## Issue # 2 - February 2020

# Newsletter



# Updates from the RADIATE project

14 partners from public research and 4 SMEs are joining forces in the RADIATE project exchanging experience and best practice examples in order to structure the European Research Area of ion technology application.

Besides further developing ion beam technology and strengthening the cooperation between European ion beam infrastructures, RADIATE is committed to providing easy, flexible and efficient access for researchers from academia and industry to the participating ion beam facilities. About 15.800 hours of transnational access in total is going to be offered free of charge to users who successfully underwent the RADIATE proposal procedure. Joint research activities and workshops aim to strengthen Europe's leading role in ion beam science and technology.

The RADIATE newsletter aims to inform interested parties on the progress of the project and what the project partners have been up to in the previous months.

Issue number 2 reports on the progress of joint research activities, training activities, and innovation activities and includes conference and research highlight reports.

If you would like to be included in the bi-annual RADIATE newsletter mailing list, please sign up here: <u>https://www.ionbeamcenters.eu/radiate/radiate-newsletter/</u>





## CIMAP

will soon acquire a SIMS (Secondary Ion Mass Spectrometry) for surface characterization. This equipment will effectively complement the various characterization techniques already present (MEB, MET, FIB, Raman, DRX, AFM, etc.) and can be used for characterization of ion irradiated/implanted materials.

## **Surrey IBC**

has been awarded a £1.5M Engineering and Physical Sciences Research Council (EPSRC) Strategic Equipment grant (Grant Ref: EP/ T01931X/1) to install time-of-flight ERD and backscattered detectors and high-resolution X-ray detector for PIXE measurements.

grant agreement no. 824096







Accelerator (VERA) facility exceeded expectations in gained experience and © Roman Garba knowledge of the use of ion beam facilities.

The 3-day stay at Vienna

Environmental Research

The first day was dedicated to a complete overview of the work of VERA laboratory by visiting <sup>14</sup>C pre-treatment lab equipped with new AGE graphitization unit and other sample preparation labs. Peter Steier gave a detailed walk-through with explanation of the accelerator's beamline elements and supportive facilities of the main 3 MV tandem accelerator capable to measure all standard AMS isotopes (10Be, 14C, 26Al, 36Cl, 41Ca, 129I) and Actinides (236U, 233U, Np, Pu, Am). Very interesting was ILIAMS (Ion-Laser Interaction Mass Spectrometry) "green laser" beamline with ion cooler - the cutting edge innovative instruments. The second day was focused on practical day-to-day operational steps such as cathode target preparation and change of cathode wheel. The next step was a visit on cosmogenic nuclide chemical laboratory at University of Natural Resources & Life Sciences Vienna (BOKU) where the samples for <sup>10</sup>Be/<sup>26</sup>Al experiments are receiving chemical pretreatment. The last day was dedicated to an open discussion with VERA lab members during the presentation "Research cases from Oman: applications of radioanalytical methods and analytical chemistry in archaeology." with scientific experiment "Numerical dating of the Qarn Fu'ād Palaeolithic raw material procurement sites in Oman using cosmogenic nuclides <sup>10</sup>Be and <sup>26</sup>Al." which will be performed at VERA as a part of Radiate Transnational Access.

As we do not have AMS facilities in the Czech Republic yet, the hands-on visit of VERA was extremely useful. It was a great opportunity to get familiar with AMS beamline instruments and the sample preparation process for non-14C cosmogenic nuclides. Twinning program expanded my knowledge and put a solid foundation for the forthcoming scientific experiment scheduled for 2020.

#### Roman Garba

For more information on RADIATE's Twinning Program, visit the website at https://www.ionbeamcenters.eu/radiate/ training/radiate-twinning-program/

# **RADIATE Alumni Network**

Many universities, research infrastructures, and companies have alumni networks to keep in touch with former employees. The aim usually is to keep track of alumni to enable cooperation with their new places of employment and to have a pool of possible candidates available for future job opportunities.

