



# CERN-MEDICIS

## Production of radionuclides for medical research On the way to clinical translation ....

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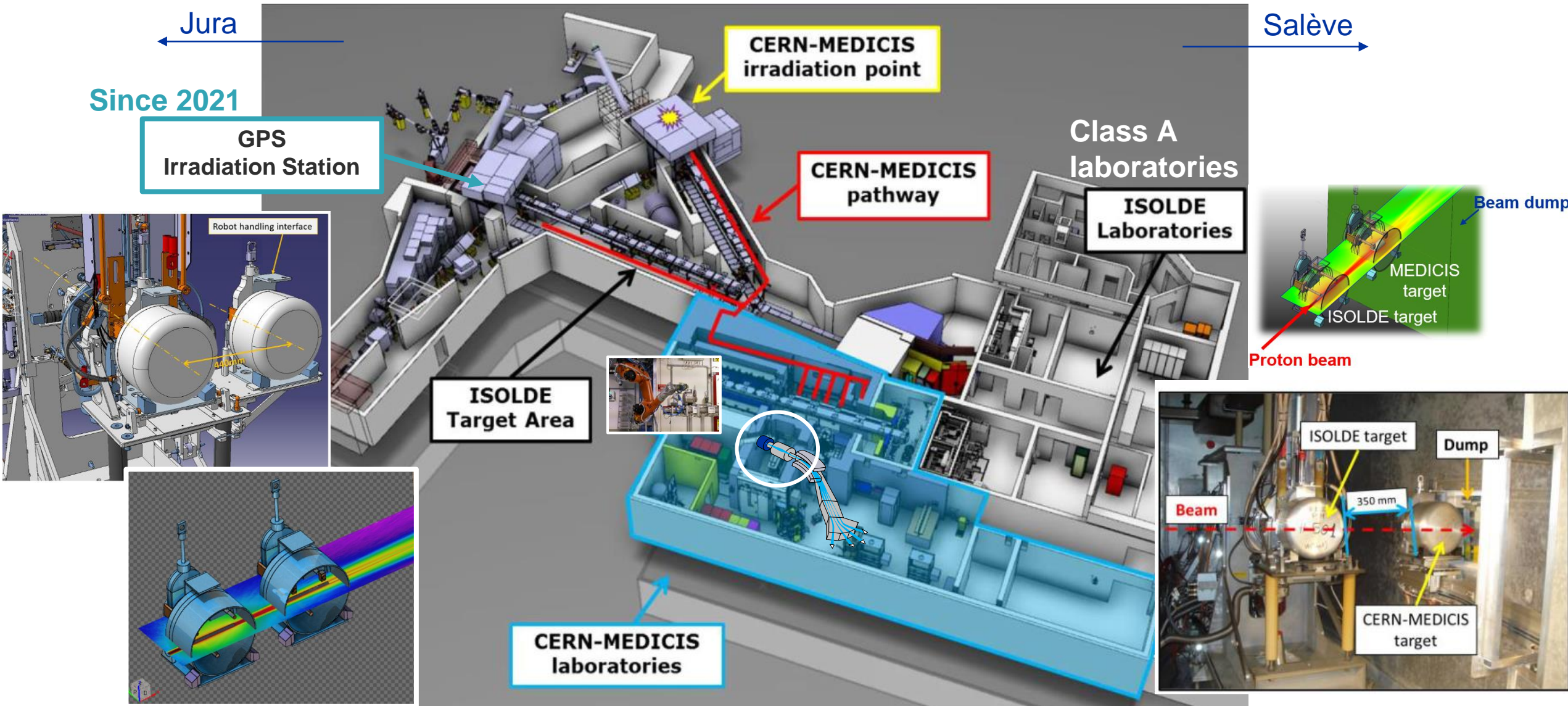
*MEDICIS experimental program coordinator & PRISMAP technical manager*

On behalf of the MEDICIS local dream-team, collaboration and all contributors

# Summary

- 1. Quick reminder of MEDICIS integration within the ISOLDE complex**
- 2. Our current irradiation possibilities : to produce our radionuclides**
- 3. A view of MEDICIS activity delivered since 2018 and increasing demand**
- 4. Our deliveries last year and where/which research projects**
- 5. Clinical translation: where we are now and implications for ISOLDE**
- 6. Long-term plan**

