

PAUL SCHERRER INSTITUT



RADIOISOTOPE
DEVELOPMENT



CENTER FOR
RADIOPHARMACEUTICAL
SCIENCES
ETH PSI USZ



WIR SCHAFFEN WISSEN – HEUTE FÜR MORGEN

h e d s

Haute école de santé
Genève

h e p i a

Haute école du paysage, d'ingénierie
et d'architecture de Genève



Hes·SO GENÈVE
Haute Ecole Spécialisée
de Suisse occidentale



Nicholas P. van der Meulen:: Proposed CH Representative

Matched Pairs Towards Theragnostics

α -Therapy

Tb 149
 4.2 m / 4.1 h
 e
 β^+ α 3.97
 α 3.99 β^+ 1.8
 γ 796; γ 352;
 165... 165...

Auger-e⁻ Therapy

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

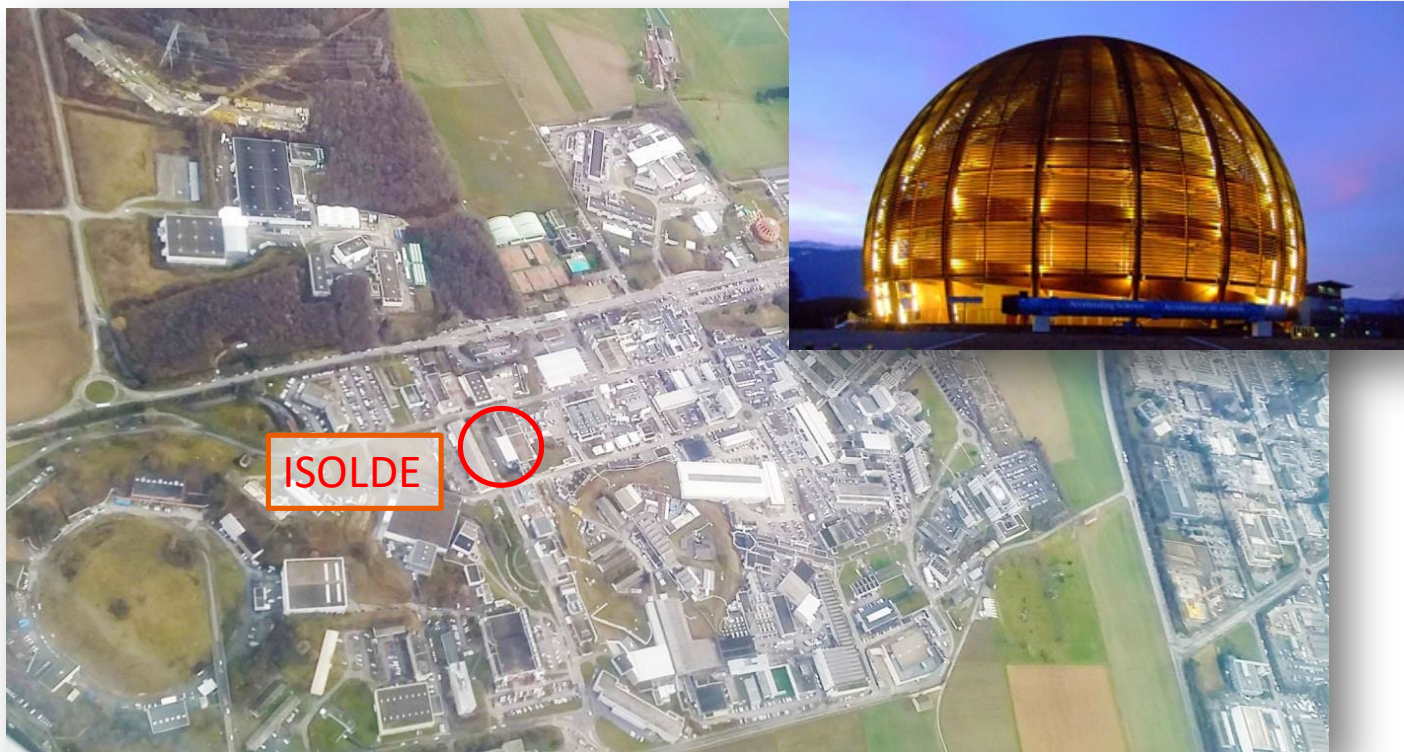
β -Therapy

PET (β^+)

