MINISTRY OF SCIENCE TECHNOLOGY AND INNOVATION

BRAZILIAN GOVERNMENT BRASIL UNITING AND REBUILDING

LNLS

11th International Workshop on Radiation Safety at Synchrotron Radiation Sources

Decommissioning of UVX

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2023.06.01

Topics

UVX

Steps of dismantling

Simulations

Challenges, problems and results

Acknowledgment

UVX

- 32 years of history
  - 1987, start the commissioning with Linac

1985
SSRL

1991
Linac works in LNLS

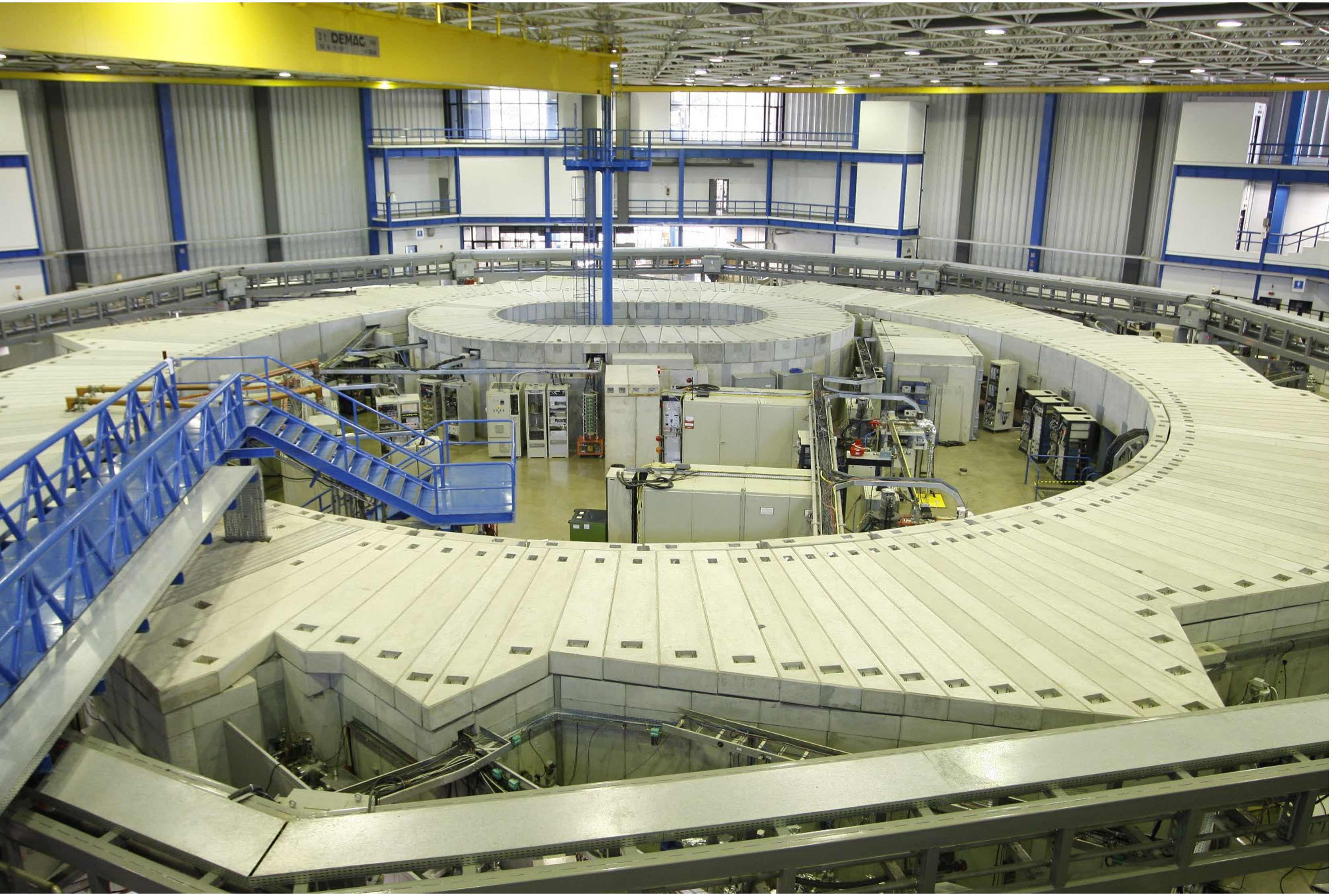
1991 – Assembling of first components

UVX

2000

Installation of the 500 MeV injector accelerator.

UVX



- 1997-2006: Operated without roof.
    - During the injection, everyone should leave the experimental hall.
- Limit of 1 mSv/year respected in the entire experimental hall.

UVX

- 1995: Assembly of the accelerators at the LNLS
- 2019: Shutdown
- 2021: Dismantling
- Supervisor Roberto Madacki (left) and Jose Roque, Director at CNPEM (right)

1995– Assembling of UVX, first dipoles

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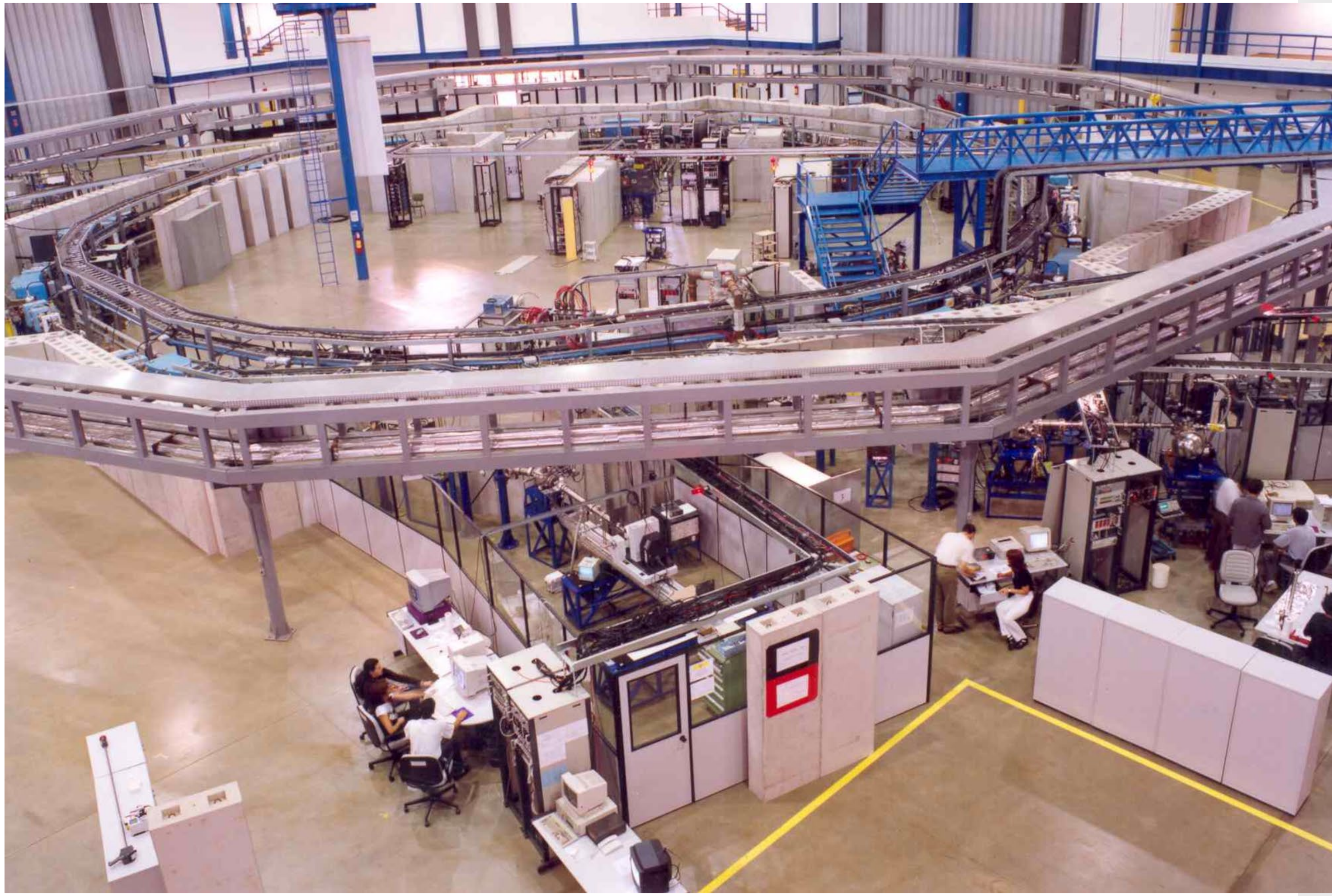
UVX

