AIR²
Access to INFRASTRUCTURES for Radiation protection Research

Issue 29
July 2018

Editorial

This is the last issue before the summer break. Summertime, although favourable to rest, is also intense in scientific events. Here are a few that I will be attending to present, among other things, the Radiation Protection Research Infrastructures: COSPAR2018 (Committee on Space Research) in Pasadena, USA (14-21 July); ERR2018 (European Radiation Research Congress) in Pecs, Hungary (21-25 August), and a little later, ERPW2018 (3rd European Radiological Protection Research Week) in Rovinj, Croatia (1-5 October). But there are many more events taking place with opportunities for everyone to present the AIR² newsletter and the AIR²D² database. To facilitate this, Maria has prepared a slide that you can show at the end of your presentations, downloadable from: http://www.concert-h2020.eu/en/Concert_info/Access_Infrastructures.

Wishing you a great summer and exciting meetings!

Dr Laure Sabatier, CEA

The floor to...

The Bulgarian National Centre for Radiobiology and Radiation Protection (NCRRP) was established in 1963 as a specialised body of the Bulgarian Ministry of Health.

Its main activities include research and training, health and environmental monitoring, radiation and health control in nuclear energy, national dosimetry system and register, measure of radioactive substances in the body, control of public exposure and risk assessment, biomonitoring of radiation-exposed population groups, radiation protection from medical exposure, biological dosimetry and food irradiation control.

NCRRP's role in Radiation Protection research and Education and Training in Bulgaria and beyond

NCRRP comprises the following facilities:

- Radiation Expertise and Radon Monitoring Laboratory, which focuses on the assessment of radon exposure in the Bulgarian population through large-scale national surveys on radon levels in residential and public buildings
- Public Exposure Monitoring Laboratory, responsible for monitoring the radioactivity levels of radiological sites, and of water, milk, food, etc
- Dosimetry Control Laboratory, consisting of four irradiation facilities equipped with ^{60}Co, ^{137}Cs and X-ray sources
- Laboratory for Protection from Medical Radiation Exposure, which carries out national surveys on patient doses, estimates the collective effective dose to the population from medical exposure and performs routine quality control and dosimetry measurements on medical equipment
- Department of Radiobiology, with a long experience in biomonitoring of workers occupationally-exposed to ionizing radiation, biological dosimetry following radiation accidents and in experimental research on radiation-induced chromosomal aberrations. This Department has participated in many national and international collaborative research projects (e.g. RENEB, WHO BioDoseNet)
- Radiation Medicine and Emergency Department, which is responsible for prophylactic radiation medicine and radiation pathology in Bulgaria
- Department of Education and Research, which offers education and training for Master's and PhD students in the fields of Radiobiology, Medical Physics and Radiation Hygiene, but also offers courses for professionals such as medical doctors, biologists, physicists and chemists.

In CONCERT, NCRRP contributes to WP7, offering training courses and seminars in the above fields. In addition, NCRRP publishes and distributes newsletters, manuals and informative materials for the benefit of the society.

Dr Valeria Hadjidekova
Director of NCRRP
&
Dr Galina Makedonska
Deputy Director of NCRRP
CONCERT WP7

Photo: NCRRP

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.wordpress.com/

Contents:

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September 2018

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

TIFPA

Trento Institute for Fundamental Physics and Applications

The TIFPA (Trento Institute for Fundamental Physics and Applications) proton irradiation facility is embedded in the Trento Proton Therapy Centre, Italy, which started clinical operations in October 2014 and has already treated more than 300 patients.

Photo: TIFPA

Photo showing the two sub-branches of the Trento proton irradiation facility, namely the 0° line (left) and 30° line (right)

The TIFPA facility comprises an experimental area dedicated to a large spectrum of scientific applications including medical physics, detector testing, radiation hardness measurements, space research and radiobiology. Following an institutional agreement with APSS, the beam is available in the experimental room outside of clinical operation hours. Research activities are managed and supervised by TIFPA, which is part of the Italian National Institute for Nuclear Physics (INFN). Access to the research beam line is open to external users in the context of scientific collaborations or industrial applications, subject to acceptance by the Programme Advisory Committee.

