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RADIATE

RADIATE Research and Development with Ion Beams - Advancing Technology in Europe

Massimo Chiari

www.ionbeamcenters.eu

@ionbeamcenters

The RADIATE project

- Ion Beam Analysis & Implantation from the top EU labs
- Supporting Academia and Industry across the Europe
- Free Transnational Access to Ion Beam Facilities across Europe

The history behind RADIATE (*deep roots are not reached by the frost*)

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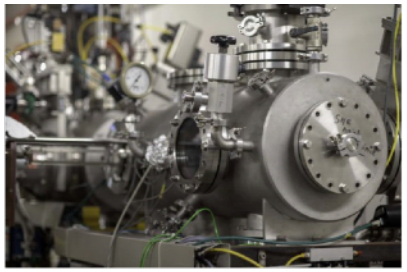
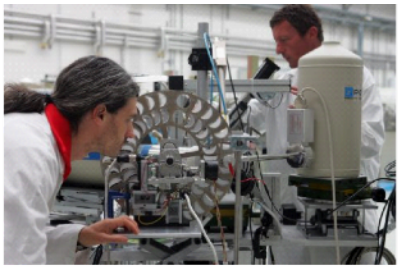
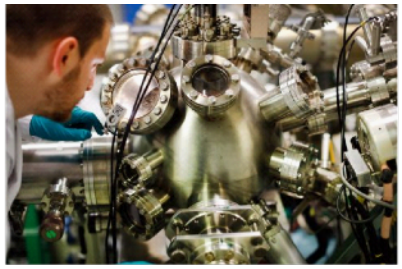
- **RADIATE**, (2018) H2020-INFRAIA-2018-2020, “Material Sciences and Analytical facilities - High and low energy ion beam labs”

The RADIATE project in numbers

- 18 project partners
- 11 facilities offering transnational access
- 4 SMEs
- 4 year runtime (1/2019 - 12/2022)
- € 9.9M budget
- 15800 hours of transnational access
- 4 calls for proposal per year