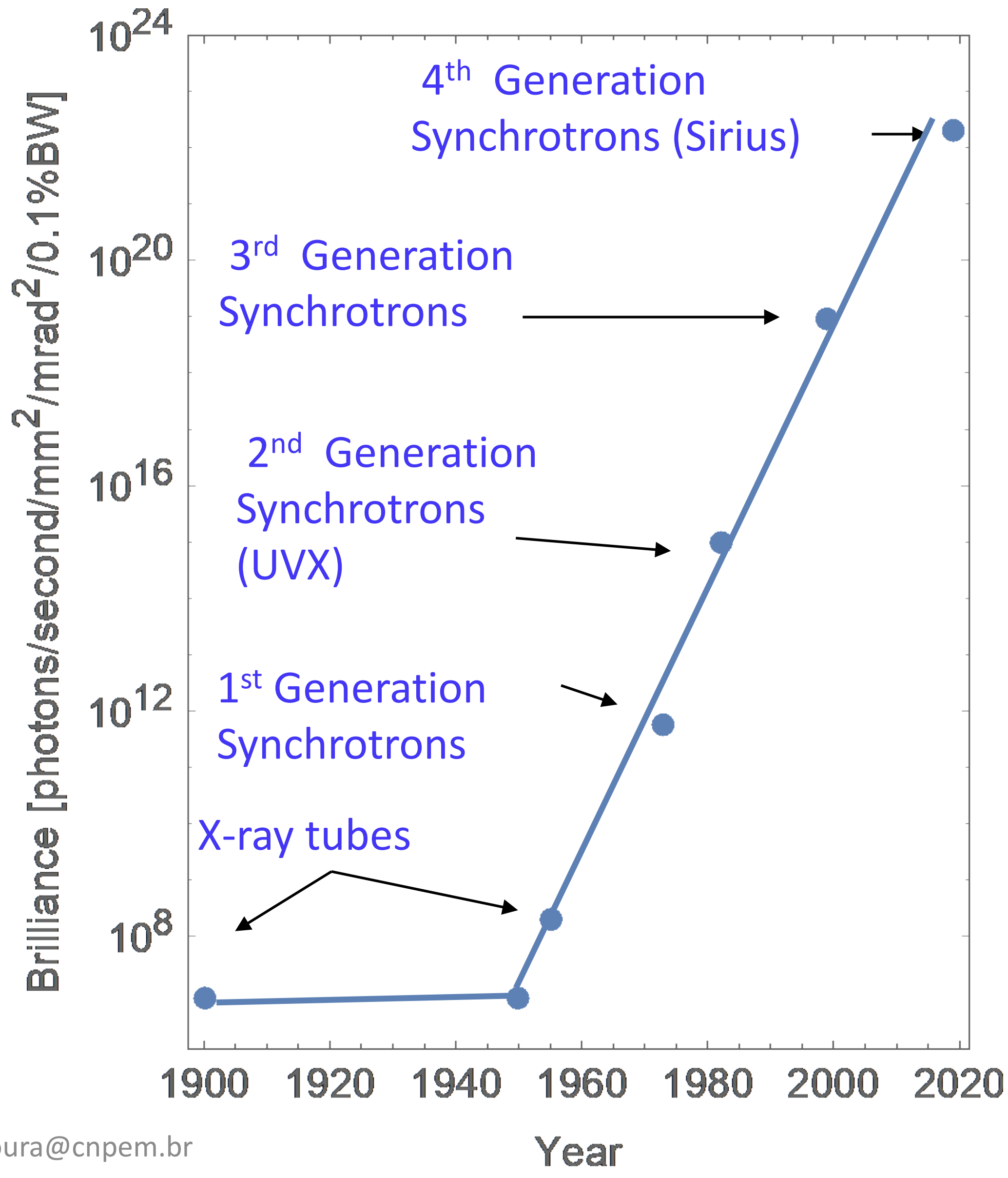
- **Light for the science for 22 years**
  - First users in June of 1997
  - Shutdown in August of 2019
  - Dismantling in February of 2021
- Annually, benefited **1200** Brazilian and foreign **researchers**.



1997 - UVX synchrotron light source is opened to the science and technology community with seven beamlines

UVX

- **Second-generation** with 100 nm.rad
- Linac: 80 keV to 120 MeV
- Booster: 120 MeV to 500 MeV
- Storage Ring: until 1,37 GeV with 250 mA
  - Critical energy: 2,08 keV
- Lifetime:
  - 15h @ 200 mA
  - 25h @ 100 mA



Topics

UVX

Steps of disassembling

Simulations

Challenges, problems and solutions

References

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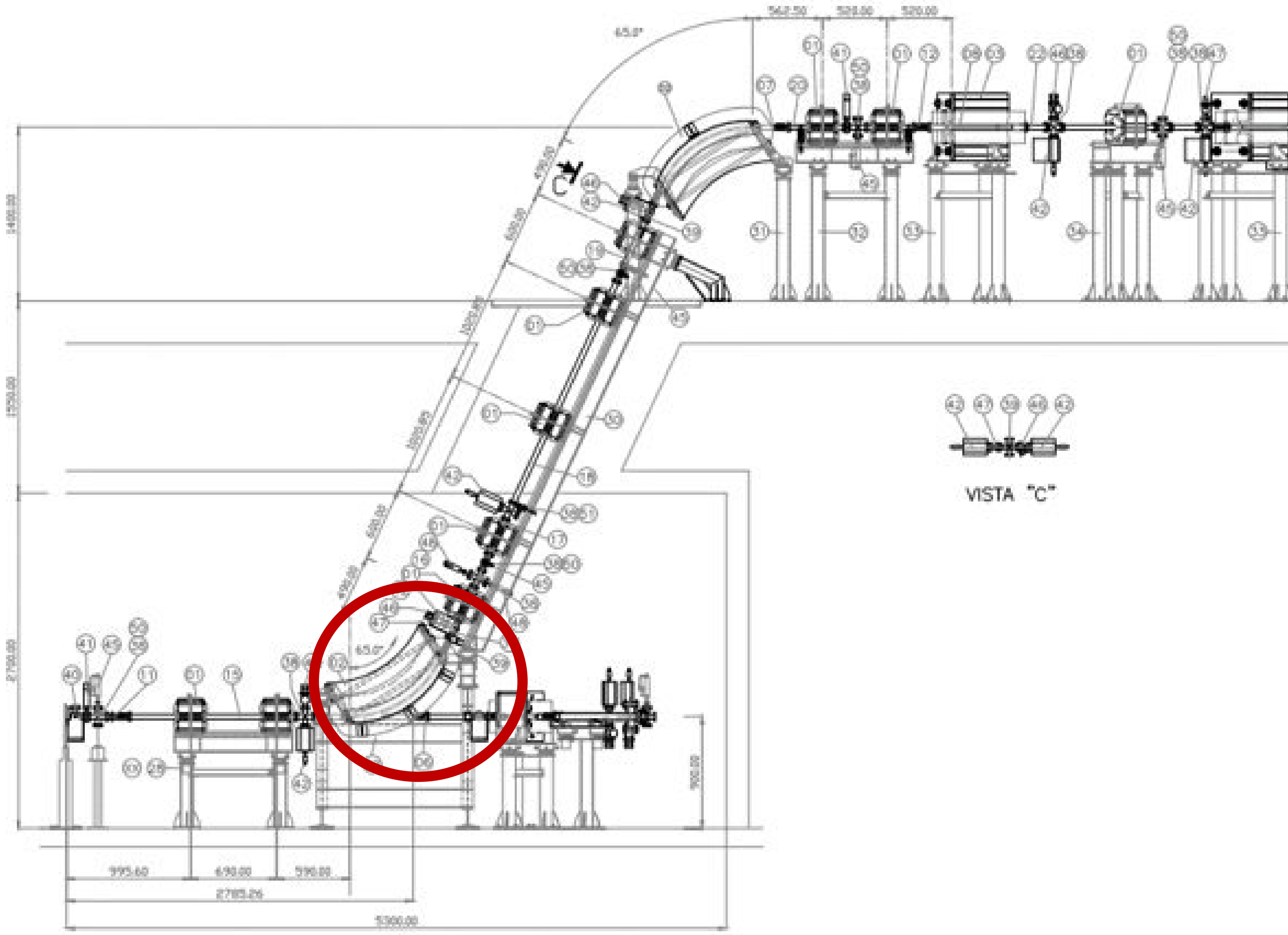
Steps