Proton beam production and transport at the Trento facility are under the responsibility of the company IBA (Ion Beam Applications, Louvain-La-Neuve, Belgium), which produced and installed the related infrastructure. The cyclotron (IBA Proteus 235) accelerates the beam to a maximum energy of 228 MeV. Shortly after the cyclotron exit, an energy selection system allows fine selection of the desired energy in a range down to 70 MeV. Two branches of the main line transport the beam to the gantries, while a third branch connects it to the experimental room. Different beam intensities can be requested at the exit of the cyclotron, ranging from 1 to 320 nA. Transport efficiency depends on the energy and ranges from 0.1 to 10%. Interestingly, in addition to the above conventional intensities, it is possible to deliver low beam intensities (i.e. fluxes in the order of 10^1-10^5 particles/s) needed for a broad spectrum of basic physics experiments by operating the accelerator in "dark current" mode.

The experimental area consists of two different spaces: a multi-functional preparation room and an irradiation cave where the beam line is split into two sub-branches, referred to respectively as the "Biology" and "Physics" beam lines. A fixed pencil beam is available at the Physics line with same energy range as the clinical beams (70 to 228 MeV), with spot size ranging from about 1 to 3 cm in diameter (Gaussian FWHM). In contrast, a double-ring passive scattering system is installed at the Biology line, which is used for *in vitro* radiobiology experiments. This allows a 90% dose homogeneity to be obtained over an extended area (6-8 cm in diameter), with an adjustable dose rate of up to about 2 Gy/min. Lasers are available for target alignment at 1.25 m from the exit window, defined as "isocenter" in analogy to the treatment rooms. Tables with adjustable heights are used for target positioning. In the first few years of activity, over 30 experiments have been performed for different Italian and European partners, ranging from basic physics to space protection and radiobiology.

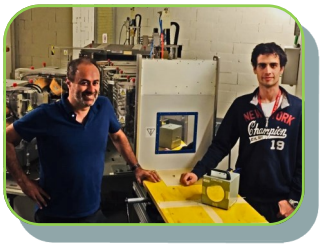
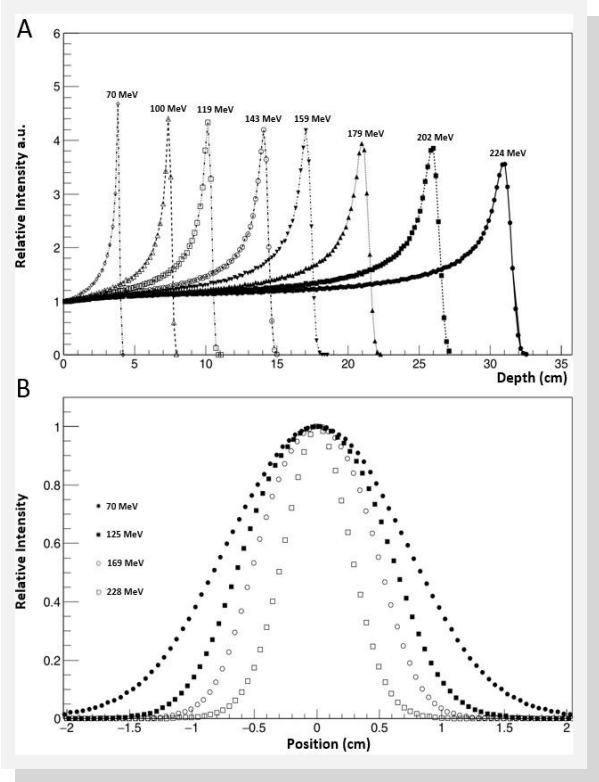


Photo: TIFPA

E. Scifoni F. Tommasino



Summary of the properties of the proton beam in air at the 30° beam line. Bragg curves (A) and Spot profiles (B) at representative energies (Tommasino et al. 2017)

Proton beam characterization in the experimental room of the Trento Proton Therapy facility, Tommasino F., Rovituso M., Fabiano S., Piffer S., Manea C., Lorentini S., Lanzone S., Wang Z., Pasini M., Burger W. J., La Tessa C., Scifoni E. et al. (2017), Nucl. Instrum. Methods Phys. Res., 869, 15-20

Study for a passive scattering line dedicated to radiobiology experiments at the Trento Proton Therapy Center, Tommasino F. et al. submitted to Radiat. Prot. Dosim.– Proceedings MICROS 2017

ID Card:

Exposure type:
External Radiation

Source:
Cyclotron, Accelerated Protons (70 -225 MeV)

Dose rate:
0.1-2 Gy/min

Irradiation type:
Horizontal proton beam

Irradiated organism type:
Cell cultures – Application in progress for small animals

