PWIE SP-B.2 &SP B.3 Kickoff Meeting

IST activities for 2021: Ion Beam Analysis of WEST samples & *more*

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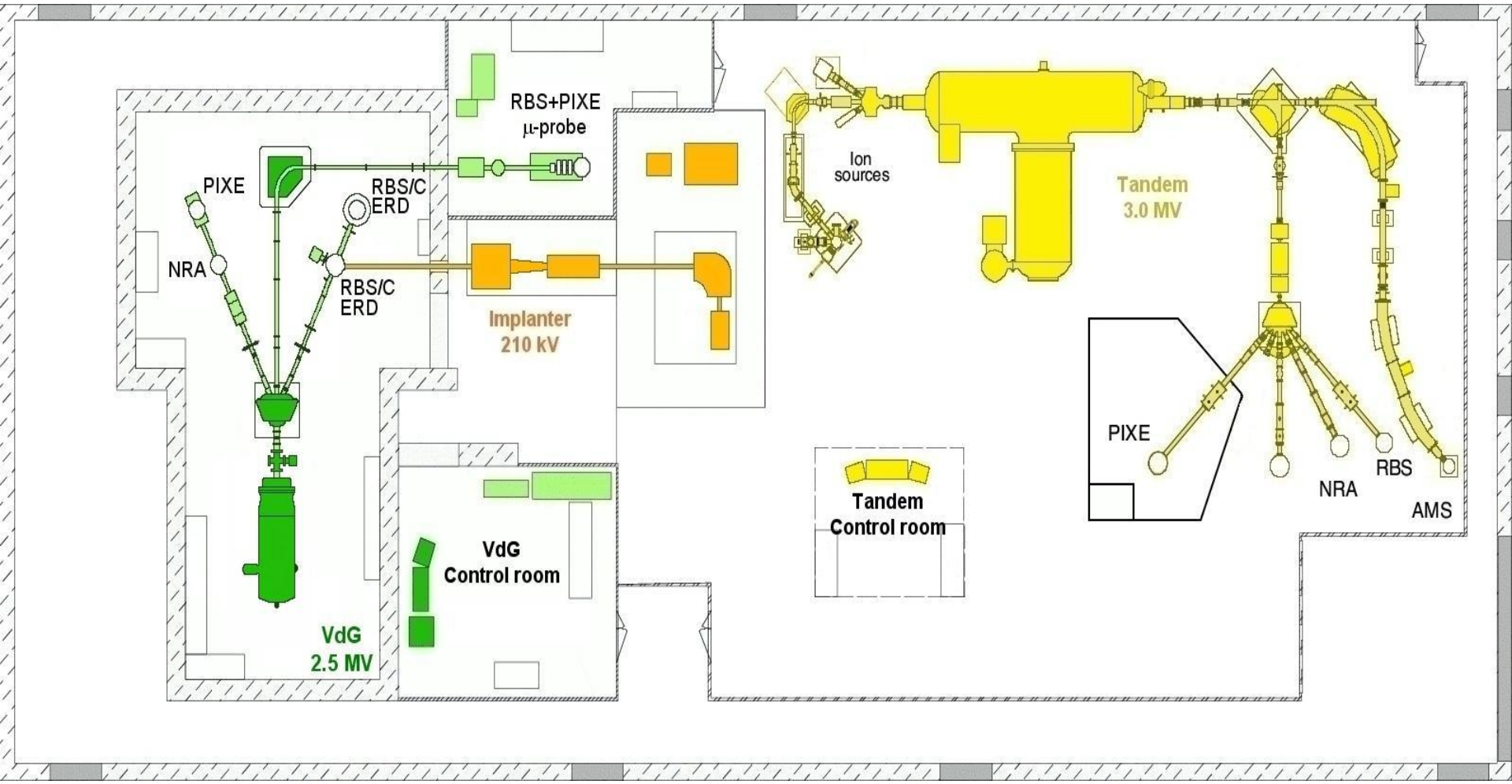
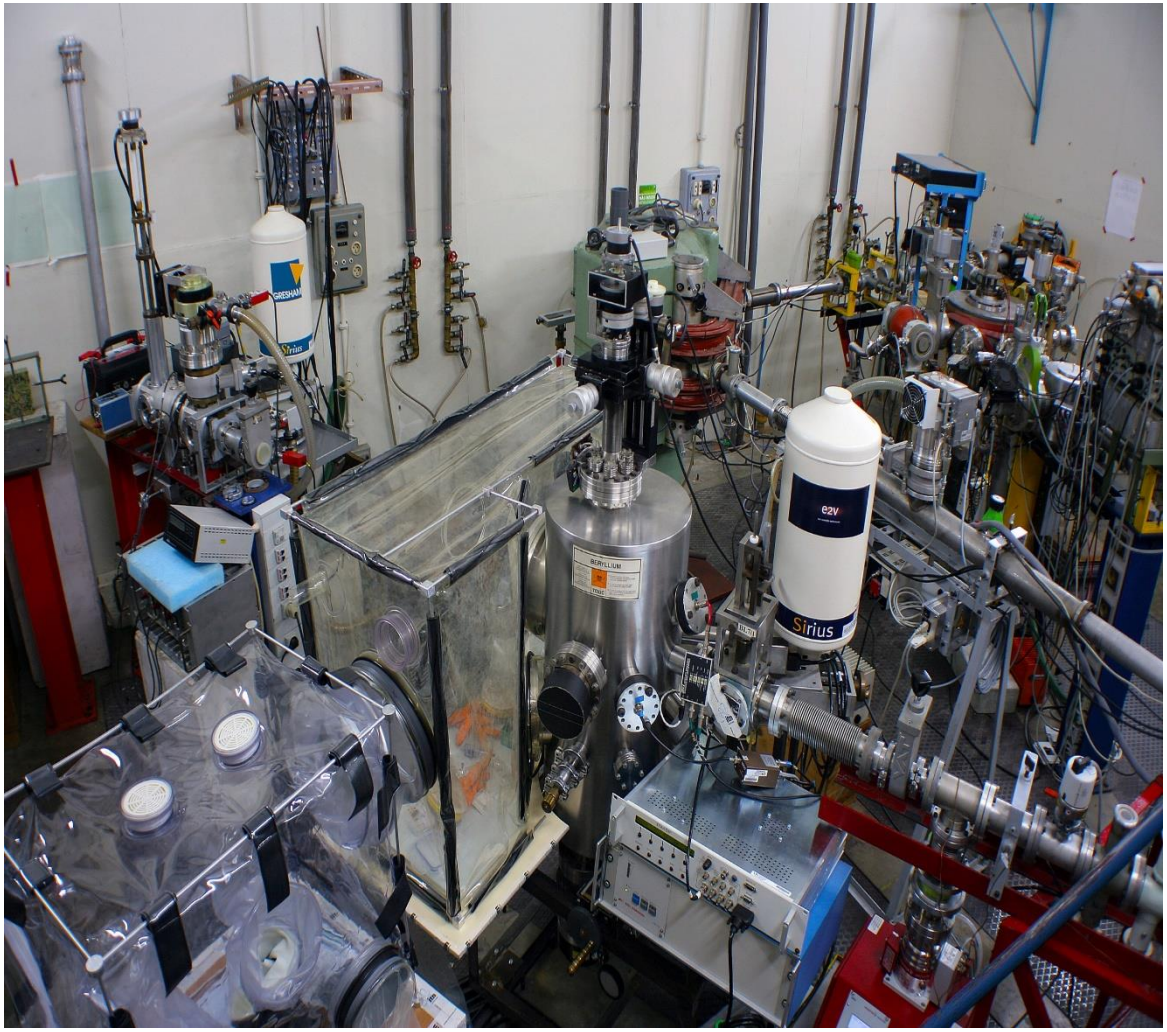
The views and opinions expressed herein do not necessarily reflect those of the European Commission.

