

Status and perspectives for medical isotope production at MEDICIS

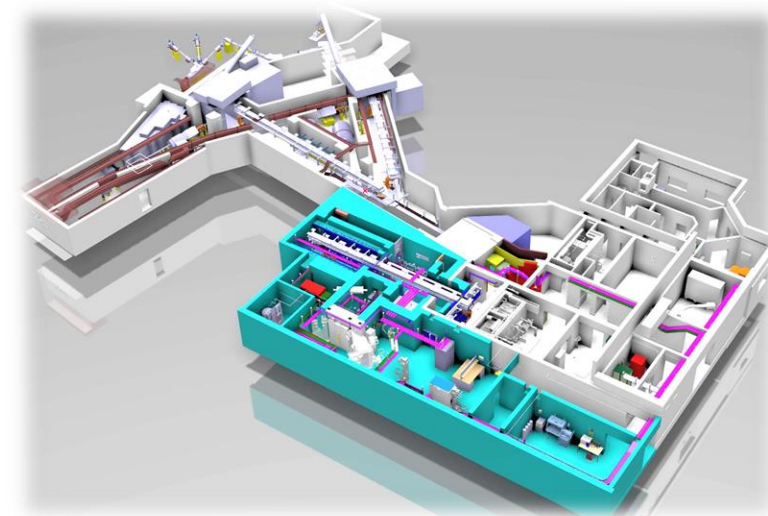
Charlotte DUCHEMIN

on behalf of the MEDICIS collaboration

MEDICIS run coordinator: **Charlotte DUCHEMIN** (Joined the team on 1st of August 2019)

Predecessor: Joao Pedro RAMOS (until mid-July 2019)

MEDICIS Class A labs coordinator: **Laura LAMBERT**



ISOLDE Workshop and Users meeting 2019
5th & 6th of December 2019

The CERN accelerator complex long-shutdown n°2

	2019			
	Q1	Q2	Q3	Q4
LHC	LS2 LHC Injectors upgrade			
Injectors				

We are here

	2020			
	Q1	Q2	Q3	Q4
LHC	LS2 LHC Injectors upgrade			
Injectors				

	2021				
	Q1	Q2	Q3	Q4	
LHC	Beam commissioning	Physics	Physics	Physics	Technical stop
Injectors	Beam commissioning	Physics	Physics	Physics	Technical stop

 Shutdown

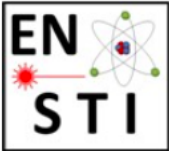
 Beam commissioning

 Physics

 Technical stop

MEDICIS is operating during LS2 !

Running offline with **external sources** provided by Institut Laue Langevin ILL (reactor) and the ARRONAX cyclotron



What do we receive from our partner facilities ?

