EUROPEAN JOINT PROGRAMME FOR THE INTEGRATION OF RADIATION PROTECTION RESEARCH

CONCERT

CERN

CERN – Radiation Protection group
Activities & facilities

Eng. Fabio Pozzi

on behalf of the CERN Radiation Protection group

RP activities at CERN

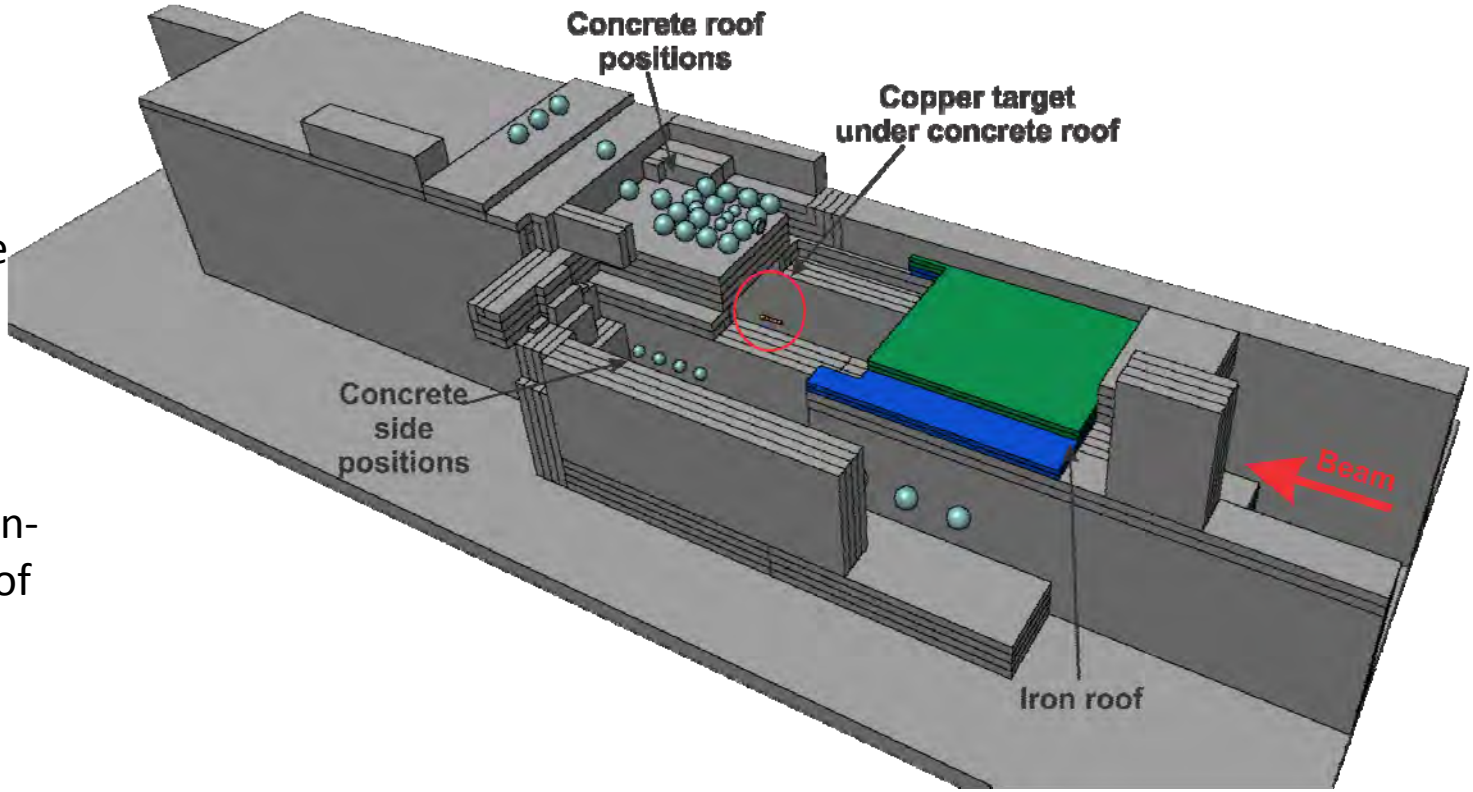
- **Operational RP** for the accelerators, experiments, sites (operational and design aspects)
- **High level dosimetry service** for the measurements of radiation **dose to organic materials**
- **Individual dosimetry** service (~8000 dosimeters, ISO accreditation ongoing)
- **Radioactive source** service
- **Radioactive waste** management service
- Laboratory for **alpha and gamma spectrometry**
- **R&D** on radiation detectors and calculation tools