- **Before disassembling:**

  - Monitoring in accessible parts of the accelerators.

  - Ionization Chamber (open window) and Geiger Muller

  - Only one point in LTB (~20 cps)



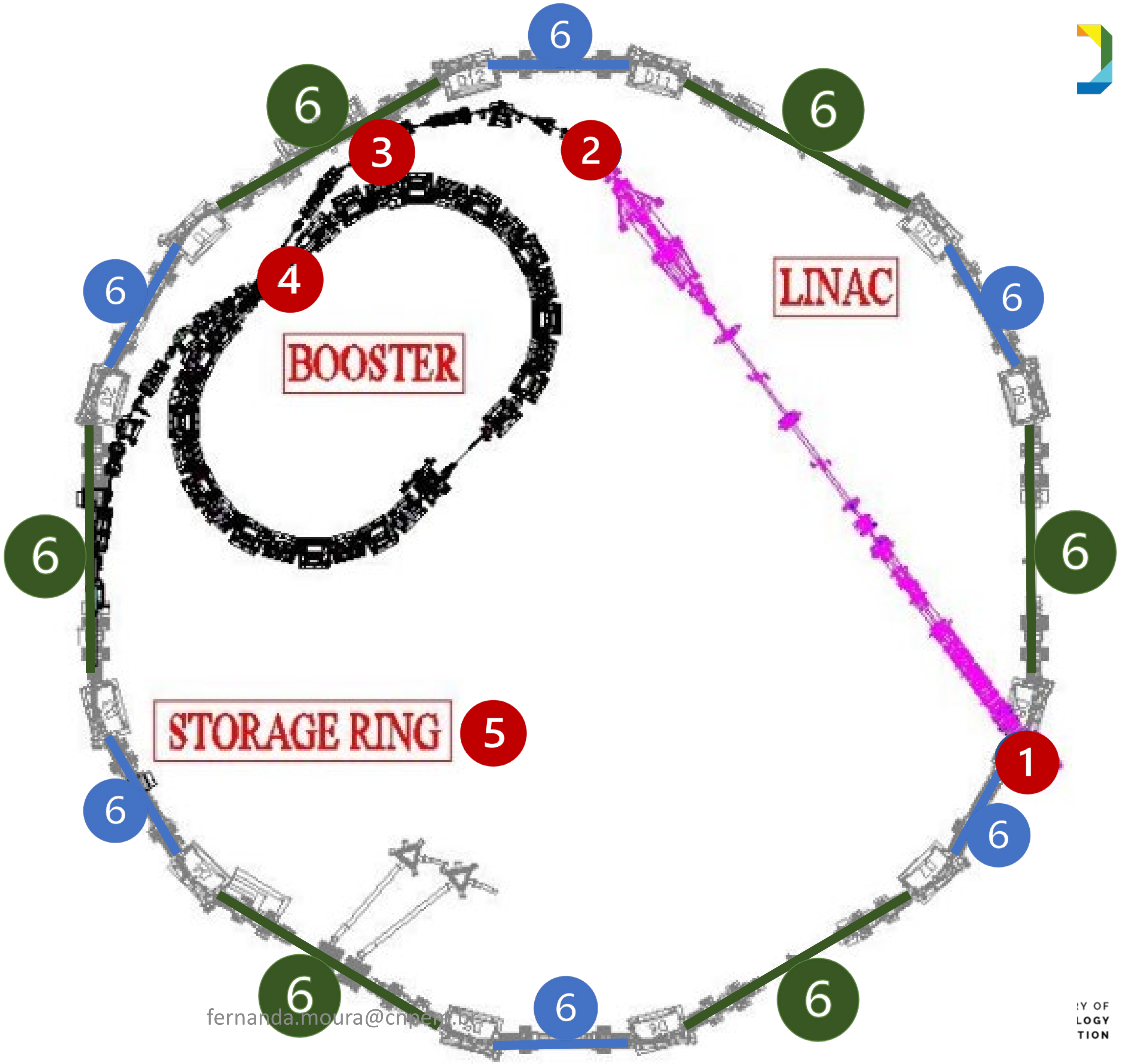
Steps

- **Before disassembling:**
  - But, and the parts we couldn't access?
  - Collect information for scenarios of *possible* activation (losses, efficiency of operation, materials, ..)
  - Simulations with **FLUKA.CERN**