ARRONAX

Nantes, France

Institut Laue Langevin

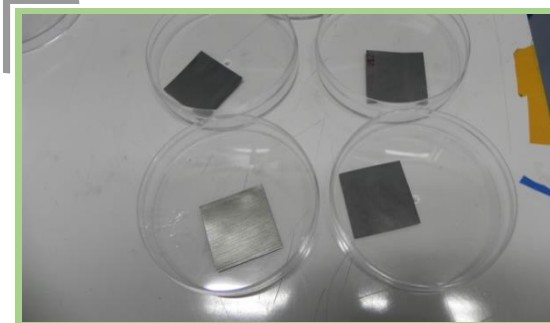
Grenoble, France



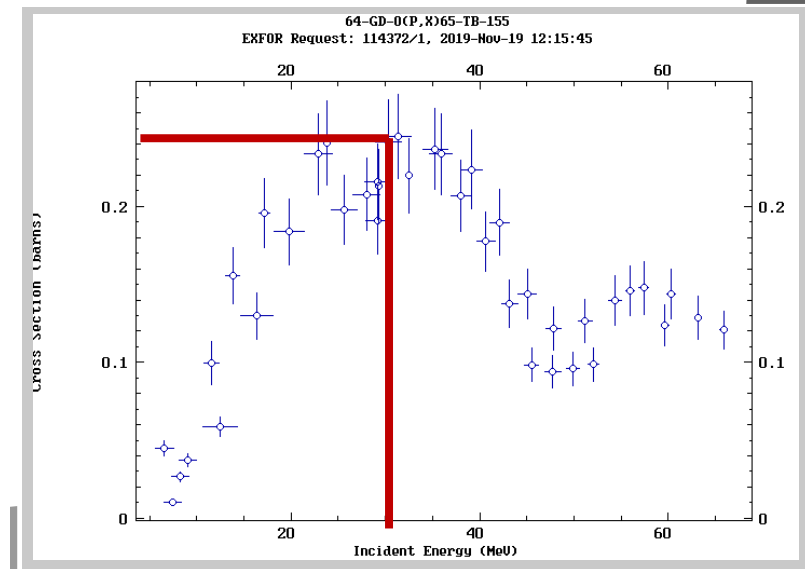
ARRONAX



Cyclotron C70 – Nantes, Fr
Protons between 30-70 MeV



Natural Gadolinium foils
25 μ m thick



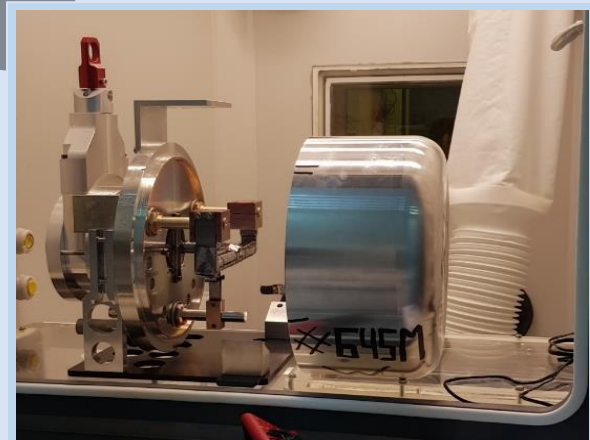
Gd-nat(p,xn)Tb-155 production cross section

Tb 149 4.2 m e p ⁺ a 3.99 g 796; 165...	Tb 152 4.1 h e p ⁺ a 3.97 g 352; 165...	Tb 155 5.32 d e g 87; 105; 180, 262	Tb 161 6.90 d e p ⁺ 0.5, 0.6... g 20, 49, 75...
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Rhenium boat

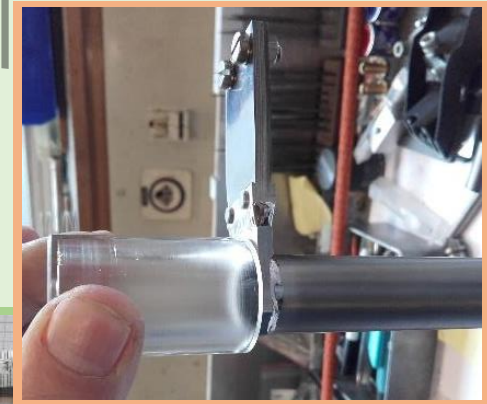
First collections performed with a Gd foil inserted inside the target



Target #645M in the ARRONAX hot cell

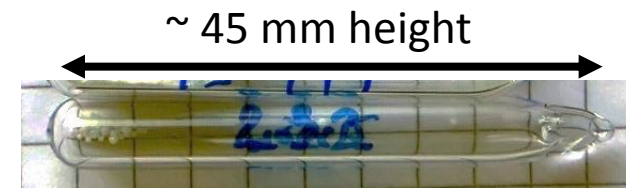


B. Crepieux &
E. Barbero
(EN-STI-RBS)



Radiochemistry now performed at Arronax after irradiation to reduce the ratio Tb/Gd

- Vials filled with enriched material – Er-168, Yb-174, Pt-194
- Irradiated by the neutron flux of the ILL reactor (50 to 56 MW);

