

Presentation of beneficiaries and partners

RADNEXT Kick Off Meeting – 19-21 May 2021

<https://indico.cern.ch/event/983095/>

<https://indico.cern.ch/event/1029314/>



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CERN

Rubén Garcìa Alìa

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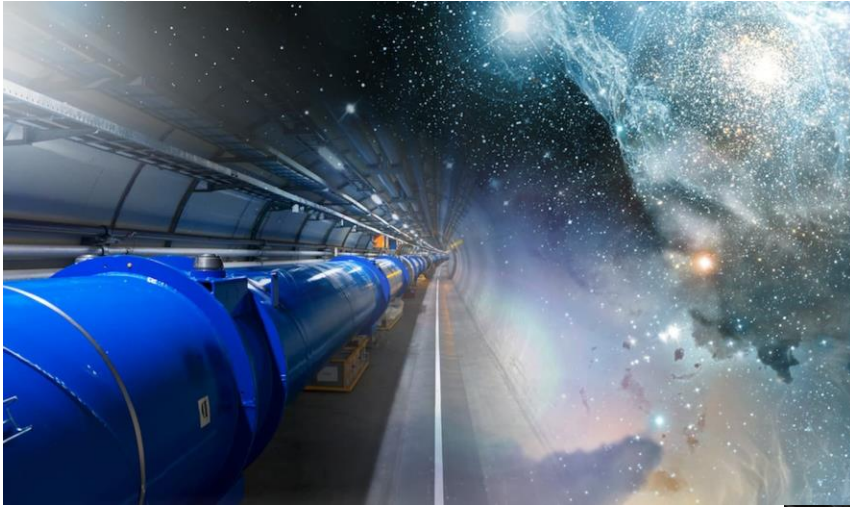
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- CERN operates the largest complex of particle accelerators
- The 65-year history of CERN is marked with impressive achievements in the construction and operation of powerful linear and circular accelerators
- CERN offers unique infrastructures for the irradiation of electronic components and systems
- CERN also concentrates an important amount of expertise related to radiation effects on electronics, mainly through the R2E project, in charge of ensuring a reliable operation of the accelerator with regards to the impact of the accelerator radiation environments on the commercial electronic components used in the critical Large Hadron Collider (LHC) and rest of the accelerator chain.
- CERN has coordinated 11 large projects funded under the Research Infrastructure programmes of FP7 and H2020, including 6 Integrating activities
- The RADNEXT project management will rely on the professional and experienced support from:
 - The EU Office
 - The Finance Department
 - The Legal Service



- CERN is RADNEXT's project coordinator, and also has technical and scientific involvement in almost all WPs

- It will be providing Transnational Access through the CHARM mixed-field facility, especially suited for system level testing



21 GANIL

Xavier Ledoux - Marie-Helene Moscatello
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**RAD
NEXT**

GANIL – Heavy ions

GANIL ION BEAM MAINLY USED FOR RADIATION TESTS

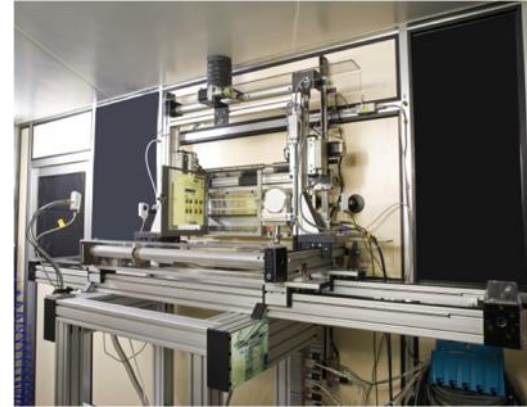
Ion	Energy (MeV/u)	LET Min (MeV.cm ² /mg)	Range (μm)	LET max (MeV.cm ² /m)	Range (μm)
³⁶ Ar	27	5,4	445	9,9	113
⁸⁶ Kr	60	11,0	1223	42,1	27
¹²⁹ Xe	50	26,5	685	64,3	35
²⁰⁸ Pb	29	72,7	258	97,6	64



