AIR²
Access to INFRASTRUCTURES for Radiation protection Research

Issue 15
March 2017

Editorial

AIR², now in its 15th issue, has become a regular monthly rendez-vous with RPR infrastructures. The mailing list is growing thanks to newsletters and websites that introduce and provide links to AIR², allowing us to reach a broad scientific community. We absolutely need your help to cover all the topics: low dose research, radioecology, dosimetry, emergency situations, medical use and social sciences. At present, low dose research and radioecology are well represented but infrastructure descriptions are lacking for the other fields, especially those relating to "databases, sample banks, cohorts". This is illustrated in this issue with two exposure platforms.

AIR² is the tool to increase infrastructure visibility, and the infrastructure e-handbook is a major deliverable of Concert WP6. So don't hesitate to register your infrastructure in the AIR²D² database or to contact us regarding AIR².

Laure Sabatier, CEA

The floor to...

Harmonize Practices and Protocols

Within the EJP-CONCERT project, WP6's mission is to increase the visibility of infrastructures related to radiation protection research. RIVM is leader of task 6.2, harmonisation and protocols. Contrary to what the name of the task may suggest, we do not aim to achieve harmonisation by prescribing strict protocols that scientists are required to adhere to; our goal is not to impose restrictions. Instead, we aim to identify and facilitate initiatives developed by scientists that address the needs for harmonisation and protocols where such needs exist. An example of such an initiative is a low dose harmonisation exercise set up by the Istituto Superiore di Sanità (Italy), Stockholm University and Public Health England where biological samples are exposed to low dose radiation from a cesium source under very similar conditions. The effects of small differences in set up in biological endpoints are being studied to determine if harmonisation would make it easier to compare experiments conducted in different laboratories. Another example is the identification of needs for collaboration between dosimetry specialists and radiobiologists to address subtle issues in dosimetry that may have profound implications for the interpretation of experimental results. An example of an area of radiation research where protocols clearly are beneficial is the European network of for biodosimetry that was set up in RENEB. Those involved emphasise that protocols for work in "peace time" should be different from those that apply in an emergency, and that bottlenecks for small scale events are different from those in large-scale events. Last but not least, within task 6.2 we support further development of the STORE database, and we recommend that whenever possible, you submit your data to this database, so that they may be used in further research in the future.

Dr Fieke Dekkers

RIVM

WP6.2 Task Leader

Photo: Fieke Dekkers (RIVM)

CONCERT CORNER

Future events:

2nd Call

March 1st, 2017: Open !

May 2nd, 2017: Deadline

WP 6 News:

Next WP6 meeting:
May 22nd, Budapest, Hungary

AIR²D²:
- Please complete the online form(s) to register your infrastructure(s) in the database.
- A new option to feature your infrastructure is now available: add document.

Contents:

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April 2017

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

Alpha particles irradiator

Irradiator for studies with cultured cells at low dose rate

The alpha-particle irradiator was designed and constructed at the Istituto Superiore di Sanità (ISS) in Rome, for the exposure of cultured cells in physiological conditions, to dose rates ranging from a hundred of microGy/h to few tens of Gy/h. It consists of a stainless steel cylindrical chamber, 240 mm in diameter and 197 mm high, that can be equipped alternatively with Cm-244 or Am-241 sources of different activities. The bottom and top of the cylinder are closed by flanges of the same stainless steel. The chamber, flushed with helium gas at a pressure kept slightly above the external pressure, is inserted into a cell culture incubator where temperature and CO2 concentration are strictly controlled. The top flange has a hole where a specially designed petri dish 56 mm in diameter, with a thin Mylar^R bottom, can be inserted to irradiate the cells growing as a monolayer on the Mylar^R foil. The residual range of alpha particles at the cell entrance is enough to irradiate the cells in a nearly track-segment mode.

