AIR^2

Access to INFRASTRUCTURES for Radiation protection Research

Issue 16

April 2017

CONCERT CORNER

Future events:

2nd Call

1 Mar 2017: Opening date

May 2nd, 2017: Deadline

WP 6 News:

Next WP6 meeting:

May 22nd, Budapest, Hungary

AIR^{2}D^2:

- Please complete the online form(s) to register your infra-structure(s) in the database.

- A new option to feature your infrastructure is now available: add document.

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May 2017

Editorial

For the second time in succession, AIR^2 highlights two exposure platforms in this 16th issue. Although exposure platforms are the cornerstone of most radiation protection research activities, featuring two together also indicates our lack of knowledge and visibility of many of the databases, sample banks and cohorts available to our research community. These less visible infrastructures are also the most fragile. Frequently created during a European project, they fall dormant afterwards through lack of sustainable funding, when they could have been so useful for future research if kept active and updated. But AIR^2 could help to keep them under the spotlight. The more attractive they are, the greater their chances of attracting new users. AIR^2 aims to optimize all efforts to revive these databases, sample banks and cohorts.

Dr Laure Sabatier, CEA

The floor to...

The goal of task 6.3, based on previous experience gained from DOREMI and OPERRA and the results of tasks 6.1 and 6.2, is to facilitate access to all suitable infrastructures identified and, in some cases, to rare or unique infrastructures for radiation protection research.

For its two infrastructure calls, CONCERT has chosen to take an open-minded approach and to accept all the various types of infrastructures, on condition that the cost of the activities for the submitted projects is included in the global cost of the research project.

The funding scheme creates access to the infrastructures but does not guarantee their sustainability nor any potential future access for our community.

The work of task 6.3 involves identifying the support needs to achieve sustainability. These include the necessary maintenance and upgrade of materials, maintaining skills and state-of-the-art facilities, developing specific training courses for relevant infrastructures, increasing accessibility through use of simple procedures and common protocols, and finally guaranteeing the quality of the results produced. These needs are all components of the strategy to ensure the continued existence of the infrastructures and thus of the research programmes related to the priorities defined in the SRA developed by the platforms MELODI, ALLIANCE, NERIS, EURADOS, and more recently EURAMED.

In summary: WP6 contributes to establishing links between infrastructures and researchers; it provides the information needed to develop opportunities with the possibility of infrastructure access and funding; it builds and offers possible ways to implement best practice and it focuses on synergies. The true success of WP6 will be measured when a roadmap approved by all parties is implemented in order to increase access to and use of these infrastructures.

Strategy for Facilitating Access to infrastructures

Jean-Michel Dolo

CEA

CONCERT WP6.3

Photo: J-M Dolo/CEA

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

Changing dose rate exposure facility

Exposure of cells to continuously changing photon dose rate

Exposure scenarios where the dose rate is continually changing are very common. A good example is aircraft flight where the dose rate of cosmic radiation can change 16-fold during take-off and landing. Moreover, there are many accidental exposure scenarios where either the sources or the exposed subjects are in motion with respect to one another. Despite the fact that many exposures involve changing dose rates, the vast majority of research studying the effects of ionising radiation is performed exposing samples at constant dose rates. It is possible that the technical limits of the irradiation equipment used may prevent other types of exposure scenarios. However, effects from such exposures may be highly relevant for the assessment of radiation risk. Thus, it is surprising that research on the biological effects of changing dose rates has, until recently, been neglected.

Photo: Andrzej Wojcik (SU)

The facility inside an incubator

The presistaltic pump is not visible. The X-ray tube is positioned below the incubator and the whole setup is enclosed in a lead cabinet for safe use

To study the effects of changing dose rates, we have constructed a facility where three samples can be simultaneously irradiated with X-rays either at an increasing, a decreasing, or a constant dose rate. The facility fits inside a 37°C incubator that can be positioned above an X-ray tube or a gamma source. Cells in tubes, flasks or Petri dishes can be simultaneously exposed to an increasing, a decreasing and a constant dose rate in the range of 2.2 to 37 mGy per minute.