# CERN-MEDICIS - integration within the ISOLDE complex



# CERN-MEDICIS - irradiation possibilities

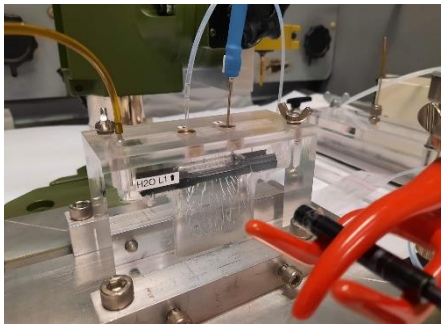
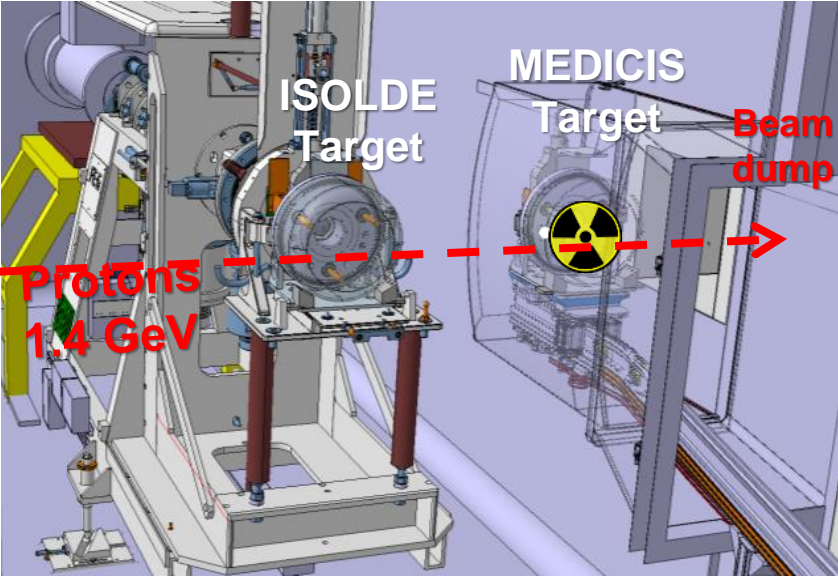
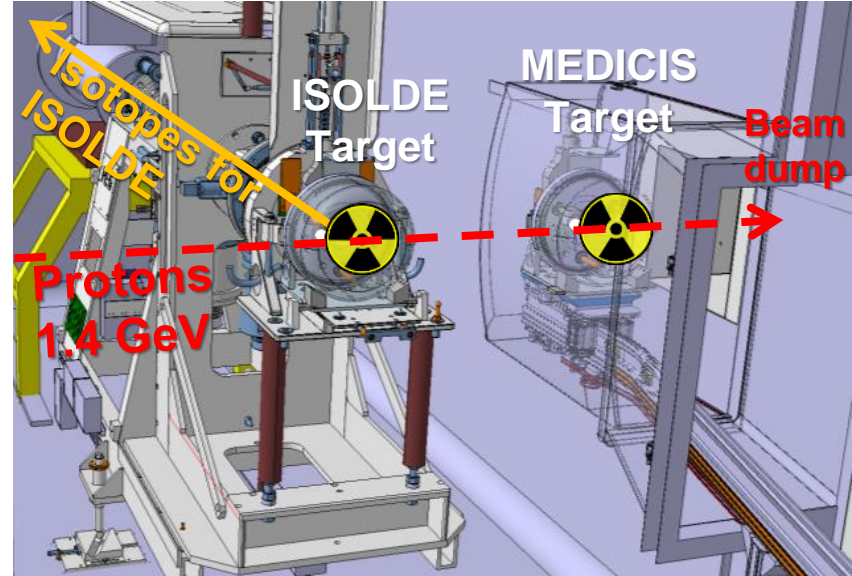
Indirect irradiation at ISOLDE (1.4 GeV)