1. Laboratory Layout

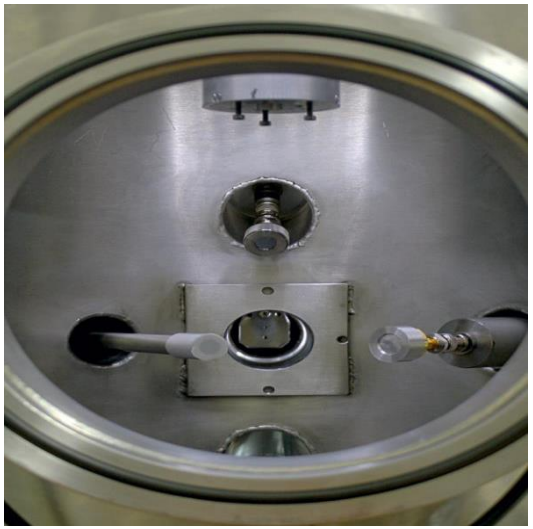


Experimental Setup

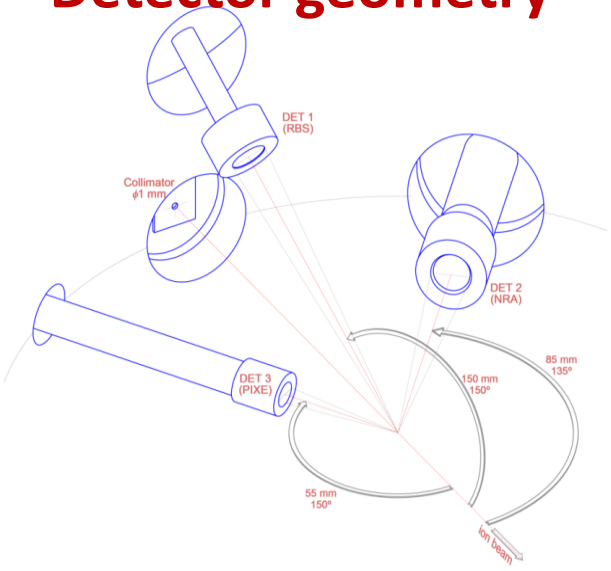
JET line



Experimental chamber



Detector geometry



Ion Beam Analysis (IBA)

- **D profiling NRA**

Nuclear Reaction Analysis - **D**(^{3}He,p)^{4}He

- **Be and C Profiling**

Nuclear Reaction Analysis - **^{9}Be**(^{3}He,p)^{11}B **^{12}C**(^{3}He,p)^{14}N

Elemental Profiling: Rutherford Backscattering Spectrometry (RBS) and Elastic Backscattering Spectrometry (EBS)