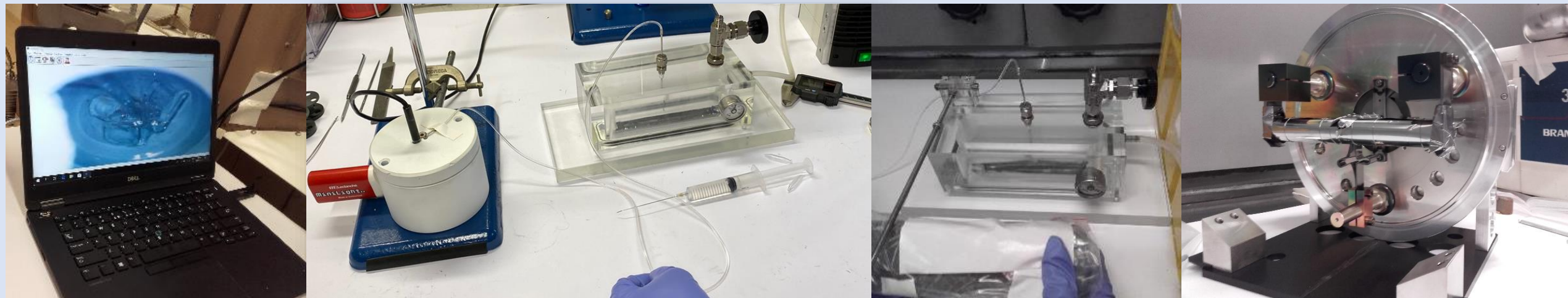


166Er STABLE 33.503%	167Er STABLE 22.869%	168Er STABLE 26.978%	169Er 9.392 D β-: 100.00%	170Er STABLE 14.910%
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170Yb STABLE 2.982%	171Yb STABLE 14.00%	172Yb STABLE 21.68%	173Yb STABLE 16.103%	174Yb STABLE 32.026%	175Yb 4.185 D β-: 100.00%	176Yb STABLE 12.096%
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- Shipped to CERN;
- Vial opening + transfer into target → performed at CERN;

Automatic system developed by B. Crepieux (EN-STI-RBS)



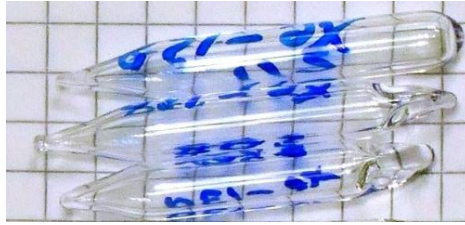
MEDICIS Facility overview 2019



MEDICIS Facility overview 2019

Jan

- Test of ILL vials opening ✓
- Montrac® monorail system maintenance ✓



Feb

- Water cooling on MEDICIS frontend ✓
- MEDICIS storage shelves ✓



Mar

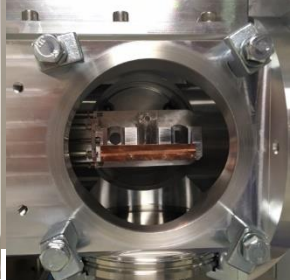
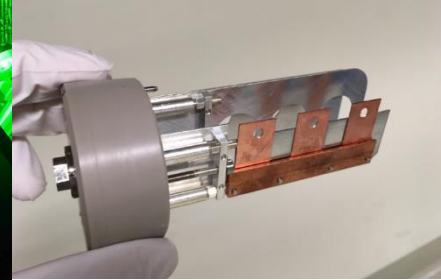
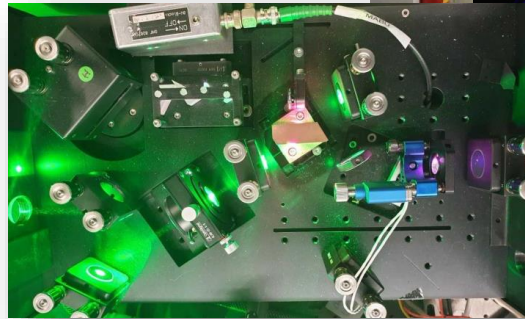
- Commissioning of the fume hood ✓
- Extraction electrode replacement:
new concept validated after repeatability tests ✓