*Recycle the protons*

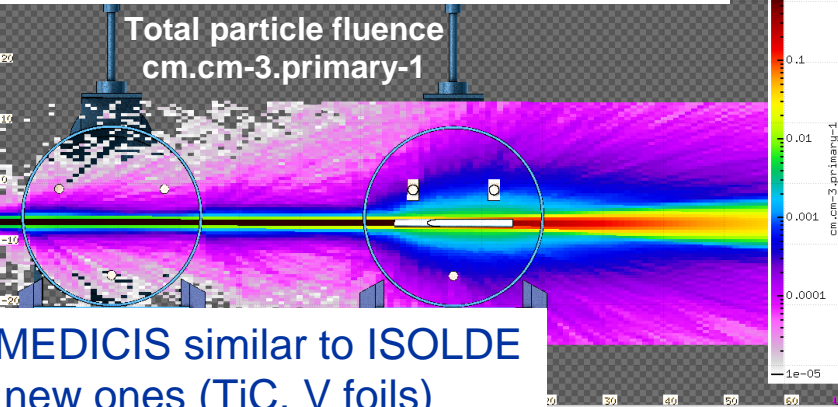
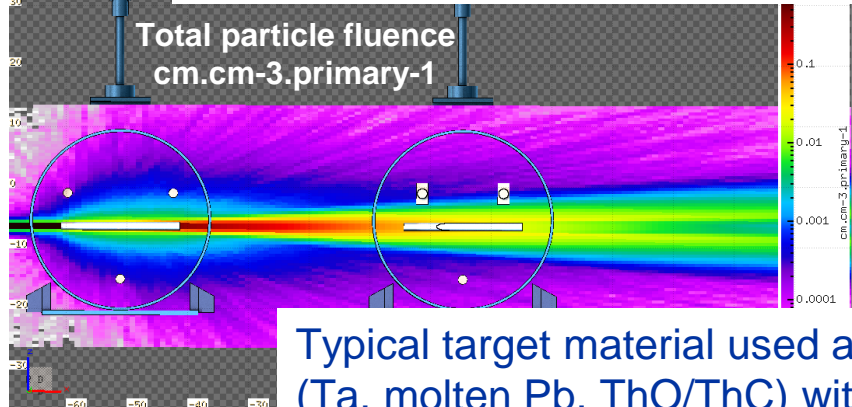
Direct irradiation at ISOLDE (1.4 GeV)

*1st time tested already in 2018*

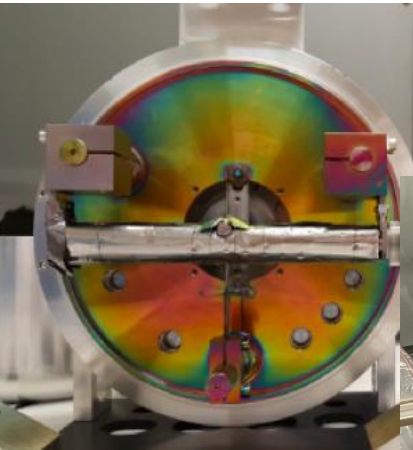
External sources produced at partner institutes



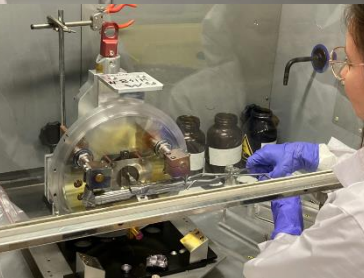
Same radionuclide inventory but x10 difference in production yield



Typical target material used at MEDICIS similar to ISOLDE (Ta, molten Pb, ThO/ThC) with new ones (TiC, V foils)