Opened mobile frame



Closed mobile frame



Standard sample holder

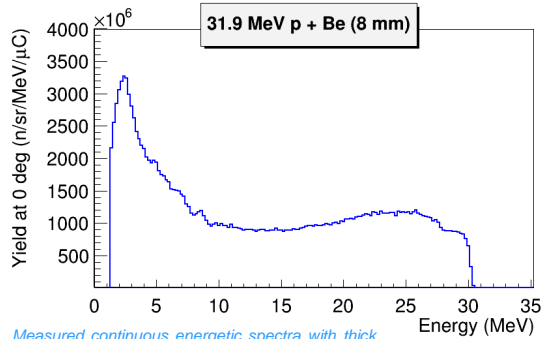
Precise alignment with laser
Various degraders for beam LET tuning

Irradiation in air
Ion Flux from 10 p/s/cm² to 2.10⁴ p/s/cm²

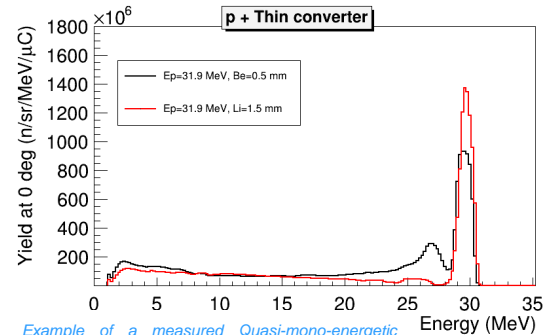
Many other possibilities for beams and set-ups
(several caves available) – to be discussed for each experiment

- Scientific Coordinator: Marie-Hélène MOSCATELLO moscatello@ganil.fr
- **158 hours available for experiments with heavy ion beams**

GANIL – NFS – neutrons (and lights ions)



Measured continuous energetic spectra with thick Be converter and proton beam



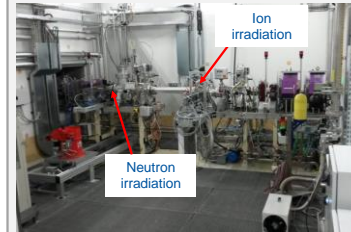
Example of a measured Quasi-mono-energetic spectra with thin Be or Li converter and proton beam

White neutron beams
(up to 40 MeV)

Quasi-monoenergetic
neutron beams from
1 to 31 MeV

Converter room :

- neutron production
- irradiation capability (neutrons and ions)



Time-of-flight hall :

- collimated neutron beam
- pulsed beam for time-of-flight measurements



Ion Beams in NFS for industrial applications and radiation tests

Ion	Energy (MeV/u)	Intensity μ A
p	33	50
d	20	50
ions up to ^{58}Ni , ^{78}Kr	14,5	tens

- Scientific Coordinator : Xavier LEDOUX xavier.ledoux@ganil.fr
- 90 hours available for experiments with neutron beams

Participation to WP05 Task 5.3.3 Characterization of neutron fields

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Institut Laue Langevin

Manon Létiche, Caroline Boudou

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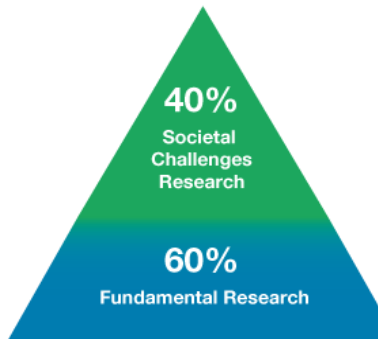
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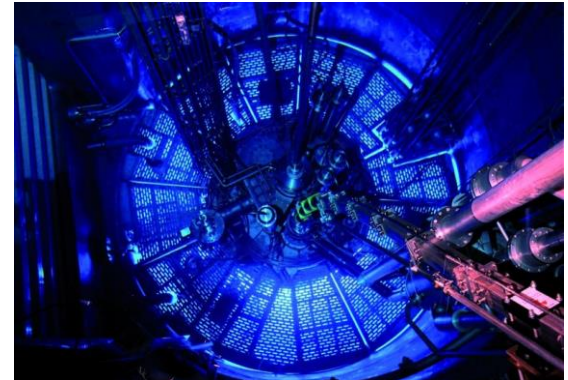
The ILL in key numbers

- Founded in 1967, the ILL is a research structure operating the powerful high flux reactor in the world (58 MW) to provide neutrons for research.
- Budget 2019: 101 M€ (France 25%, Germany 25%, United Kingdom 25%, other countries 25%), 523 employees.
- More than 150 scientific experts and 30 instruments for academic users and industries.
- Around 850 experiments are performed and 1200 scientist visitors per year.