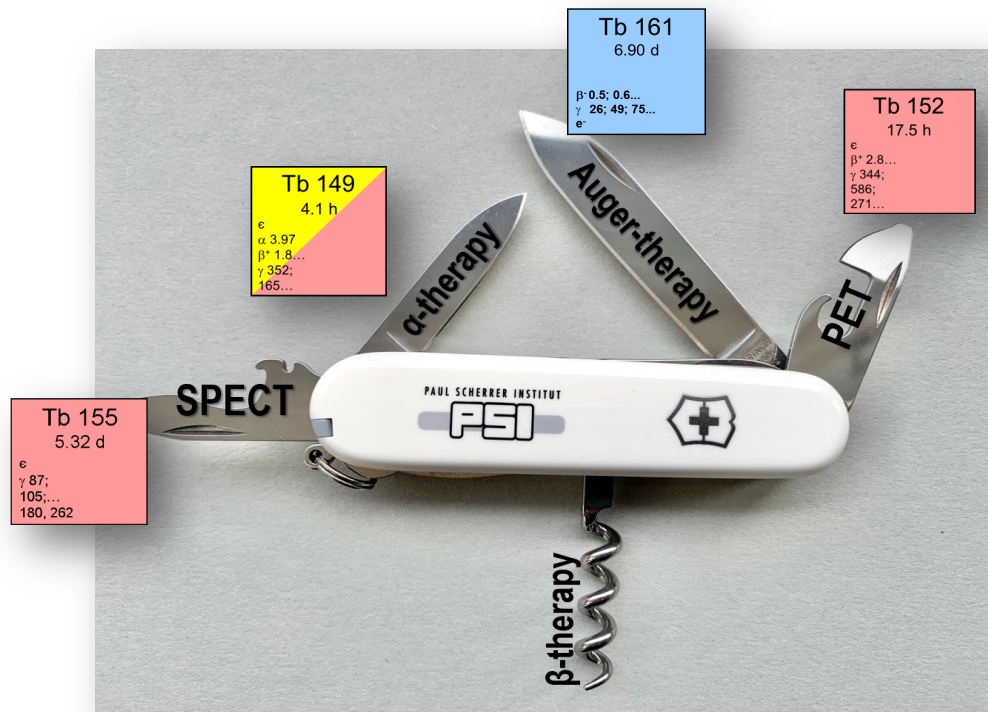
Tb 152
 4.2 m / 17.5 h
 e
 β^+ 283; β^+ 2.3...
 160... γ 344;
 α β^+ ... 586;
 γ 344; 271...
 411...

SPECT (γ)