CERN-EU high-energy Reference Field (CERF) facility

www.cern.ch/cerf

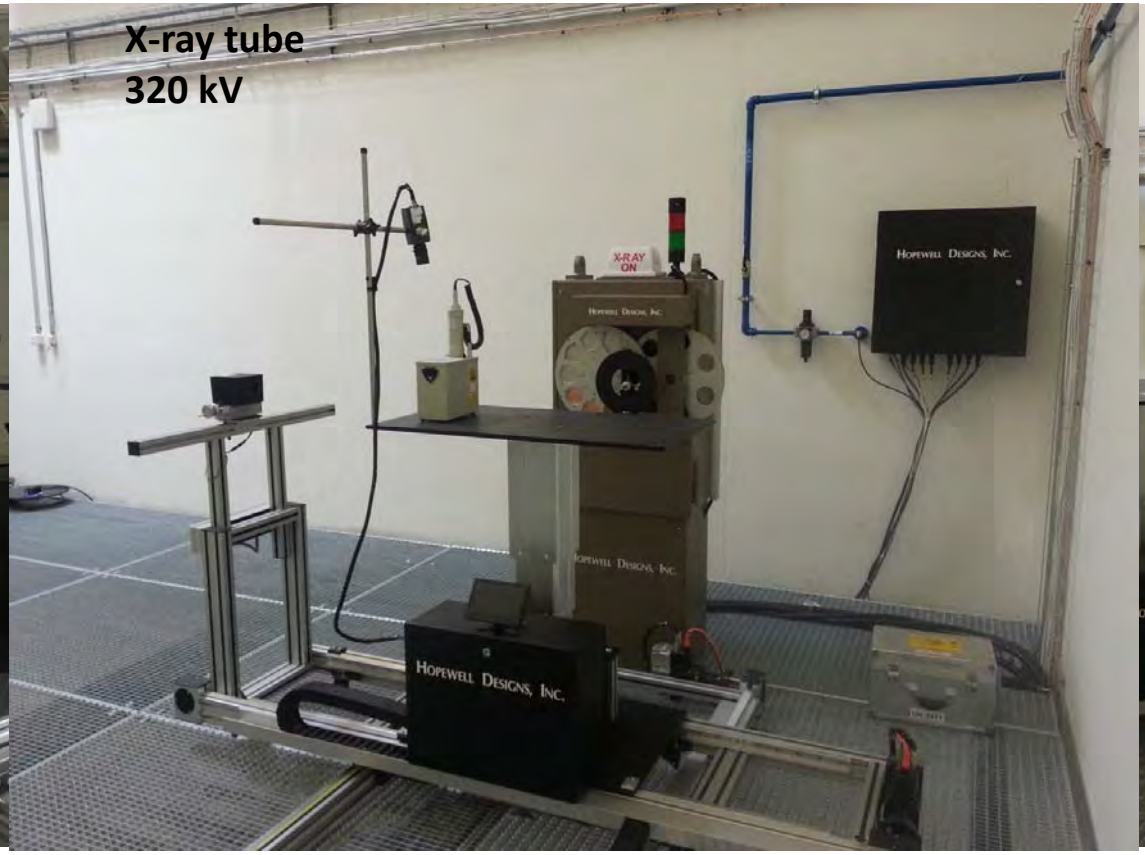
A 'field calibration' facility for radiation protection instrumentation used at high-energy accelerators and a 'simulated workplace field' to determine the response of detectors and dosimeters used for air crew dosimetry

RBE determination of a mixed neutron-gamma radiation field at low doses (of simulated cosmic radiation)*



*"*Cytogenetic analysis in human lymphocytes after exposure to simulated cosmic radiation which reflects the inflight radiation environment"* A. Heimers, International Journal of Radiation Biology 75, 691 (1999)

CALibration LABoratory (CALLAB)