The only mode of operation during LS

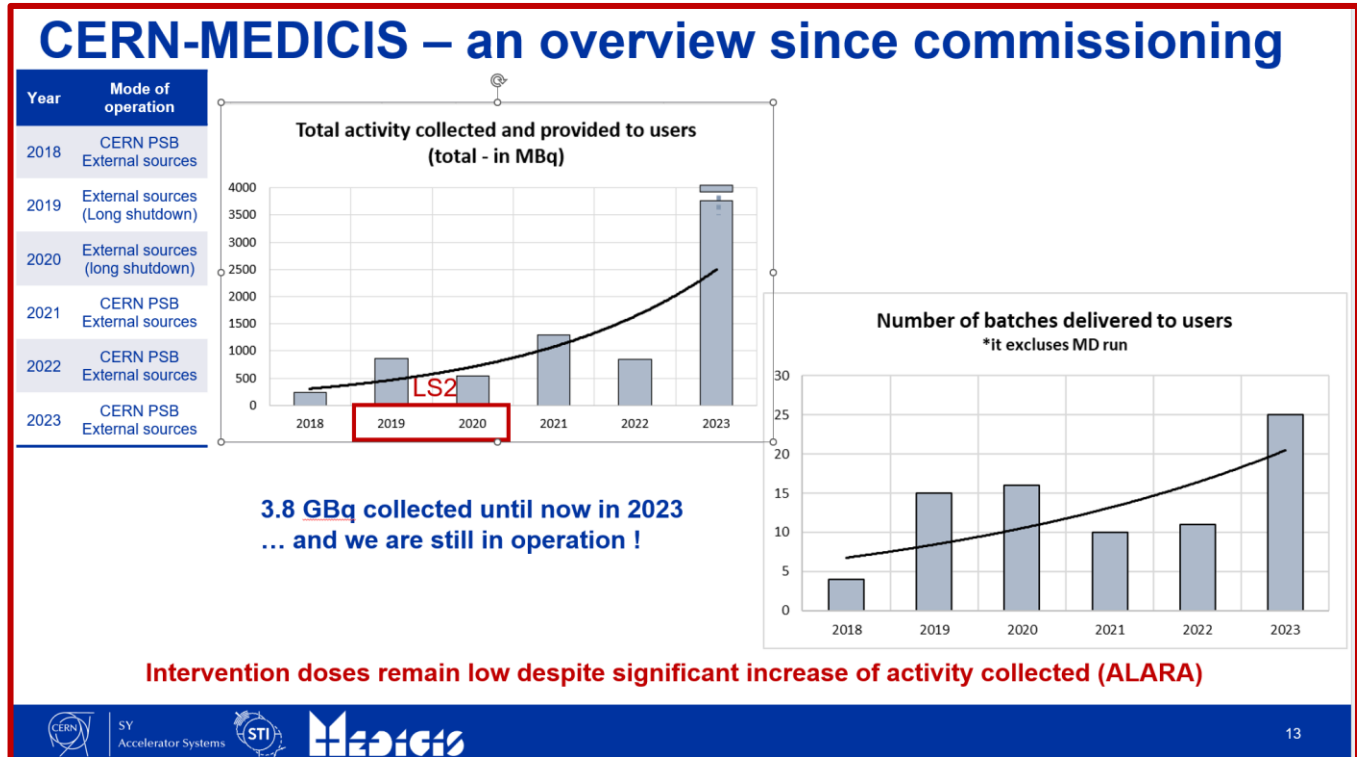
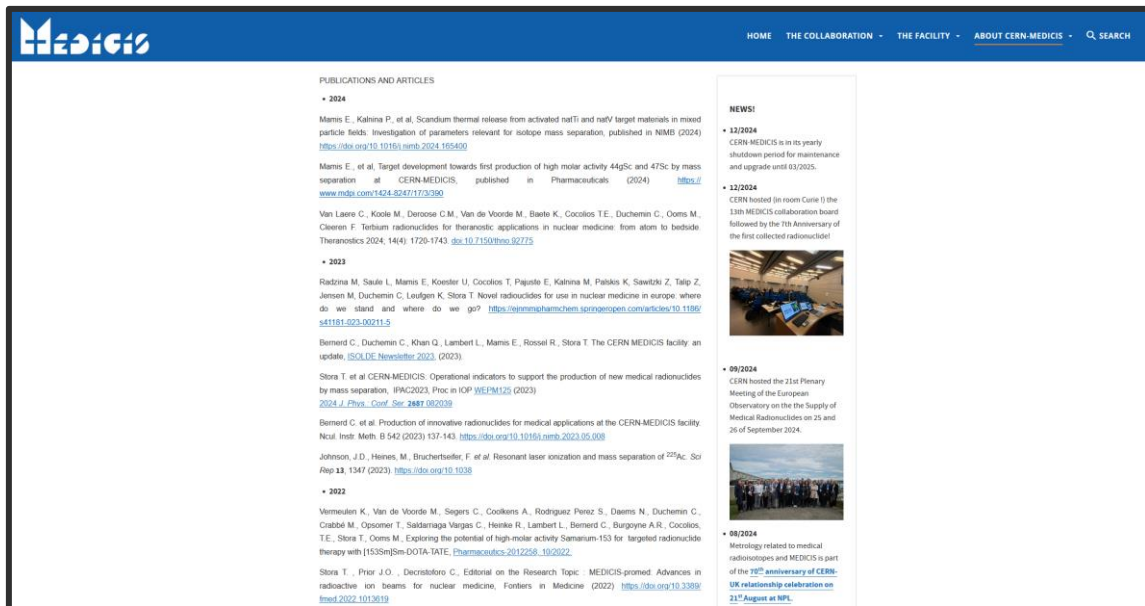