The RADIATE alumni network is free of charge and run by IMEC. The alumni network is open to all RADIATE project partner alumni. If you are interested in joining, please sign up for the alumni network at https://www. ionbeamcenters.eu/ radiate/alumni-network/



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#### **RADIATE alumni network perks**

- Networking opportunities with leading European ion beam facilities, research infrastructures and industry
- Possibility to take part in certain RADIATE meetings
- Updates on the RADIATE project and ion beam research at European ion beam facilities in general
  - Subscription to the RADIATE newsletter and RADIATE Report Series

## Joint Research Activities

#### Progress on JRA1: Ion sources and beams Ion Cooling for AMS

by Oscar Marchhart, Alexander Wieser, Peter Steier, Johannes Lachner, Martin Martschini, Robin Golser



#### © University of Vienna

Accelerator Mass Spectrometry (AMS), an ultra-sensitive method to measure longlived isotopes, is presently available for a handful of isotopes. A powerful new method based on laser-ion interaction will be developed for Transnational Access (TA). Scientific interest and imminent applications reinforced our efforts to make <sup>135</sup>Cs, and <sup>90</sup>Sr available for TA. We present the progress made on this topic in the first nine months of the project.

Cooling of positively charged ions is well established at some radioactive ion beam facilities dedicated to nuclear physics. In contrast, cooling of negatively charged ions and in particular for usage in AMS are still in their infancy. An ion cooler for anions dedicated to AMS with the Vienna Environmental Research Accelerator (VERA) has recently been developed at the University of Vienna (UW). At present, two students finishing their Master (Oscar Marchhart, Alexander Wieser) and one lab technician for Chemistry (Florian Mozina) are employed via RADIATE to speed up development work and sample preparation. After graduation they will continue to work on this project within their PhD thesis. Martin Martschini, Robin Golser and Johannes Lachner (now at HZDR) contribute to this task as in-kind personnel.

<sup>135</sup>Cs and <sup>90</sup>Sr are both produced in nuclear fission with rather high accumulated yields of 6.5% and 5.7%, respectively. <sup>90</sup>Sr has a half-life of 28.90 yrs, <sup>135</sup>Cs is in the range of 2 Myrs. Since both isotopes are pure beta emitters, measurements via radiometric methods are time consuming and cumbersome. Similarly, classical mass spectrometric techniques fail, since the interfering isobars, barium in the case of cesium and zirconium in the case of strontium, are not separable from the isotope of interest by conventional techniques. With the Ion Laser InterAction Mass Spectrometry (ILIAMS) Setup at VERA we overcome the isobar problem by exploiting the difference in electron affinities of the isobar and the isotope of interest. Overlapping the ion beam



with a cw-laser with suitable photon energy in the ion cooler -a linear radiofrequency quadrupole, 800mm long and filled with low-pressure He gas, the interfering isobaric anions get neutralized by photodetachment and are thus eliminated whereas the anions of the isotope of interest remain unaffected.

The radioisotope  $^{135}$ Cs was successfully measured relative to its radioactive sister isotope  $^{137}$ Cs and the stable isotope  $^{133}$ Cs by extraction as CsF<sub>2</sub>– from a Cs<sub>2</sub>SO<sub>4</sub>+PbF<sub>2</sub> matrix. Transmissions through the cooler of 30% with 0.3 mbar of helium gas could be achieved. Utilizing a green laser ( $\lambda$  = 532nm, E<sub>y</sub> = 2.33 eV) BaF<sub>2</sub>– could be suppressed by five orders of magnitude. By ILIAMS, VERA reaches an abundance sensitivity of  $^{135}$ Cs/Cs = 2  $\cdot$  10<sup>-12</sup>. This value is an improvement by almost two orders of magnitude since last year. The aim is to finally measure abundance ratios as low as  $^{135}$ Cs/Cs  $\approx$  10<sup>-14</sup> for environmental samples.

For <sup>90</sup>Sr oxygen was mixed to the helium buffer gas for further isobar reduction as the interfering molecules chemically react with  $O_2$ . With additional photodetachment by the green laser, an isobar separation of  $ZrF_3$ –/ $SrF_3$ –  $\approx 10^{-7}$  was achieved. First test runs on in-house made reference materials showed reproducible results down to <sup>90</sup>Sr/Sr =  $10^{-14}$ . With ILIAMS a detection limit of 0.1 mBq has been achieved in the latest tests, which is more than an order better than previous mass spectrometric or radiometric methods. For the next beamtimes first "real" environmental samples will be investigated.