Tb 155
 5.32 d
 e
 γ 87;
 105...
 180, 262

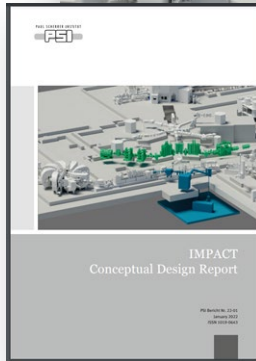
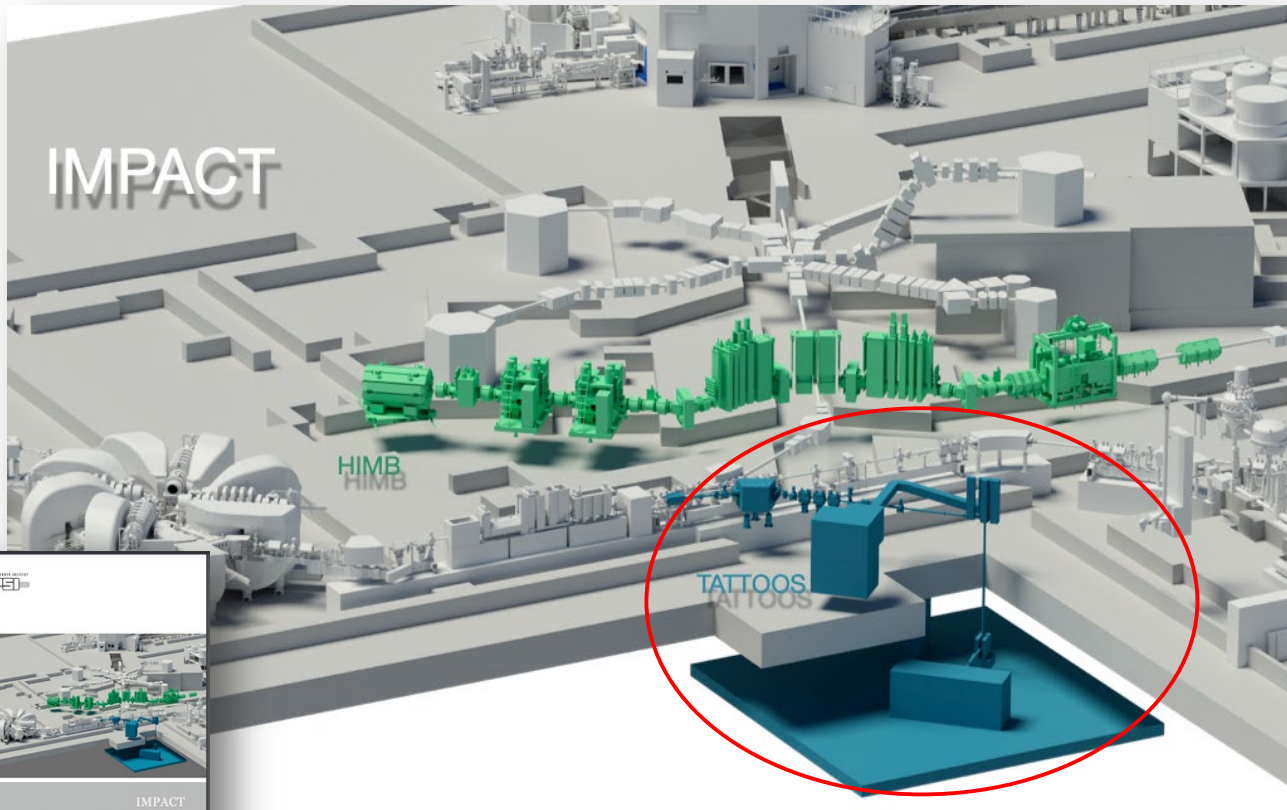


The Terbium “Sisters”



Not possible without ISOLDE collaboration!