Address:
via Al Desert 14
38123 Trento
Italy

Access:
Programme Advisory Committee (PAC):
http://www.tifpa.infn.it/sc-init/med-tech/p-beam-research/

Access fee applies

Supporting lab:
Cell culture lab. Possible access to other biological laboratories at the University of Trento

Internet link:
http://www.tifpa.infn.it/sc-init/med-tech/p-beam-research/

Contact:
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Involved in:
MoVe IT
FOOT
ESA Core ground-based facility

Related to:
MELODI, EURADOS

Russian Human Radiobiological Tissue Repository (RHRTR)

A unique resource for studies of radiation-exposed workers

A cohort of workers from the Russian atomic industry facility, the Mayak Production Association (PA), located in the Southern Urals close to the city of Ozyorsk, constitutes a unique research resource. The advantages of this cohort include its large size, extensive follow-up period (70 years), individual measured doses from a wide-range of external and internal radiation exposures, sex/age/ethnicity/initial health status heterogeneity, complete data on health effects and vital status, and available information on non-radiation risk factors. One of the main advantages of this cohort is the availability of biological samples from 25% of the cohort members.

Photo: SUBI

Preparation of biological samples for analyses in the laboratory of SUBI clinical department

A collection of biological samples (organs and tissues fixed in formalin and embedded and stored as paraffin blocks and histology slides) was initiated in 1970. The Human Radiobiological Tissue Repository (abbreviation RHRTR) has been significantly extended since 1998 thanks to a Russian-US research collaboration.

Currently, the Repository of the Southern Urals Biophysics Institute (SUBI) stores about 350,000 biological specimens from 9,560 donors (3,460 samples from males and 6,100 samples from females) who were Mayak PA workers and residents of Ozyorsk located close to the nuclear facility. The Table on the right presents the types of biological material and storage conditions.

Photo: SUBI

Dr Tamara V. Azizova

Each biospecimen is labelled with a barcode which provides a unique identification number, linking the sample to information about the donor, the sample type, date of collection, storage location and conditions, etc.

Importantly, the complete demographic information and medical data collected throughout the entire follow-up period is available for each donor, as well as data on occupational history, individual measured annual doses from external and internal radiation provided for 18 organs and tissues, and data on non-radiation risk factors such as smoking, alcohol consumption, height, weight, etc. These data are contained in the "Clinic" medical and dosimetry database. Notably, all techniques employed for collection, extraction, preparation and storage of biological specimens are based on, and comply with, standard operating protocols for certified laboratories.

The "Clinic" medical and dosimetry database and the Repository of biological specimens from the Mayak PA worker cohort constitute a unique resource for potential research which aims to investigate the biological mechanisms of radiation-induced cancer and non-cancer outcomes, to study individual radiosensitivity, and to identity biological markers of radiation exposure, etc., in individuals exposed to low-dose ionising radiation over prolonged periods.

Biosample type	Registrants		Storage conditions
	Mayak PA workers	Non-Mayak PA workers	
Tumour and non-tumour tissues	1,015	480	-80°C; formalin; paraffin-embedded blocks; histology slides
Peripheral blood and its components (whole blood, plasma, serum, leukocytes, lymphocytes, erythrocytes)	7,194	709	-80°C
DNA	6,426	482	-80°C
Other tissues (buccal epithelial cells, suspension and supernatant of induced sputum)	1,575	111	-80°C

Types of biological specimens stored in the SUBI Repository

ID Card:

Organism type of sample:
Humans (radiation workers, population of a city located close to a nuclear production facility)

Storage conditions:
18 - 20°C, -20°C, -80°C, liquid nitrogen

Sample type:
Tumour and non-tumour tissues (formalin-fixed, paraffin-embedded tissue blocks, histology slides), peripheral blood and its components, DNA

Condition of use:
In accordance with standardised protocols

Address:
Southern Urals Biophysics Institute
Ozyorskoe shosse 19
456780 Ozyorsk
Chelyabinsk region, Russia

Access:
Samples are available on request and following approval of their use for scientific research purposes. Sample transfer is regulated by special customs approval for biological specimen transfer.