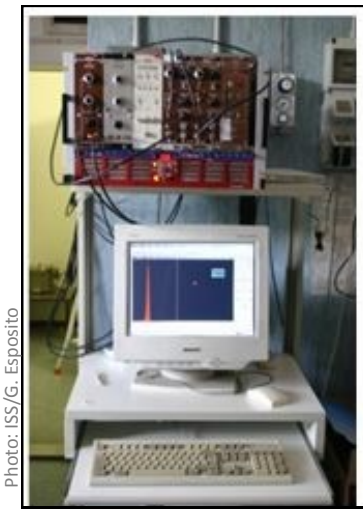
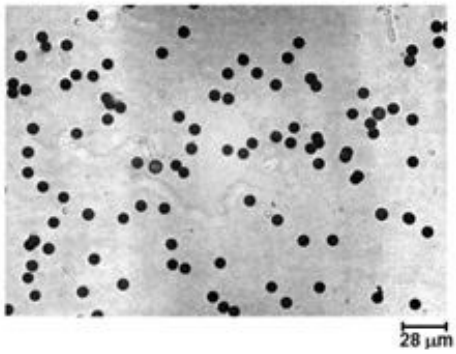


Photo: ISS/G. Esposito

← **Electronic chain implemented by (NIM)-modules for the energy spectrum measurement**



↑ **Etched tracks in a CR39 detector**

Spectrometric and dosimetric characterisation of the irradiator was carried out by means of an ion-implanted silicon charged-particle detector, CR39 detectors, and Monte Carlo simulations. For both sources, the uniformity of the alpha particles dose on the sample was better than ±7 %; this uniformity is obtained by an appropriate compromise between the source-to-sample distance and the sample area. The values of the LET incident on the cell sample can be varied in the range (90 – 130) keV/micron approximately. The dose rate can be varied by changing the source-to sample distance or by placing a collimator in proximity of the source.

The facility is especially suitable for bystander experiments. Adaptors have been designed in order to reproduce the geometry of commercial cell culture companion plates. A co-culture system can be used to investigate effects induced by factors released into the culture medium from directly targeted cells on cells, growing on inserts, placed at a distance that is well beyond the range of the alpha particles. Partial irradiation of the sample can also be performed by shielding part of the irradiation dishes. For both the Cm-244 and Am-241 sources, the photon dose to directly irradiated and bystander cells is negligible.

Photo: ISS/G. Esposito

Dr Giuseppe Esposito

This alpha irradiator facility represents a useful resource to study a variety of biological effects induced by low dose rate alpha particles. These studies can provide data of interest for radiation protection and therapy due to the role of alpha particles in background radiation exposure (which is largely due to inhalation of radon and its progeny) and in nuclear medicine therapies with alpha emitters. The facility is open for collaboration, and any suggestions for projects with CONCERT partners are very welcome.

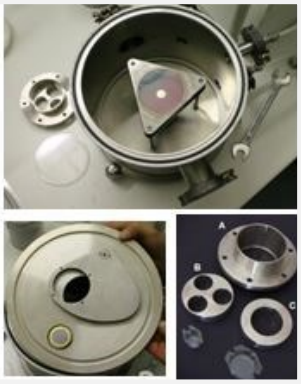


Photo: ISS/G. Esposito

Alpha particles irradiator at the Istituto Superiore di Sanità

Esposito G. et al., 2006, A ^{244}Cm Irradiator for protracted exposure of culture mammalian cells with alpha particles, Health Physics, 90, p66-73

Esposito G. et al., 2009, An alpha particle irradiator for biological research and its implementation for bystander effect studies, Radiation Research, 172, p632-642

ID Card:

Exposure type:
External

Source:
Am 241 or Cm 244

Dose rate:
~130 µGy/h to 20 Gy/h

Irradiation type:
Alpha particles

Irradiated organism type:
Cells

Address:
Istituto Superiore di Sanità
Viale Regina Elena, 299
00161 Roma, Italy

Access:
joint research collaboration

Supporting lab:
Cell culture, biochemistry and molecular biology labs

Internet link:
Under construction

Contact:
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Related to:
MELODI, EURADOS

CALIBRATION LABORATORY AT KIT

Accreditation for irradiations according to ISO 17025

The Irradiation Facility at Karlsruhe Institute of Technology provides photon, electron and neutron irrradiations in the dose range from 50 µGy up to 5 Gy. Dose rates vary from 2 µGy/h up to 80 mGy/h (air KERMA rate for photons). All doses can be converted to the appropriate operational quantities (e.g. Hp (3) or H*(10)) in Sieverts.