MEDICIS Facility overview 2019

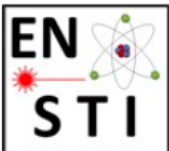
April

- Ventilation ✓
- Robot ✓
- Test of sample transfer ✓
- Laser MELISSA ✓



May

- Endoscopy analysis of frontend
- Extraction electrode mechanical issue
Delay until beginning of July



MEDICIS Facility overview 2019

June

- Reception of new electrode, installation and offline tests ✓
- 26th of June beam permit signed by EN-STI group leader ✓
- 2 vials received from ILL → 1xEr-169 for collection + 1xPt-195m for HUG



HUG Hôpitaux
Universitaires
Genève



Beam Permit

CPS Beam Permits

MEDICIS

Limited
Irradiation Permit
Approved

Limit: no proton beam operation

July

- 2nd of July : first collection from external sources ✓
- 3 additional sources of Er-169 received from ILL
- 4 weeks - 307 hours of collection
- Total of **140 MBq** of **Er-169** collected
- Distributed to PSI and NPL



PAUL SCHERRER INSTITUT
PSI

NPL
National Physical Laboratory



KU LEUVEN

MEDICIS

MEDICIS Facility overview 2019

August

- First importation of irradiated source (second external source)
- Low activity source for first time
 - Collection of **95 kBq** of Tm-171



September

- Busy month!
 - 2nd source from Arronax: 1x irradiated Go-192
 - 4 sources from ILL: 2x Er-169 + 2x Yb-175
- And in between ...
 - around 1400 visitors @



4th MEDICIS Collaboration board

mercredi 18 sept. 2019 à 09:00 → 17:00 Europe/Zurich

530/R-030 - EN-EA Conference Room (CERN)



- Reports from collaboration members
- Status updates of experiments
- New proposals and future upgrades discussed



MEDICIS Facility overview 2019

Oct

- 4 sources from ILL → 2x Yb-175 for collection + 2xPt-195m for HUG
 - **208 MBq** of **Yb-175** collected for PSI

Nov

- Period of tests at MEDICIS
 - Including Gd & Tb resonance studies performed by the LASER experts from EN-STI-LP & KU Leuven;
 - From ARRONAX side, development of their radiochemistry steps to reduce the proportion of Gd in the sample.

Dec

- 2 sources from Arronax → 2x irradiated Gd for Tb-155 collections
 - Radiochemistry steps post-irradiation
 - 1st Tb-155 collection → **cancelled** due to issues after a CERN wide power cut
 - 2nd Tb-155 collection → ongoing ...



Summary of the 2019 collections at MEDICIS

2 External sources

ARRONAX
Nantes, France



Institut Laue Langevin
Grenoble, France



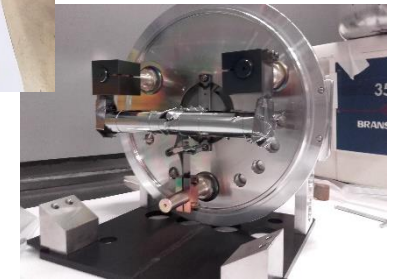
4 Research Institutes received activity

KU Leuven / SCK (BE)
PSI (CH)
NPL (UK)
HUG (CH)