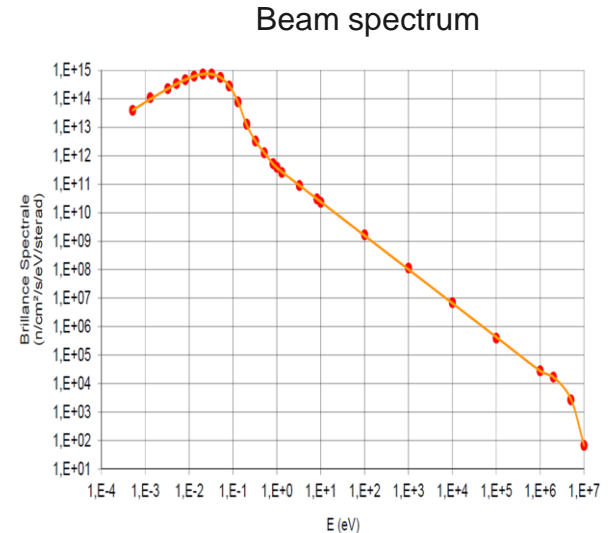
- ✓ Material and engineering
- ✓ Biology and health
- ✓ Chemistry
- ✓ Crystallography
- ✓ Liquids and glasses
- ✓ Magnetism
- ✓ Soft matter
- ✓ Particle and nuclear Physics

+ production of radio-isotopes



The role of the ILL in RADNEXT

- Role: Provide thermal neutron
- Facility: **Thermal and Epithermal Neutron Irradiation Station (TENIS)**
- Scientist in charge: Manon Létiche
- Contact address: letiche@ill.eu or industry@ill.eu
- Characteristics:
 - Fission spectrum
 - Captured flux: $2,86 \times 10^9$ n/cm²/s (thermal + epithermal neutrons)
 - Square beam of 50x50 mm²
 - (x,y) motorized mechanical translation for sample alignment
- Access mode : 100h through **TransNational Access**
- Reactor cycles:
 - 2021: 24/08 – 13/10
 - 2022: long shutdown a restart is foreseen in December



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IROC Technology SA

Dan Alexandrescu

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Partner #23: IROC Technologies SA (IROC)



- French SME, located in Grenoble, founded in 2020 as a spinoff of CNRS
- Provide solutions for Reliability and Functional Safety Management
- Strong experience on Single Events in microelectronics
- Recognized SEE solutions supplier for TSMC (OIP), Samsung (SAFE), GlobalFoundries and many other foundries, component providers and system integrators in aerospace, automotive, networking, HPC and medical
- Contribution to RADNEXT:
 - Industrial qualification of irradiation facilities (all types, all effects - SEE & TID)
 - through use of advanced test devices
 - Corelation of simulation and experimental results
 - Board and system-level testing; radiation as a fault injection mechanism

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Université Jean Monnet

Sylvain Girard

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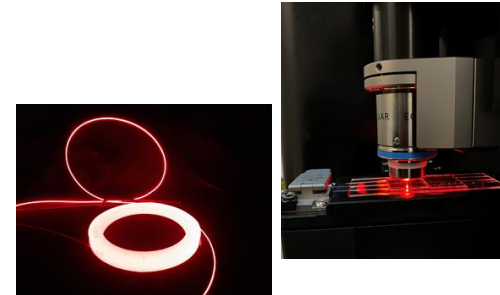
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Université Jean Monnet Saint-Etienne (UJM)



