

ION ACCELERATOR BASED RESEARCH INFRASTRUCTURES EUROPEAN ION BEAM CENTERS

Stefan Facsko (HZDR), Lino de Costa Pereira (KU Leuven)
on behalf of the RADIATE consortium

also present:

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Director CMAM, Universidad Autónoma de Madrid

Rafael Garcia.-Tenorio

Director CNA, Seville

Ion Beam Center
Institute of Ion Beam Physics and Materials Research



LEAPS Workshop, Brussels, 21.02.2020

> 300 electrostatic ion accelerators worldwide (IAEA database) ($E < 200$ MeV)

~ 70 ion beam labs in Europe (incl. universities, excl. ^{14}C AMS labs)

~ 25 ion beam centers in Europe with user access

Ion Beam Analysis

Elemental and isotopic composition
Elemental concentration mapping or depth
profiles

Materials Modification

Ion implantation, doping
Semiconductor and electronic devices
Nanotechnology
Quantum Technology



History of Ion Beam EU Projects (I³)



- AIM - Center for Application of Ion Beams in Materials Research
1998 – 2010
- LEIF (FP5) - Low Energy Ion Beam Facilities: 2000 – 2004
- ITS LEIF (FP6) – Ion Technology and Spectroscopy at Low Energy Ion Beam Facilities: 2006 – 2010
- SPIRIT (FP7) – Support of Public and Industrial Research using Ion Beam Technology: 2009 - 2013
- SPIRIT 2020 – unsuccessful application in 2014
- RADIATE – Research And Development with Ion beams – Advancing Technology in Europe: 2019 – 2023

- 18 Partners: 11 ion beam centers / labs with user access
 - 4 AMS facilities
 - 3 ion beam centers / lab participating in research act.
 - 4 SMEs
- Budget: 10 Mio €
- Duration: 4 years
- Delivered beamtime: > 15.800 h
- Total person month: 795
- 73 Deliverables



Partners: Trans-National Access (TA)



Participant No	Participant organisation name	Country
1 (Coordinator)	Helmholtz-Zentrum Dresden-Rossendorf (HZDR) J. Fassbender, S. Facsko, W. Möller	Germany
4	Centre National de la Recherche Scientifique (CNRS) A. Cassimi, H. Lebius, I. Vickridge	France
5	Eidgenoessische Technische Hochschule Zurich (ETHZ) H.-A. Synal, Ch. Vockenhuber, M. Döbeli	Switzerland
7	Istituto Nazionale di Fisica Nucleare (INFN) M. Chiari	Italy
11	Jožef Stefan Institute (JSI) P. Pelicon, K. Matjaz	Slovenia
12	Jyväskylän Yliopisto (JYU) T. Sajavaraa, K. Arstila	Finland
13	Katholieke Universiteit Leuven (KUL) A. Vantomme, L. Pereira	Belgium
15	Ruđer Bošković Institute (RBI) I. Bogdanovich, M. Jaksic	Croatia
16	University of Surrey (SUR) R. Webb, J. England	United Kingdom
17	Universität der Bundeswehr München (UBW) G. Dollinger, A. Bergmeier	Germany
18	Universität Wien (UW) R. Golser, P. Steier	Austria

Partners without TA

Participant No	Participant organisation name	Country
2	Atomki Institute of the Hungarian Academy of Sciences (Atomki) I. Rajta, Z. Fülöp	Hungary
6	Interuniversity Microelectronics Centre (IMEC) J. Meersschaut	Belgium
10	Instituto Superior Técnico (IST) E. Alves	Portugal

Industrial Partners (SMEs)

Participant No	Participant organisation name	Country
3	Costruzioni Apparecchiature Elettroniche Nucleari S.p.A (CAEN) A. Iovene	Italy
8	IONOPTIKA P. Blekinsopp	United Kingdom
9	Ionplus A. Müller	Switzerland
14	Orsay Physics A. Delobbe	France