The RADIATE consortium

Facilities available





Analysis

- **Elemental, Thin Film & Depth Profiling**

  RBS, ERD, PIXE, PIGE/NRA, MEIS

- **Chemical and Molecular**

  MeV-SIMS, in-situ MS, High Res PIXE

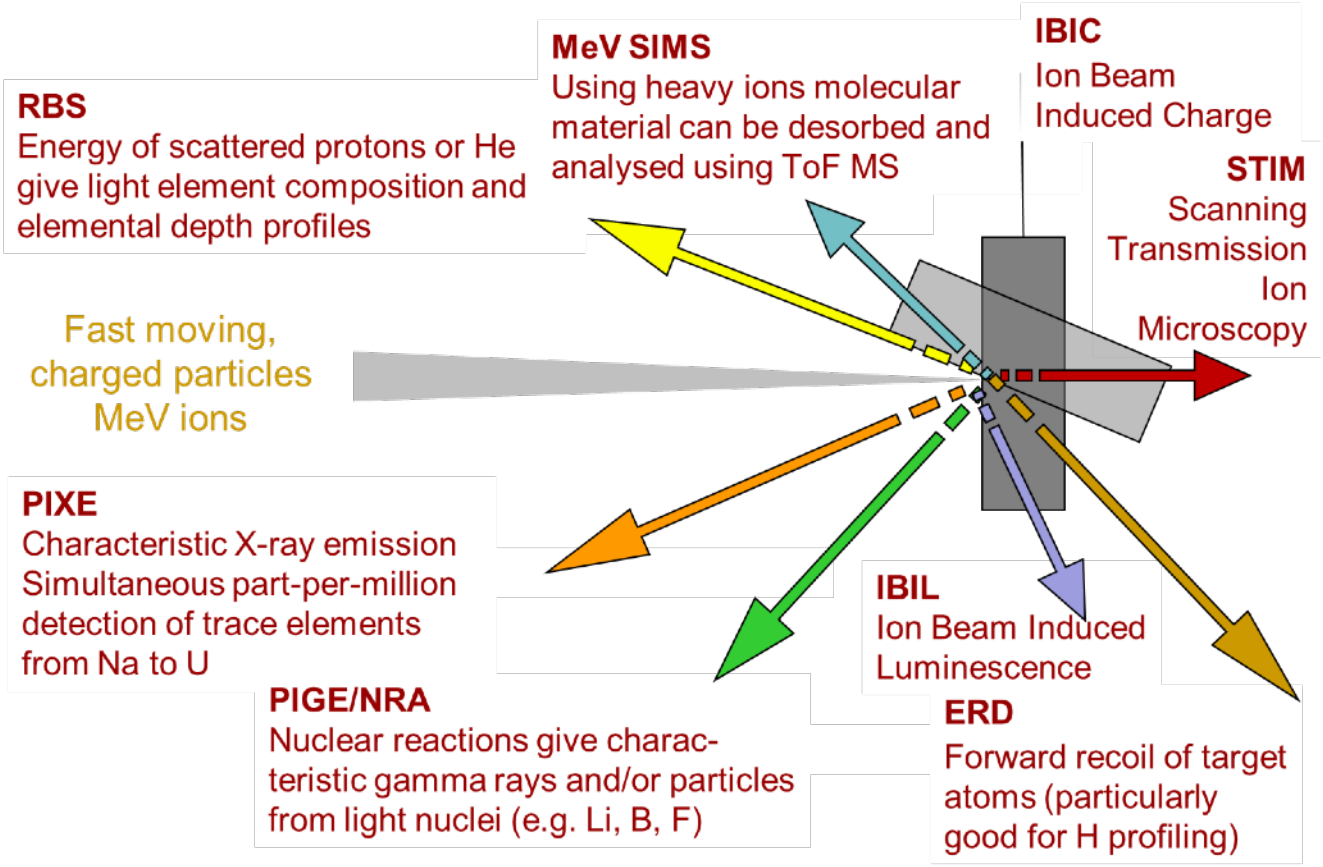
- **Ultrahigh Sensitivity**

  AMS (Note: does not include 14C)

- **Ambient (and Vacuum) Imaging**

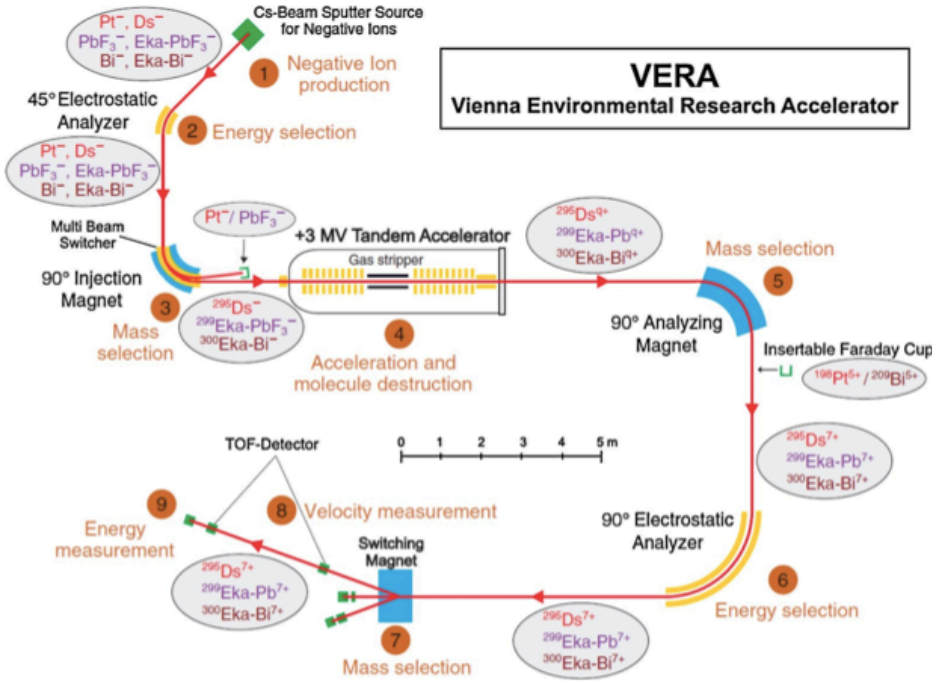
  PIXE, MeV-SIMS, H, He-Ne microscopy, IBIC