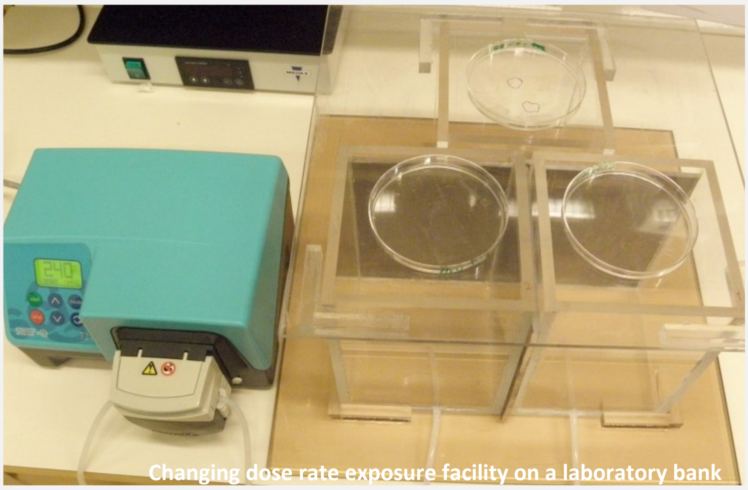
The facility is composed of three identical Plexiglas tanks, separated by 4 mm lead plates to absorb scattered radiation. Tanks 1 and 2 are interconnected by a silicone tube via a peristaltic pump. Cell samples can be positioned on top of the tanks. The facility fits inside a 164 l cell incubator modified so that there are no wires or electronic components in its bottom plate. An X-ray tube is placed under the incubator and the distance from the X-ray source to the bottom of the facility is ~ 30 cm. The beam angle, as given by the manufacturer, is 40º x 55º.

Photo: Andrzej Wojcik (SU)

Andrzej Wojcik

During exposure, the pump transfers the shielding medium, an aqueous solution of barium chloride, from one tank (increasing dose-rate, IDR) into the other (decreasing dose-rate, DDR), resulting in an exponential, 14-fold dose-rate change during the exposure. Tank 3 (average dose-rate, ADR) contains a volume of barium chloride resulting in the same dose-rate on top of the tank as the average dose-rate on top of tanks 1 and 2. The exposure is monitored with an ionisation chamber positioned on the tank that is acting as the IDR tank, and terminated when the starting conditions have been reversed on top of tanks 1 and 2. Consequently, the same total dose will have been delivered on top of all three tanks when the exposure is terminated.

The facility makes it possible to characterise the cellular response to changing dose rates. The design and low building cost of the device permit users to customise and build a device to suit their particular needs, encouraging other research groups to contribute to the understanding of the effects of changing dose rates.



Changing dose rate exposure facility on a laboratory bank

Photo: Andrzej Wojcik (SU)

Petri dishes are placed on top of tanks between which a barium chloride solution is pumbed with the help of a peristaltic pump (green). A third tank (visible behind the two front tanks) is permanently filled with a volume of barium chloride that yields the average dose rate. Consequently, cells on all three tanks receive the same dose

Stockholm University

ID Card:

Exposure type:
External

Source:
Xray machine

Dose rate:
2.2 to 37 mGy per minute

Irradiation type:
photons, vertical beam

Irradiated organism type:
Cells in culture

Address:
Stockholm University

Access:
free, decision by source owner

Supporting lab:
Biomolecular and cell culture lab

Internet link:

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Related to:
MELODI, EURADOS, RENEB

A NEW DEVICE TO EXPOSE CELLS TO CHANGING DOSE RATES OF IONISING RADIATION, Brehwens K et al. Radiation Protection Dosimetry, 148 (2003), 366-371

MICRONUCLEUS FREQUENCIES AND CLONOGENIC CELL SURVIVAL IN TK6 CELLS EXPOSED TO CHANGING DOSE RATES UNDER CONTROLLED TEMPERATURE CONDITIONS, Brehwens K et al. International Journal of Radiation Biology, 90 (2014), 241-247

Low dose rate facility at Stockholm University

Low dose rate exposure facilities for cells and animals

Stockholm University was founded in 1878. Today, it has 70,000 students, 1,800 doctoral students and a staff of 5,000 who are active within science, the humanities, social sciences and law. The first Chair of Radiobiology was appointed in 1962, at a time when the work focused on genetics and plant breeding. In 1972, Radiation Biology moved to the Wallenberg Laboratory at the new campus in Frescati, and in 1985 to the Arrhenius Science Laboratories.