Isotope and Muon Production using Advanced Cyclotron and target Technologies

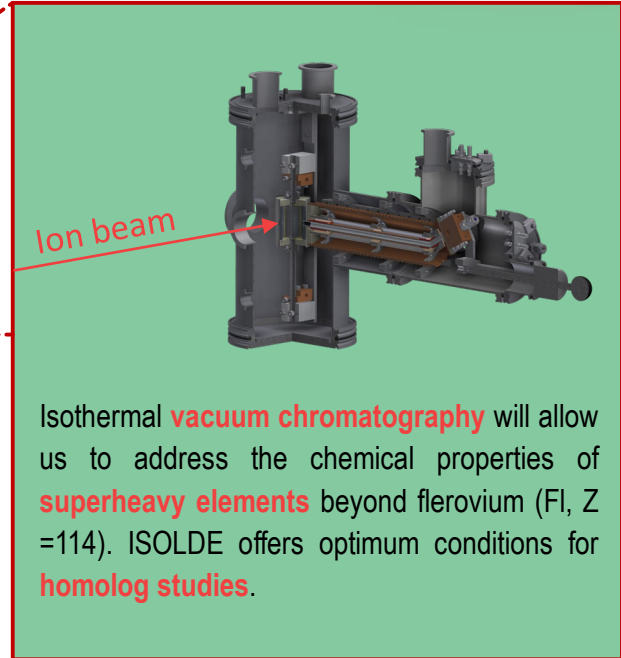


<https://www.psi.ch/en/impact>

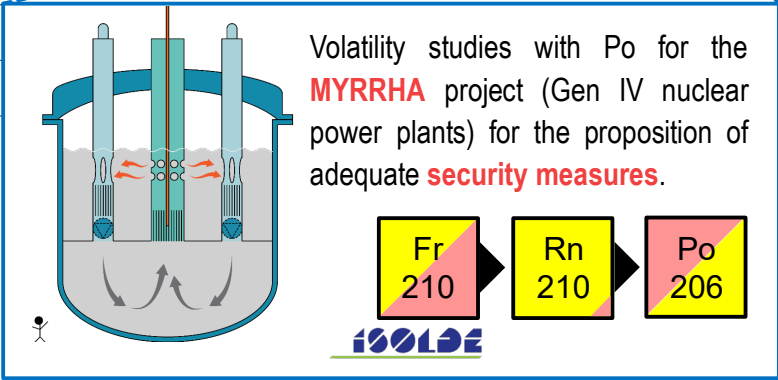
CDR: <https://www.dora.lib4ri.ch/psi/islandora/object/psi:41209>

Fundamental radiochemical studies at ISOLDE

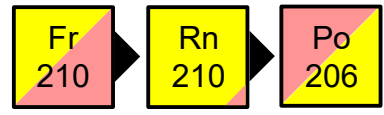
1 H hydrogen 1.0080 ± 0.0002																	2 He helium 4.0026 ± 0.0005																				
3 Li lithium 6.94 ± 0.05	4 Be beryllium 9.0122 ± 0.0001	Key: atomic number name symbol element standard atomic weight																10 B boron 10.81 ± 0.02	11 C carbon 12.011 ± 0.002	12 N nitrogen 14.007 ± 0.001	13 O oxygen 15.999 ± 0.001	14 F fluorine 18.998 ± 0.001	15 Ne neon 20.180 ± 0.001														
11 Na sodium 22.990 ± 0.001	12 Mg magnesium 24.305 ± 0.002	19 K potassium 39.098 ± 0.001	20 Ca calcium 40.078 ± 0.004	21 Sc scandium 44.956 ± 0.001	22 Ti titanium 47.887 ± 0.001	23 V vanadium 50.942 ± 0.001	24 Cr chromium 51.996 ± 0.001	25 Mn manganese 54.938 ± 0.001	26 Fe iron 55.845 ± 0.001	27 Co cobalt 58.933 ± 0.001	28 Ni nickel 58.693 ± 0.001	29 Cu copper 63.546 ± 0.003	30 Zn zinc 65.38 ± 0.002	31 Ga gallium 69.723 ± 0.001	32 Ge germanium 72.630 ± 0.001	33 As arsenic 74.922 ± 0.001	34 Se selenium 78.971 ± 0.008	35 Br bromine 79.904 ± 0.002	36 Kr krypton 83.798 ± 0.002	37 Rb rubidium 85.468 ± 0.001	38 Sr strontium 87.62 ± 0.01	39 Y yttrium 88.906 ± 0.001	40 Zr zirconium 91.224 ± 0.002	41 Nb niobium 92.906 ± 0.001	42 Mo molybdenum 95.94 ± 0.01	43 Tc technetium 98 ± 0.01	44 Ru ruthenium 101.07 ± 0.01	45 Rh rhodium 102.91 ± 0.01	46 Pd palladium 106.42 ± 0.01	47 Ag silver 107.87 ± 0.01	48 Cd cadmium 112.41 ± 0.01	49 In indium 114.82 ± 0.01	50 Sn tin 118.71 ± 0.01	51 Sb antimony 121.76 ± 0.01	52 Te tellurium 127.60 ± 0.03	53 I iodine 126.90 ± 0.01	54 Xe xenon 131.29 ± 0.01
55 Cs caesium 132.91 ± 0.01	56 Ba barium 137.33 ± 0.01	57-71 lanthanoids	72 Hf hafnium 178.49 ± 0.01	73 Ta tantalum 180.95 ± 0.01	74 W tungsten 183.84 ± 0.01	75 Re rhenium 186.21 ± 0.01	76 Os osmium 190.23 ± 0.03	77 Ir iridium 192.22 ± 0.01	78 Pt platinum 195.08 ± 0.02	79 Au gold 196.97 ± 0.01	80 Hg mercury 200.59 ± 0.01	81 Tl thallium 204.38 ± 0.01	82 Pb lead 207.2 ± 0.01	83 Bi bismuth 208.98 ± 0.01	84 Po polonium [209]	85 At astatine [210]	86 Rn radon [222]	87 Fr francium [223]	88 Ra radium [226]	89-103 actinoids	104 Rf rutherfordium [261]	105 Db dubnium [262]	106 Sg seaborgium [263]	107 Bh bohrium [264]	108 Hs hassium [265]	109 Mt meitnerium [266]	110 Ds darmstadtium [267]	111 Rg roentgenium [268]	112 Cn copernicium [269]	113 Nh nihonium [270]	114 Fl flerovium [279]	115 Mc moscovium [280]	116 Lv livermorium [283]	117 Ts tennessine [284]	118 Og oganesson [284]		