Summarizing, the development shows excellent progress. If no unexpected obstacles show up at lower levels, the isotopes <sup>135</sup>Cs, and <sup>90</sup>Sr may become available for TNA earlier than expected.

## Joint Research Activities



Image of an MCP obtained with  $O^{2*}@40$  keV with 20  $\mu m$  for field of view. @ CIMAP

#### Progress on JRA1: Ion sources and beams Microbeam Optics

A new ECR source on the PELIICAEN platform and new performances by Henning Lebius, Jimmy Rangama, Stephane Guillous

The CIMAP has just equipped with an ECR source and modified the FIB column of the PELIICAEN platform (equipped in addition to a SEM and an AFM/STM microscope). It is thus possible to obtain single and multiply charged focused ion beams with a very large choice on the nature and on a larger range of kinetic energy than conventional FIB (3q to 30q keV, q being the charge state). The

current performance of the system allows target beam sizes down to 250 nm and 50 nm resolution in imaging mode. A very high performance beam chopper has been added to allow for single ion implantation. Contact: <u>stephane.guillous@ganil.fr</u>

# Transnational Access

Are specific trace elements depleted from the caseum of a tuberculous granuloma? by Claire Brooks

This past December, Laura Nicolas Saenz (PhD Student) and Claire Brooks (Research Technician) from the Biomedical Imaging and Instrumentation Group (BIIG) at the Universidad Carlos Tercero de Madrid (UC3M) travelled to the Surrey Ion Beam Centre (SIBC) as part of RADIATE's Transnational Access program. In collaboration with the Dartois Lab at the Hackensack Meridian Health Center for Discovery and Innovation (hmh-cdi), the BIIG group has become interested in the use of PIXE/ RBS as a component of the multimodal image analysis of tuberculosis lesions and took the opportunity to attend the experiment at SIBC in order to become familiar with the technique and the data produced. Upon arrival, the group was given a tour of the SIBC facilities and were an overview of the IBA techniques performed there by Catia Costa (Liaison Fellow), Melanie Bailey (Reader in Forensic Chemistry), and Janella De Jesus (Research Fellow). This included a review of some of the active research goals of the centre as well as the breadth of topics that have been investigated through RADIATE's Transnational Access program. In the afternoon there was a meeting on the technical details of the planned experiment and setup of the data acquisition. The following day preliminary results were available and prompted a discussion of next steps, including the potential benefits of MALDI/IBA multimodal imaging for data interpretation, which is of ongoing research interest to the SIBC.



Tissue sections sent by the Hackensack Meridian Health Center for Discovery and Innovation and ana lysed by PIXE at Surrey. © Univ. Surrey

## **RADIATE Innovation Managers appointed**

One of RADIATE's goals is to increase technology transfer activities of ion beam facilities. The RADIATE project funds three innovation managers at East European facilities – Ida Srdic at RBI, Croatia, Richárd Rácz at ATOMKI, Hungary, and Andrej Kosicek at JSI, Slovenia.

In the coming years, they will develop business plans for potential commercial spin-offs and attract SMEs to the ion beam facilities by raising awareness of the exploitation potential of ion beam technology, supporting the technology transfer along the whole value chain, and becoming active in spin-off commercial activities. A wanted side effect of economic success associated with the growth of industrial service and technology transfer activities will be a step towards the ion beam facilities' self-sustainability, which is increasingly becoming important.

To get them off to a good start, the RADIATE consortium is supporting the newly appointed innovation managers with a training program and knowledge transfers.

Read more on Innovation Managers here: https://www.ionbeamcenters.eu/radiateinnovation-managers-appointed/



RADIATE's Innovation Managers: Richárd Rácz at ATOMKI (left), Ida Srdic at RBI (middle), and Andrej Kosicek at JSI (right) © HZDR / A. Berens

## Highlights

### Use of IBA techniques in forensic document examination https://doi.org/10.1021/acs.analchem.9b03058

by Katherine Louise Moore, Marko Barac, Marko Brajković, Melanie Jane Bailey, Zdravko Siketić, Iva Bogdanović Radović





Figure 1. Intersections between laser toner (black) and ballpoint pen (green). The ballpoint pen is deposited above toner (up) and below toner (down) © 2019 Analytical Chemistry, ACS

One of the problems in forensic work is examination of authenticity of different documents such as contracts, testaments, etc. In such documents there are often intersections between printed pages and signatures where determination of deposition order between different writing tools such as toners and pens can help to spot the forgeries or alterations done at the documents. For that purpose, many scientific methods are conventionally employed for the forensic work, among them various microscopies and spectroscopies, video analysis tools, digital imaging etc.