# Increasing demand and activity delivered since first year of operation in 2018

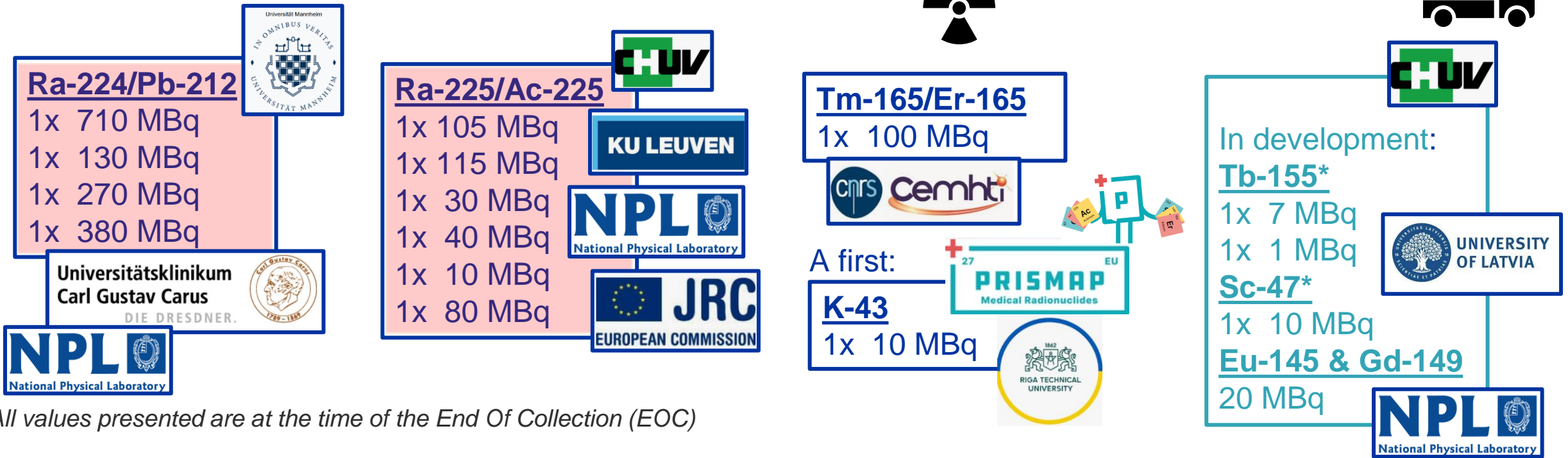
Thanks to **increased experience** in the operation of the facility AND **smooth and efficiency coordination** between MEDICIS and ISOLDE without perturbing the ISOLDE physics program

Slide presented at the ISOLDE workshop end of 2023

And many scientific publications every year (more details on <https://medicis.cern>)



# CERN-MEDICIS –2024 productions and deliveries



All values presented are at the time of the End Of Collection (EOC)

72% collection efficiency reached for Ra ! (= activity collected vs activity at start)