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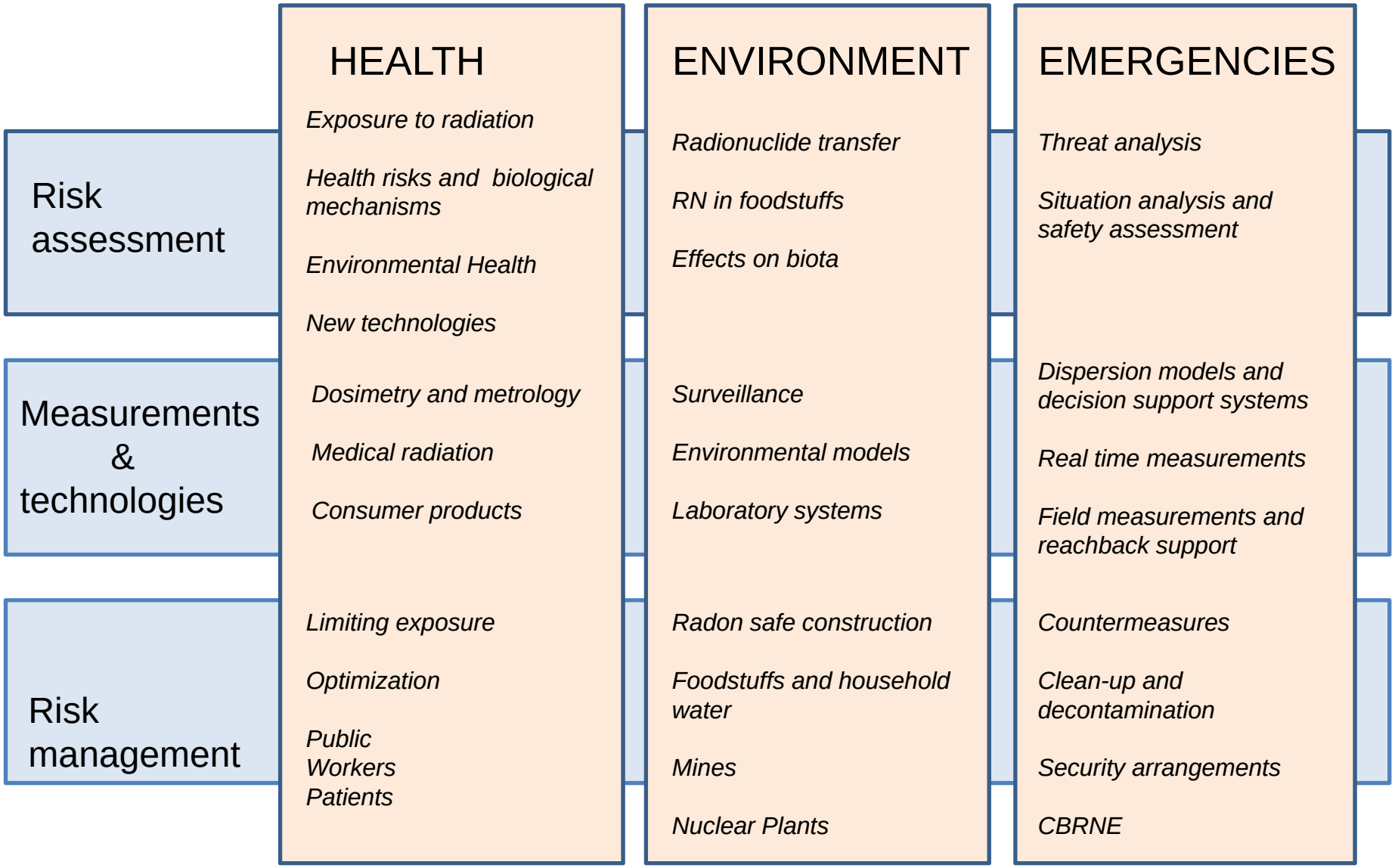
Thank you
for your kind attention!