In the article recently published in Analytical Chemistry scientists from the Ruder Bošković Institute in Zagreb, Croatia together with the scientists from the University of Surrey, UK have explored the potential of two accelerator based Ion Beam Analysis (IBA) techniques Secondary Ion Mass Spectrometry with MeV Ions (MeV-SIMS) and Particle Induced X-Ray Emission (PIXE) to solve some of the difficult cases where standard forensic methodology fails. Six different cases involving one ballpoint pen, three laser printers and two inkjet printers were studied.

MeV-SIMS detects secondary molecular ions sputtered from the uppermost surface layers after bombardment with a heavy energetic ion beam, hence it is an excellent choice for such a study. As the molecules from the surface are detected, the trace made last will yield a continuous line in a 2D MeV-SIMS image and will not be interrupted. Conversely, the trace made first will show a break in the line, the reason being the molecules from

underneath are not sputtered and detected. By using only MeV-SIMS, they were able to determine deposition order for cases involving ballpoint pen and laser printer toner (2 out of 6 combinations). Figure 1 shows 2D molecular maps (left) and optical images (right) of intersections between a ballpoint pen and laser printer toner. Ballpoint pen was deposited above toner (up) and below toner (down). The laser toner is distinguished from the paper and ballpoint pen by lack of sodium (black). Ballpoint pen is characterized by Basic Violet 3 (m/z 372, green). The paper is characterized by sodium (red, m/z 23).

However, all the cases involving inkjet ink and other writing tool (laser printer or ballpoint pen) shown in 2D MeV-SIMS images break in the inkjet line, leading to the conclusion that inkiet ink was deposited first in all cases, which was not correct. Inkjet ink tends to be mainly composed of water, meaning it penetrates deep into the paper and any remaining ink on the surface evaporates. Because MeV-SIMS is a surface technique, this leads to a hypothesis that the inkjet ink was not adhering at the intersection at all if some other writing tool was already deposited there.

to the MeV-SIMS, in the case when inkjet ink is deposited first there should be no break in the 2D X-ray map of inkjet ink while inkjet ink is adhering well to the paper. If the laser printer toner or ballpoint pen trace is already deposited on the paper, and the inkjet ink is deposited second, there will be a break in the elemental maps corresponding to the inkjet ink, where it does not adhere to other already deposited writing tool. Figure 2 shows 2D X-ray images of intersections between laser toner and inkjet ink. Inkjet ink is visualized through S X-rays, while laser toner through Si X-rays. The upper S map shows continuation at the intersection region, proving that inkjet ink is deposited first and directly on the paper. The lower S map shows a case where inkjet is deposited after laser toner and there is no S at the intersection. It is important to mention that by just looking at the optical image, the opposite conclusion would be (incorrectly) made.

By using combination of MeV-SIMS and PIXE, authors managed additionally to predict the correct deposition order in 2 out of 4 problematic cases. In the other 2, the result was inconclusive. The only reason why PIXE was not able to resolve 2 remining cases was



Figure 2. 2D PIXE maps of Si (representing laser toner) and S (representing inkjet ink). Inkjet is deposited below toner (S X-ray map up) and above toner (S X-ray map down). © 2019 American Chemical Society

To investigate this further they used PIXE, which provides information about elemental composition from deeper layers in the sample through the emitted X-rays. For PIXE, 2 MeV proton microbeam was used. PIXE can resolve the behavior of the inkjet ink if it is characterized by unique elements (via characteristic X-rays) not present in the paper and another writing tool. In contrast

due to a lack of a characteristic element only present in inkjet and not in paper or other writing tool. The results of the two methods combined contributed to understanding the behavior of inkjet ink at the intersection and helped resolve the issue in most cases. Further analysis using more inkjet inks in combination with different writing tools is needed to establish the wider benefits of MeV-SIMS and PIXE.