**DISPATCH TO PARTNER INSTITUTES**  
18 radioactive transports

2 GBq total collected ! including 1.5 GBq Ra-224/Pb-212 & 380 MBq Ra-225/Ac-225 ....

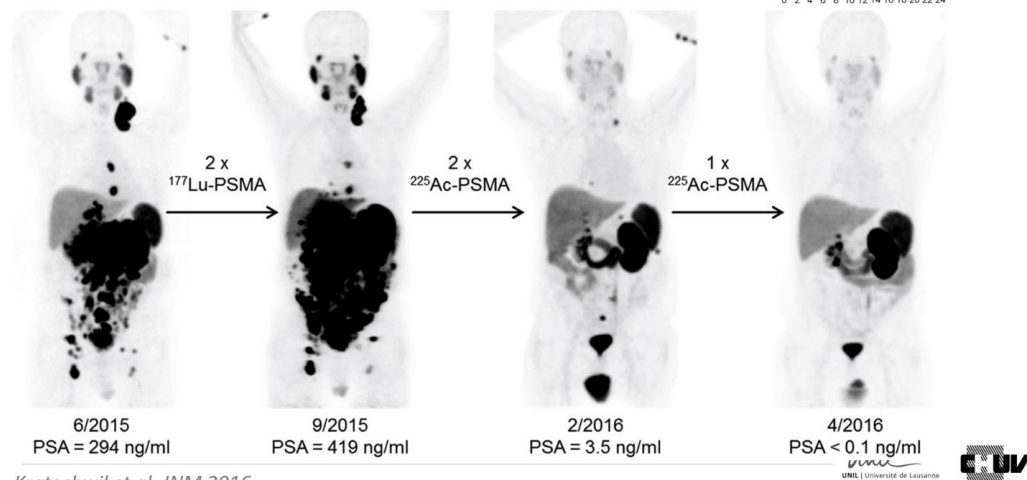
Respectively corresponding to 8 and 38 clinical doses !

**But why such a high demand for these two radionuclides?**

# CERN-MEDICIS: radionuclides and research projects

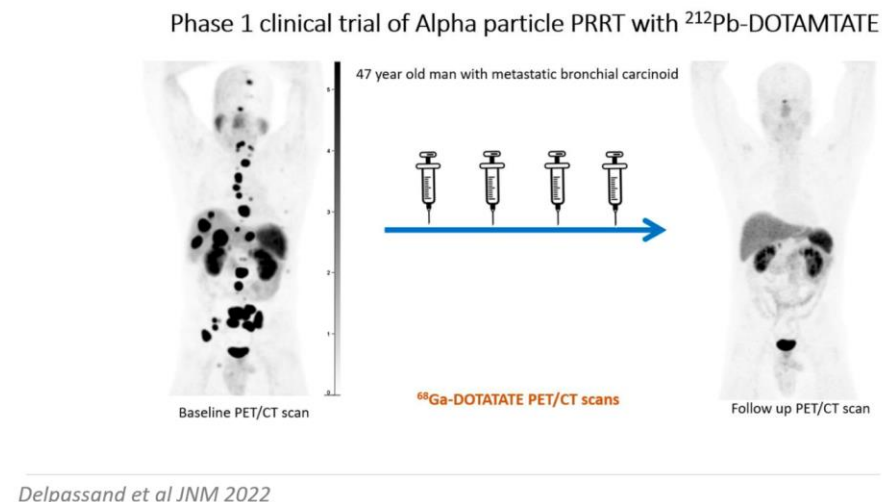
## Why such a high demand for these two radionuclides Ra/Ac-225 and Ra-224/Pb-212

### $^{225}\text{Ac}$ -PSMA



Kratochwil et al, JNM 2016

### $^{212}\text{Pb}$ -DOTAMTATE



Delpassand et al JNM 2022

Unil  
UNIL | Université de Lausanne



**Very limited world-wide availability** of these radionuclides required to speed-up research of targeted alpha therapy

**HIGH DEMAND** to pursue research efficiently as **clinical trials = injection into patients**

These radionuclides are **produced and delivered** by **CERN-MEDICIS** with **high purity and high efficiency >50%**



SY  
Accelerator Systems



\*Kratochwil et al. Journal of nuclear medicine, 2016  
\*\*Delpassand et al. Journal of nuclear medicine, 2022

EDMS 3230562

Courtesy of Prof. John Prior (CHUV)

# Requests to go for clinical trials

Because MEDICIS showed already its possibility/capability to produce activity levels and purity levels suitable for clinical applications

Both from externally irradiated samples and irradiations at ISOLDE



The latter successfully tested in 2024 thanks to a smooth and efficient coordination with ISOLDE without perturbing the ISOLDE physics program 😊

The authorization to provide our radionuclides for clinical trials is going to be discussed at the CERN council in March 2025 and it is pending for approval.





