AIR²
Access to INFRASTRUCTURES for Radiation protection Research

Issue 30
September 2018

Editorial

Many of you are now in the final stages of preparation for project submission to the 2018 EURATOM calls (deadline 27 September). All the necessary information on the numerous infrastructures is available in the AIR² bulletins and in the AIR²D² database. Open access and data management are an important part of the proposal, and the STORE platform is available to meet these needs. STORE is a database for archiving and sharing of primary data and outputs of all kinds, including epidemiological and experimental data from research on the effects of radiation. Don't forget that STORE will be all the more useful if associated with your data management from the beginning of the project. So make your data Open and FAIR (Findable, Accessible, Interoperable, Reusable).

Dr Laure Sabatier, CEA

The floor to...

VUJE was established in Slovakia in 1977 as a state research institute, and in 1994 was transformed into a joint stock company. Since the beginning of the 21st century, emergency and post-accident management, as well as preparedness processes, have been at the origin of stakeholder involvement activities in the area of nuclear or radiological emergency and post-accident recovery, both in the context of the European Commission Framework Programmes and independently.

VUJE's role in building capabilities, trust and confidence in radiation protection issues

As a national project coordinator, VUJE has been actively involved in the development and implementation of decision support systems, the preparation and conduct of International Nuclear Emergency Exercises (INEX), and the development and implementation of training courses and workshops on preparedness and response to nuclear or radiological emergences and post-accident and recovery management. Key activities over the last decades have focused on the building of capabilities, trust and confidence in radiation protection issues including stakeholder involvement, and on the establishment of a stakeholder panel in Slovakia and the facilitation of multi-stakeholder processes.

Following agreement by the Public Health Authority of the Slovak Republic, VUJE was mandated by the NRA SR as a Programme Manager in the CONCERT project and is actively involved in the majority of the CONCERT activities. As a supporting organisation of the NERIS Platform and a member of the NERIS Management Board, VUJE contributes actively to the development of the NERIS Strategic Research Agenda (SRA) and to the Social Sciences and Humanities SRA (WP2), as well as to the development of a Joint Roadmap (WP3).

The valuable long-term experience and research results of VUJE contribute to the success of WP5 activities in the area of stakeholder involvement and communication in radiation protection research. Education and training, as an essential part of dissemination and knowledge management, is one of the key activities of VUJE in WP7. In addition, VUJE actively contributes to WP9 through its participation in the CONCERT research projects, CONFIDENCE and ENGAGE.

Tatiana Duranova
VUJE
CONCERT WP2, WP3, WP5, WP7, WP9, CONFIDENCE & ENGAGE

Photo: Tatiana Duranova/VUJE

CONCERT CORNER

Future events:

October 3rd 2018
ExB/ESAB

October 4th 2018
MB meeting

Call for Travel Grants
Next deadline: 30th September 2018
Information

WP 6 News:

October 2nd 2018
WP6 meeting at Rovinj
Information:
jean-michel.dolo@cea.fr

The first version of CONCERT's Web-handbook (D6.4) is now online!

AIR²D²:
- Please complete the online form(s) to register your infrastructure(s) in the database.

Follow STORE on Twitter: @STOREDatabase

Follow the TERRITORIES PROJECT BLOG
https://territoriesweb.wordpr

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October 2018

This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 662287

HIT

Platform for experiments with scanned ion beams

The Heidelberg Ion-Beam Therapy Centre (HIT for short) is part of the University Hospital of Heidelberg in Germany, and is strategically located at only 45 minutes from Frankfurt airport. It serves to provide tumour therapy with light ions. Approximately 750 patients per year are treated with proton and carbon ion beams, and it is planned to introduce helium treatments in the near future. The Centre also has extensive experience in treating children and adolescents.

The beam application system is based on the technology of intensity-modulated raster scanning which allows maximal flexibility for the 3D distribution of radiation dose. In terms of measurements, several trigger signals are available as well as an online oscillograph for beam position, focus, intensity and many other parameters.