In the 1970's, low dose radiation facilities were constructed for field experiments, mainly for plant genetics and genotoxicology. At that time there was already a strong focus on DNA damage, and several new methods were invented to measure DNA strandbreaks as well as chromosomal damage in plants and eukaryotic cells.

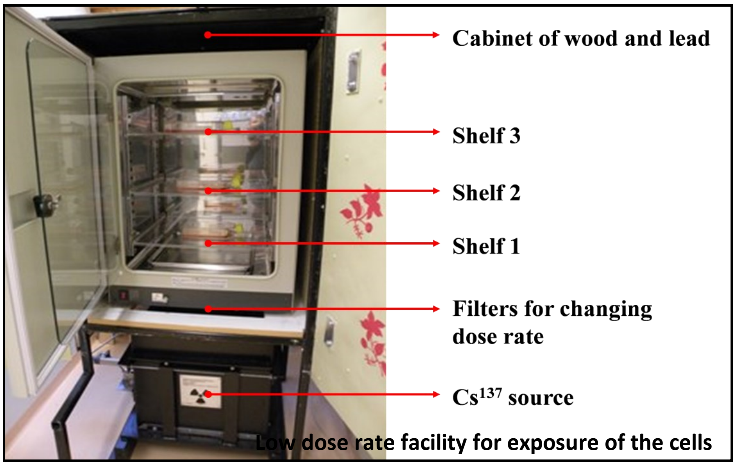
In the last two decades, the interest of the research groups has gradually moved towards risk estimates of low doses and dose rates, and to exploration of new technologies such as omics to study the cellular responses to doses in the mGy range. Thus new radiation exposure facilities were needed in the department and, with the help of skilled technicians and an excellent workshop, several new facilities were constructed, as described below.

At present two radiation facilities with caesium sources are available for chronic exposure of cells in culture, with dose rates ranging from 1 mGy/h up to 50 mGy/h, and dose rate can be decreased by lead shielding to a few µGy/h (picture 1) [1, 2].

A new radiation facility for animal exposure was constructed in 2015 and is equipped with a caesium source. This facility is constructed for exposure of mice to low doses and low dose rates. The dose rates range from 1 mGy/h up to 70 mGy/h and dose rate can be decreased by lead shielding to a few µGy/h. Mice can be exposed chronically and exposure time should not exceed 4 weeks. The animals are hosted in standard cages with space for up to 5 mice per cage. The facility can accommodate four cages placed one on top of the other, providing a gradient of dose rates (picture 2). After exposure, the mice can be kept in the animal facility for extended periods depending on the choice of endpoints.

Photo: Siamak Haghdoost (SU)

Siamak Haghdoost



Low dose rate facility for exposure of the cells

Photo: Siamak Haghdoost (SU)

The construction has been approved by the Swedish Radiation Safety Authority (SSM) and complies with the ethical rules for animal experiments. The primary objective is to provide scientists in the field of radiation protection research with access to a low dose and dose rate exposure facility for short term exposure of mice.

The animal exposure facility is located in the Stockholm University animal facility, and includes animal care, animal exposure and post irradiation handling, for example, preparation of organs/samples at different times post irradiation. This radiation facility is primarily constructed for the study of biomarkers in response to low doses and dose rates and for studies of the mechanisms behind cellular/organ responses. It may also be used for pilot studies where only a small number of animals are needed.

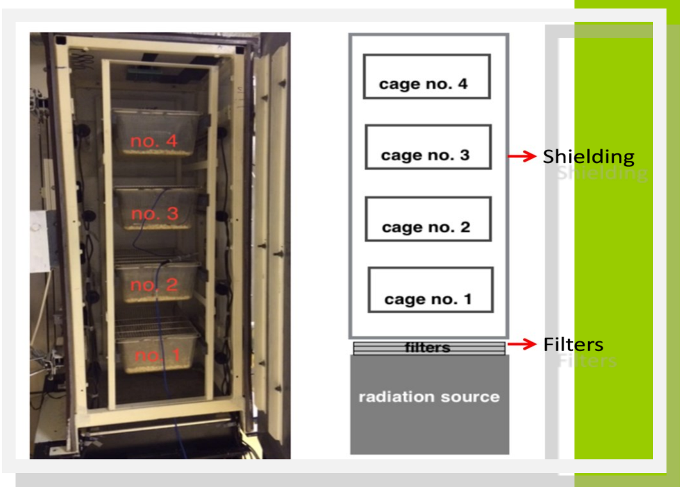


Photo: Siamak Haghdoost (SU)