8 Targets

Re-used up to 3 times



3 Radionuclides collected at MEDICIS

Tb-155
Yb-175
Er-169

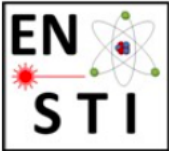
Tb 155
5.32 d

Yb 175
4.185 d

Er 169
9.392 d

15 collections

922 hours
15 weeks of operation
870 MBq in total collected this year

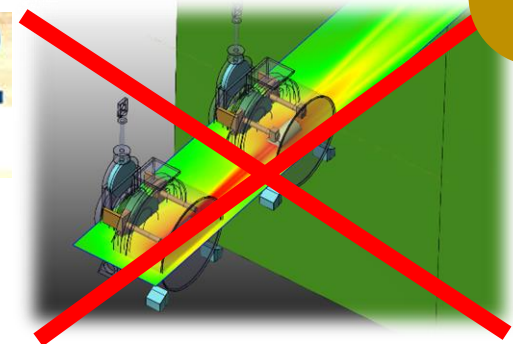


MEDICIS outlook for 2020



What's next?

- MEDICIS **technical stop** foreseen until end of February
- **LS2** continues next year – **no proton** beams
- Need of **external sources** provided to MEDICIS next year



• Cyclotrons

- ARRONAX will continue to provide Tb-155 for next year
- PSI: possibilities to produce Tb isotopes from their proton beam
- New external source: Riga Nuclear Medicine Center – 18 MeV cyclotron



• Reactors

- ILL in shutdown until mid-2020
 - New irradiated vials will arrive at MEDICIS by autumn 2020
- Pakistan Atomic Research Reactor or (PARR) – *under discussion*



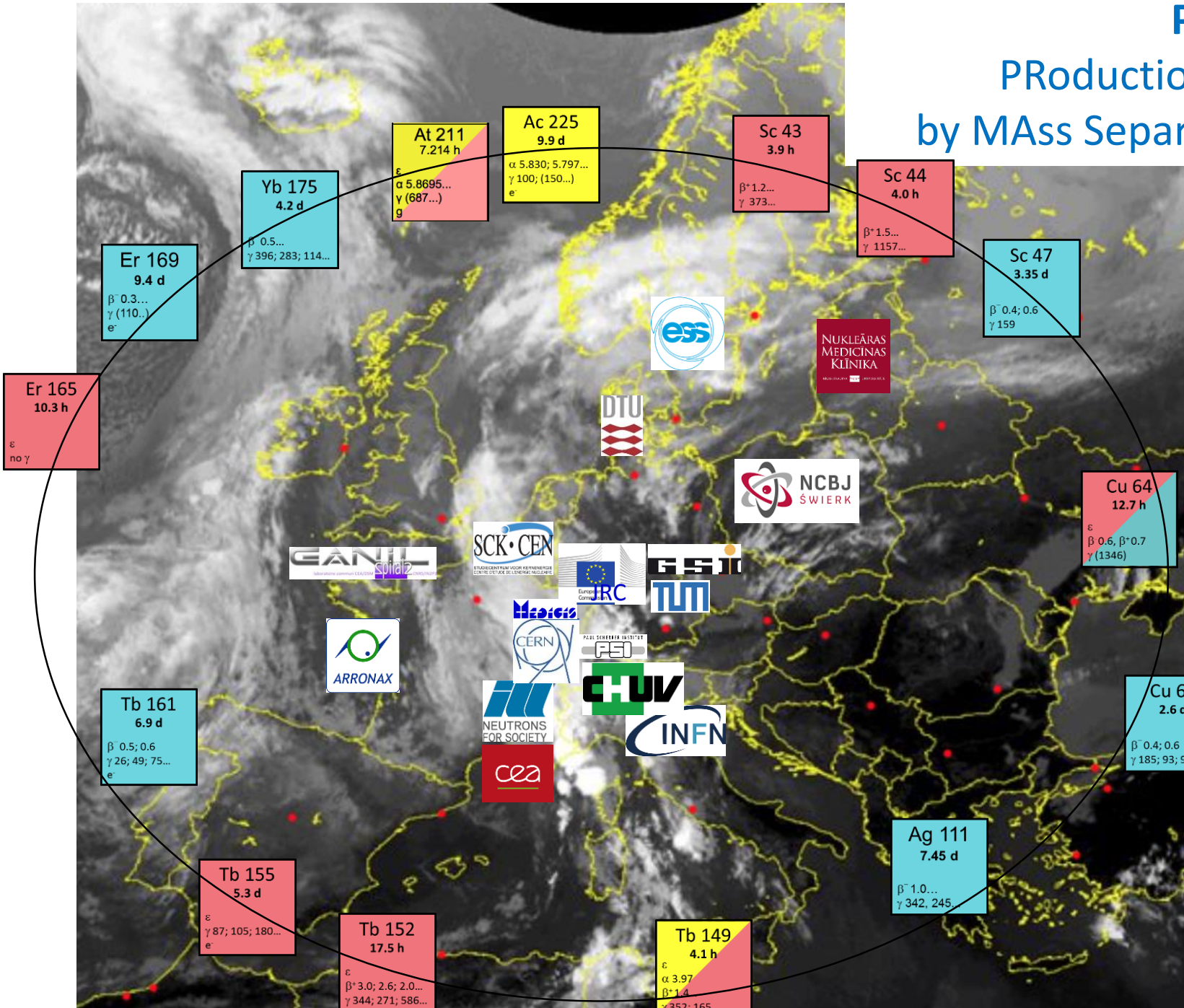
- Tests to collect long-lived actinides from targets irradiated one year ago at