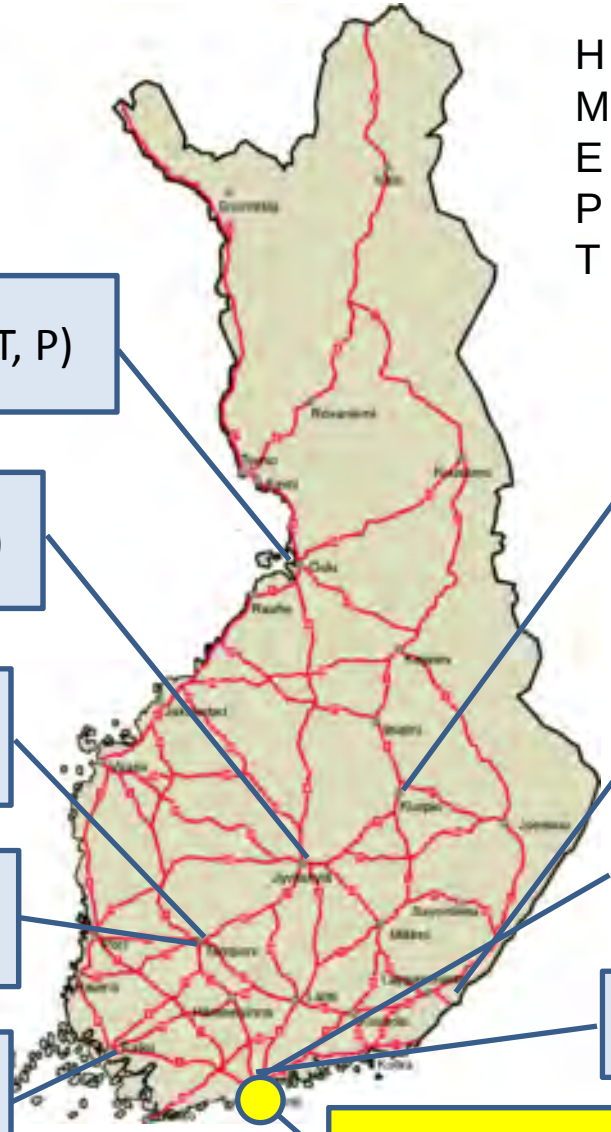
Radiation Safety Research Program of Finland



CORES.fi – Consortium for Radiation Safety Research Finland

POM + LTPs

H = Health
M = Medical
E = Environment
P = Prepareness for emergencies
T = Technologies and measurements



University of Oulu (E, T, P)

University of Jyväskylä (T)

University of Tampere (H, M)

Tampere Technological University (T)

University of Turku (H, M)

University of Eastern Finland (H, M, E, T)

Lappeenranta University of Technology (T)

University of Helsinki (T, E, P, M)

Aalto University (T)

STUK, Helsinki (H, E, P, M)

Research on biological and health effects of radiation at the University of Eastern Finland (UEF)

Key persons at the Department of Environmental and Biological Sciences:

- Sisko Salomaa, Professor
- Jukka Juutilainen, Professor
- Jonne Naarala, Docent
- Päivi Roivainen, Researcher

Local and national collaborators:

- Several departments of UEF
- Kuopio University Hospital
- STUK (Helsinki)
- National Institute of Health and Welfare (Kuopio)
- Finnish Institute of Occupational Health (Helsinki)

UNIVERSITY OF EASTERN FINLAND

Research on non-ionising and ionising radiation since the 1980s

- In vitro studies
- Animal studies
- Epidemiology, human studies
- Exposure assessment

Health endpoints

- Carcinogenesis
- Reproductive and developmental effects
- Behavioural, cognitive and nervous system effects

Infrastructures

- Dept of Environmental and Biological Sciences: Cell biology laboratory and exposure systems for IR and NIR
- Cancer Centre of the University Hospital, Radiation Biology Unit: Cell biology lab next to a linear accelerator. Possibility to obtain samples from radiotherapy or diagnostic radiology patients
- Live Cell Imaging
- Laboratory Animal Centre: animal facilities
- University Genome Centre, eg. Next Generation Sequencing

Methods available at UEF (ref. biomarker studies)

Cellular redox status

Cytosolic: Hydroperoxide levels (DCF-probe); Superoxide levels (DHE-probe); Lipid peroxidation (DPPP-probe)

Mitochondrial: Superoxide levels (MitoSox-probe); Membrane potential (JC-1 –probe); Dysfunction (MTT-probe)

Cell cycle and proliferation

Flow cytometric analysis of cell cycle phases (SYTOX Green); Fluorometric proliferation assay (AlamarBlue)

Cell death processes

Necrotic cell death (PI-method)

Apoptotic cell death: DNA ladder formation (by electrophoresis); Sub-G1 phase (by flow cytometry); Annexin V (by flow cytometry); Caspase 3/9 activity (by fluorometry); Clonogenic cell survival (by colony counting)

Genotoxicity endpoints and omics assays

Comet assay, Damage and repair components measured

Micronucleus formation (flow cytometric scoring)

Single molecule PCR assay for expanded simple tandem repeats (ESTRs)

Phosphorylation of histone H2AX (γ-H2AX)