Low dose rate facility for animal exposure

Stockholm University

ID Card:

Exposure type:
Low dose rates external gamma radiation

Source:
Cesium 137

Dose rates

Cell culture facility:
From 1 to 50 mGy/h with lead shielding

Animal facility:
From 1 up to 70 mGy/h with lead shielding
Housing capacity: 4 cages and 5 mice per cage

Preferred type of organism for irradiation:
Mouse

Exposure time:
Up to 4 weeks

Address:
Centre for Radiation Protection Research
Department of Molecular Bioscience, Wenner-Gren Institute
Stockholm University
10691 Stockholm
Sweden

Access:
Joint research collaboration and upon ethical approval by the ethical committee

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Related to:
MELODI, EURADOS

THE NUCLEOTIDE POOL, ATARGET FOR LOW-DOSE GAMMA-RAY-INDUCED OXIDATIVE STRESS,T. Sangsuwan, S. Haghdoost, Radiation Research, 170 (2008), 776-783
QUANTITATIVE PROTEOMIC ANALYSIS REVEALS INDUCTION OF PREMATURE SENESCENCE IN HUMAN UMBILICAL VEIN ENDOTHELIAL CELLS EXPOSED TO CHRONIC LOW-DOSE RATE GAMMA RADIATION, Yentrapalli, O. Azimzadeh, Z. Barjaktarovic, H. Sarioglu, A. Wojcik, M. Harms-Ringdahl, M.J. Atkinson, S. Haghdoost, S. Tapio, Proteomics, 13 (2013) 1096-1107

Advanced Technologies Network (ATeN) Center

A large research infrastructures for advanced biotechnologies

The Advanced Technologies Network (ATeN) Center, directed by Prof. Maurizio Leone, is a centre of excellence of the University of Palermo (Sicily) which provides cutting-edge research, development and service activities for technological transfer to the public and private sectors. The Center consists of three macro-areas (Cellular and Molecular Biotechnology, In vivo Analysis, Biocompatible Materials and Systems) in which scientists with different backgrounds (e.g. biotechnology,

Photo: Agenzia CMC Studio

Ion PGM™ System for Next-Generation Sequencing

biology, chemistry, physics, engineering, medicine, bioinformatics) work together to produce the technological know-how needed to achieve highly competitive scientific results. Due to its sophisticated structure and equipment (25 laboratories housed in 2500 m² with approx. 100 instrumentation facilities), ATeN is among the few centres in the world able to provide a production chain ranging from the synthesis of materials to in vivo tests.

The macro-area of Cellular and Molecular Biotechnologies deals with the production and propagation of stem cells and primary cell cultures, large-scale analysis of DNA, RNA and proteins. The laboratory of genomics and proteomics provides molecular analysis at advanced technological level. The laboratory works in different advanced sectors through the analysis of large families of genes, proteins, enzymes and metabolites. These sectors include: development and technological improvement of drugs including proteins, vaccines and monoclonal antibodies, which are largely obtained from targeted application of genetic modification techniques and personalised medicine; characterisation, through the analysis of genetic and protein profiles and of molecular pathways, experimental cellular and animal models of disease; identification of specific response markers of cells and tissues to exposure to ionising radiation and/or molecules with biological activity and potential pharmacological activity; validation of products for molecular diagnostics; development of services for advanced diagnostics and for drug discovery; development of bioinformatics products (acquisition, storage, distribution, analysis and interpretation of the data mainly for molecular biology, genetics and biochemistry).

Photo: Agenzia CMC Studio

Maurizio Marrale

The In Vivo Analysis macro-area, with two enclosures containing small animals and zebrafish, carries out analyses on the effects of ionising radiation and the testing of drugs, biomaterials, biomarkers and radiopharmaceuticals, as well as functional analyses for the production of primary cultures from transgenic organisms and 3D imaging.

Multiple bioimaging techniques are available to explore the biological structure and function of molecules in live cells and in tissues by means of 3D and 4D measurements.

Confocal and multiphoton microscopy, atomic force microscopy, together with advanced spectroscopy techniques (e.g. Raman, EPR, NMR) can be applied to analyse biological, physical and chemical phenomena in order to characterise the material properties.