Total Ion Beam Analysis



Accelerator Mass Spectrometry

- Accelerator Mass Spectrometry (AMS) is a technique which supresses molecular isobars from heavy isotope measurement
- It is particularly good at separating ^{14}C from ^{14}N and can measure isotopic abundancies down in the range of 10^{-12} to 10^{-18}
- It can be used to measure heavy radionuclides from ^{10}Be up to ^{244}Pu



Modification

- **Broad beam**

  Implantation/doping, Multi-beam, clean environment

  Deep - MeV, swift heavy ions

  Shallow - keV or highly charged ions

- **Focussed beam**

  Non-Ga FIB lithography

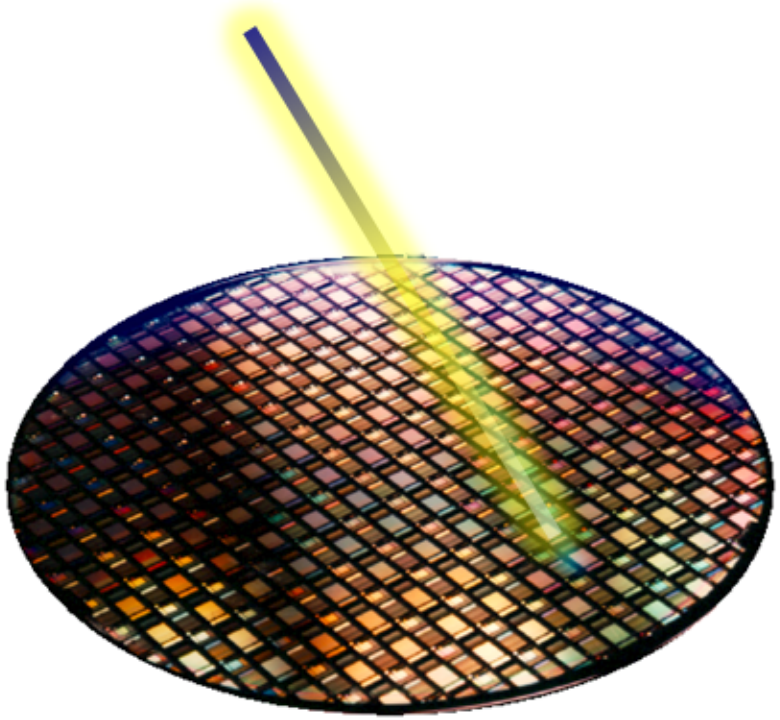
- **Single Ion**

  Deterministic implantation for Quantum applications

  Biological cell irradiation

Ion implantation

- The **charge on the ion** can be collected so that each ion can be counted as it enters the material ensuring precise control on **quantity**
- The **charge on the ion** enables a single isotopic mass to be selected in a magnetic field providing **high purity**
- These features are essential in industries such as microelectronics.
- Absolute ion dose can be controlled to better than 1% and uniformity over 40cm x 40cm to better than 1%



INFN in RADIATE

- Team Leader: Massimo Chiari
- Deputy: Giulia Calzolai
- Local TA manager: Silvia Nava
- Administration: Silvia Cappelli

Budget	
Totale contributo	407.758,65 €
Costi infrastrutture	195.000,00 €
OH INFN	28.367,77 €
OH Struttura	1.418.388 €