Gene expression analysis (microarrays, PCR arrays)

Non-targeted metabolite profiling (LC-qTOF-MS system)

Global DNA methylation and expression of DNA methyl transferases

microRNA PCR array analysis

Radiobiology and Biophysics Group

Diana Savu dsavu@nipne.ro

Department of Life and Environmental Physics

"Horia Hulubei" National Institute for Physics and Nuclear Engineering, IFIN-HH

Bucharest-Magurele, Romania

Research activities

1. Impact of ionising radiation on biological systems

Genetic, epigenetic, nontargeted effects
(bystander, adaptive)
Individual radiosensitivity
Radiopharmaceuticals

Health risk:
Occupational exposure; radiotherapy; diagnosis;
Cosmic - like radiation (**ELI-NP)**

2. Cellular and molecular biophysics

Proteins & DNA (VDJ recombination)
Genomic instability-Lymphocytes, Lymphoma

New therapeutical solutions
Biomarkers

3. Nanostructured materials

Functionalizing
In vitro toxicity

Biotechnological application

1. Impact of ionising radiation on biological systems: research activities

Study of in vitro and in vivo effects of low dose tritiated water (HTO) contamination modulated by dose rate: direct effects and adaptive response

acute and chronic irradiation

collaboration with OSSKI, Budapest, Hungary

In vivo and in vitro toxicity of radiopharmaceuticals ⟶ radiotherapy and/or radioimaging

Collaboration with DRMR and CCR IFIN-HH and Hospitals

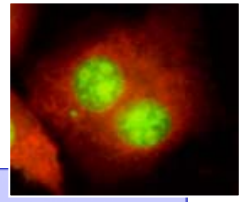
Individual radiosensitivity

-Characterize the *in vitro* radiosensitivity of peripheral blood lymphocytes in pathologies associated with oxidative stress and DNA repair impairment (multiple sclerosis, cancer).

-Correlate individual radiosensitivity with adverse effects of cancer patients undergoing radiotherapy

Initiated in collaboration with University of Ghent
Continued with the Oncologic Institute Bucharest

1. Impact of ionising radiation on biological systems: research activities



on going collaboration with University of Leicester

Genetic, epigenetic, nontargeted effects induced by genotoxic agents

Deciphering underlying mechanisms of non targeted effects of genotoxic stressors:

1. Role of cellular microenvironment molecules
2. Compartmental/organellar signaling mechanisms (ER, mitochondrial and cytoplasmic stress)
3. Involvement of mitochondrial quality control in modulation of nuclear DNA damage and non-targeted effects

Genotoxic agents: X-ray , Bleomycin

Cell models: fibroblasts and neuronal cells (with deficiency in mitochondrial quality control and stress signalling)

End-points and methods used: Cell viability and proliferation; Genotoxicity (micronuclei); DNA damage and repair; oxidative stress; mitochondrial function; Gene (RT-PCR) and protein expression (Western blotting)

Future work: particularities of these signaling mechanisms in immune cells (from brain and circulating blood)

INFRASTRUCTURES

- **Complete cell cultures laboratory**
- **Molecular biology:** Comet assay system; PCR machines; Western blot equipment; UV transiluminator; DNA electrophoresis; Flow cytometer; Multi plate reader
- **Molecular Biophysics:** spectrophotometer, spectrometers spectrofluorimeters
- **Imaging:** fluorescence microscopes
- **Standard chemistry laboratory infrastructure**
- **Animal house for small animals** (mice, rats, Guinea pigs, rabbits)

- **External irradiation facilities:** XSTRAHL XRC 160 X-rays; UV lamp (UV-C and UV-B)
- **Radiation counters:**
- **Cyclotron:** short lived isotopes
- **Ultra low level radiation laboratory**

- **Access to genetic laboratory:** Sanger Sequencing; Next Generation Sequencing: Ilumina MySeq; Microarray: Agilent DNA Microarray, RT PCRs
- **Access to the X-rays machine from hospital:** Primus Siemens (6MV)

Research interest in CONCERT Topic 1

❖ Study of individual susceptibilities to low doses of radiation in biological samples from patients undergoing diagnostic/ therapeutic irradiation; to identify the sensitive individuals and biomarkers of exposure.

❖ Genetic, epigenetic and non-targeted effects involved in low dose radiation response of diverse cells (external and internal irradiation). Focus on compartmental / organellar signalling mechanisms contribution and immunomodulation.