Development

PRISMAS-MAP :

PRoduction of hIgh purity iSotopes by MAss Separation for Medical Application



Courtesy of T.STORA

Project proposal
Next H2020-INFRA call

Inspired from the NIDC



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



Project management



Operational RP and safety



Engineering, Target assembly and handling



LASER, Robot, Operations and Controls

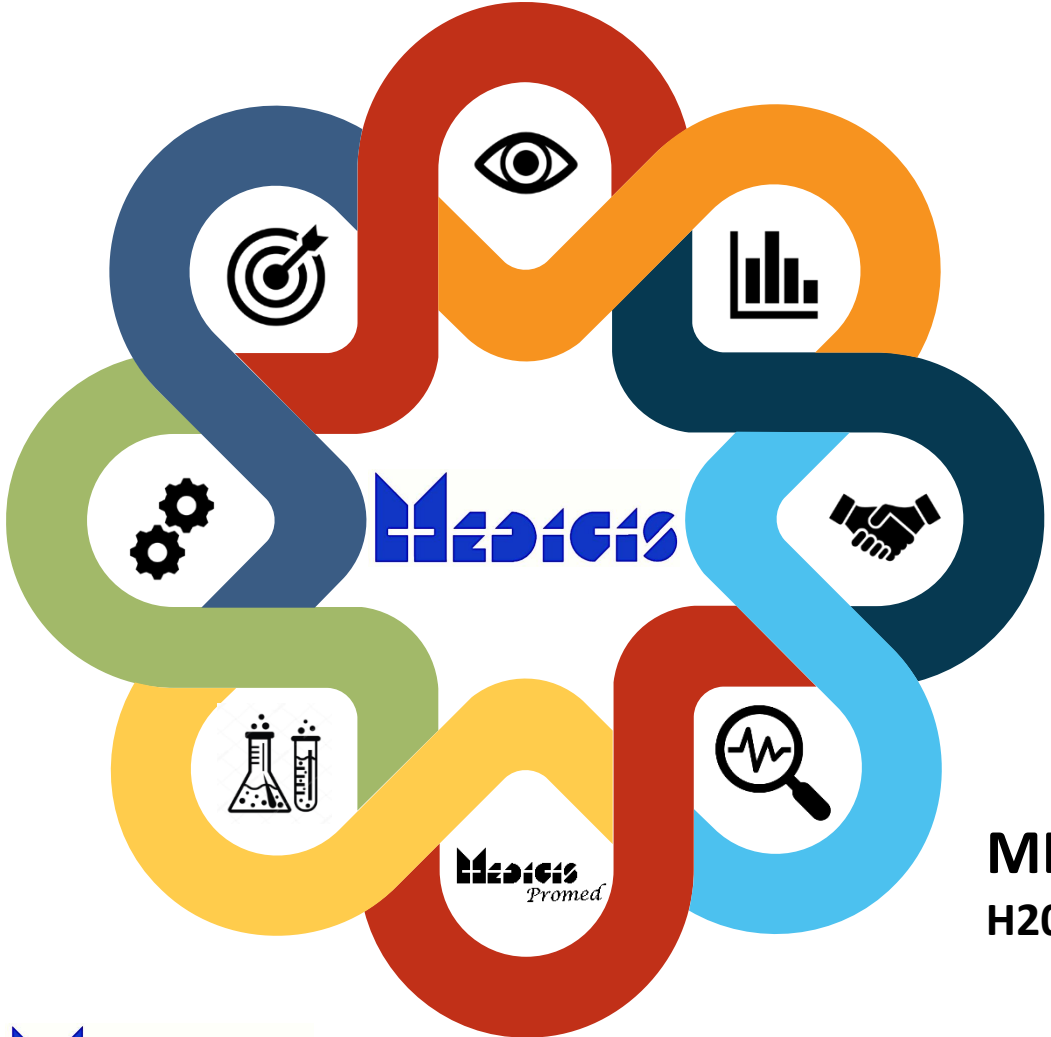
Collaboration institutes



γ -spectrometry and shipping



Radiochemistry



MEDICIS Promed
H2020 contract #642889



THANK YOU FOR YOUR ATTENTION !

BACK-UP

The MEDICIS program is driven with input from the collaboration

1st MEDICIS Collaboration Board Meeting

Wednesday 21 Feb 2018, 09:00 → 17:00 Europe/Zurich

4-3-001 (CERN)

Description [Liste de participants:](#)

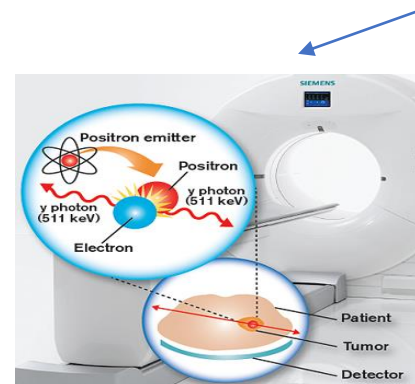
- Thierry Stora (CERN)
- Frédéric Bordry (CERN's Director for Accelerators and Technology)
- Simone Gilardoni (CERN)
- Thomas Elia Cocolios (KULeuven)
- Prof. Oyen Wim (ICR – Institute of Cancer Research, UK)
- Nick van Dermeulen (PSI)
- Antonio Paulo (Instituto Superior Técnico, Portugal)