Kick-off meeting

22. January 2019



- Providing easy, flexible and efficient access - TA
- Opening Europe's ion beam facilities to users from new communities and young researchers; widening service – NA + TA
- Increasing visibility and awareness – NA
- Supporting experienced and new users – TA + NA
- Intensifying and consolidating the cooperation –NA
- Expanding cooperation with ion beam centers outside Europe – NA
- Develop and Upgrade the ion beam research infrastructures – JRA
- Consolidating and widening the access by European Industry – NA
- Cooperating with other European infrastructures – NA

TNA topic distribution			HZDR	CNRS	ETHZ	INFN	JSI	JYU	KUL	RBI	UBW	UKNIBC	UW
Category	Topic	Method	1	4	5	9	11	12	13	15	16	17	18
Analysis	Elemental Analysis & Depth Profiling	RBS											
		ERDA											
		NRA											
		PIXE / PIGE / PES											
		MEIS											
	Ultrahigh Sensitivity	Cosmogenic dating AMS											
		High-energy AMS											
		Environmental tracer AMS											
	Lateral Imaging	External microbeam IBA											
		(ambient) MeV SIMS											
		PIXE (μ -beam, camera)											
		He-Ne microscopy											
		H microscopy											
		IBIC											
	Defect Analysis	RBS/PIXE-C											
		In-situ TEM											
	Real-time in-situ Analysis	Dynamic / high-T IBA											
Implantation & Irradiation	Broad Beam	Implantation / Doping											
		Multi-beam											
		Clean environment											
	Local	Non-Ga FIB, He/Ne microscope											
		Single ion implantation											
		Cell irradiation											
	Deep	MeV ions											
		Swift heavy ions											
	Shallow	Low-energy ions											
		Highly charged ions											

 Primary Provider
  Secondary Provider



IonBeamCenters.eu aims to unite and to increase the visibility and awareness of the European ion beam community. IBC.eu aspires to become a one stop web portal for sharing information on ion beam use, publications of scientific results, as well as software and data related to ion beam research.

IonBeamCenters.eu is also home to the EU funded **RADIATE** project, which is running from 2019 to 2022 and will provide valuable scientific input and resources to the ion beam community.

OUTREACH

You can find us on Twitter [@ionbeamcenters](#)

Comments and questions are welcome on our [contact page](#).

A newsletter will be available shortly for subscription.

PUBLICATIONS

coming soon

IMPORTANT DATES & EVENTS

To view more events visit [the calendar](#)

Jan 22 2019 - Jan 23 2019

RADIATE KICK-OFF MEETING ●

HZDR

- Setup, development and operation of the Ion Beam Web Portal
- Creation of web front-ends for simulation and data analysis
- Integration of an open data management system

Home > Ion Beam Facilities

Ion Beam Facilities

IonBeamCenters.eu aims to grow this site beyond the scope of the RADIATE project and to include a comprehensive list of European (and beyond!) ion beam facilities. If you would like your ion beam center to be featured here, feel free to contact us via [e-mail](#) or via the [contact form](#).



AGOR, the Netherlands



Atomki, Hungary



CIMAP (CNRS), France



ETH Zürich, Switzerland



HZDR, Germany



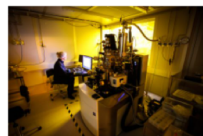
INFN, Italy



IST, Portugal



JSI, Slovenia



JYU, Finland



KU Leuven, Belgium



NPI, Czech Republic



RBI, Croatia



Surrey, UK



Uni BWL, Germany



University of Vienna,
Austria



Uppsala University,
Sweden

ABOUT IONBEAMCENTERS.EU

Ionbeamcenters.eu launched on 01 January 2019 with ion beam facilities taking part in the **RADIATE** project. Other (European) facilities are invited to be featured on IBC.eu as well to showcase European know-how and expertise in the field of ion beam physics.