Administrative Co-ordination and Management

Natalia Semioshkina
RADRISK/r.e.m.

CONCERT INFO DAY

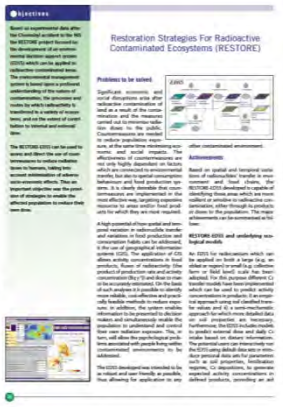
From project initiation throughout project implementation and project closure, we offer management according to European and International Project Management tools.

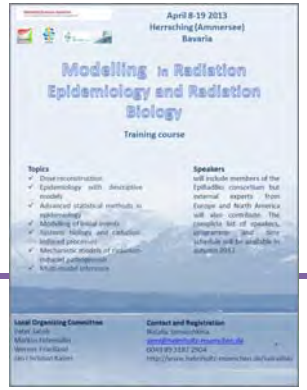
We offer to establish a competent Project Office for:

- project administration
- day to day project management
- development and administration of the project website
- administrative and financial coordination and management
- control and management of scientific documentation
- risk analysis and mitigation
- supporting the exploitation and dissemination of results

- As **scientists** we are familiar with scientific goals and objectives of projects in the field of radiation protection, but with administrative management as well.

- We have many years experience in successfully managing EU projects such as **RESTORE**, **EVANET-TERRA**, **SOUL** and **EpiRadBio** with numerous participants of industry, research institutions, governmental, and non-governmental organisations.





CONCERT TOPIC 1
Competencies and research interests – NRPA

Dr. Åste Søvik, Head of Research
Department of Monitoring and Research

Munich, 27.01.2016

Statens strålevern
Norwegian Radiation Protection Authority

www.nrpa.no

Norwegian Radiation Protection Authority (NRPA)

- The competent authority in radiation protection and nuclear safety in Norway
- The Norwegian POM in CONCERT
- Member of MELODI, EURADOS, ALLIANCE and NERIS
- Partner in numerous EU projects since FP4
  - CONCERT, DoReMi, EPI-CT, EURALOC, RENEB, SEMI-NUC
- Partner in Norwegian Centre of Excellence CERAD
- Does not request EU funding for its participation in EURATOM projects – is funded by the Research Council of Norway

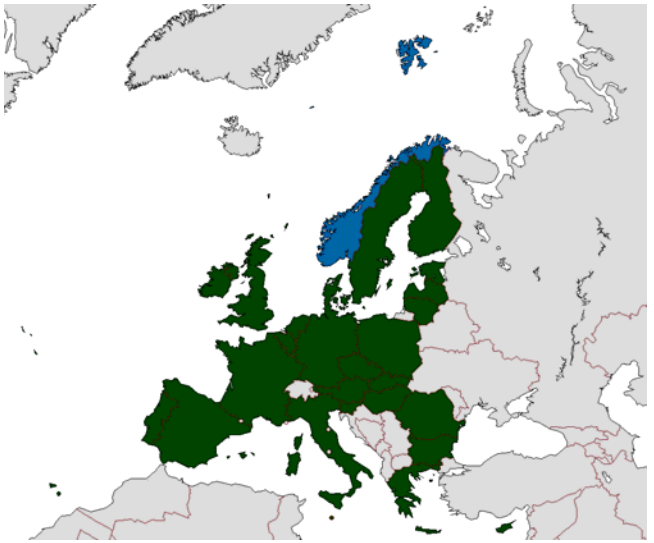
EPI-CT

DoReMi
Integrating Low Dose Research

RENEB
Realising the European Network of Biodosimetry

Euraloc
European epidemiological study on radiation-induced lens opacities among interventional cardiologists

SEMI-NUC project: Prospective cohort study of residents near the Semipalatinsk nuclear test site – feasibility assessment



NRPA research interests and competencies

- **Epidemiological assessment of cancer risk and other health risks from low-dose ionising radiation exposure in medical applications**
  - Expertise on large scale harvesting of medical exposure data from radiology databases
  - Extraction of detailed and accurate exposure parameters from DICOM data enables high level of accuracy for organ dose estimates
  - DICOM, PACS, RIS medical database technologies
  - Expertise on de-identification of DICOM data
- **Dosimetry on large sets of medical exposure data**
  - Individual patient dosimetry, automated interpretation
- **Dosimetry for medical applications on organ level**
  - Body size specific dose estimates
  - Monte Carlo modelling of dosimetric uncertainties
- **Dose-response modelling in low-dose domain**