For photon irradiations, the facility uses 6 sources of Cs-137 at different activity levels ranging from 1E+7 Bq up to 1E+13 Bq, and two X -Ray tubes (soft X-rays with voltages up to 60 kV, hard X-rays up to 320 kV, currents up to 20 mA), in combination with different filters. The irradiation workbench, 8 metres in length, allows maximum field sizes of up to 100 cm x 100 cm (95% isodose). Mounting frames for different kinds of samples are available. Figure 1 shows the placement before irradiation of a 10 L ionisation chamber for low dose rate, located within the facility.

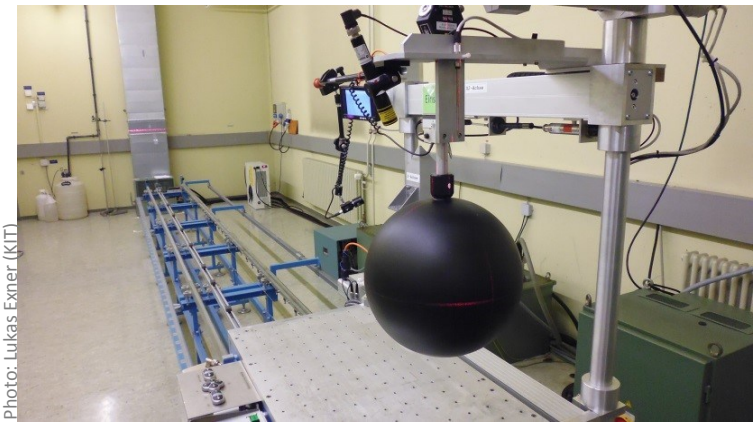

Photo: Lukas Exner (KIT)

The positioning of a 10L ionisation chamber for low dose rate before irradiation with photons. A moveable arm is used to move the chamber into the correct position, a Laser system is used to monitor the correct placement

A Beta Secondary Standard (BSS2) with sources of Pm-147, Kr-85 and Sr-90/Y-90 (activities in the E+08 Bq range) is available for electron irradiation.

In 2009, the facilities for photon and electron irradiation were awarded an accreditation to the ISO/IEC 17025:2005 standard.

Neutron irradiations in air are performed using either a Cf-252 source (E+06 Bq, E=2.13 MeV, 11,3 neutrons/cm^2*s) or an Am-Be-Source (E+11 Bq, E=4.16 MeV, 225 neutrons/cm^2*s). The hall in which these irradiations are performed is constructed from wood materials to reduce backscatter. Application for accreditation of these irradiations is also planned in the near future.

Photo: Lukas Exner (KIT)

Lukas Exner

A solid state dosimetry laboratory using TLD and track-etch detectors is available, close to the facility. The irradiation facility was originally designed for the irradiation and calibration of active and passive dosemeters, but in addition has always been used for research and development. For example, both laboratories recently developed a dosemeter for monitoring doses to the eye lens in the appropriate quantity Hp(3). This new dosimeter has been used in a study on eye lens doses in the workplaces and took part in several intercomparison exercises.

Access to the facilities is available via research collaborations or service contracts for irradiations.

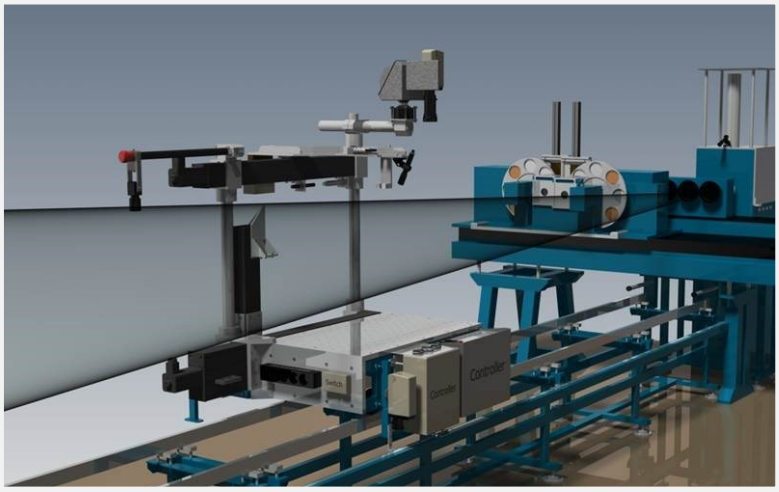

Photo: Florian Arend (KIT)