RADIATE bodies

- External Advisory Board
  - Aumayr Friedrich
  - Boaretto Elisabetta
  - Mackova Anna
  - Mayer Matej
  - Moncoffre Nathalie
  - Nastasi Michael
  - Nordlund Kai
  - Simon Aliz
  - Terrasi Filippo
  - Trautmann Christina
- User Selection Panel
  - Alkemade Paul (ISI, HIM)
  - Beck Lucile (IBA)
  - Chamizo Elena (AMS)
  - Friedl Anna (Radiobiology, Medicine)
  - Garman Elspeth (Bio materials, IBA)
  - Hardie Chris (IBMM, Multi beam)
  - Jones Brian Nathaniel (MeV SIMS)
  - Kokkoris Mike (IBA)
  - Lohstroh Annika (IBIC)
  - Mashanovic Goran (Implantation, Si photonics)
  - Mergia Konstantina (IBA, Multi beam)
  - Pinheiro Theresa (Bio materials, IBA)
  - Quinto Francesca (AMS)
  - Raisanen Jyrki (IBA)
  - Sicard-Roselli Cecile (Bio materials, Chemistry)
  - Szidat Sönke (AMS, Environment)
  - van der Beek Kees (IBMM)

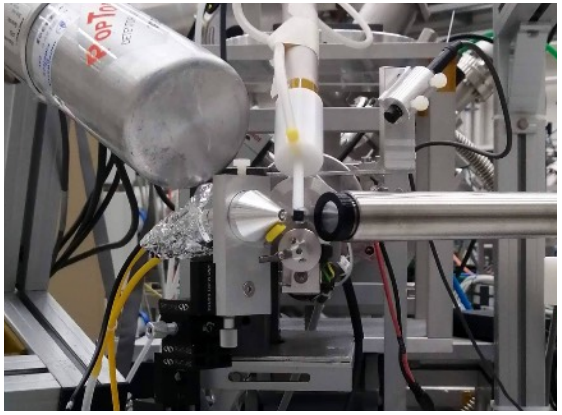
Transnational access

- More than 15800 hours of transnational access (TA) will be offered at 11 of RADIATE's project partners
- 1000 hours of TA will be offered at INFN LABEC
- RADIATE's main target group are users working in EU member states and associated states. A user is only eligible for beam time in a different country than the country of employment

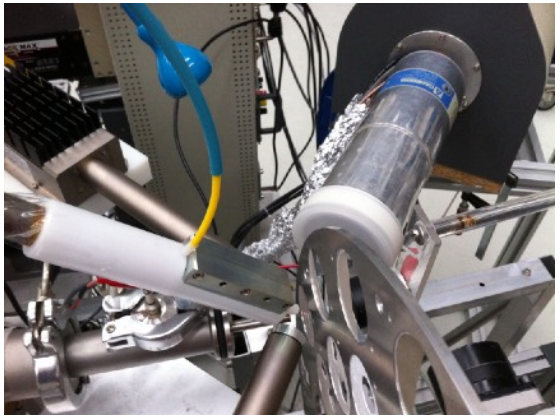
Infrastructures offering Transnational Access

- Helmholtz Zentrum Dresden Rossendorf (Germany)
- Katholieke Universiteit Leuven (Belgium)
- Jozef Stefan Institute, Ljubljana (Slovenia)
- Universität der Bundeswehr München (Germany)
- CEA-CIMAP, Caen (France)
- Universite Pierre Et Marie Curie, Paris (France)
- Ruder Boskovic Institute, Zagreb (Croatia)
- INFN, Florence (Italy)
- University of Jyväskylä (Finland)
- University of Vienna (Austria)
- University of Surrey (United Kingdom)

LABEC facilities offered to TA



External beam for low-current non-destructive PIXE, PIGE and RBS/EBS analysis of cultural heritage