Simulation

Legend of scenarios

1: E-Gun
2: Linac
3: LTB
4: BTS
5: Storage Ring (lifetime)
6: Gas Bremsstrahlung

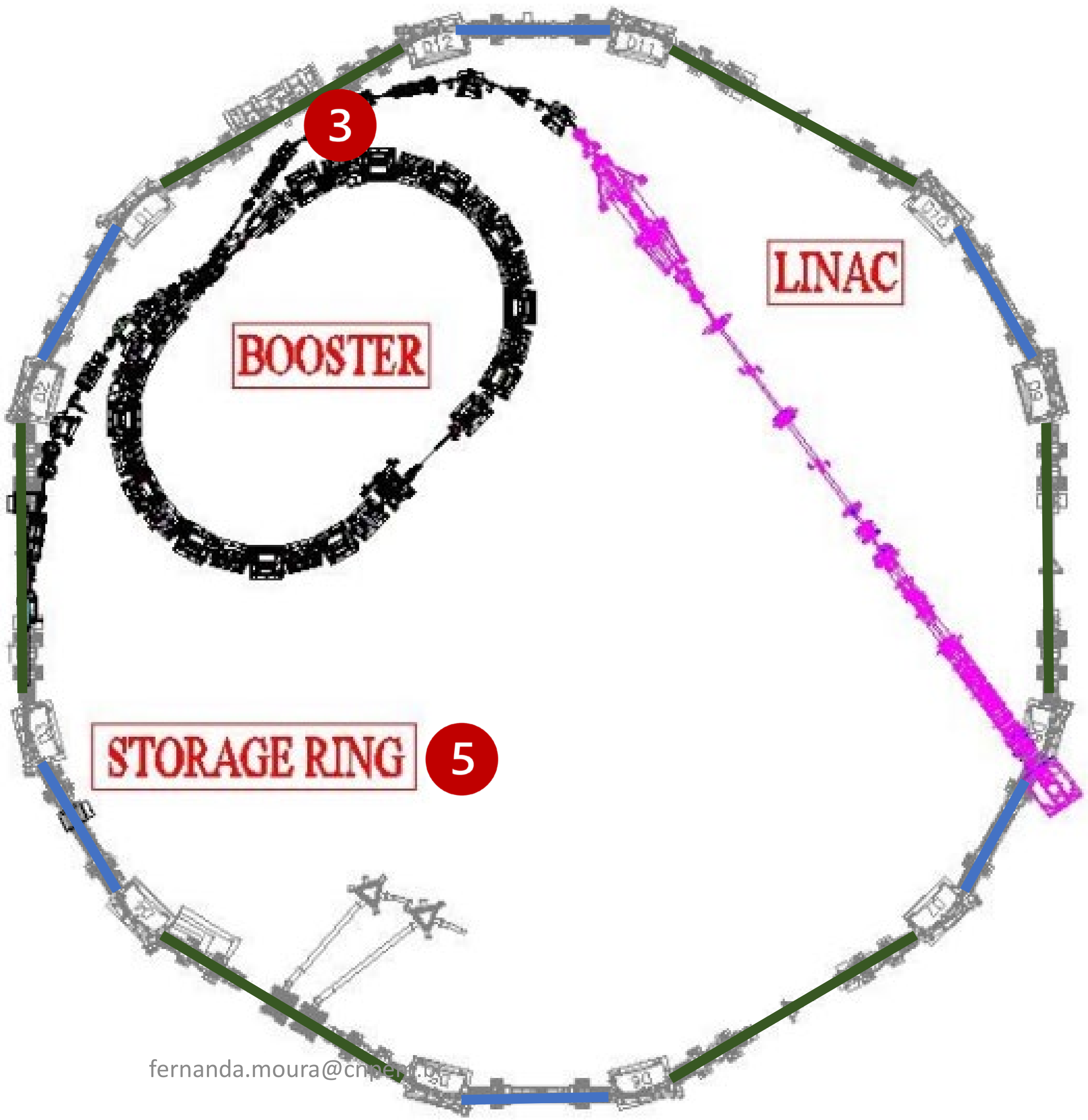


Simulation

Legend of scenarios

Activation

1: E-Gun
2: Linac
3: LTB
4: BTS
5: Storage Ring (lifetime)
6: Gas Bremsstrahlung



Simulation

But.. Operation time, material and dimensions?

Operation time

8.285 days (11 months/ year in 25 years interrupting)

Cooling time: 500 days (since Nov 2019)

Material

Carbon steel, stainless steel, aluminum, lead, copper, concrete, and titanium

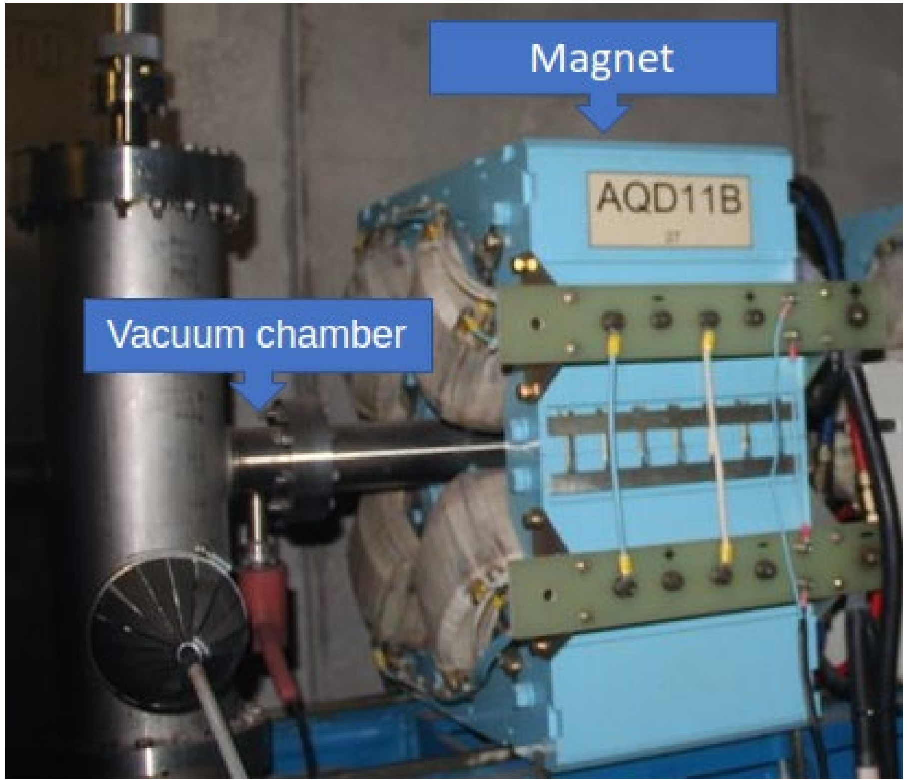
Element	Carbon steel (%)	Stainless steel (%)
Fe	98,11	66,145
Mn	1,03	2,000
C	0,29	0,030
Si	0,28	1,000
Cu	0,20	-
S	0,05	0,030
P	0,04	0,045
Cr	-	17,000
Ni	-	11,250
Mo	-	2,500

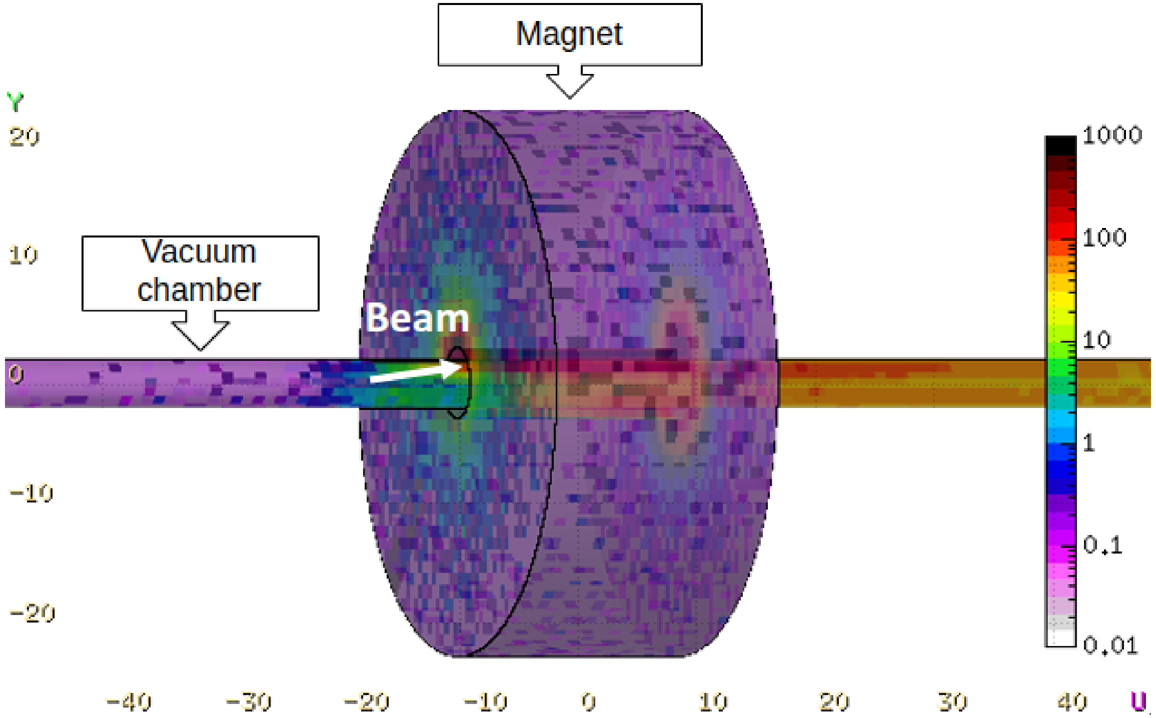
Simulation

But.. Operation time, material and dimensions?