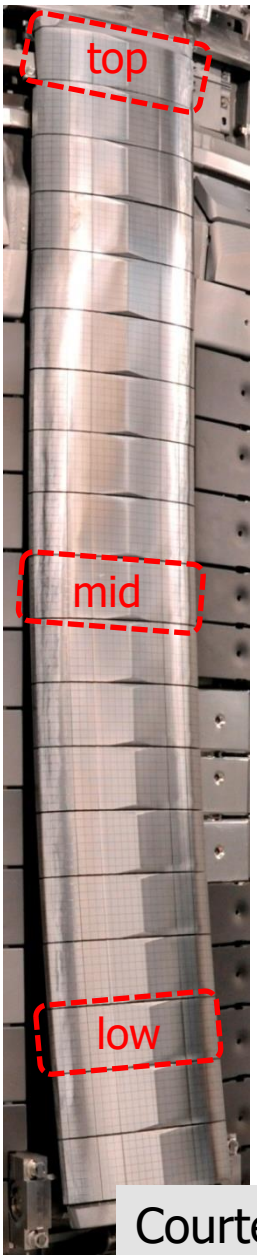
- **Trace impurities (metals)**

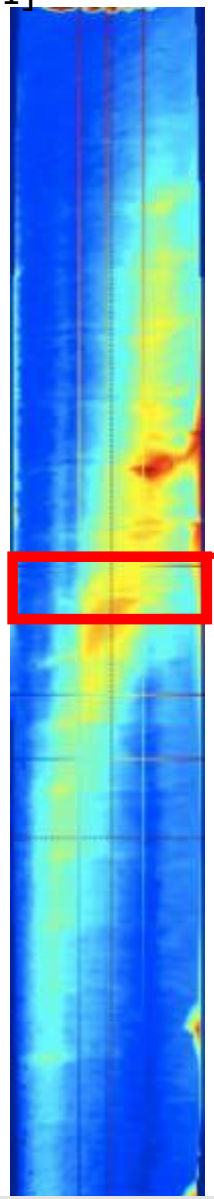
PIXE (X-ray emission)

- Computational analysis: **WiNDF**

Case studies: JET Results (IWGL)

from Ref. [1]