Photo: HIT

Prof. T. Haberer & Prof. J. Debus

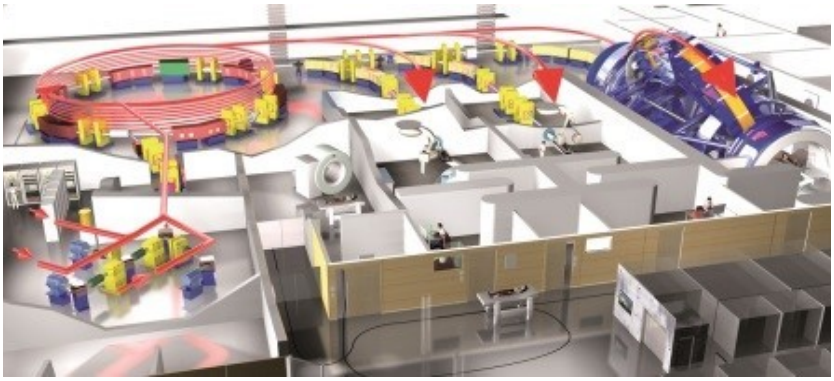


Photo: HIT

Schematic view of the therapy system. The experimental room is not visible but is located in the upper right corner of the diagramme.

Biological experiments can be performed in the experimental room (classified as an S1 lab) and are frequently done with cells, mice and rats. Labs are also available on-site, and access is subject to prior agreement. Local support personnel (physicists, radiobiologists, etc.) can also be provided.

Treatments take place in three dedicated treatment rooms, two of which have a horizontal beamline (fixed beam rooms) and the third is equipped with the world's first ion beam gantry, which allows treatment from every direction. In addition to the three treatment rooms, HIT has an experimental room with a technically identical beamline and beam-monitoring system. This room is typically available for conducting experiments during the night (23:00 – 05:00) and at weekends.

The cost of beam time is approximately €1300 per hour. Applications for beam time are evaluated by HIT and should be sent to Proposal.HIT@med.uni-heidelberg.de.

Before submitting an application, an informal contact would be helpful for both sides (see ID Card for local contact points).

Acceleration is done with a synchrotron; beam extraction is slow and therefore a continuous beam can be extracted for 5 s per ring filling. Approximately 420 full cycles per hour are available. ^{1}H, ^{4}He, ^{12}C and ^{16}O are provided in 255 energy levels corresponding to a penetration depth in water of 20-300 mm. Several intensities are preconfigured for each ion species with maximum values appropriate for a dose of 1 Gy/l/min; lower intensities can be provided upon request. Beam shape is Gaussian pencil beam with typical FWHM of 4-30 mm.

Photo: HIT

Beam exit with scanning nozzle in the experimental room

ID Card:

Exposure type:
Intensity Modulated Scanned Pencil Beam

Source:
Synchrotron

Dose rate:
Adjustable, customised, typically up to 10^9 particles/s or 1 Gy/l/min

Irradiation type:
^{1}H, ^{4}He, ^{12}C, ^{16}O

Irradiated organism type:
Cells
Mice, rats, etc. subject to prior discussion

Address:
Im Neuenheimer Feld 450
69120 Heidelberg
Germany

Access:
Selection Committee (HIT)

Supporting lab:
Technical support on site.
Bio labs on site, availability to be discussed in advance.

Internet link:
www.hit-centrum.de

Contact:
Prof. Thomas Haberer
Thomas.Haberer@med.uni-heidelberg.de

Applications to:
Proposal.HIT@med.uni-heidelberg.de

Involved in:
CORA IBER (ESA)

Related to:
EURAMED

The Heidelberg Ion Therapy Center, Haberer Th., Debus J., Eickhoff H., Jäkel O., Schulz-Ertner D., Weber U. (2004), Radiother Oncol, 73 (Suppl. 2), S186-S190

Particle therapy at the Heidelberg Ion Therapy Center (HIT), Combs S. E., Jäkel O., Haberer Th., Debus J. (2010), Radiother Oncol, 95 (1), 41-44

The TRACY cohort

A French cohort of uranium workers with detailed risk factors data

Cohorts of workers monitored for internal contamination have a strong potential for solving several current key questions in radiation protection, in particular on the effects of protracted low-dose and internal exposure to ionising radiation, the different types of radiation (e.g.: α, γ) and the heterogeneity of energy deposition. Uranium (U) is one of the internal emitters most frequently encountered in occupational exposure situations. However, the potential health effects of chronic exposure to U are not well characterised. This is notably due to the complexity of reconstructing individual doses from U exposure, as compared to external exposure, and to the rarity of large cohorts that provide such information.