Dimensions

Extensive volumes with the beam incident normal to the face of the piece





Simulation

Linac to Booster (LTB)

Number	Reference	Energy	Charge Lost Per Pulse (nC)	Configuration*
3	Linac to Booster	120 MeV	20	2.000 nC/day

Lifetime

Number	Reference	Energy	Configuration*
5	Storage Ring	1.37 GeV	250 mA

*Amount corresponding to 10% of the total losses in the stretch. Most of the losses in this case (90%) occur at energies below MeV, which are insufficient for activation

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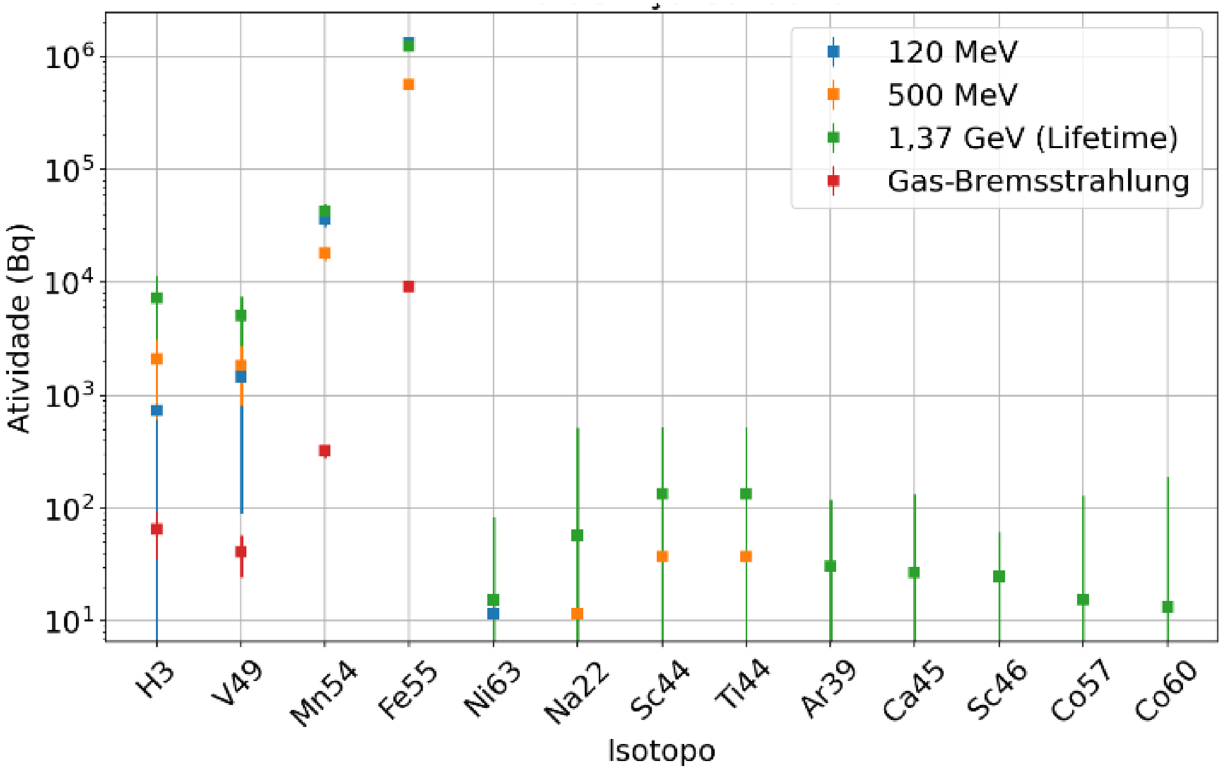
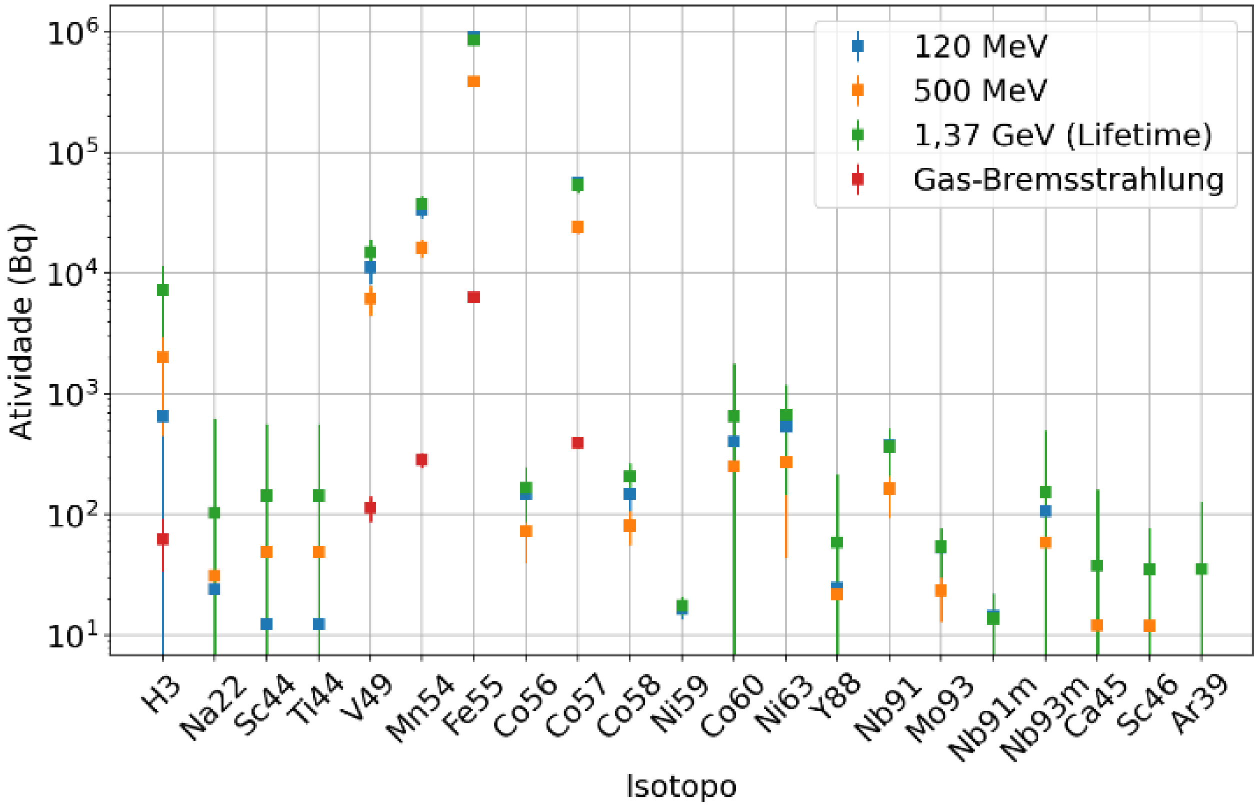
Simulation