A CAD-drawing of the photon irradiation set-up. The field generated by one of the ^{137}Cs sources is displayed. The X-Ray tubes with the different filter options mounted on the two wheels have been moved into the parking position

ID Card:

Exposure type: *external*
Source:
Photons : Cs-137, X-Ray tubes
Electrons: Beta Secondary Standard BSS2
Neutrons: Cf-252, Am-Be
Dose rate:
2 µGy/h – 80 mGy/h (air Kerma)
Irradiation type:
Photons, Electrons, Neutrons
Irradiated organism type:
Samples and Measurement Devices

Address:
Karlsruhe Institute of Technology
Sicherheit und Umwelt
Kalibrierlabor
Hermann-von-Helmholtz-Platz 1,
76344 Eggenstein-Leopoldshafen

Access:
joint research collaborations, service contracts

Supporting lab:
solid state dosimetry laboratory

Internet link:
www.sum.kit.edu

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Phone: +49 721 608 22644

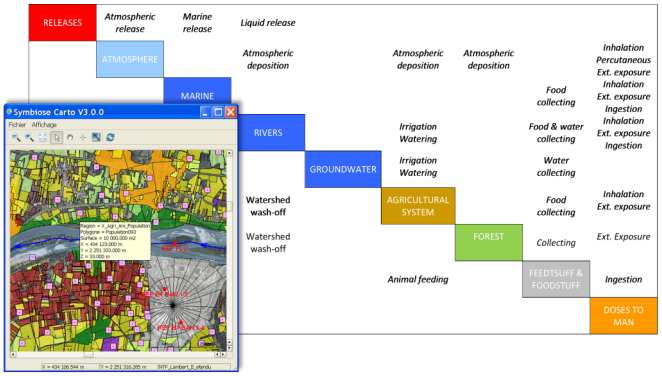
Related to:
MELODI, EURADOS

Behrens et al., 2016, Intercomparison of eye lens dosemeters, Radiation Protection Dosimetry (http://rpd.oxfordjournals.org/content/early/2016/03/22/rpd.ncw051.full, Radiat Prot Dosimetry (2016) doi: 10.1093/rpd/ncw051)
Burgkhardt B. et al., 2002, Experience in long-term neutron dose equivalent measurements using etched track detectors with (n, alpha) converters in moderator, Radiation Protection Dosimetry, 101, p579-584

Symbiose

A Modeling Platform for Environmental Radiological Assessment

SYMBIOSE is a simulation platform that aims at modelling the fate and dispersion of radioactive substances in environmental systems, and assessing their impact on humans and biota, accounting for uncertainty and variability. This platform can be used in a wide range of situations for assessing risks induced by radioactive releases from nuclear facilities under normal operational, accidental, or decommissioning conditions. As shown in Figure 1, environmental models in SYMBIOSE address atmospheric, terrestrial, freshwater and marine systems, as well as the main transfer processes at their interfaces.



SYMBIOSE: matrix featuring the environmental systems (diagonal boxes) and the interactions between them (off-diagonal boxes), which depict exchanges of mass, energy or information; example of landscape around an NPP for spatial predictions

The modelled exposure pathways for humans are external irradiation (plume shine and ground shine) and internal contamination (inhalation, percutaneous transfer for tritium, ingestion).

SYMBIOSE deals with several hundreds of radionuclides, derived from up to 70 chemical elements including chlorine, hydrogen and carbon, for which specific non-equilibrium approaches have been proposed. Outputs such as concentrations, activities, stocks and fluxes of pollutants or (a)biotic mass obey mainly to mass conservation equations (ODE & PDE ordinary and partial differential equations). When the previous approach is not possible, empirical parameterisations such as transfer factors or transfer functions are adopted. Spatial predictions are produced for a given sub-system on a specific spatial frame (i.e. collection of points, polylines or polygones). The specification of these frames, along with the spatial interactions between the frames, defines a landscape model.