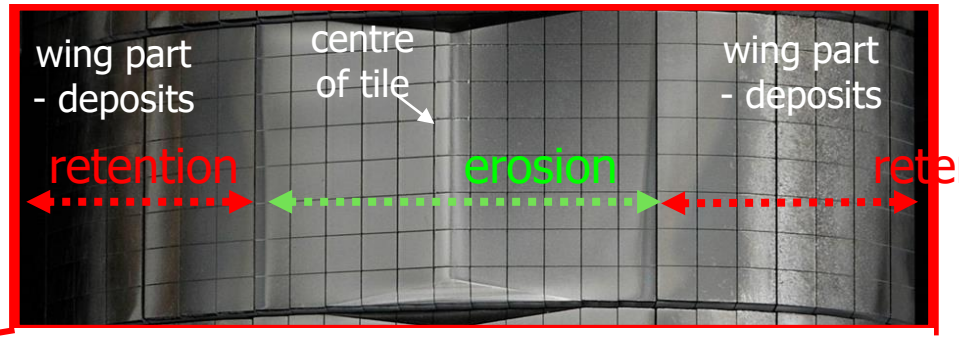


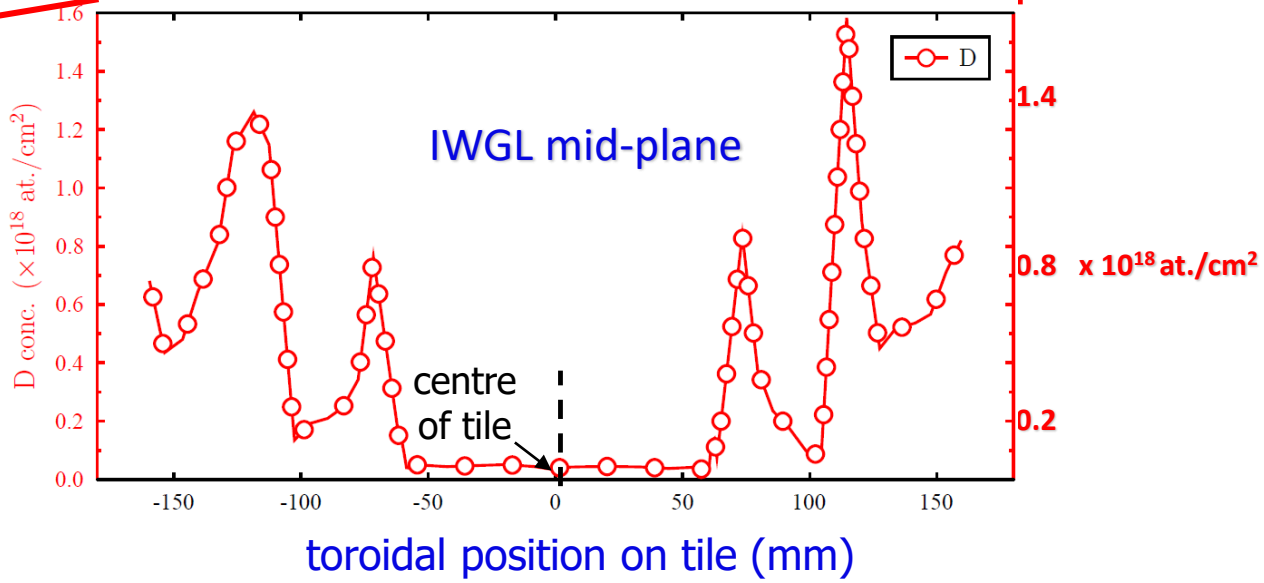


Courtesy Kalle Heinola

[1] G. Arnoux, Phys. Scripta T159, 014009 (2014)
[2] K. Heinola, Phys. Scripta T159, 014013 (2014)
[3] A. Baron-Wiechec, J. Nucl. Mat., *in press* (2015)

- IBA results cover *whole* IWGL tile toroidally

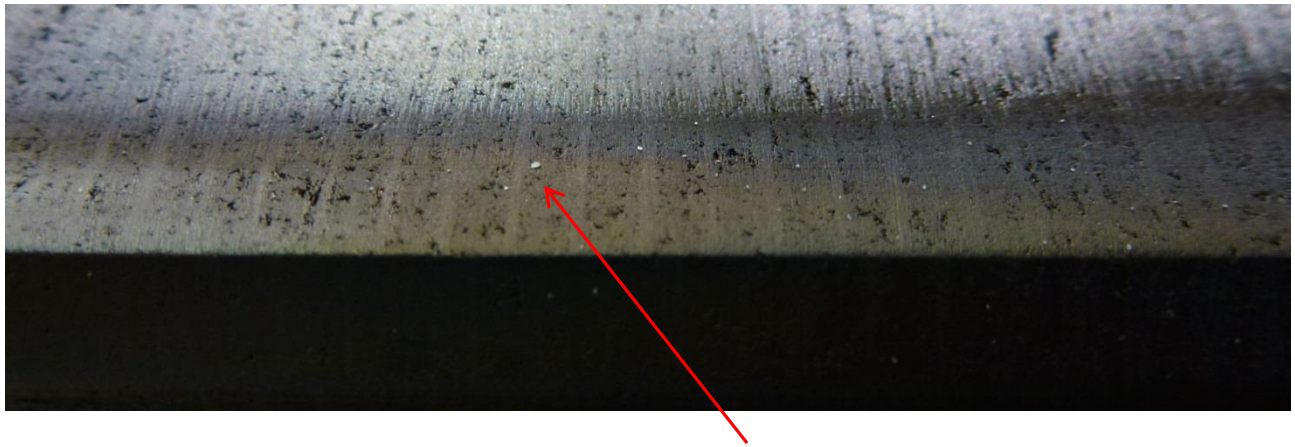




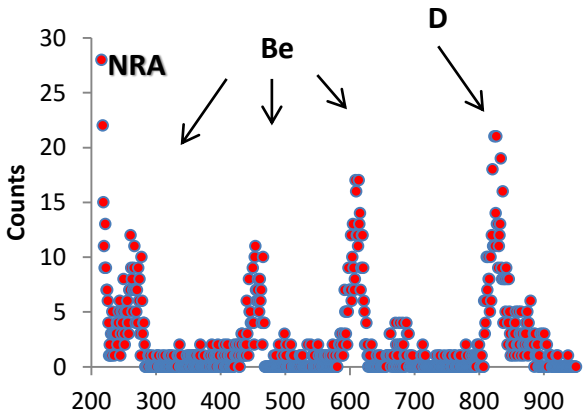
- IWGL mid-plane region is the main Be erosion source [1,2]
- Co-deposition of D in the wing parts of the tile [2,3]