Results above 1 MBq (maximum)

Carbon steel



Stainless steel



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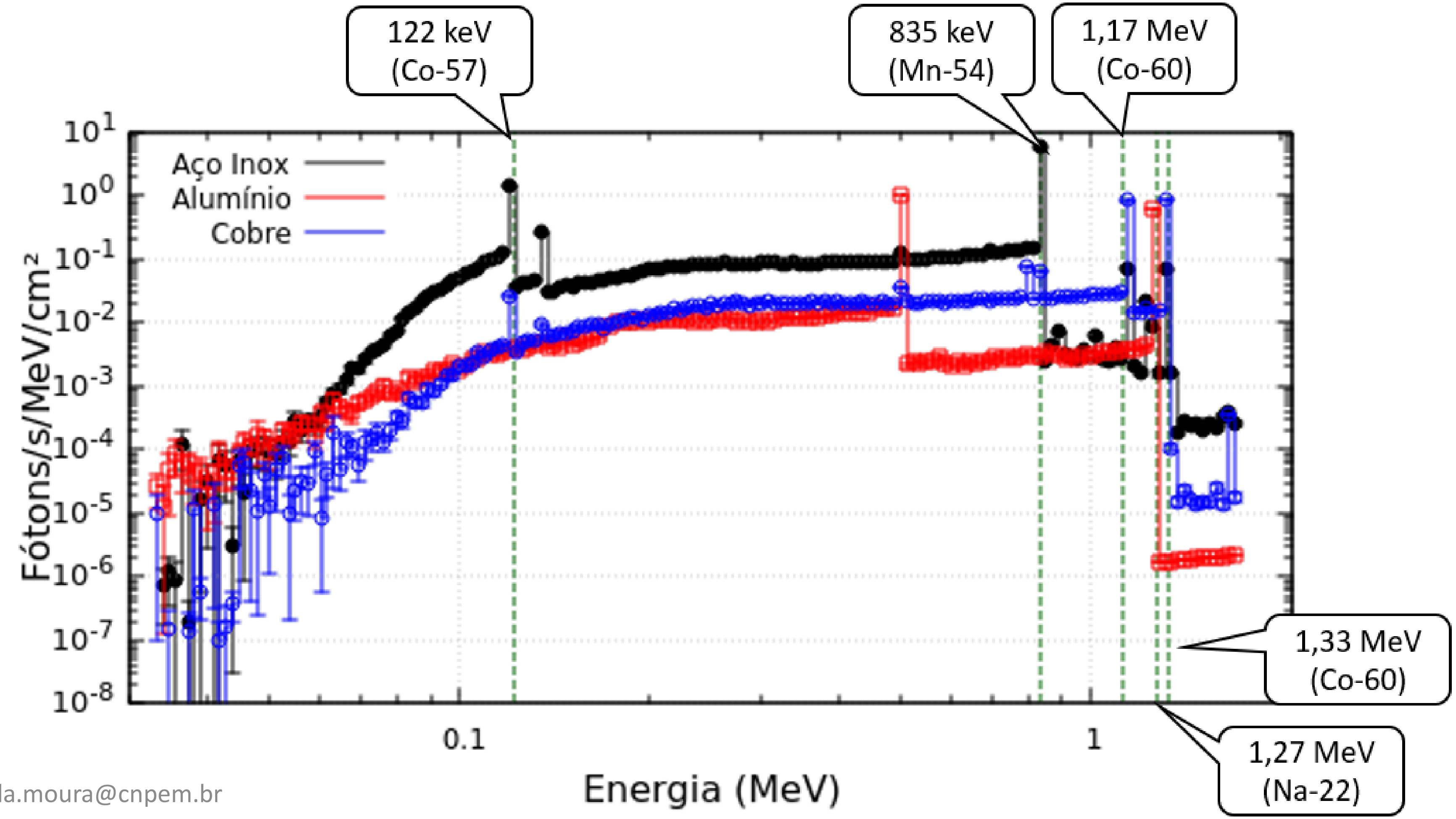
Simulation