- UJM (MOPERE team of LabHC, 5 permanent researchers) will lead WP05-JRA1, participate in WP07-JRA3
- Scientist in charge: Sylvain Girard, sylvain.girard@univ-st-etienne.fr
- MOPERE main expertise concerns the **radiation vulnerability and radiation hardening studies of photonic & optoelectronic technologies**
 - Bulk glasses, Sol-Gel Materials, Optical fibers and Fiber Sensing
 - Optical and Illumination Systems for rad-hard cameras
 - Point and Distributed fiber-based dosimeters
- MOPERE main tools: **2 X-ray machines** (160kV, 220kV) with T control (-100°C to 400°C), multiple femtosecond laser platforms, spectroscopic tools, fiber-related interrogators and systems.
- Coordinator of RADMEP EMJMD (with JYU, KUL and UM): <https://master-radmep.org/>
- Member of PHOTON HUB project: <https://www.photonhub.eu/>



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Université de Montpellier

Frédéric Saigné

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RAD NEXT

Université de Montpellier

Radiation effects on devices and circuits

2 laboratories involved :
(5 researchers, 1 technician)

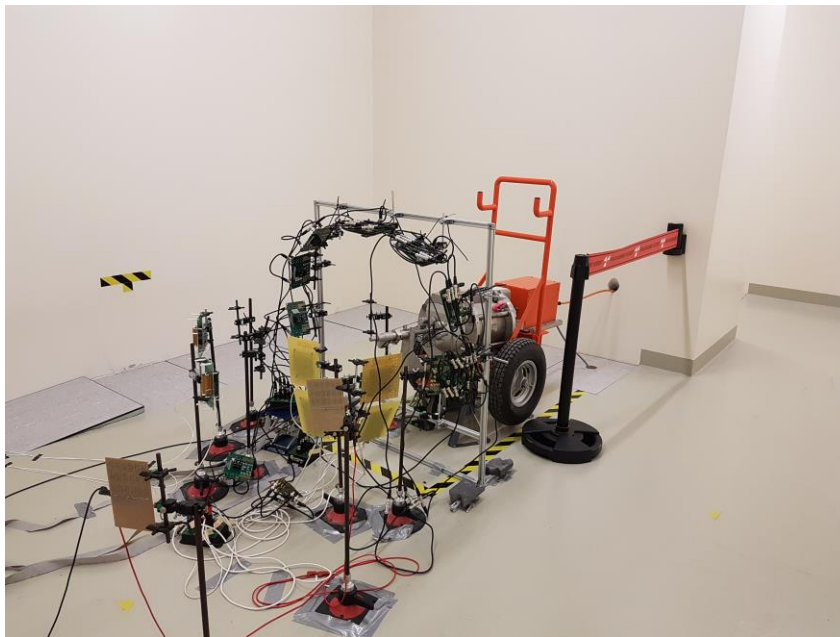


- WP leaders :
- WP6 (JRA2) Luigi Dilillo “ Standardization of system level radiation qualification methodology “
 - WP7 (JRA3) Jérôme Boch ” Cumulative radiation effects on electronics ”
 - WP8 (JRA4) Frédéric Wrobel ” Complementary modelling tools ”

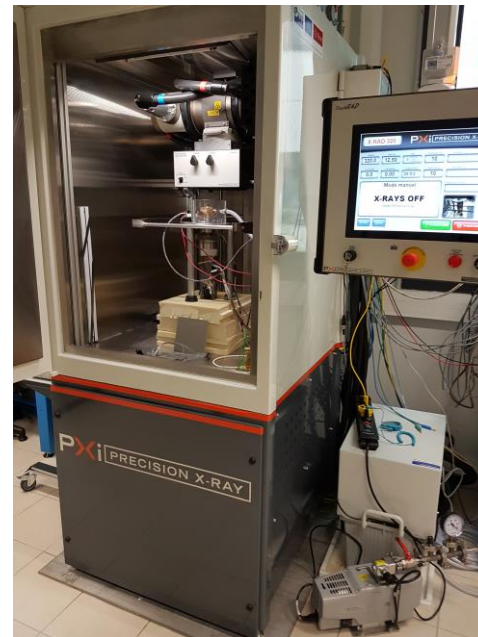
Participation to WP5 (JRA1) ” Radiation monitors, dosimeters and beam characterization”

Co-WP leader : WP1 Frédéric Saigné « Project Management »