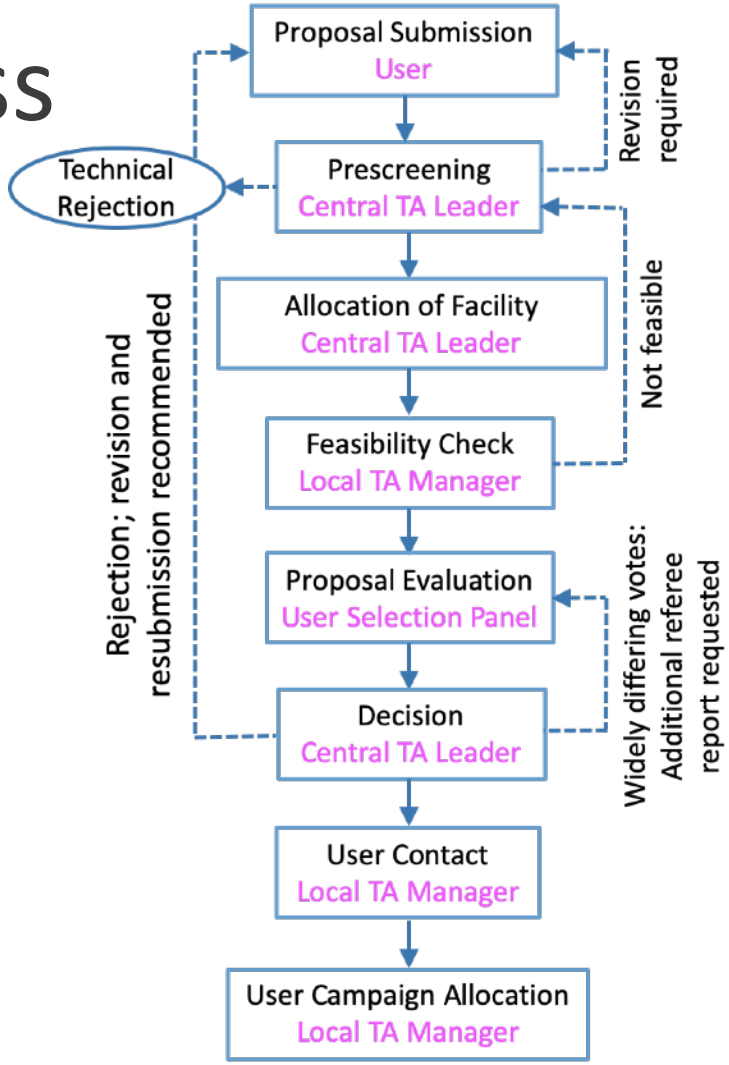
External beam high-current and high-throughput PIXE and PIGE analysis of atmospheric aerosols

In-vacuum scattering chamber equipped for PIXE, PIGE and multi-detector RBS/ EBS/ERDA analysis

External beam with scanning microprobe with detectors for PIXE, PIGE and RBS/EBS analysis

Transnational access

- The user have to submit a proposal to RADIATE's proposal submission system, RADIATE GATE (https://gate.hzdr.de/user/)
- Access is granted free of charge to positively evaluated proposals as long as the allocated hours are not used up
- Up to 2 persons per user group; travel costs up to 300 € per person; accommodation in the facility's recommended hotel
- The user has then to submit an experimental report



Joint Research Activities

- Ion Sources and Beams
- Detectors and Electronics
- Software and Data Handling

JRA Detectors and Electronics

- Multidetector/multitechnique arrangements

  Development of integrated photon and charged particle detector chip to enable more efficient simultaneous PIXE and RBS measurements

  Common development enabling larger throughput and multi-detector setups with common data acquisition involving the use of digital pulse processing

- High-resolution X-ray detectors

  Development of multi-pixel TES spectrometers for high resolution PIXE both in air and in vacuum