Results spectrum @ 120 MeV

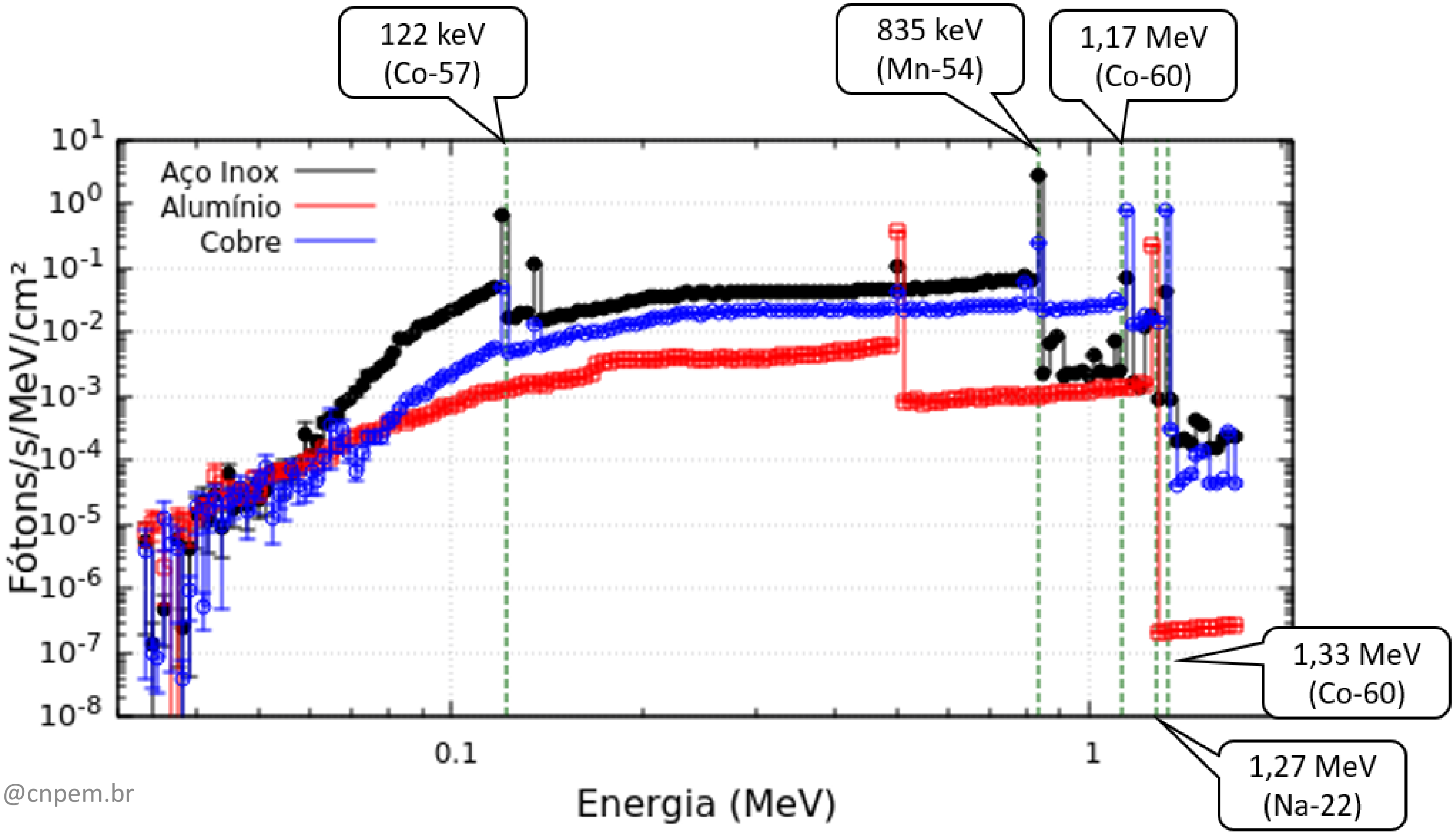
Stainless steel



Simulation

Results spectrum @ lifetime

Stainless steel



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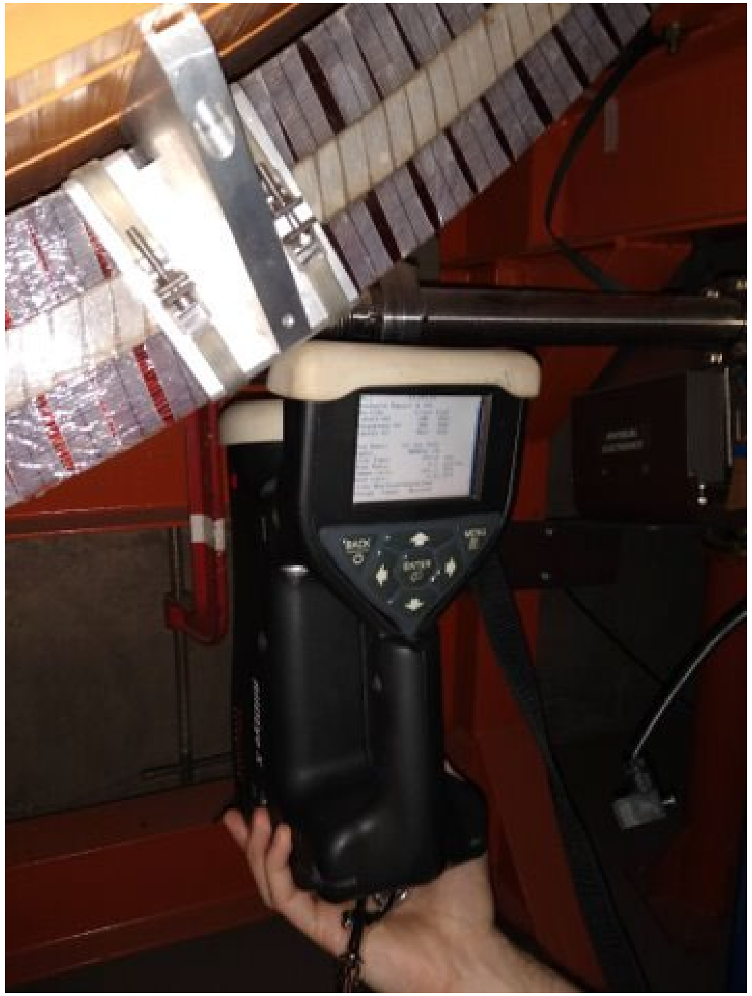
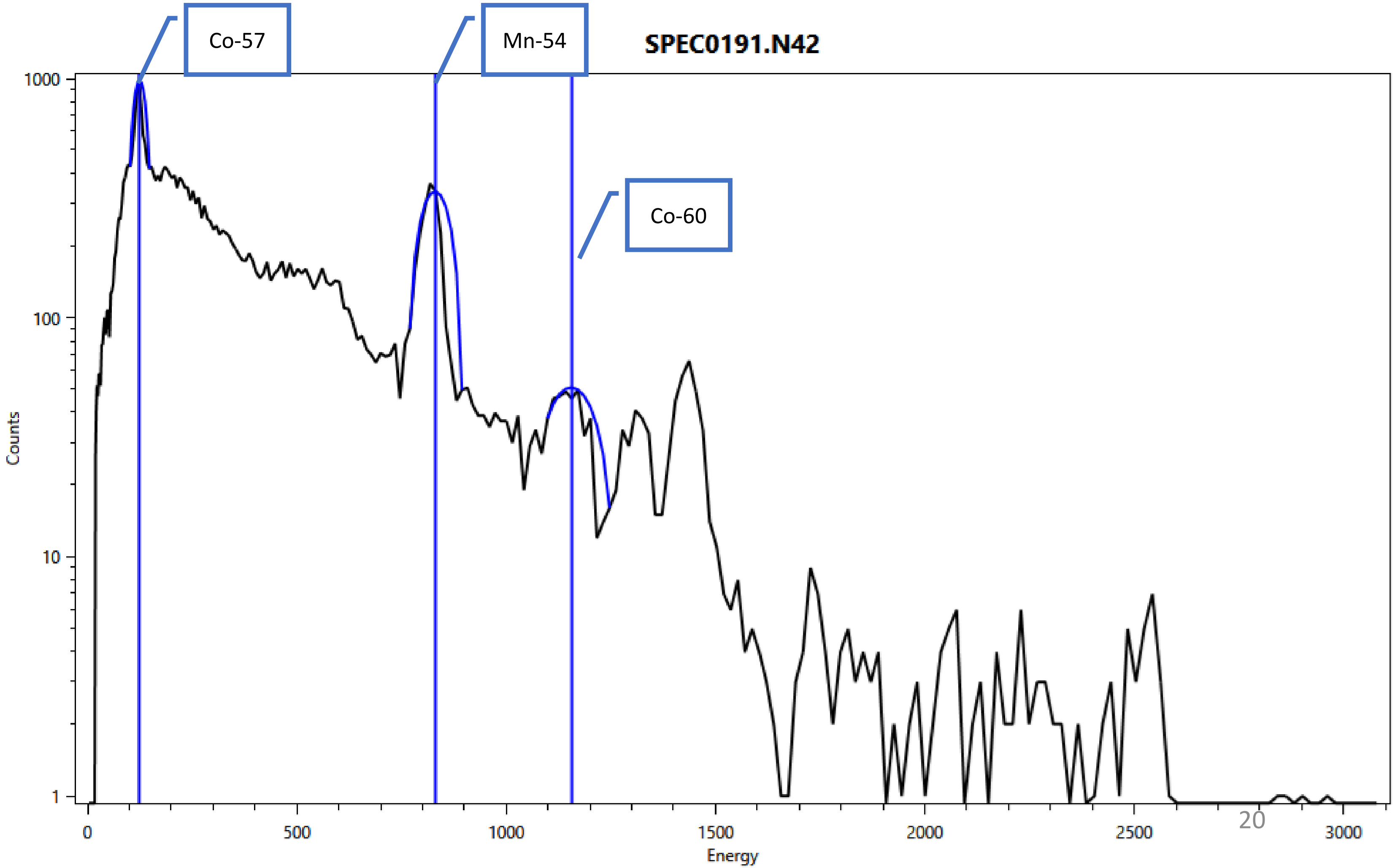
Practical result

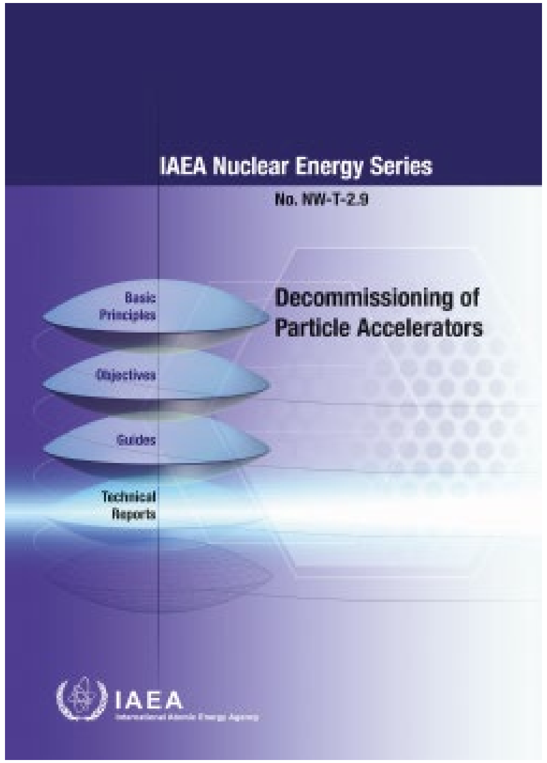
But, what is the conclusion?