Université de Montpellier



Co60 source



X-Rays 320 eV

*Image Source: PRESERVE platform Université de Montpellier
The University of Montpellier PRESERVE platform has been funded thanks to the financial support of the Region Occitanie and the European Regional Development Fund.*



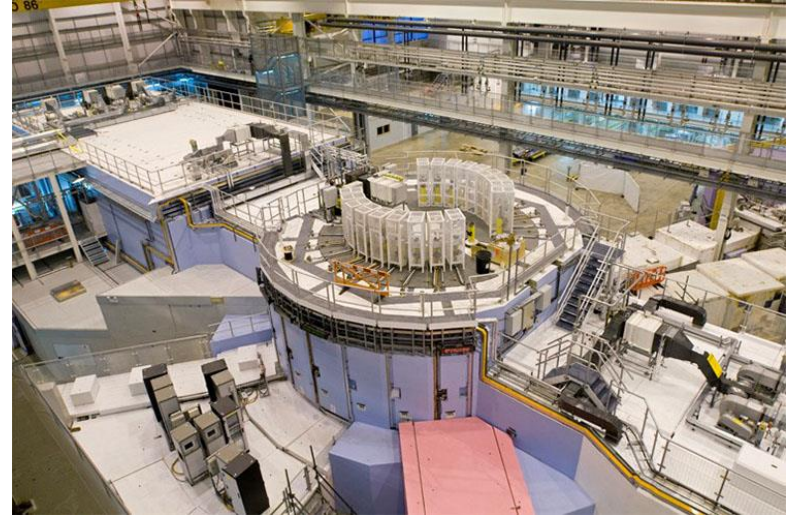
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UKRI-STFC

Carlo Cazzaniga, Maria Kastriotou, Chris Frost
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Science and
Technology
Facilities Council

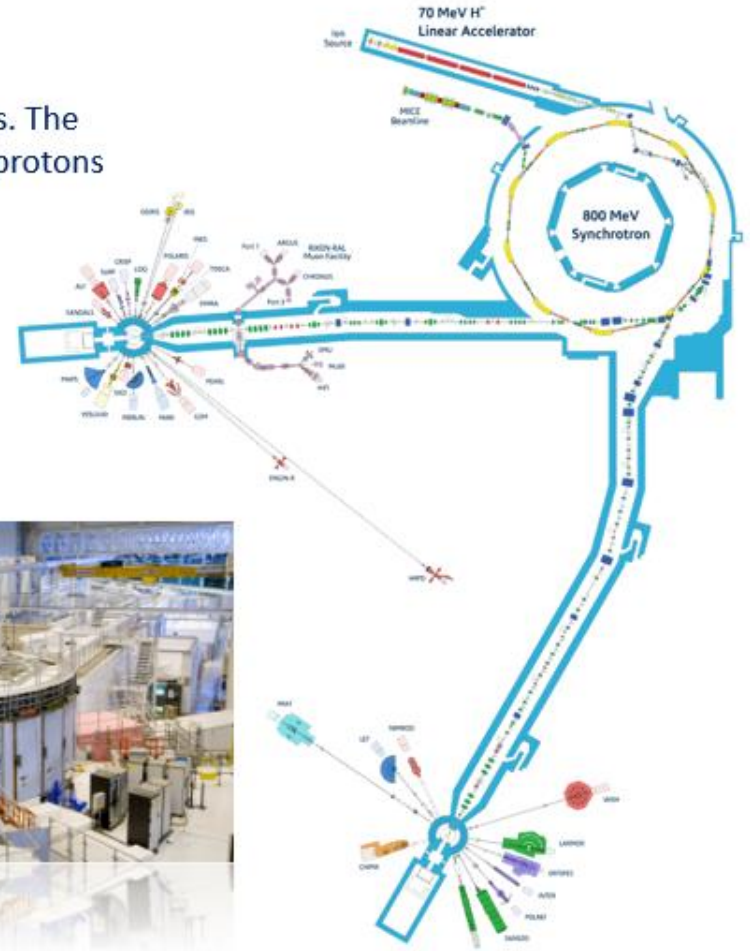
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Rutherford Appleton Laboratory Oxfordshire, UK