The TRACY (TRAvailleurs du CYcle) cohort includes 12,649 workers involved in various activities throughout the nuclear fuel production cycle in France, i.e. purification and conversion of natural U, enrichment of U, fuel manufacturing and activities such as storage and decontamination. The TRACY study is conducted in the context of a collaboration between IRSN and ORANO, with agreement from the French Data Protection Authority (CNIL). Vital status, dates and causes of death (from both cancer and non-cancer causes) have been obtained from national registries for the period 1968-2008, and this follow-up is being extended. Specific efforts are devoted to the reconstruction of lifetime internal dosimetry following U exposure.

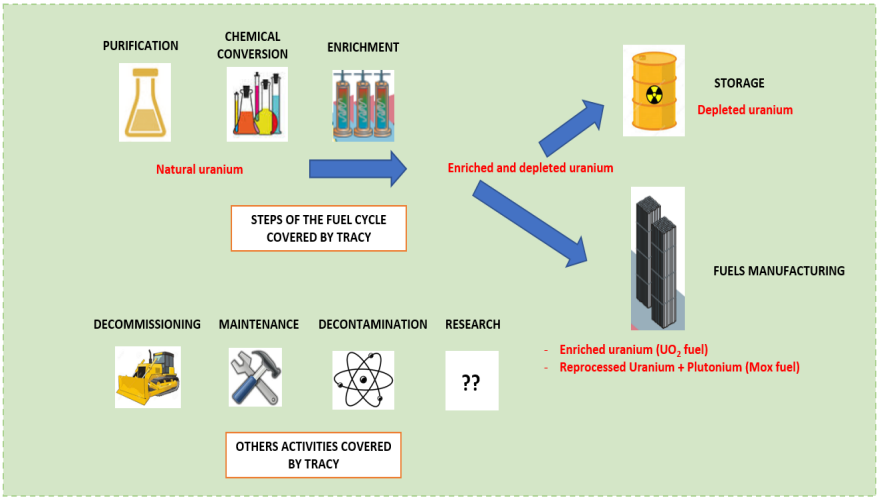
Job exposure matrices have been developed to characterise exposure to various types of U compounds (chemical forms, isotopic compositions …) and also, for more than 5,000 workers, to non-radiological occupational risk factors. Bioassay data on U exposure monitoring and records of external doses are progressively being collected from medical records and computerised. Protocols for internal dose reconstruction, developed in collaboration with other European research groups as part of the DoReMi Concerted Uranium Research in Europe (CURE) project, have also been applied and refined. In addition, methodological developments are underway in close collaboration with dosimetrists, biostatisticians and epidemiologists to account for dosimetric uncertainties in the estimation of dose-risk relationships.

Photo: IRSN

Eric Samson

Information on individual risk factors noted in medical records (e.g. smoking, body mass index, blood pressure, diabetes, cholesterol, glycemia and other blood parameters) have been computerised for 4,500 workers and this collection of data is being extended to the entire cohort. Such data will be valuable for exploring the potential influence of individual risk factors on dose-risk relationships. A nested case-control study of mortality from circulatory diseases has already been conducted using this data, and similar studies are being performed as part of a larger cohort analysis. In the long term, the TRACY cohort will help to improve characterisation of the health effects of occupational U exposure, and more generally of α-particles and low doses of ionising radiation.

Figure: IRSN



Main steps of the nuclear fuel cycle and related activities covered by the TRACY cohort

ID Card:

Cohort type:
Individual data on 12,649 workers employed between 1958 and 2006 in French companies involved in the production of nuclear fuel.

Workers monitored for external gamma and internal alpha-radiation from uranium exposure at low doses over prolonged periods.

Age:
At exposure: 18-65 years
Attained: the mean age at the end of the current follow-up (to end of 2008) is 60 years. The follow-up is being extended.

Biobank available:
No, but full protocol developed as part of the Concerted Uranium Research in Europe (CURE) DoReMi FP7 project

Address:
Institut de Radioprotection et de Sûreté Nucléaire - IRSN

31 Avenue de la Division Leclerc
92260 Fontenay-aux-Roses
France

Access:
Access to the data is restricted according to rules defined by the French Data Protection Authority (CNIL)—agreement number DR-2012-611. The principal investigator can be contacted to explore opportunities for scientific collaboration.

