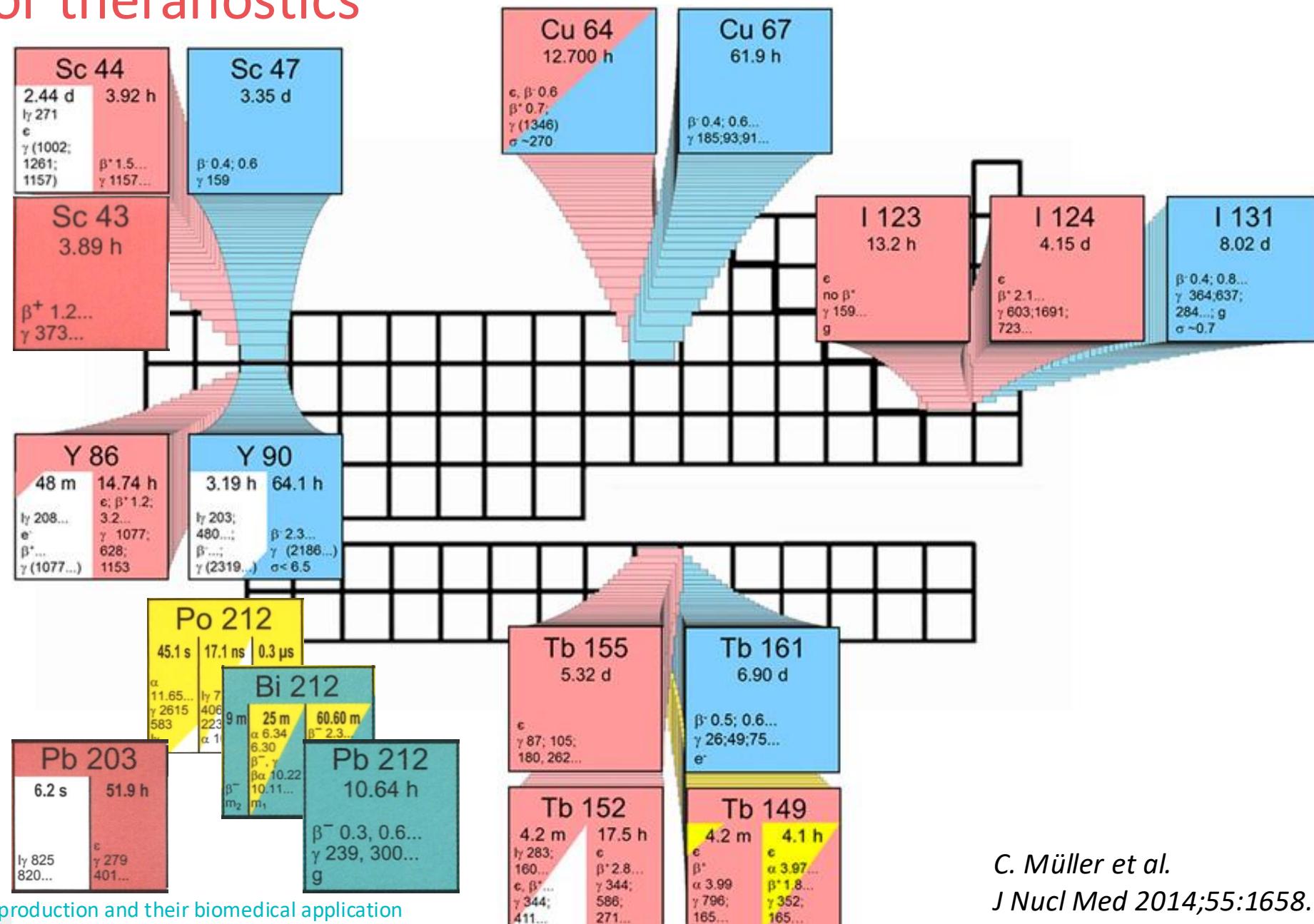
1 A=155 atom in $\sim 10^7\text{-}10^8$ Ta atoms



A very useful beam dump



Matched pairs for theranostics



C. Müller et al.
J Nucl Med 2014;55:1658.

Production of non-carrier-added Pb-203 and At-211 at ARRONAX

Pb 203	Pb 204	Pb 205	Pb 206
6.2 s	51.9 h	67.2 m	1.4
$\text{ly } 825$ 820...	$\text{c } 279$ 401...	$\text{ly } 899, 912$ 375...	$\text{no } \gamma$ $\sigma \sim 5$
		$\sigma 0.68$	$\sigma 0.027$
TI 202	TI 203	TI 204	TI 205
12.23 d	29.52	3.78 a	70.48
ε		$\beta^- 0.8$	
$\gamma 440, (520...)$	$\sigma 11$	ε	
	$\sigma_{n,\alpha} < 0.0003$	$\text{no } \gamma, g$	$\sigma 0.11$
		$\sigma 22$	