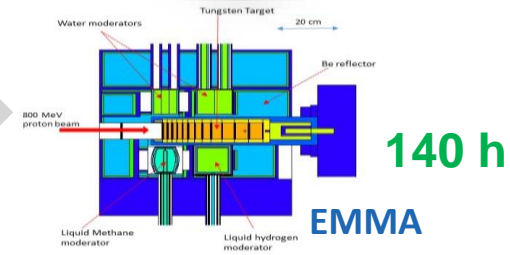
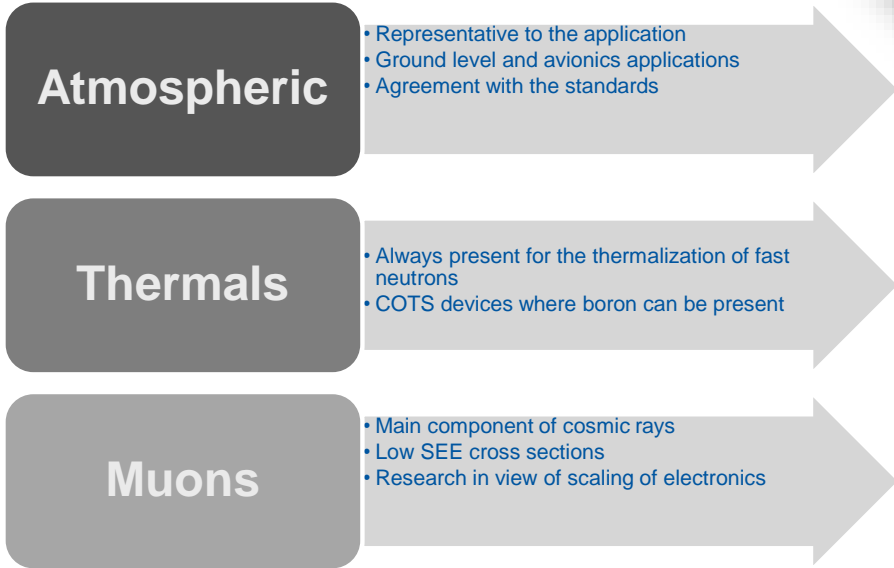


Neutron Facilities

Spallation Neutron Sources are based around particle accelerators. The UK's ISIS Neutron Source uses a proton synchrotron to accelerate protons to 800MeV (about 84% the speed of light).



Suit of beams at Rutherford Appleton Laboratory for testing of microelectronics



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ENEA

Salvatore Fiore

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Agenzia nazionale per le nuove tecnologie,
l'energia e lo sviluppo economico sostenibile



ENEA (IT)

ENEA: Italian R&I institute for energy, environment and sustainable economic development

Fusion and Nuclear Safety department: reference Italian fusion research coordinator

Two research centres in **Rome area**, several **irradiation facilities:**

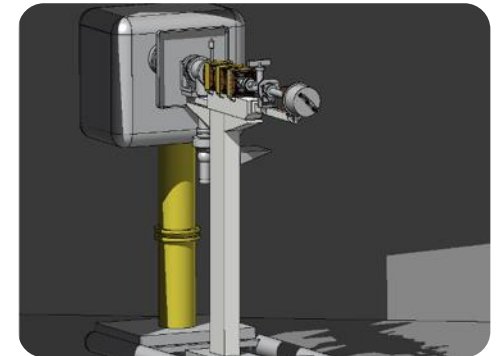
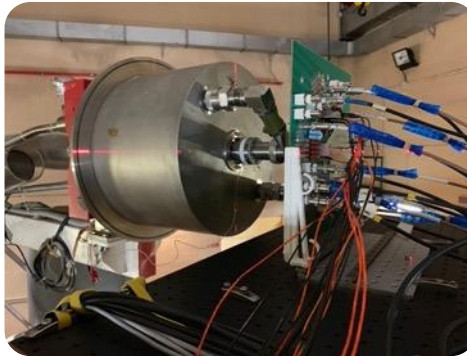
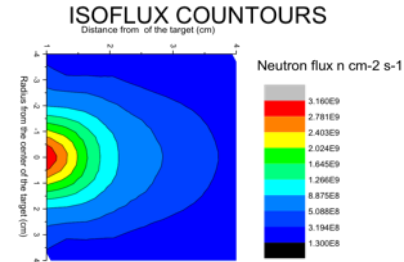