Internet link:
http://rhtr.subi.su

Contact:
Dr Tamara V. Azizova
azizova@subi.su
+7 35130 29395

Involved in:
- "Epidemiological Studies of Exposed Southern Urals Populations" (SOLO, FP7)
- "Combining epidemiology and radiobiology to assess cancer risks in the breast, lung, thyroid and digestive tract after exposures to ionizing radiation with total doses in the order of 100 mSv or below" (EpiRadBio, FP7)
- "Cardiovascular Risk from Exposure to Low-dose and Low-dose-rate Ionizing Radiation" (PROCARDIO, FP7)

Related to:
MELODI

The Russian Human Radiobiological Tissue Repository: a unique resource for studies of Plutonium-exposed workers, Loffredo C., Goerlitz D., Sokolova S., Leondaridis L., Zakharova M., Revina V., Kirillova E. (2017), Radiat Prot Dosim, 173 (1-3), 10–15
A dose-dependent perturbation in cardiac energy metabolism is linked to radiation-induced ischemic heart disease in Mayak nuclear workers, Azimzadeh O., Azizova T., Merl-Pham J., Subramanian V., Bakshi M. V., Moseeva M., Zubkova O., Hauck S. M., Anastasov N. et al. (2017), Oncotarget, 8 (6), 9067–9078

D-DAT

Dynamic Dose Assessment and Transfer model for marine biota

In many situations involving radionuclide discharges to the ocean, activity levels in biota are not in equilibrium with fluctuating levels in the surrounding water. There are many processes at play, such as oceanographic, sediment and biological processes. D-DAT is a successful model designed to represent them and make predictions for radiological assessment. The model was initially developed for application to the Sellafield site and is now adapted for Fukushima to calculate time-variable ^{131}I, ^{134}Cs, ^{137}Cs and ^{90}Sr concentrations and doses in fish, crustaceans, algae, plankton and molluscs.

Photo: Personal archive

Prof. Jordi Vives i Batlle

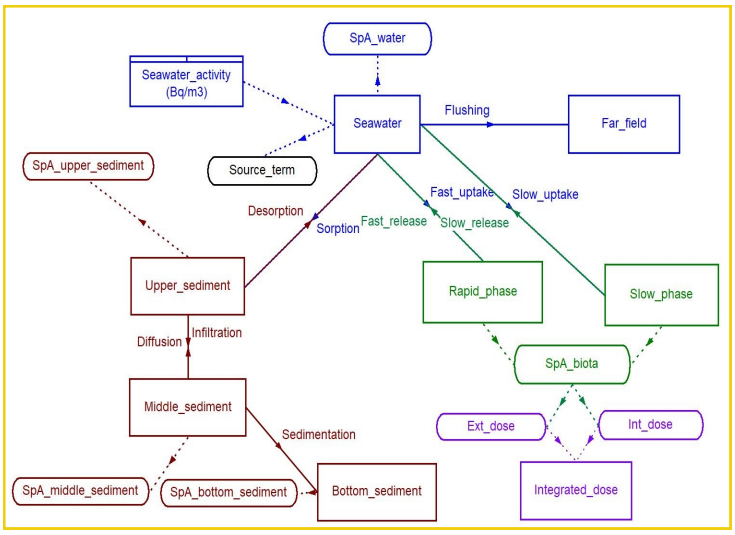

Photo: Jordi Vives i Batlle/SCK•CEN

D-DAT conceptual model showing the relevant aquatic, sediment and biological compartments (rectangles), fluxes (arrows) and variables (rounded rectangles)

At the heart of D-DAT is a biokinetic model comprising two biological compartments that exchange radionuclides individually with the water via a slow and a fast process respectively, with two biological half-lives as the key parameters. At equilibrium, the ratio of concentration in biota to that of seawater approaches the concentration factor.

The current version of D-DAT, developed during the EC COMET project, includes a module to represent radionuclide interactions between particulates, water and three layers of sediment (upper, middle and bottom). Particle scavenging and mixing, diffusion, pore water mixing and sedimentation processes regulate radionuclide migration across sediments. With this addition, the model can now deduce correctly the initial amount of radionuclides released during the accident, using a mass balance approach.

Using the calculated time-dependent biota concentrations, D-DAT generates internal and external dose rates to the biota using dose rate per unit concentration (DPUC) values for the relevant radionuclides and marine reference organisms, derived from a template run of the ERICA assessment tool. The time-dependent dose rates obtained are integrated to obtain the total dose received by a marine organism over the acute discharge period.