#### High-Throughput PIXE Accurate Metalloprotein Structural Analysis <u>https://doi.org/10.1021/jacs.9b09186</u> by G. W. Grime, O. B. Zeldin, M. E. Snell, E. D. Lowe, J. F. Hunt, G. T. Montelione, L. Tong, E. H. Snell, E. F. Garman

A new high-throughput method has revealed metals previously undetected in 3-D protein structures. The study, led by the Universities of Surrey and Oxford is thought to have major implications for scientists using protein structure data.

Proteins that contain metal, known as metalloproteins, play important roles in biology, regulating various pathways in the body, which often become targets for lifesaving drugs. While the amount of metal in such proteins is usually tiny, they are crucial to determining the function of these complex molecules, but there hasn't been a reliable, analytical method for determining the identity and quantity of metal atoms in metalloproteins.

In a study published in the Journal of the American Chemical Society, an international multi-disciplinary team of researchers report that they have developed a way to unambiguously identify and count metal atoms in proteins in an efficient and routine way. Using it they revealed new information that was there but hidden.

The method was developed by a University of Surrey physicist, Dr Geoffrey W. Grime, and crystallographer from the University of Oxford, Elspeth F. Garman. In a new breakthrough described in the paper, the researchers have now extended the method to allow many samples to be analysed sequentially in a high throughput 'pipeline'. The significance of the method was quickly realised by protein chemist Edward H. Snell of the Hauptmann Woodward Institute from the University of Buffalo in the US, who set up a study in which the team measured 30 randomly selected metalloproteins, which are already in the global repository of protein structures called the Protein Data Bank (PDB). The results showed that the methods previously used to determine some of these 30 random protein structures had either misidentified the metal atoms or, in some cases, completely missed them. In about half of the samples studied the metals built into the PDB models were incorrect.

The PDB is a critical resource for researchers worldwide. In 2017, there were on average 1.86 million downloads per day in the U.S. alone. An enormous number of researchers use PDB structures without

knowledge of the potential fundamental errors that may be present. Extrapolating from the published results suggests that over 350,000 models downloaded per day may not contain the correct metal. This has profound implications for those using the models. If these models are wrong, the



Key components of the experimental setup showing (a) the sample drop array, (b) a schematic of the high-throughput sample stick and sample holder, (c) a schematic of the experimental chamber, and (d) a photograph of the microbeam end station at the University of Surrey Ion Beam Centre, Guildford, UK © 2020 Journal of the American Chemical Society, ACS

understanding of the millions of people who use them becomes flawed.

In addition to Snell, Garman and Grime, other co-authors on the paper are Oliver B. Zeldin and Edward D. Lowe of Oxford University; Mary E. Snell of HWI; John F. Hunt and Liang Tong of Columbia University; and Gaetano T. Montelione of Rensselaer Polytechnic Institute.

#### Quantifying nitrogen in GeSbTe:N alloys http://dx.doi.org/10.1039/C9JA00382G

by C.Jeynes, E.Nolot, C.Costa, C. Sabbione, W. Pessoa, F. Pierre, A. Roule, M.Mantler

Quantifying light elements in thin films is currently very difficult where high accuracy is required: for example, in industrially relevant materials where cooperation between multiple sites is needed.

GeSbTe:N (GST-N) alloys are phase-change materials used industrially in memory applications for the automotive industry. In-fab metrology uses wavelength-dispersive X-ray fluorescence (WD-XRF), which is routinely calibrated to <1% precision for heavy elements using Fundamental Parameters software. But for light elements (such as N) the Fundamental Parameters are not known and although XRF has sensitivity, no sampleindependent calibration is possible without wellknown reference GST-N materials.

Unprecedented measurement precision (1% XRF linearity) for N in GST-N was achieved by critically

demonstrating reliable accuracy of elastic backscattering spectrometry (EBS) scattering cross-sections, specifically the 3.7 MeV resonance of the 14N( $\alpha$ , $\alpha$ )14N reaction which allowed sufficient sensitivity of EBS to N in this material (with a measurement precision of 0.4 at%). Reference materials are certified by EBS resulting in a calibration curve of the WD-XRF (wavelengthdispersive X-ray fluorescence) spectrometer.