SYMBIOSE has been developed in the context of an R&D project led by IRSN and co-funded by Electricité de France (EDF). Each of the co-owners (IRSN and EDF) are able to provide SYMBIOSE to licensees for specific purposes.

Photo: M.A. Gonze, C. Mourlon,IRSN

M.A. Gonze, C. Mourlon

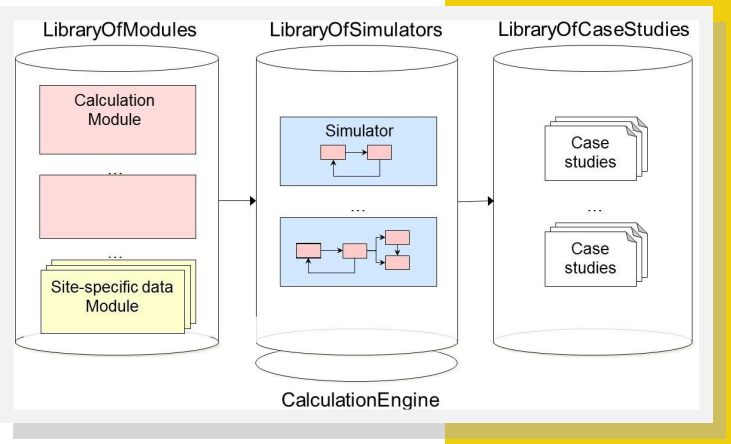
The industrial version is regularly upgraded to take account of user feedback. The most recent version, SYMBIOSE V2.3, was released in early 2017. As shown in Figure 2, the SYMBIOSE platform, which runs under Windows/Linux OS, in French/English language, features a highly flexible and modular architecture. This consists of four major components:

-A library of modules, a module being an autonomous/reusable piece of software that models an environmental sub-system and encapsulates related parameters (generic/site-specific and deterministic/probabilistic values),

-A library of simulators, a simulator being a fit-for-purpose code that addresses a specific environmental problem, built by instantiating and connecting pre-existing modules through a graphical user interface,

-A library of case studies for the various existing simulators, and

-The application itself for managing modules and simulators or performing simulations through the use of a powerful calculation engine capable of dealing with complex space and time dynamics.



Simplified scheme displaying the architecture of SYMBIOSE platform

ID Card:

Purpose:
A Modeling and Simulation Platform for Environmental Radiological Impact Assessments

Use:
Restricted to co-owners (IRSN and EDF) and licensees; some skills and initial training needed.

Training proposed on the software:
One or two sessions per year for co-owners (IRSN and EDF) or licensees

Access:
Licenses for specific needs (possibly free for certain uses)

Internet link:
https://gforge.irsn.fr/gf/project/symbiose/

Contact:
symbiose@irsn.fr

Related to:
ALLIANCE

Simon-Cornu M. et al., 2015, Evaluating variability and uncertainty in radiological impact assessment using SYMBIOSE, Journal of Environmental Radioactivity, 139, p91-102
Gonze M. A. et al., 2016, Modeling the dynamics of ambient dose rates induced by radiocaesium in the Fukushima terrestrial environment, Journal of Environmental Radioactivity, 161, p22-34

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 SCK CEN
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
Mar 2017, #15	Alpha Particles Irradiator Calibration Laboratory at KIT		Symbiose
Coming soon:			
Apr 2017, #16	Changing Dose rate (SU)	To Be Announced	To Be Announced

Future events:

March 7-9, 2017: Radiation effects on the immune system: an updated state of the art and future research needs, Budapest, Hungary

25-27 April 2017: COMET final event, Bruges, Belgium

8-11 May 2017: ConRad 2017, Bundeswehr Institute of Radiobiology, München, Germany

14-19 May 2017: Neutron and Ion Dosimetry Symposium, NEUDOS13, Krakow, Poland

23-26 May 2017: Operra final event, Budapest, Hungary

3-8 September 2017: ICRER 2017, 4th Internotional conference on Radioecology and Environmental Radioactivity, Berlin, Germany

10-12 October 2017: Joint ICRP-RPW 2017, Paris, France

5-11 November 2017: MICROS 2017, 17th International Symposium on Microdosimetry, Venezia, Italy

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