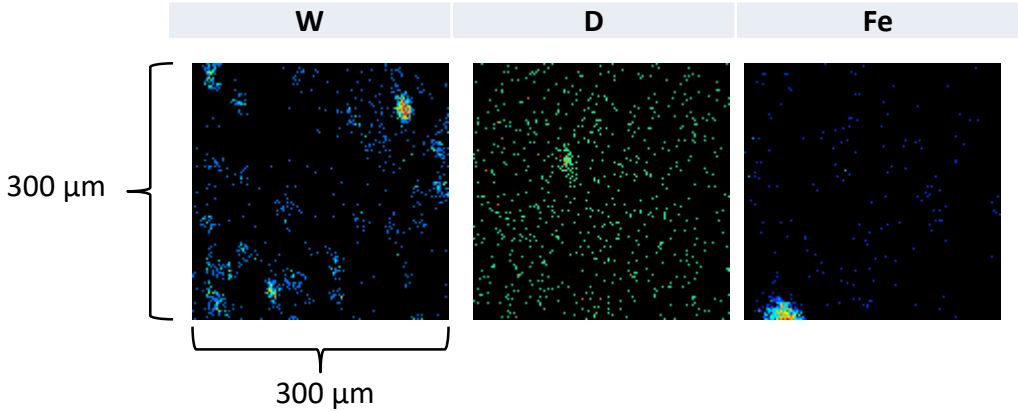
Case studies: Divertor dust

- particulates seen on tile 1 (apron) were collected with C-sticky pads



- first assessment with SEM detected BN, W, Mo, Fe (@ CCFE)
  - Be is not measured with present SEM
- analysis of dust on C-sticky pads with NRA and μ-beam IBA (@ IST):





PWIE: IST Deliverables

Fuel retention and erosion/redeposition studies on selected WEST PFU´s and reference coatings plasma exposed at MAGNUM-PSI, PSI-2 and GyM.

❖SP B3 Characterization of plasma exposed materials

D004: RBS & NRA characterization of selected WEST PFU´s and plasma reference samples

- WEST Samples of interest from sectors

Q2A and Q3B

- Number of samples

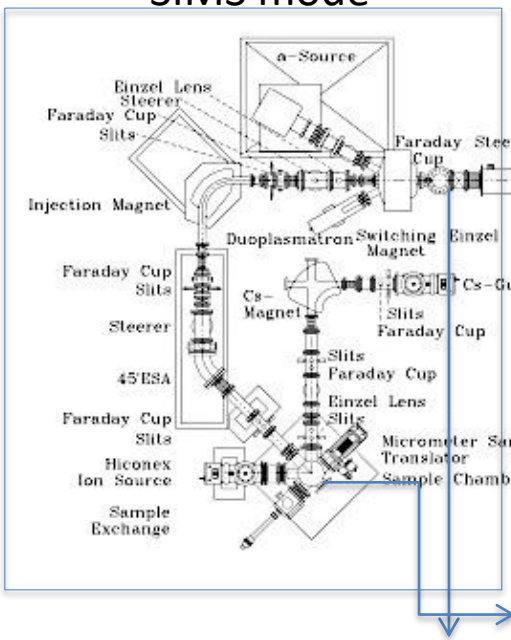
To be discussed.

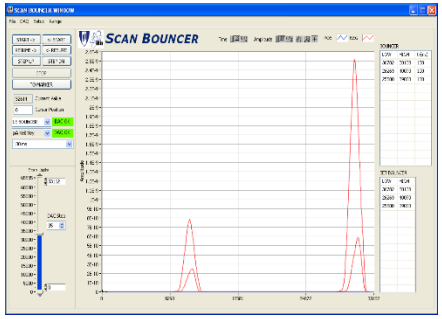
❖SP B4 Reference Coatings for iTER and DEMO

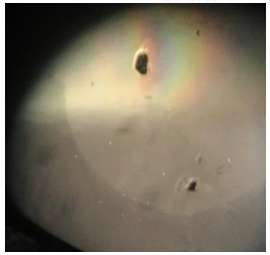
D005: RBS & NRA characterization of selected reference layers of Be and W.