This is a seminal advance in accurate XRF for the analysis of light elements. It is also a seminal advance in accurate resonant EBS for the analysis of light elements. Ion Beam Analysis (IBA) may use any or all of EBS (including RBS, Rutherford backscattering: a special case of EBS), ERD (elastic recoil detection: also an elastic scattering technique very useful for H analysis), PIXE (particle-induced X-ray emission: a technique very similar to XRF) or NRA (nuclear reaction analysis utilising inelastic reactions). Up to now, traceable accuracy has been demonstrated only for RBS. However, this work demonstrates a traceable accuracy of 4 % for the analysis of N using EBS. This is the first time full metrological traceability has been demonstrated for EBS.



Result of measured N-content in test set of Ge2Sb2Te5:N samples. XRF calibrated using a set of reference materials certified by IBA © J. Anal. At. Spectrom, RSC

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#### On the Accuracy of Total-IBA

#### https://doi.org/10.1016/j.nimb.2019.12.019 by C.Jeynes, V.V.Palitsin, M.Kokkoris, A.Hamilton, G.W.Grime



3080 keV 4He EBS of an unknown 19th century soda lime glass. Na and Al are quantified by EPMA, and the other minor and trace elements are quantified by PIXE. This glass contains 16 measurable elements. "R" shows the position of the 2663 keV resonance in the 160( $\alpha$ , $\alpha$ )160 signal © NIMB, Elsevier

Typically, Total-Ion-Beam-Analysis ("Total-IBA") is a synergistic combination of PIXE and EBS (particle-induced X-ray emission, and elastic backscattering spectrometry). The beauty of Total-IBA is that it can effect fully quantitative analyses of "hard" samples, that is, samples intractable for either PIXE or EBS alone. Glasses with surface modifications are good examples of "hard" samples since EBS is not sensitive to trace elements (or minor ones, usually), and PIXE is not directly sensitive to depth profiles. Thus, Total-IBA relies for its accuracy on different techniques (PIXE/EBS) for different elements. It has been regularly claimed that the analysis "inherits the accuracy of its most accurate technique", but this claim has never been quantified. Until now. For this analysis "simple" sample а was chosen, that is, one without surface modifications. For such homogeneous samples the composition may be unambiguously and accurately determined by any version of "XRF"

(X-ray fluorescence) whose sensitivity is not compromised by Bremsstrahlung: that is, properly calibrated PIXE, or EPMA (electronprobe microanalysis), or true XRF. These are excited respectively by ions, electrons and photons, where EPMA uses WDX (wavelength dispersive X-ray spectrometry) to increase sensitivity. In this case the PIXE was calibrated only roughly (~10 %) since the "correct" composition was obtained by EPMA at an absolute accuracy of about 0.6 wt%. On the other hand, the EBS cross-sections for Si at this beam energy are demonstrated by benchmarking to be ~10 % in error (too low: the effect of this can be seen in the Ca, Si, Na signals of the EBS spectrum). Nevertheless, the Total-IBA analysis was demonstrated to have an accuracy about 2 at%. The origins of this enhanced accuracy are in the mass-closure properties of the EBS: where all major elements are visible in the EBS spectrum then the relative heights of the signals are a further strong constraint on their interpretation.

In this analysis the Na and the Al were determined by EPMA. But both can be determined readily by PIXE (with appropriate conditions), and in fact the Na is also analysed here by EBS. This glass contains neither Li nor B, but in such cases NRA (nuclear reaction analysis) can be used in the Total-IBA. Here again, the accuracy can be determined absolutely since the sample is homogeneous and a parallel accurate EPMA analysis is possible. In the general case (of a weathered glass, for example) EPMA can no longer be used, but Total-IBA will be able to determine the surface modifications due to the weathering with an accuracy behaviour similar to that for the homogeneous sample.