RADIATE



Publications



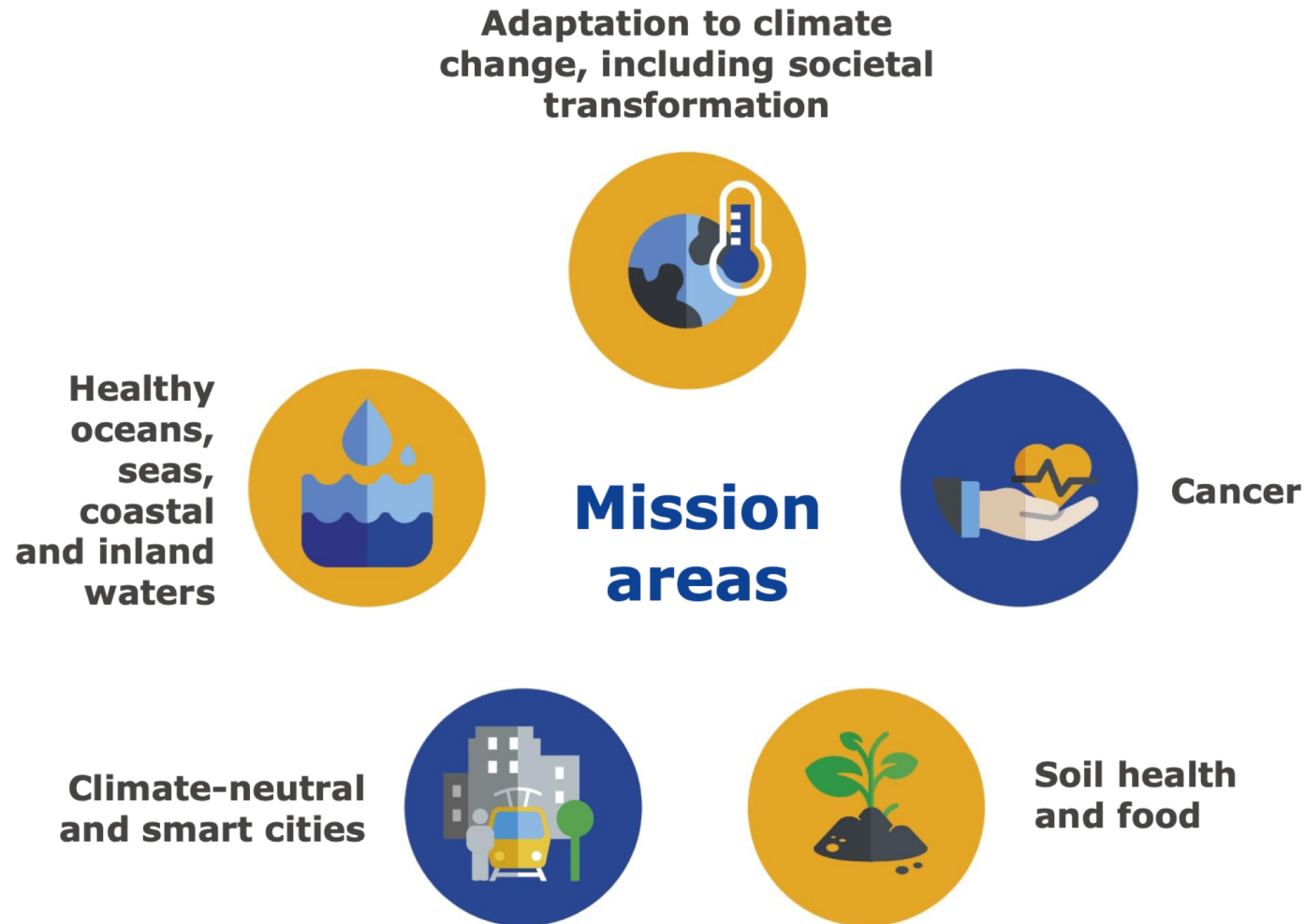
Ion Beam Software



Report Series



RADIATE Newsletter



Interdisciplinary topics

Adaptation to climate change including societal transformation

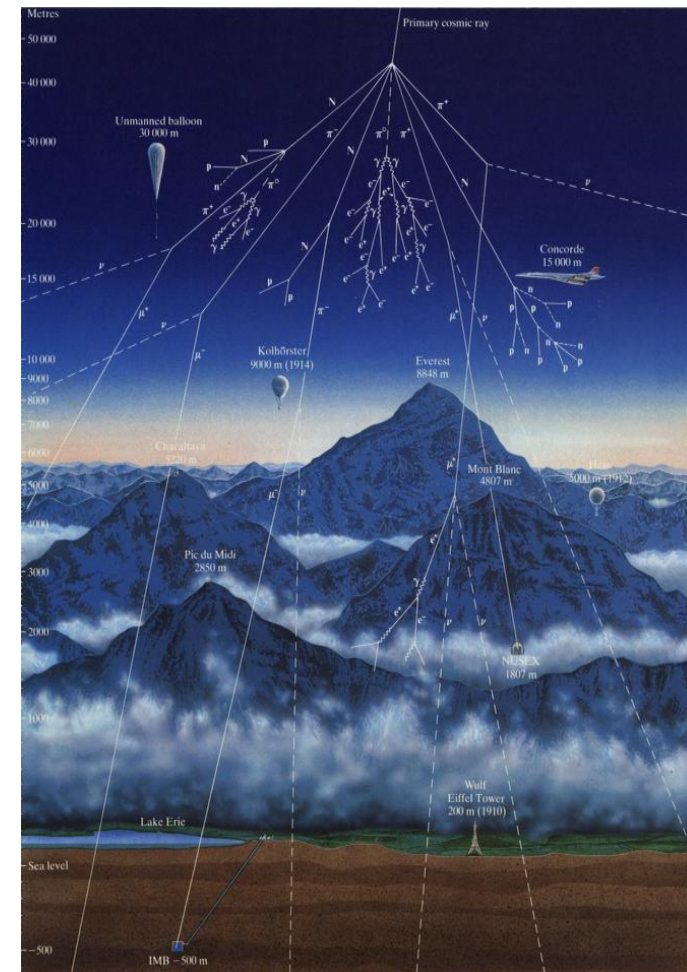
A M S
Accelerator Mass Spectrometry

Investigating the natural factors that caused climate change in the past