The Micro-AMS system at LATR/CTN-IST

SIMS mode







-small diameter Cs primary beam (100 µm and below)
- Allows for spatial and in-depth analysis of samples without pre-treatment

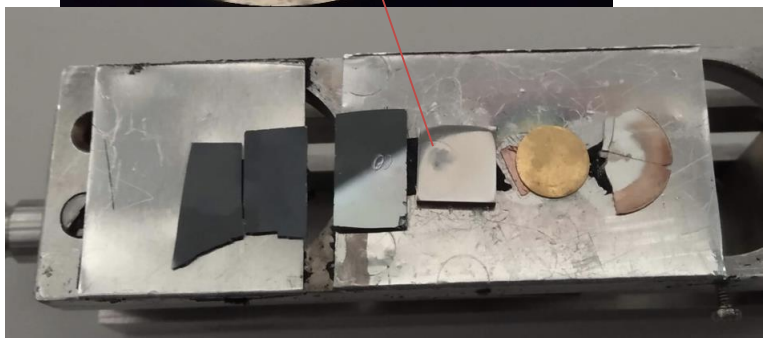
HE bouncer

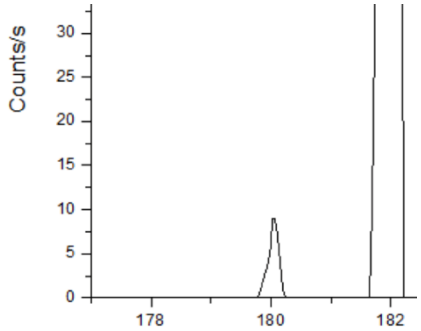
Allows for the quasi-simultaneous injection of isotopes into the detector chamber improving system precision

Micro-AMS can generate high-purity beams of isotopes of most* elements of the periodic table, with energies of more than 30 MeV in some cases, and with beam currents from a few nA down to the particle per second range.

* See Middleton's "Negative Ion Cookbook"

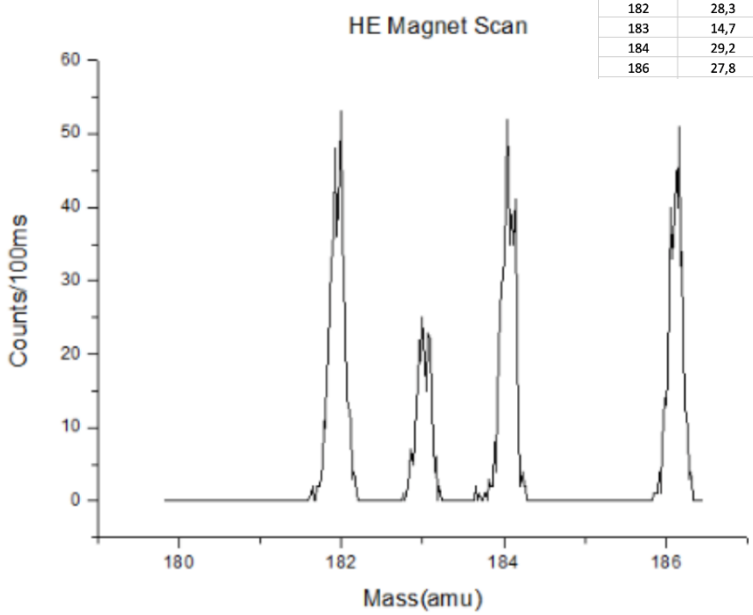
Micro-AMS analysis of a pure W target





isotope	Nat. %
^{180}W	0,12
^{182}W	26,5
^{183}W	14,3
^{184}W	30,6
^{186}W	28,43

Mass (amu)	measured (%)	NAT. (%)
182	28,3	26,5
183	14,7	14,3
184	29,2	30,6
186	27,8	28,4



HE Magnet Scan of tungsten isotopes in charge state 4+, from a pure tungsten target.

Summary

Within the PWIE IST will use Ion Beams to study reference samples exposed to plasmas at MAGNUM-PSI, PSI-2 and GyM. Together with the studies of samples from PFM´s from WEST we want to give our contribution to make Fusion Energy on earth a reality for the humanity.

Complex pattern observed on WEST divertor (image after C3)