Internet link:
http://www.irsn.fr/FR/Larecherche/Organisation/equipes/radioprotection-homme/Lepid/Pages/Lepid-cohorte-Tracy.aspx#.W3pq5gNOKUk

Contact:
Eric Samson
eric.samson@irsn.fr
+33 1 58 35 83 33

Involved in:
CURE

Related to:
MELODI

Cancer and non-cancer mortality among French uranium cycle workers: the TRACY cohort, Samson E., Piot I., Zhivin S., Richardson D. B., Laroche P., Serond A. P., Laurier D., Laurent O. (2016), BMJ Open, 6 (4): e010316
Circulatory disease in French nuclear fuel cycle workers chronically exposed to uranium: a nested case-control study, Zhivin S., Guseva Canu I., Davesne E., Blanchardon E., Garsi J. P., Samson E., Niogret C., Zablotska L. B., Laurier D. (2018), Occup Environ Med, 75 (4), 270–276

COOLER

COmputation Of Local Electron Release

The effects of ionising radiation are typically summarised by Relative Biological Effectiveness (RBE) values. They guide the selection of radiation weighting factors, which are adopted in radiation protection and sometimes by legal regulations to estimate risks. Since RBE is defined as the ratio of the absorbed doses required by two radiations to cause the same effect, it is extremely important to be able to calculate precise dose values.

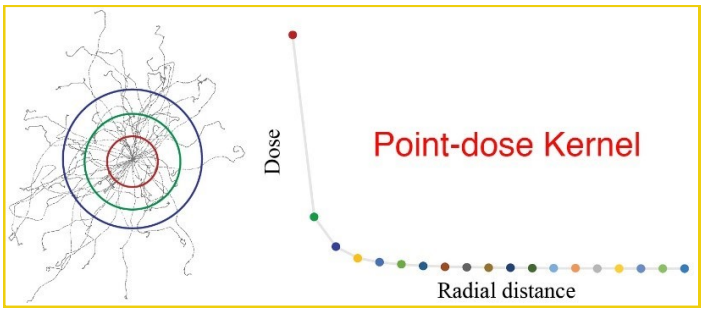


Photo: Mattia Siragusa/DTU-Nutech

Multiple electron tracks are generated in water, isotropically from a point source, using the Monte Carlo track structure code PARTRAC. The amount of energy delivered within consecutive spherical shells, concentric with the source, is scored and then divided by the volume of the corresponding shells. In COOLER, this is called a point-dose kernel.

Thanks to a partnership between The Hevesy Laboratory at The Technical University of Denmark and the Radiation Biophysics and Radiobiology group at the University of Pavia, a new tool, named COOLER, has been defined for dosimetry assessment at the subcellular scale. This tool is suitable to convert given distributions of administered low-energy electron-emitting radionuclides to radiation doses, a critical step in risk/benefit analysis for advancements in internal radiotherapy.

COOLER provides absorbed dose values *via* convolution of a geometrical term with a physical one. The geometrical part includes information on the cell type (e.g. the growing condition, the nuclear and cellular diameters ...) and the activity distribution. The physical term contains Monte Carlo-derived stopping power information which has been tabulated and stored in COOLER in the form of monoenergetic point-dose kernels. In its current version, the software can handle electron energies up to 50 keV. In addition, it contains (but it is not limited to) cellular models that ideally represent V79 cells, cultured under adherent or suspension growing conditions.

Photo: Personal archive

Dr Mattia Siragusa

COOLER has been developed from monoenergetic electron sources, but it can also work with beta decay spectra. Extension of the code to other particles is possible, as well as to radionuclides that generate mixed field radiation or initiate a decay chain, provided that decay and spatial energy deposition data are implemented. As Monte Carlo codes are sometimes beyond the practical reach of the preclinical and clinical researcher, the use of analytical tools such as COOLER should be preferred.

COOLER is a valuable tool for experiments carried out on living cells. In a recent application, it was used by the authors to study a realistic case of cellular contamination with tritiated water, that is, a radioactive form of water where stable H atoms are replaced with tritium. The software was employed to investigate the cell growing conditions and the tritium full beta-decay spectrum impact on absorbed doses, and subsequently on the RBE for clonogenic cell survival experiments.