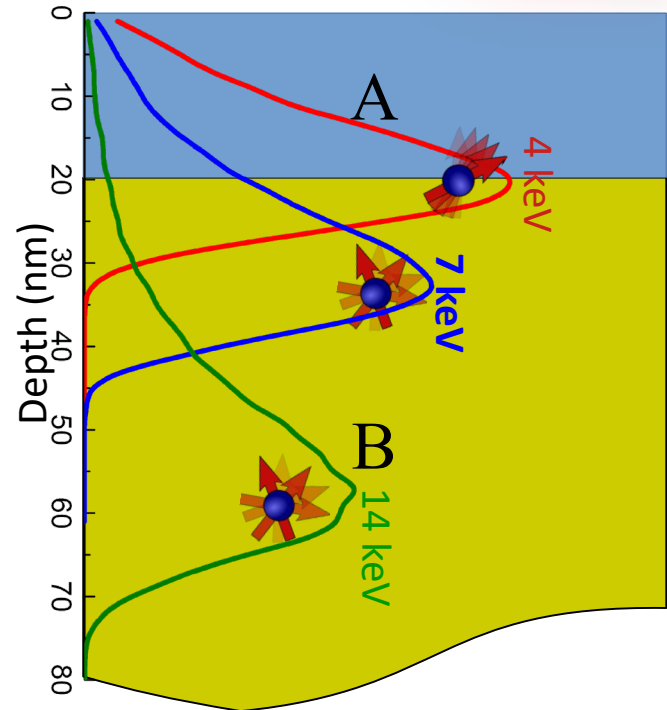
Isothermal **vacuum chromatography** will allow us to address the chemical properties of **superheavy elements** beyond flerovium (Fl, Z = 114). ISOLDE offers optimum conditions for **homolog studies**.



Volatility studies with Po for the **MYRRHA** project (Gen IV nuclear power plants) for the proposition of adequate **security measures**.



- Use radioactive ions as implanted spin probes to study magnetic and electronic properties of materials.
- The ions may be spin polarized using optical pumping schemes, then used for beta-detected nuclear magnetic resonance.
- By implanting the ions at variable energies between 1-30 keV, depth-resolved measurements in the range of 1-200 nm can be performed.
- Most experiments probe either the surface or the bulk. Such implanted probe cover a range of depths that cannot be easily probed.



Xe Radioisotopes for Medical Imaging

- Collection of $^{129\text{m}}$, $^{131\text{m}}$, $^{133\text{m}}$ Xe for the gamma-MRI project;
- using spin-polarized (hyperpolarized) mXe, MRI signals observed as changes in asymmetry of gamma-decay from externally-polarised long-lived Xe isomers;
- optimise and evaluate different ways of producing and extracting mXe, including collections at ISOLDE.

ISOLDE collections:

- In 2018: production/polarisation;
- In 2019: polarisation (chemical lab);
- From 2021 (EU project): production, Xe sample characterization and purification.



Motivation & Future Potential

PSI-TATTOOS and CERN-ISOLDE is seen as an asset in serving Switzerland as a whole:

- synergies for the implementation of TATTOOS;
- for further facility developments;
- for strengthening a common national and international user base;
- foster new research directions not yet pursued in Switzerland, connected to fundamental nuclear and particle physics studies
- it will provide a stable link for other interested Swiss parties.

Various groups have performed various physics- and medically-related projects, where Swiss parties have been involved in many ISOLDE-related publications.

CH will commit to its partnership by investing 60k CHF into the ISOLDE collaboration.