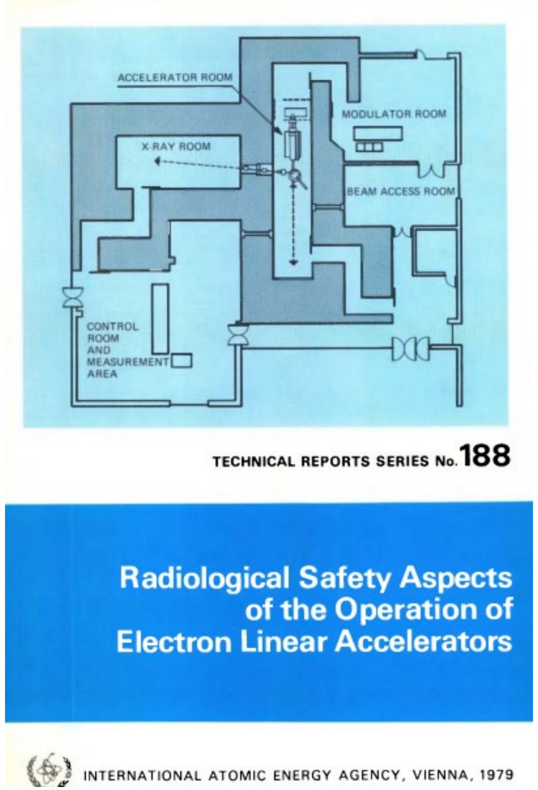




Steps

- **Before to disassembling:**
  - License to decommissioning with CNEN (Brazilian Nuclear Energy Commission)





Steps

- **Disassembling:**
  - Blocks of Pb: Almost 80 ton of located shielding, 20% with high counts (kcpm).
  - How to proceed? Use of spectrometer to confirm the radioactive elements

Steps

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  - Blocks of Pb: Almost 80 t of located shielding, 20% with high counts (kcpm).
  - How to proceed? Use of spectrometer to confirm the radioactive elements

RIIDEye X-GN da
Thermo Fisher Scientific

Inspector 1000 Canberra

Steps

- **Disassembling:**
  - How to proceed? Measurement with HPGe and stored.

Report by IPEN/USP

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*****************************************************************
*****   I N T E R F E R E N C E   C O R R E C T E D   R E P O R T   *****
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Nuclide Name	Nuclide Id Confidence	Wt mean Activity (Bq /g)	Wt mean Activity Uncertainty
CD-109	0.945	1.793061E+002	1.870266E+001
PB-210	0.998	3.669779E+003	5.304593E+002
BI-214	1.000	4.212703E-003	7.447005E-004

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

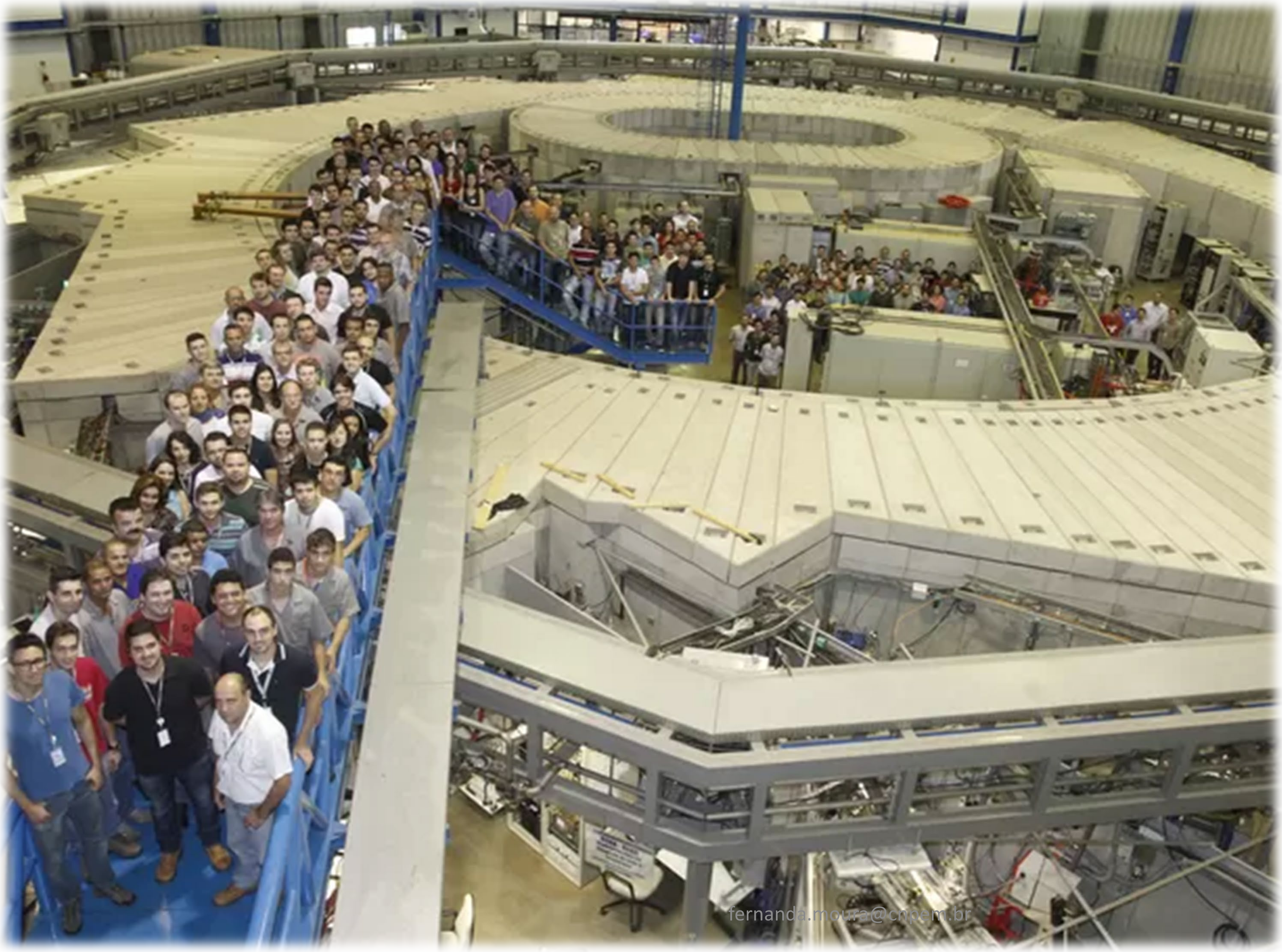
Errors quoted at 1.000 sigma

Steps

- **After disassembling:**
  - Validation: No radioactive waste.
  - Pb: Stored all the blocks.

  - More than 80% of the beamline elements were transferred to Sirius

  - **Financially**:
    - Dismantling: - R$ 370.00,00 (69 k €)
    - Sale: + R$ 1.000.000,00 (185 k €)
    - Save: + R$ 35.000.000,00 (6.5 M €)



Thank you

Merci pour votre écoute
Obrigada

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