To summarise, COOLER can perform accurate absorbed dose calculations for different cellular models, electron energy inputs and activity distributions. Hopefully this tool, and future versions of it, will be of benefit to research projects aimed at assessing the role of low-energy electrons in, for example, therapeutic applications and radiation protection scenarios.

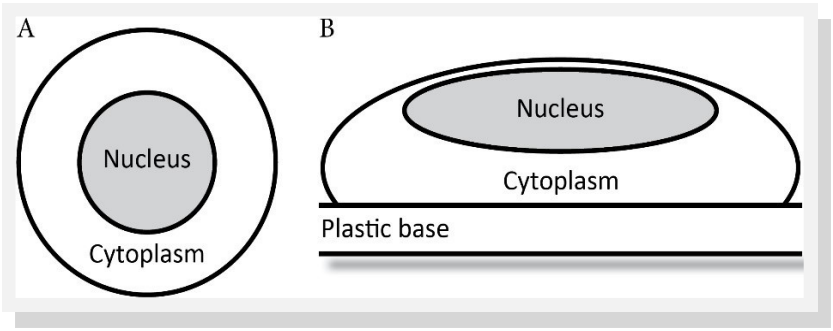


Photo: Mattia Siragusa/DTU-Nutech

Schematic representation of the cellular geometries included in COOLER. The suspension cell is spherical (panel A), while the adherent cell (panel B) is represented as an ellipsoid with the cytoplasm deformed by attachment to the cell culture flask; the nucleus is considered an ellipsoid.

ID Card:

Purpose:
General purpose: Absorbed dose calculation tool for subcellular energy depositions by internal electron emitters

Use:
Anyone familiar with MATLAB

Housed at:
Software repository at DTU-Nutech

Training proposed on the software:
On request

Access:
Open access. Licensed under the terms of the MIT licence

Internet link:
www.nutech.dtu.dk/english/research/medical-isotopes/open-source-software

Contact:
Dr Mattia Siragusa
masir@dtu.dk

Related to:
MELODI
EURADOS
EURAMED

The COOLER code: a novel analytical approach to calculate subcellular energy deposition by internal electron emitters, Siragusa M., Baiocco G., Fredericia P. M., Friedland W., Groesser T., Ottolenghi A., Jensen M. (2017), Radiat Res, 188 (2), 204–220
Radiobiological effects of tritiated water short-term exposure on V79 clonogenic cell survival, Siragusa M., Fredericia P. M., Jensen M., Groesser T. (2018), Int J Radiat Biol, 94 (2), 157-165

AIR²

Access to INFRASTRUCTURES for Radiation protection Research

Issue	Exposure platforms	Databases, Sample banks, Cohorts	Analytical platforms, Models & Tools
Published to date:			
Oct 2015, #1	FIGARO	FREDERICA	RENEB
Nov 2015, #2	B3, Animal Contamination Facility	The Wismut Cohort and Biobank	The Hungarian Genomics Research Network
Dec 2015, #3	Pulex Cosmic Silence	STORE	METABOHUB
Feb 2016, #4	SNAKE	French Haemangioma Cohort and Biobank	Dose Estimate, CABAS, NETA
Mar 2016, #5	Radon exposure chamber	3-Generations exposure study	PROFI
Apr 2016, #6	Biological Irradiation Facility	Wildlife TransferDatabase	Radiobiology and immunology platform (CTU-FBME)
May2016, #7	CIRIL	Portuguese Tinea Capitis Cohort	LDRadStatsNet
Jun 2016, #8	Mixed alpha and X-ray exposure facility	Elfe Cohort	ERICA Tool
Jul 2016, #9	SCRS-GIG	RES³T	CROM-8
Sep 2016, #10	Facility radionuclides availability, transfer and migration	INWORKS cohort	France Génomique
Oct 2016 #11	LIBIS gamma low dose rate facility ISS	JANUS	Transcriptomics platform SCKCEN
Nov 2016, #12	Microtron laboratory	EPI-CT Scan cohort	CATI
Dec 2016, #13	Nanoparticle Inhalation Facility	UEF Biobanking	The Analytical Platform of the PREPARE project
Feb 2017, #14	Infrastructure for retrospective radon & thoron dosimetry	Chernobyl Tissue Bank	HZDR Radioanalytical Laboratories
Special Issue 1	1st CONCERT Call: CONFIDENCE, LDLensRad, TERRITORIES	1st CONCERT Call: CONFIDENCE, LDLensRad, TERRITORIES	1st CONCERT Call: CONFIDENCE, LDLensRad, TERRITORIES
Mar 2017, #15	Alpha Particles Irradiator Calibration Laboratory at KIT		SYMBIOSE
Apr 2017, #16	Changing Dose rate (SU) Low dose rate (SU)		Advanced Technologies Network Center
May 2017, #17	Chernobyl Exclusion Zone	Chernobyl clean-up workers from Latvia	BfS whole and partial body Counting
Jun 2017, #18	MELAF	Belgian Soil Collection	INFRAFONTIER
Jul 2017, #19	MICADO'LAB	Estchern Cohort	ECORITME
Sep 2017, #20	DOS NDS		CERES