JRA Software and Data Handling

- Multi-Parameter Data Filtering and Anlysis

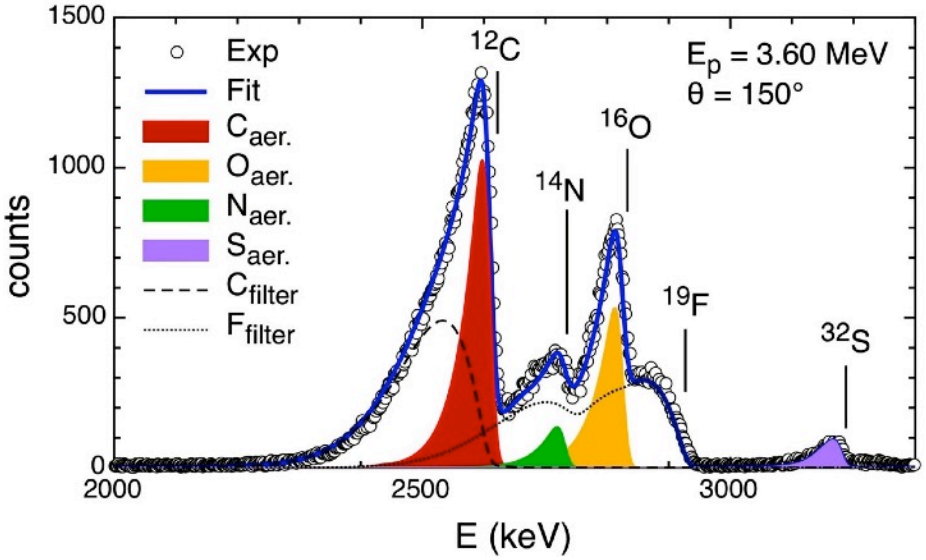
  Algorithms to combine and analyze the spectra from a large set of detectors

- Deep Learning Algorithms for IBA fitting and Target Recognition

  Implementation of artificial neural networks in elastic backscattering spectrometry (EBS), where the contribution of non-elastic scattering events makes the operator-based spectrum analysis very tedious and time consuming

Artificial Neural Network (ANN) analysis of aerosol on Teflon filters

- Aerosol sampling campaigns produce huge amounts of data: simulating each EBS spectrum is time consuming
- ANNs are an ideal solution to analyze huge data sets
- ANNs have been already successfully applied to IBA and in particular to the analysis of RBS spectra



Comparison between experimental and simulated EBS spectra of particulate matter samples on Teflon filters (CF_2) measured at 3.60 MeV proton energy and 150°scattering angle.