D-DAT uses real-time seawater concentrations from hydrodynamic files as its primary input. In addition, the model uses a biokinetic-allometric database of transfer parameters, oceanographic parameters and dose coefficients purposely optimised for Fukushima.

The model was successfully applied in the first international UNSCEAR assessment of the impact of Fukushima on the marine environment (2011-12). It was found that doses to marine organisms were generally below levels causing measurable effects on populations except for ^{131}I in macroalgae near the discharge point in the earliest days after the accident. In the subsequent COMET project, D-DAT was perfected, as described, to better match the biota concentrations observed in the long term (2012-17) and to assess exposures found to be below thresholds for population effects.

In summary, D-DAT can represent the complex time evolution of radionuclides in highly dynamic ocean environments, bringing more realism to the predictions. Therefore, we are readier now than before the Fukushima accident in terms of having models to assess accident situations.

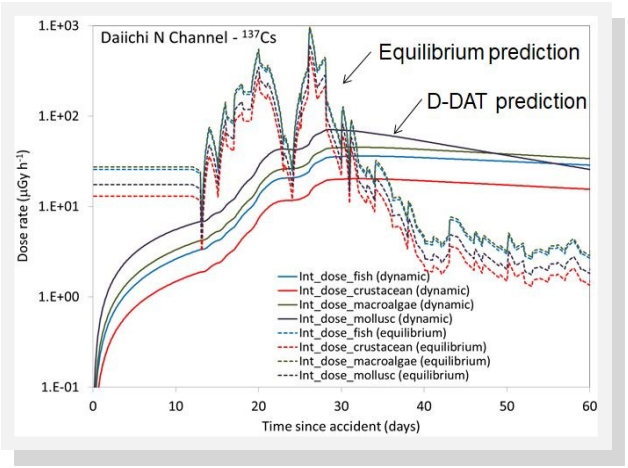

Photo: Jordi Vives i Batlle/SCK•CEN

Output of dynamic model D-DAT compared with calculation assuming instantaneous equilibrium of biota with seawater

ID Card:

Purpose:
Dynamic model for the calculation of radionuclide concentrations and assessment of dose to marine biota

Capacity:
Simultaneous assessment for six species of biota: fish, crustaceans, macroalgae, plankton and mollusk, and six radionuclides: ^{90}Sr, ^{129}I, ^{131}I, ^{134}Cs, ^{137}Cs and ^{236}U. It is also able to perform calculations in seawater and sediments as well as source term estimations

Use:
Requires some skills in marine radioecology to parameterise the model for a specific situation/ radionuclide/species

Housed at:
Current model version 6 is implemented on the ModelMaker 4 for Windows® modelling platform and resides at the host institute (SCK•CEN)

Address:
Belgian Nuclear Research Centre (SCK•CEN)
Boeretang 200,
2400 Mol, Belgium

Access:
D-DAT v.6 code is proprietary to SCK•CEN but SCK•CEN can perform model runs and share results as part of scientific collaborations
An Excel-based version 2 with more basic capabilities is freely available for use and can be downloaded from the Radioecology Exchange (https://wiki.ceh.ac.uk/display/rpemain/Marine+dynamic+model)

Internet link:
www.sckcen.be

Contact:
Prof. Jordi Vives i Batlle
jvibatll@sckcen.be

Involved in:
COMET

Related to:
ALLIANCE

The impact of the Fukushima nuclear accident on marine biota: Retrospective assessment of the first year and perspectives, Vives I Batlle J., Aono T., Brown J. E., Hosseini A., Garnier-Laplace J., Sazykina T., Steenhuisen F., Strand P. (2014), Sci Total Environ, 487, 143–153
Dynamic modelling of radionuclide uptake by marine biota: application to the Fukushima nuclear power plant accident, Vives i Batlle J. (2016), J Environ Radioact, 151, 502-511

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
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: LEU-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
Coming soon:			
Sep 2018, #30	To Be Announced	To Be Announced	To Be Announced

Future events:

Other Events

14-22 July 2018
COSPAR2018, Pasadena California, USA

20-24 August 2018
NEA International Radiological Protection School (IRPS), Stockholm, Sweden

22-25 August 2018
ERR 2018, Pecz, Hungary

1-5 October 2018
3rd ERPW, Rovinj Rovigno, Croatia
Abstract submission deadline till 16 July 2018

8-11 October 2018
HEIR 2018, Fontenay-aux-roses, France

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

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

See also on CONCERT website

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

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