- Geological processes
- Glacial advance and retreat
- Meteoric impacts
- Fault movements
- Lava flows and mud slides

Outcomes:

- Understanding the past allows prediction of the future
- Collaborations with:

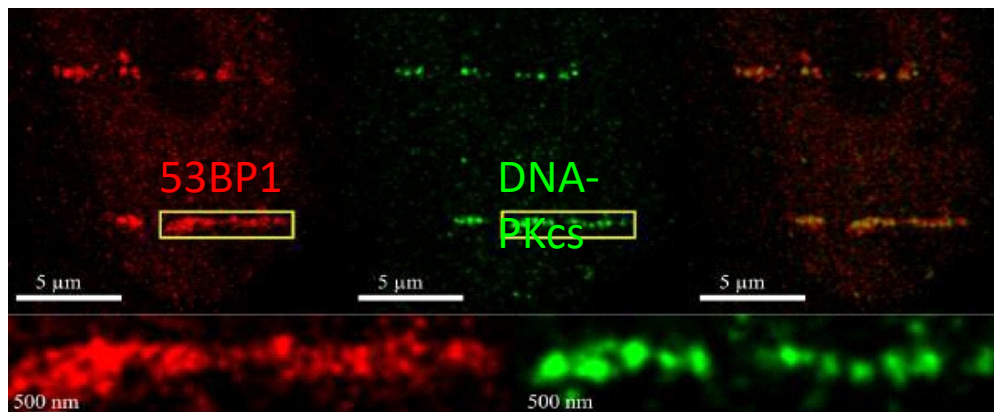


(provided by Prof. Anton Wallner, HZDR)