Photo: Agenzia CMC Studio

Laboratory of Pulsed Electron Paramagnetic Resonance

CHAB mediterranean center for human health advanced biotechnologies

ID Card:

Analytical platform type:
Biological dosimetry and physical retrospective dosimetry, exposure markers, proteomics, genome sequencing, transcriptome sequencing, transcriptomics, metabolomics, exosomes, small molecules

Main techniques proposed:
Panel of cytogenetic assays, gene expression assay, protein markers, EPR/TL dosimetry, gamma spectrometry, microscopy

Capacity:
20 measurements per week

Waiting time:
None

Duration of experiment:
Dependent on experiment and assay

Address:
Viale delle Scienze Edificio 18 I-91128 Palermo (Italy)

Access:
Free

Internet link:
http://www.chab.center/home-en

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Related to:
MELODI, EURADOS, RENEB

MONITORING FEW MOLECULAR BINDING EVENTS IN SCALABLE CONFINED AQUEOUS COMPARTMENTS BY RASTER IMAGE CORRELATION SPECTROSCOPY (CADRICS), G. Arrabito, F. Cavaleri, V. Montalbano, V. Vetri, M. Leone, B. Pignataro, Lab on a Chip, 16 (2016), 4666-4676

PRELIMINARY APPLICATION OF THERMOLUMINESCENCE AND SINGLE ALIQUOT REGENERATION METHOD FOR DOSE RECONSTRUCTION IN SODA LIME GLASS, M. Marrale, A. Longo, A. Bartolotta, M. D'oca, and M. Brai, Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, 297 (2013), 58-63

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Access to INFRASTRUCTURES for Radiation protection Research

Issue	Exposure platforms	Databases, Sample banks, Cohorts	Analytical platforms Models & Tools
Published to date:			
Oct 2015, #1 Nov 2015, #2	FIGARO B3, Animal Contamination Facility	FREDERICA The Wismut Cohort and Biobank	RENEB The Hungarian Genomics Research Network
Dec 2015, #3 Feb 2016, #4	Pulex Cosmic Silence SNAKE	STORE French Haemangioma Cohort and Biobank	METABOHUB Dose Estimate, CABAS, NETA
Mar 2016, #5 Apr 2016, #6	Radon exposure chamber Biological Irradiation Facility	3-Generations exposure study Wildlife TransferDatabase	PROFI Radiobiology and immunology platform (CTU-FBME)
May2016, #7 Jun 2016, #8	CIRIL Mixed alpha and X-ray exposure facility	Portuguese Tinea Capitis Cohort Elfe Cohort	LDRadStatsNet ERICA Tool
Jul 2016, #9 Sep 2016, #10	SCRS-GIG Facility radionuclides availability, transfer and migration	RES^{3}T INWORKS cohort	CROM-8 France Génomique
Oct 2016 #11	LIBIS gamma low dose rate facility ISS	JANUS	Transcriptomics platform SCK CEN
Nov 2016, #12 Dec 2016, #13	Microtron laboratory Nanoparticle Inhalation Facility	EPI-CT Scan cohort UEF Biobanking	CATI 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
Apr 2017, #16	Changing Dose rate (SU) Low dose rate (SU)		Advanced Technologies Network Center
Coming soon:			
May 2017, #17	To Be Announced	To Be Announced	To Be Announced

Future events:

CONCERT Short Courses

24-28 April 2017
Emergency and recovery preparedness, and response
NCRRP, Sofia, Bulgaria
Contact:
n.chobanova@ncrrp.org

24 April-5 May 2017
Cellular effects of ionising radiation – introduction to radiation biology
Stockholm University, Sweden
Contact:
andrzej.wojcik@su.se

22 May-2 June 2017
Modelling radiation effects from initial events
University of Pavia, Italy
Contact:
Andrea.Ottolenghi@unipv.it

6-16 June 2017
Assessing risk to humans and the environment
NMBU, Oslo, Norway
Contact:
deborah.oughton@nmbu.no

Other Events

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

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

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

23-26 May 2017
Operra final event
Budapest, Hungary

11-17 June 2017
RAD 2017 Fifth International Conference on Radiation and Applications in Various Fields of Research
Budva, Montenegro

3-8 September 2017
ICRER 2017, 4th International 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,
Venice, Italy

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