Future events:

Other Events

21 September 2018
TREE project dissemination event, London, UK

27 September 2018
Webinar on the Implementation of the International Commission on Radiological Protection (ICRP) Dose Limits for the Lens of the Eye

1-5 October 2018
3rd ERPW, Rovinj Rovigno, Croatia

8-11 October 2018
HEIR 2018: 12th International Conference on the health effects after intake of Radionuclides, Fontenay-aux-roses, France

8-12 October 2018
NKS-B RadWorkshop 2018: Workshop on Radioanalytical Chemistry for Nuclear Decommissioning and Waste Management, Roskilde, Denmark

22-25 October 2018
MODARIA II (Modelling and Data for Radiological Impact Assessments) - Third technical meeting, Vienna, Austria

29-31 October 2018
3rd Geant4 International User Conference at the Physics-Medicine-Biology frontier, Bordeaux, France

Editorial Committee: Maria Panagiotopoulou, Jean-Michel Dolo, Elisabeth May, Laure Sabatier

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AIR2

Access to INFRASTRUCTURES for Radiation protection Research

Issue	Exposure platforms	Databases, Sample banks, Cohorts	Analytical platforms, Models & Tools
Published to date:			
Oct 2017, #21	CALLAB Radon Calibration Laboratory		CORIF
Nov 2017, #22	Calibration and Dosimetry Laboratory (INTE-UPC)	German airline crew cohort	Centre for Omic Sciences (COS)
Dec 2017, #23	NMG	Techa River Cohort (TRC)	iGE3
Special Issue 2	MEDIRAD	MEDIRAD	MEDIRAD
Feb 2018, #24	UNIPI-AmBe	Greek interventional cardiologists cohort	SNAP
Special Issue 3	2nd CONCERT Call: LEU-TRACK, PODIUM, SEPARATE, VERIDIC, ENGAGE, SHAMISEN-SINGS	2nd CONCERT Call: L EU-TRACK, PODIUM, SEPARATE, VERIDIC, ENGAGE, SHAMISEN-SINGS	2nd CONCERT Call: LEU-TRACK, PODIUM, SEPARATE, VERIDIC, ENGAGE, SHAMISEN-SINGS
Mar 2018, #25	IRRAD	MARiS	BIANCA
Apr 2018, #26	Forest observatory site in Yamakiya	BBM	OEDIPE
May 2018, #27	Belgian NORM Observatory Site	The German Thorotrast Cohort Study	VIB Proteomics Core
Jun 2018, #28	CERF	Mayak PA worker cohort	Geant4-DNA
Jul 2018, #29	TIFPA	RHRTR	D-DAT
Sep 2018, #30	HIT	The TRACY cohort	COOLER
Coming soon:			
Oct 2018, #31	To Be Announced	To Be Announced	To Be Announced

Future events:

Other Events

6-9 November 2018
15th SPERA Conference: South Pacific Environmental Radioactivity Association, Perth, Australia

9-25 January 2019
Radioecology Courses 2019 - NMBU, Aas, Norway
Contact:
Ole Christian Lind
olelin@nmbu.no

3-5 April 2019
5th NERIS Workshop & 10th General Assembly, Roskilde, Denmark

13-16 May 2019
Confidence training course
Use of uncertain information by decision makers at the various levels within the decision making process and its Communication, VUJE, Trnava, Slovak Republic

27-31 May 2019
ICDA-3: 3rd International Conference on Dosimetry, Lisbon, Portugal

See also on CONCERT website

Editorial Committee: Maria Panagiotopoulou, Jean-Michel Dolo, Elisabeth May, Laure Sabatier

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