# Requests to go for clinical trials – projects concerned

1. **Sm-153 from external sources (reactor product) → do not involve irradiations at ISOLDE but irradiations at  partner institutes**
2. **Ra-224/Pb-212  project → involve irradiations at ISOLDE (ThC with 1.4 GeV)**
  - **Success in 2024 leading to the request to move to clinical application in Dresden Hospital in Germany in 2025**

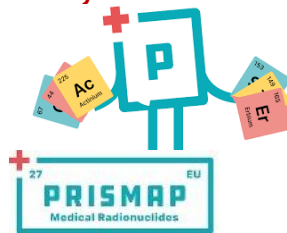
CERN-MEDICIS is one of the pillar of **PRISMAP**,  
the **European medical isotope program**

**A single entry-point for external user to get access to  
medical radionuclides for cancer research**

INFRA-2-2020 European Commission [www.prismap.eu](http://www.prismap.eu)

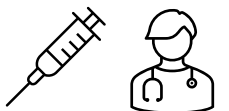
Coordinated by CERN

Involving key European infrastructures in the production of medical radionuclides  
such as MEDICIS, ILL, SCK CEN, PSI, POLATOM, Hevesy Lab, ARRONAX, JRC K.



**47 projects selected for funding within PRISMAP**  
providing radionuclides and transnational accesses  
to external researchers

Only 2 are ready to move to clinical trials  
**1 needs us and  
our Ra capabilities ! 😊**



# Requests to go for clinical trials – where we are now and implications for ISOLDE



We know we are **capable of producing the amount of activity** of Ra-224/Pb-212 that would be necessary for future clinical trials → **tested in 2024** with up to 700 MBq produced

## Requirements to move forwards in 2025:

1. Produce 200 to 500 MBq Ra-224/Pb-212 (x3) for shipping to Dresden Hospital in Germany
2. Need about 24 hours direct irradiation of ThC with 1.4 GeV beam and 2 uA at ISOLDE
3. Operate without perturbing the ISOLDE physics program

During stable set-up time for instance, as currently done.

Or during slots usually dedicated to development time (TISD CERN-internal for instance)



**SENSITIVE**

**Concrete example: clinical deliveries from JRC Karlsruhe are scheduled every two months with the planning known for the year to come**

**However, as patients will be scheduled and waiting: these irradiations must be flagged as critical/sensitive, known at least couple months in advance and not be delayed**

# And on the long term ...



Following successful international review end of 2023, MEDICIS is now submitting the formal approval request to run up to 2031 ...

## We have a Long-term Plan

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
L4, PSB				LS3							LS4						EY										
L3, LBIR				LS3							LS4						EY										
PS				LS3							LS4						EY										
SPS				LS3							LS4						EY										
LHC		RUN3		LS3 / HL/ATLAS/CMS					RUN4		LS4 / ALICE/LHCb?				RUN5		EY										
CLEAR				pending MTP 2025							LS4						EY										
ISOLDE				LS3 / BD, Upgr.							LS4						EY										
HI-ISOLDE				LS3 / BD, Upgr.							LS4						EY										
MEDICIS				Operation as pos.		pending MTP 2025					LS4						EY										
n_TOF				LS3							LS4						EY										
East-Area				LS3							LS4						EY										
AD/ELENA				LS3		SPSC Open Call					LS4						EY										
HiRadMat				LS3							LS4						EY										
AWAKE				LS3 / QNGS/ 2b -> 2c		Run-2c		Run 2d			LS4						EY										
North Area				LS3 / NA-CONSPH-I							LS4 Ph-II						EY										
ECN3 -> HI-ECN3				NA62 Dism. / TOC2		BDF					LS4 NA						EY										
SHIP				TDR/ CE/ Experiment Installation							LS4 NA						EY										
Future lepton injector																											
Future flagship																											
Future hadron injector																											



Short-/Mid-/Long-term Decisions affecting:  
**RUN4/5, LS4 related consolidation/upgrades**  
 Related studies, preparations, scheduling



29/01/2025

Chamonix 2025: A vision for a diverse future at the CERN accelerator complex

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Taken from M. Brugger, M. Lamont, Chamonix workshop 2025

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# Executive summary

- **Since 2018 MEDICIS operates by taking beam at ISOLDE without perturbing the physics program (good coordination required!)**
- **Clinical translation at MEDICIS requested for two ongoing projects → being evaluated by the CERN council**
- **One project would require direct irradiation at ISOLDE**

To be coordinated “as usual” but with a special flag: critical/sensitive

# A BIG THANKS TO ALL THE PEOPLE, GROUPS, SERVICES, INSTITUTES, COLLABORATION ... INVOLVED IN MEDICIS!



THE Dream-Team



**THANK YOU FOR  
YOUR ATTENTION !**

**Any questions/concerns?**



[home.cern](http://home.cern)