# **Upcoming International Conferences**

14th International Topical Meeting on Nuclear Applications of Accelerators Vienna International Centre, Austria, from 5-9 April 2020

11th International Particle Accelerator Conference GANIL, Caen, France, from 10-15 May 2020

3rd biennial HeFIB: Helium and Emerging Focused Ion Beams Knoxville, Tennessee, USA, from 18-21 May 2020

2020 Spring Meeting of the European Materials Research Society (E-MRS) Strasbourg, France, from 25-29 May 2020 ICACS & SHIM 2020 Holsinki, Finland, from 21, 26, June 2

Helsinki, Finland, from 21-26 June 2020

COSIRES 2020 : The 15th conference of COmputer Simulation of IRradiation Effects in Solids Porquerolles, France, 29 June-3 July 2020

Ion Implantation and Other Applications of Ions and Electrons, ION 2020 Kazimierz Dolny, Poland, from 29 June-2 July 2020

26th Conference on Application of Accelerators in Research and Industry and the 52nd Symposium of North Eastern Accelerator Personnel: CAARI-SNEAP 2020 Las Vegas, Nevada, USA, from 2-7 August 2020 7th International Symposium on Negative Ions, Beams and Sources University of Auckland, New Zealand, from 30 August – 4th September 2020

17th International Conference on Nuclear Microprobe Technology and Applications Bled, Slovenia, from 13-18 September 2020

2nd ANSTO-AINSE workshop "Nuclear techniques for Cultural Heritage" Macquarie University, Sydney, Australia, from 14-17 September 2020

International Conference on Ion Implantation Technology 2020 (IIT 2020) San Diego, California, USA, from 20-24 September 2020



## **Conference Reports**



### RADIATE Summer School C2RMF in Paris, France, from 10-11 October 2019 by Ian Vickridge

The First RADIATE Summer School was held in Paris, France, at the auditorium of the Centre de Restoration et de Recherche des Musées de France (C2RMF), in the Palais du Louvre, from 10 to 12 October 2019. It immediately preceded the 24th International Conference on Ion Beam Analysis, which was held in Antibes from 14 to 18 October. The first two days of tutorials aimed to give a solid base of the physics underlying Ion Beam Analysis. After the final lecture, a dozen or so participants made short (5-10 minutes) presentations of the work or research projects. This exercise was well respected by the participants (a maximum of 5 slides) and appreciated not only by the participants, but also by the lecturers who were present. The rest of the participants presented their work during a similar session on Day 2.

Day 2 was dedicated to tutorials on the practical realization of IBA techniques, starting with the widely used elastic scattering techniques, then PIXE and finally NRA and PIGE. The final lecture was a presentation

of the main ideas and some cases underlining the estimation of uncertainties in quantities measured by IBA. It was particularly satisfying to see this presented to early stage researchers, since often uncertainty estimates are only made as a last touch after a series of experiments, whereas IBA is a quantitative method that merits serious attention being paid to uncertainty estimates.

Although initially not foreseen, it was possible to organise a visit to the C2RMF restoration and research laboratories, including the AGLAE accelerator dedicated to IBA for cultural heritage. Here, Thomas Calligaro (C2RMF) explains the external beamline, dedicated to IBA in air of large, fragile and valuable objects such as paintings, statues, ceramics and so on.

The Friday evening Summer School dinner was held at the Lycée Jean Drouant training restaurant in central Paris. A gourmet meal, cooked by trainee chefs and served by trainee waiters in an Art Deco décor reminiscent of the liner 'Normandy', was very much appreciated by the Summer School participants.

The Summer School was attended by 23 participants from 11 countries. The Tutorials on Applications of IBA on Saturday 12 October were in addition attended by a further 25 participants, and the topics presented lead to lively discussions, in particular with regards to the place of ERDA as a 'the most powerful ion beam technique in materials science'.

24th International conference on Ion Beam Analysis (IBA2019)

Antibes, France from 13-18 October 2019 by Pierre Couture



In October 2019, the Ion Beam community convened in the beautiful city of Antibes in the French Riviera for IBA2019, hosted by the French Vacuum Society (Société Française du Vide) and its Ion Beam Division, based in France and Belgium. The 59 invited and oral contributions, 13 of those from RADIATE partners, focussed on areas such as applied ion beam analysis for art archaeometry, cultural heritage, planetary sciences, environmental sciences, biology, medicine, imaging with micro- and nanoprobes, materials science - thin layers, semiconductors - surfaces/interfaces of nanomaterials. The speaker also discussed the effects of ion beam on materials including the fundamentals, modelling of ion-solid interaction, particle-induced x-ray emission, modification of solids induced by probing ions. The other topics were Spectroscopy by mass accelerator and secondary ion mass and computer simulation and analysis. Participant came from 18 European countries as well as Algeria, Argentina, Brazil, Canada, China, Egypt, Ghana, India, Iran, Japan, Jordan, Lebanon, Mexico, Russia, South Africa, Thailand and United-States.