Artificial Neural Network (ANN) analysis of aerosol on Teflon filters

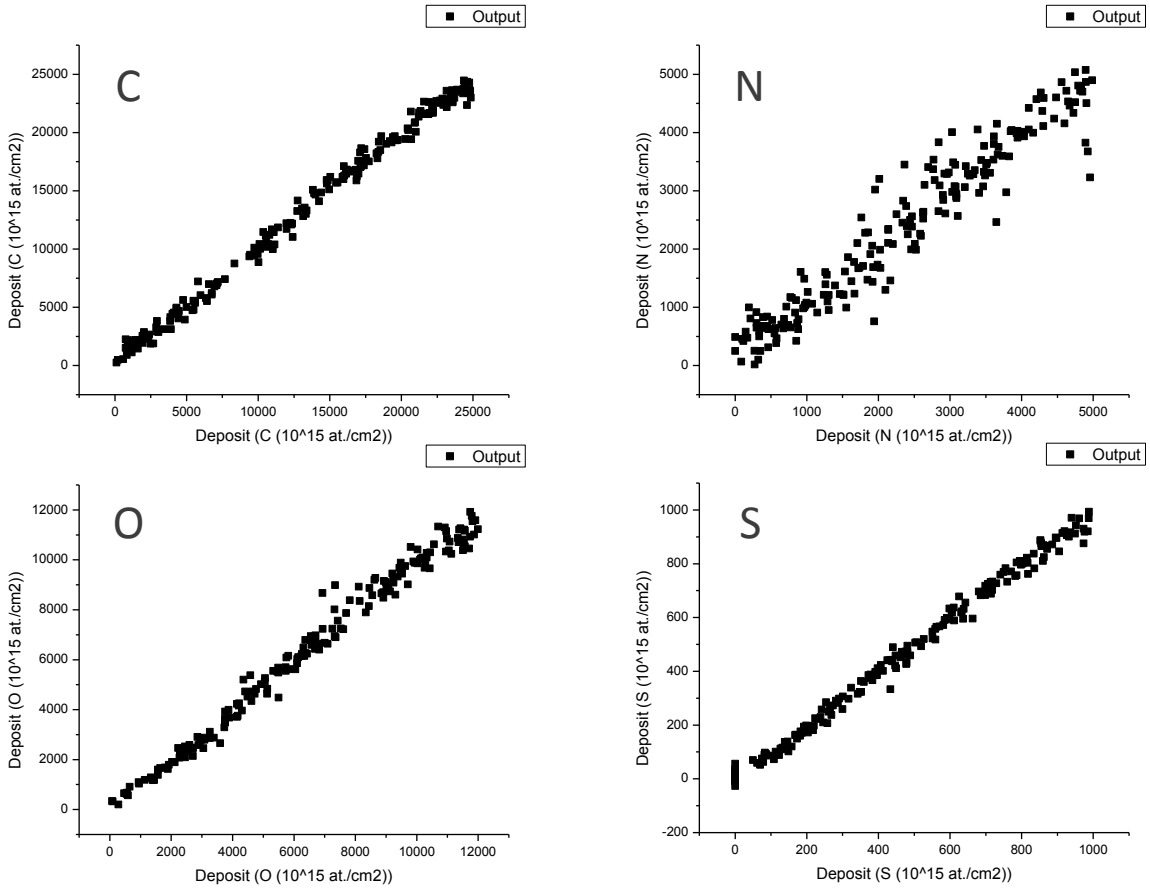
- *Supervised learning:* a network has to be trained by numerous simulated EBS spectra
- The training set will be constructed using NDF realistic simulations and selected boundary conditions for the outputs

Boundary conditions for ANN parameters

	Min	Max
Teflon thickness	10000	45000
Teflon roughness	x 0.3	x 0.7
C	100	25000
N	0	5000
O	0	12000
S	0	1000
Aerosol roughness	x 0.4	x 3.4

In units of 10^{15}at/cm^2

ANN results from the training set



ANN performance on estimating the C, N, O and S concentration in the deposited film. Conc. Is expressed as 10^15at./cm2

Networking, Training, KET

- Exchange of good practices (QA for IBA and IBMM)
- Summer schools
- Twinning program
- Guest researcher program

QA for IBA

- Measuring accelerator absolute energy
- Monitoring beam energy stability
- Monitor experimental hall temperature
- Recording beamline performance (FC reading, beam spot size…)
- Recording detectors energy resolution and energy calibration; collecting spectra of reference samples

News

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RADIATE Summer School registration open

2019-05-21

RADIATE is committed to training the next generation of ion beam physicists and is organizing a number of summer schools

Read more

Job offer: 15 post-doc positions available at INFN

2019-04-23

RADIATE project partner INFN is offering 15 post-doc positions as part of the FELLINI project. The duration of the fellowship

Read more

NanoPatterning 2019 workshop announcement

2019-04-08

The 10th International Workshop on Nanoscale Pattern Formation at Surfaces (NanoPatterning 2019) is taking place from 07-10 July 2019 at

ABOUT IONBEAMCENTERS.EU

Ionbeamcenters.eu launched on 01 January 2019 with ion beam facilities taking part in the RADIATE project. However, this site is not exclusively for RADIATE partners and intends to include other European facilities as well to showcase European know-how and expertise in the field of ion beam physics.

RADIATE

RADIATE summer school

Training new users of ion beam technology