Scientist in charge: **Salvatore Fiore**

- **WP3-NA2 coordination:** Transnational Access Management and Harmonization
- **Transnational Access coordination** role in RADNEXT

ENEA – Frascati Neutron Generator FNG

- 14 MeV D-T monoenergetic neutron source, max yield 10^{11} n/s
- Maximum usable flux 5×10^9 n/cm²s
- Large hall, low backscattering, low thermal n contamination
- FLUKA and MCNP full facility simulations, setup model integration
- passive and active dosimetry, ISO 9001



550 beam time hours committed to RADNEXT Transnational Access

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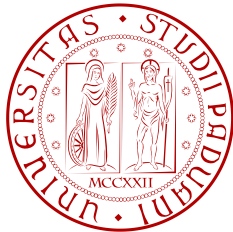
Università degli studi di Padova

Marta Bagatin

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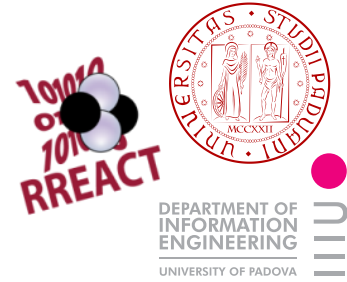
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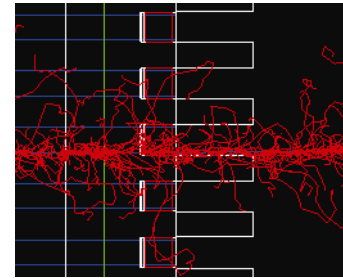


**RAD
NEXT**

Università degli Studi di Padova (UniPD)



- **RREACT** group at Information Engineering Dept.: research on **electronics reliability**, focus on **radiation effects**
 - **Staff:** 1 Full Prof (A. Paccagnella), 1 Assoc Prof (S. Gerardin), 1 Assist Prof (M. Bagatin)
 - **Collaborations:** semiconductor companies (Micron, STMicro, ...), space agencies (ASI, ESA, NASA), research institutes (CERN, ITER, ...), companies/univ across the globe
- **Field of activity**
 - **Non-volatile memories:** Floating gate (3D NAND Flash), emerging technologies (RRAM, PCM) for mainstream and critical applications (space, medical, ...)
 - **Tecnologies for zero-FIT applications** (automotive)
 - **Complex devices** (uP, ASICs) for space applications
 - **Advanced CMOS technologies for extreme environments** e.g. CERN, ITER
 - **Innovative devices** (tunnel FETs, organic thin film transistors, ...)
- **Capability:** radiation tests, simulations, modeling/predictions, identification of mitigation strategies
- **Role in RADNEXT:** Development/test of a **dosimeter/SEU monitor based on 3D NAND Flash memories (WP5)**



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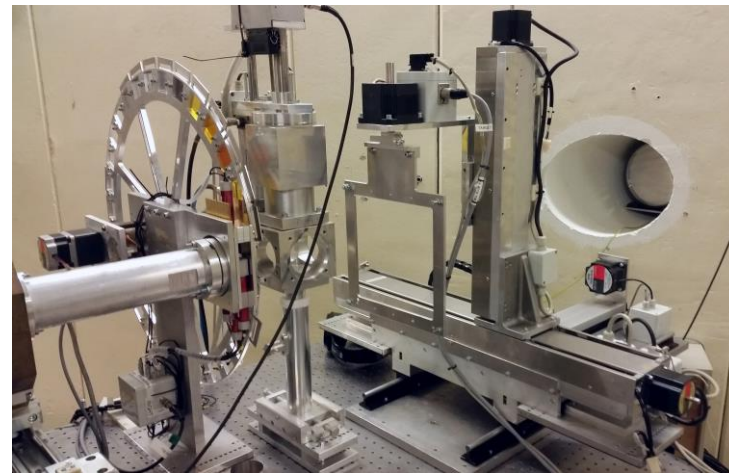
University of Groningen