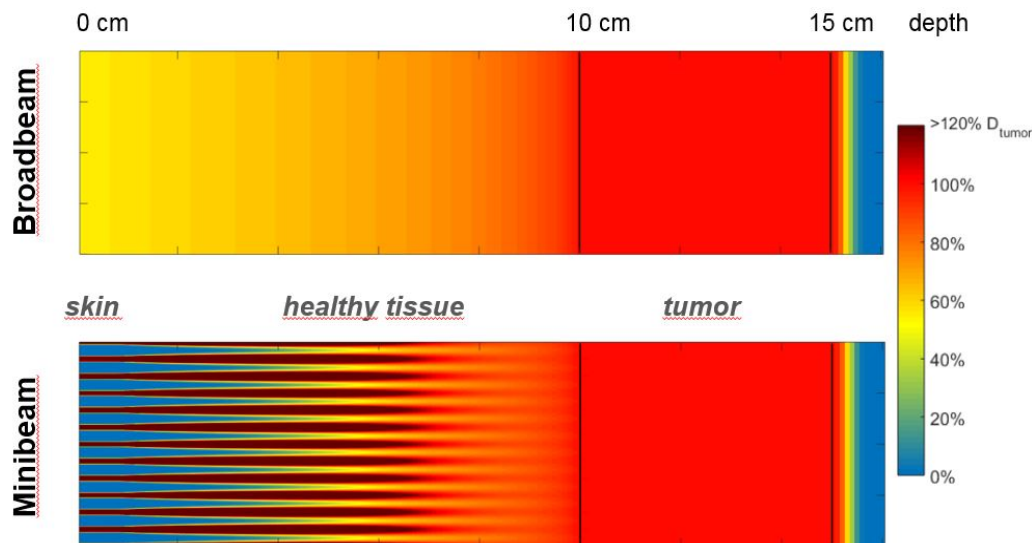
Radiation Biology: Local radiation effects in cells and repair mechanism

Detection of double strand breaks within a 27 MeV carbon ion track



J. Reindl, PhD thesis,
2017, Univ. Bundeswehr
München

Radiation Medicine: Proton Mini-Beam



M. Sammer et al,
Medical Physics 44
(2017) 6096

Climate-neutral and smart cities

Application of Ion Beam Technology



Power Electronics

(Diodes, IGBT, GTO)

Less power loss

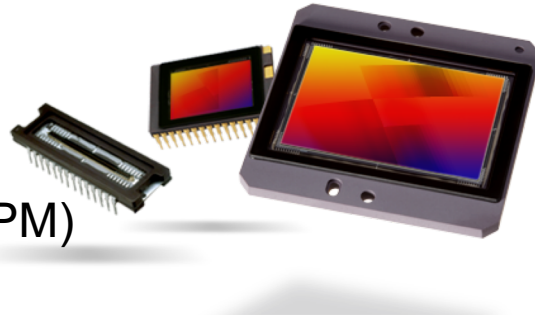
Higher switching speed

Opto-Electronics

CMOS image chips

Improved lasers

Detectors (APDs, SiPM)



Surface Engineering

(Glass, TiAl, Polymers)

Light-weight materials

Resistant displays

Nanomembranes / -filters

Collaborations with industry:

FROM



TO

R&D
Projects

Ion Beam
Services

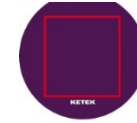
HZDR
INNOVATION

HZDR Spin-Off (2011)

Selected partners:



BOSCH
Technik fürs Leben



KETEK



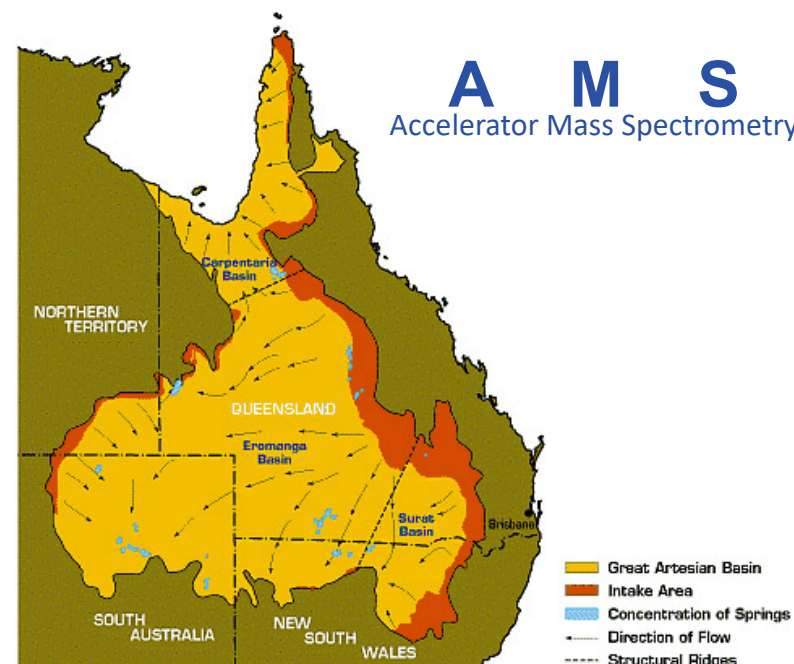
Tracking and Dating Groundwater

Determining the age and provenance of our groundwater resources

- ^{36}Cl produced by cosmic rays in the rain
- World's most sensitive measurement capability
- Date basin water residence times
- Trace groundwater flow patterns and directions
- Information on the source, origin and recharge of the aquifer