- Dr. Michel Forni (Hôpital de La Tour, Geneva)
- Prof. Ismael Martel Bravo (FABRIS - Fundación Andaluza Beturia para la Investigación en Salud, Spain)
- Prof. Ferid Haddad (Arronax, France)
- Prof. Klaus Wendt (University of Mainz, Germany)
- Prof. Martin Walter (Head of Nuclear Medicine and Molecular Imaging, Geneva Hospital)
- Gerda Neyens (CERN)
- David Viertl (Lausanne University Hospital Center)
- Dante Gregorio (CERN)
- Tor Bjørnstad (IFE – Institute for Energy Technology, Norway)
- Frank Bruchertseifer (European Commission)



- 2nd Coll. Board – 3rd Oct 2108
- 3rd Coll. Board – 20th Mar 2019
- 4th Coll. Board – 18th Sep 2019

Courtesy of T.STORA

Biomedical research in Theranostics



MED015	RSU	44Sc production with 18MeV cyclotron and study of scandium-labeled peptide based ligands for clinical use
MED016	Huelva hospital	Theranostic radiolabeled nanoparticles for ovarian cancer by folate receptor targeting



Project proposal to the MEDICIS Collaboration board



44Sc production with 18 MeV cyclotron and study of scandium-labeled peptide based ligands for clinical use

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