Participants and guests were delighted by the dinner at Marineland where starters were offered around the shark tunnel. Conference outing included multiple options to either discover the beautiful city of Antibes, its coastal area or the neighbouring village. Some participants enjoyed the Picasso arts museum or the parfum factory.



**Gyula Nagy** has recently joined the RADIATE project as a post-doc at Atomki, Debrecen. He obtained his PhD degree by the end of November 2019 at the University of Debrecen. His doctoral work focused on experimental and computer simulation investigation of the propagation and behaviour of ion beams in electrostatic fields generated by the electric charge-up of an insulating material. In the RADIATE project he is also involved in ion optics related tasks: optimization of the microbeam and nanobeam lines using computer simulation software packages, then assembly, installation and testing of the beamlines in the new Tandetron Laboratory of Atomki.

**Ida Srdić** joined the RBI (Ruđer Bošković Institute) in September 2019 and was appointed as an Innovation Manager in the Laboratory for Ion Beam Interactions. She is working on rising awareness of the exploitation potential of ion beam technology and to support the technology transfer along the whole value chain and to spin-off commercial activities. Ida obtained her B.Sc. and M.Sc. in Computing and Communications from University of Zagreb, Faculty of Electrical Engineering and Computing, Croatia. During her carrier she worked in private sector for Croatian Telecom and IBM in the area of product, services and portfolio management and recently in innovation management in Horizon 2020 program. She successfully launched more than 15 innovative and competitive products and services to the market with an approximate cumulative revenue stream of 2,5 Billion €. Her recent engagement before joining RBI team was with different stakeholders in exploring new business models and connecting industry and researchers around innovations.





**Anthony Sineau** joined the CIMAP in Caen, Normandy in November 2019 as a member of the technical support team, he will help the teams to ensure the running of the experiences, especially in the skills of instrumentation, command & control and electrotechnic. He worked over than 12 years in the field of ECR ion source and associated equipment as diagnostics, high voltage deck, beam lines... He participated to the design, the installation and the tests of all those equipments for hadrontherapy (Siemens, medAustron, CNAO) and for several labs as LNL, IPR, BARC, KVI, INSP.

With a background in electronics, **Franck Dardy** studied at Université Polytechnique Haut de France « UPHF », where he practiced as technical assistant during 16 years in different disciplines such as electronics, electrical engineering, automation, IT, mechanical, etc. There he obtained a Diplôme Universitaire de technologie « DUT » in Génie Electrique et Informatique Industrielle speciality « GEII » through the Validation des acquis professionnels's plan « VAP85 ». Since the first of December 2019, following an external CNRS technician competition, he has been assigned to CIMAP « Centre de Recherche sur les Ions les Matériaux et la Photonique » - CEA-CNRS ENSICAEN-University of Caen laboratory). He has joined the electronic acquisition team.





**Matthew Sharpe** joined the Surrey Ion Beam Centre in 2019 as a Modelling Officer and has recently been employed as a Research Assistant. Matthew obtained his BEng in Electronic Engineering from the University of Surrey and stayed on to do a PhD initially on Lead Sulphide Nanocrystals/C60 fullerite photodetectors and subsequently characterising bismuth containing III-V materials. Matthew's interests include the modelling of ion beam analysis processes and the Rutherford Backscattering Spectrometry of bismuth containing III-V materials. Matthew's most recent work revolved around the modelling of the irradiation of nanoporous iron targets using SRIM, TRIDYN and TRI3DYN at Surrey.

## Exhibitions

As part of RADIATE's Dissemination, Training, Outreach & Public Engagement work package, RADIATE has been promoted at conference and exhibitions all around Europe, for example:



Thin Film Coatings for Electro-Optics. 5 September 2019, Liverpool, UK. © Univ. Surrey





Physics-based Contributions to new Medical Techniques (PCMT) 27 November 2019, Institute of Physics, London, UK. © Univ. Surrey