Outcomes:

- Understanding the Great Artesian Basin
- Collaborations with:



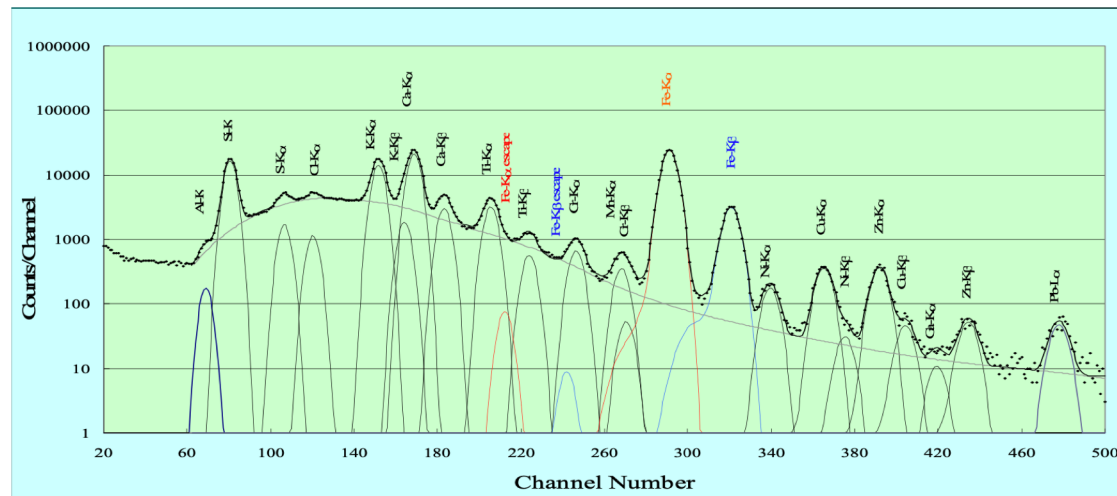
(provided by Prof. Anton Wallner, HZDR)