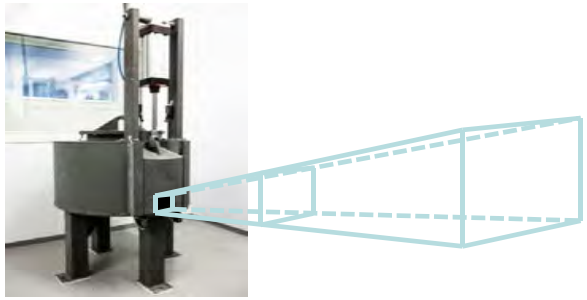
rileychildrenshospital.com

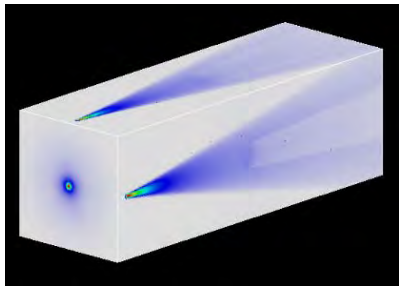
NRPA research interests and competencies

- **Computational dosimetry for radiobiological research**
  - Active development of Monte Carlo dosimetric models for radiobiological research, including comprehensive uncertainty estimation
  - Member of EURADOS WG 6

- **The NRPA dosimetry laboratory**
  - Designated National Calibration Laboratory for the units Gy, Sv, Bq (SSDL)
  - Calibration for radiobiological research, ensuring accurate and traceable dosimetry
  - Radiation beams: Co-60 gamma beam, X-ray 10-320 kV, source carousel Cs-137, Co-60, Am-241

Norwegian Radiation Protection Authority

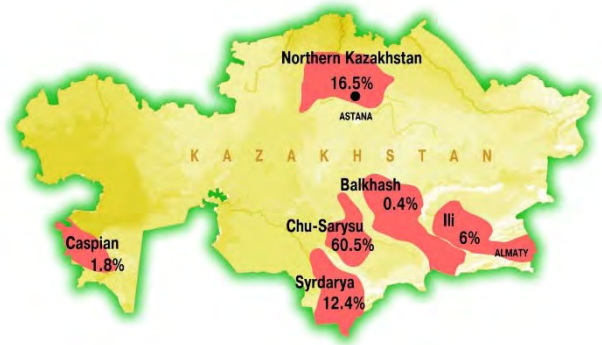


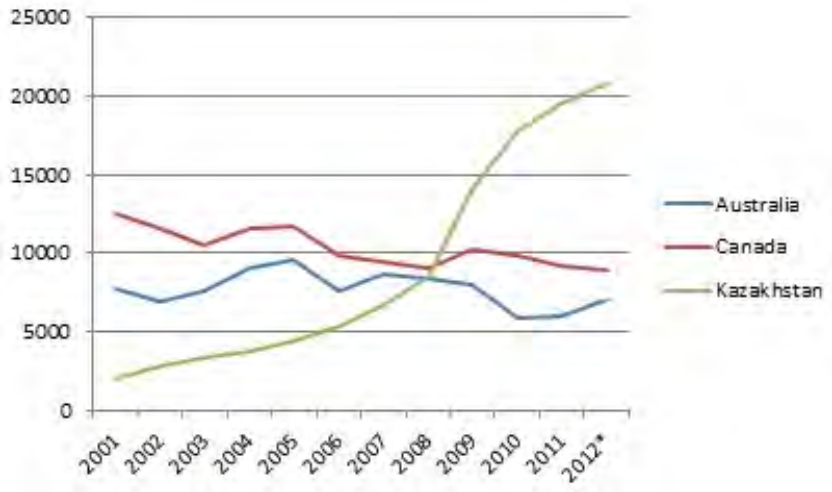


NRPA research interests and competencies

- **Health assessment in uranium workers and populations residing near uranium mining sites in Kazakhstan**
  - Epidemiological study in uranium miners and populations living near uranium mining sites
  - Contact with Kazakh research group through our Kazakh epidemiologist – aiming to extend epidemiological investigations; seeking European collaborators

- **Internal dosimetry**
  - Facility for whole body counting
  - Member of EURADOS WG 7





http://www.mining.com/