At 210	At 211	At 212	At 213
8.3 h	7.22 h	119 ms	314 ms
$\varepsilon, \alpha 5.524$	ε	$\alpha 7.84$	$\alpha 7.68$
5.442, 5.361...	$\alpha 5.867...$	7.90...	7.62...
$\gamma 1181, 245$	$\gamma (687...)$	$\gamma 63...$	$\gamma 63...$
1483...	g	e^-	e^-
			9.08
Po 209	Po 210	Po 211	Po 212
102 a	138.38 d	25.2 s	45.1 s
$\alpha 4.881...$	$\alpha 5.30438...$	$\alpha 7.275$	$\alpha 11.65...$
ε	$\gamma (803)$	8.883...	$\gamma 728$
$\gamma (895, 261$	$\sigma < 0.0005 + < 0.030$	570...	406
263...)	$\sigma_{n,\alpha} 0.002$	100...	223...
	$\sigma_t < 0.1$	570...)	$\alpha 10.22$
			$\alpha 8.785$
Bi 208	Bi 209	Bi 210	Bi 211
$3.68 \cdot 10^5$ a	100	$3.0 \cdot 10^6$ a	2.17 m
	$1.9 \cdot 10^{19}$ a	$\alpha 4.946$	$\alpha 6.6229$
	$\alpha 3.077...$	4.908...	$6.2788, \beta^- ...$
	$\sigma 0.011 + 0.023$	$\gamma 266$	$\gamma 351...$
	$\sigma_{n,\alpha} < 3E-7$	$\sigma 0.054$	$\alpha \rightarrow g, \beta^- \rightarrow g$
		$\gamma (305$	
		266)	



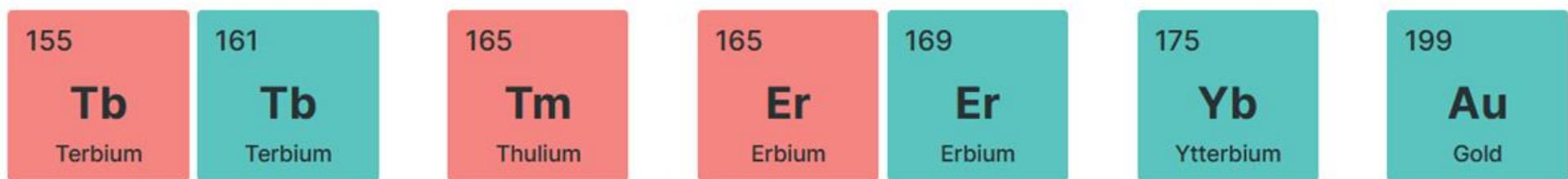
Production of non-carrier-added Mn-52 and Pd-103 at DTU

Mn 50	Mn 51	Mn 52	Mn 53
1.75 m β^+ 3.5 3.7... γ 1098 783 1443... 283 ms γ (3626 2844)	46.2 m β^+ 2.2... γ (749...)	21 m β^+ 2.6... γ 1434... γ 378 5.6 d β^+ 0.6... γ 1434 936, 744... ε no γ σ 70	$3.7 \cdot 10^6$ a ε β^+ 0.6... γ 1434 936, 744... σ 70
Cr 49	Cr 50	Cr 51	Cr 52
42 m β^+ 1.4, 1.5... γ 91, 153, 62... σ 15	4.345	27.7010 d ε γ 320 σ < 10	83.189 σ 0.8

Pd 102	Pd 103	Pd 104
1.02 σ 3.2	16.991 d ε γ (357...) m	11.14
Rh 101	Rh 102	Rh 103
4.4 d ε γ 307 545... γ 157	3.3 a ε γ 127, 198 325...	207 d ε β^+ 1.3 β^- 1.2 γ 475 628... γ 475 628... ε γ (40) e^- σ 11 + 134



The PRISMAP radionuclide portfolio (grown by user demands)





FOLLOW MARIA SALOMEA'S FOOTSTEPS !



WWW.PRISMAP.EU



PRISMAP PROJECT



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008571 (PRISMAP).