Soil health and food

Proton Induced X-Ray Emission (PIXE) for

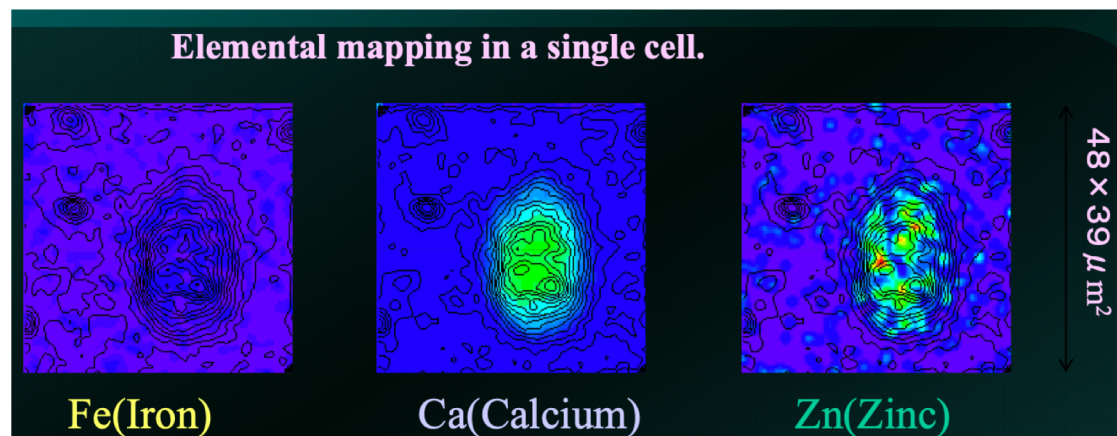
Aerosol Analysis

Soil Analysis



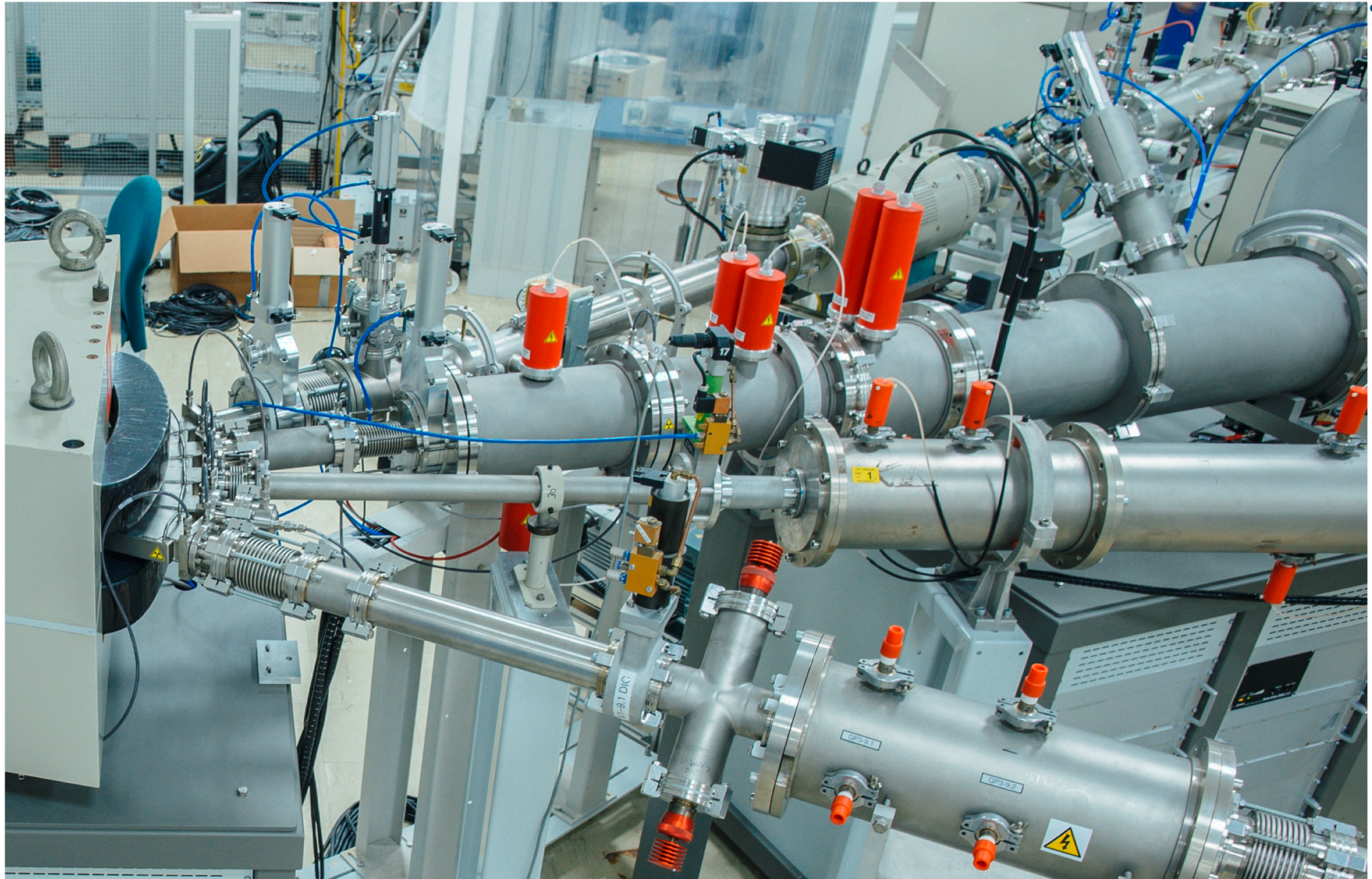
Elemental mapping with
 μm resolution

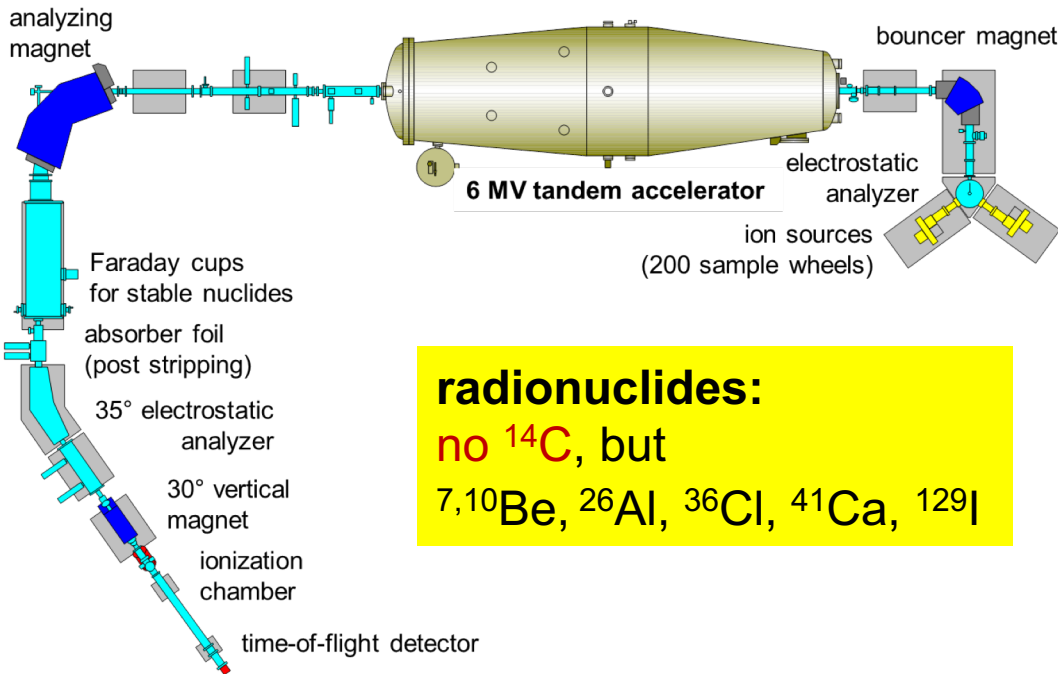
Food Analysis



Josef-Stefan Institute, Slovenia

Thank you for your attention





radionuclides:

no ^{14}C , but

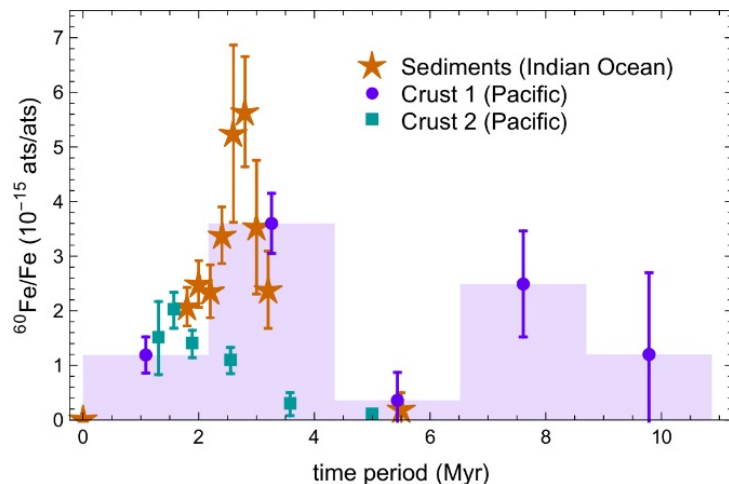
$^7,^{10}\text{Be}$, ^{26}Al , ^{36}Cl , ^{41}Ca , ^{129}I

Earth-quake triggered landslides in Himalaya region probed by ^{10}Be



W. Schwanghart et al.; Science 351, 147 (2016).

Near-earth supernovae in deep sea materials probed by ^{60}Fe (+ ^{10}Be , ^{26}Al)



Australian National University



© J. Feige, TUB.

A. Wallner et al.;
Nature **532**, 69 (2016).