Brian N. Jones, Marc-Jan van Goethem,
Sytze Brandenburg

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umcg



partrec

RAD
NEXT

PARTREC proton and heavy ion irradiation facility

- Our facility offers a wide array of beams and energies with the option of scattering or scanning in air
- www.partrec.nl
- New investment, including new beamline for medical research
- Transnational access being offered (475 hours)
- Beams available: 190 MeV protons, 90 MeV/amu (H, He, C, O, Ne) or 30 MeV/amu heavy ion cocktail (O, Ne, Ar, Kr, Xe)
- Experimental beamline(s):
 - In-air setup
 - In-vacuum setup (depending on enough demand)
- Technical questions: irradiations@kvi.nl

partrec

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Uppsala University

Alexander Prokofiev

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UPPSALA
UNIVERSITET

RAD
NEXT

Uppsala University and its involvement in RADNEXT (I)

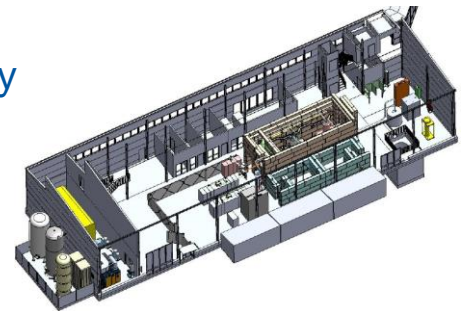
Who are we?

- The university is founded 1477, one of the oldest in Europe.
- has ranked among the world's 100 best universities in several high-profile international rankings
- has over 50,000 students and more than 7,000 employees



- Long-term tradition in radiation facilities and research in radiation sciences
- Experience in / techniques for physical characterization of particle beams
- Has, or has had partnerships with the majority of entities active in RADNEXT
- Infrastructure for radiation work / accelerator developments: the FREIA laboratory →

Contact: alexander.prokofiev@physics.uu.se

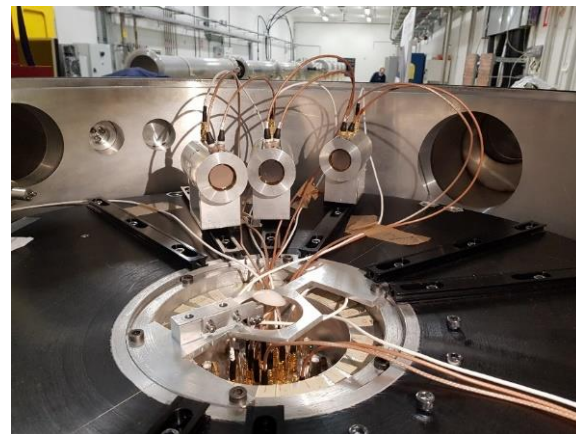


Uppsala University and its involvement in RADNEXT (II)

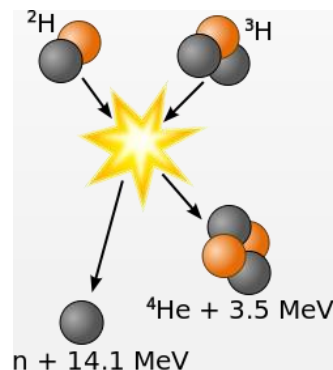
Actual work packages / tasks / facilities

- **WP05-JRA1: Radiation monitors, dosimeters and beam characterization**
- **Task 5.3 : Innovative instrumentation applied to RADNEXT facilities**
 - Sub-Task5.3.3 - *Characterization of neutron fields at the emerging NFS facility*

The key partner:



- **WP9-TA1: Neutron, muon and mixed-field spallation facilities and irradiation**
- **The NESSA neutron facility**
 - **NESSA = NEutron Source in uppSAla**
 - Neutron energy: 14 MeV
 - Yield: $\geq 4 \cdot 10^{10}$ n/s
 - Flux: from $\geq 10^9$ n/cm²/s to single neutrons/cm²/s
 - Planned amount of beam time for TA: ≥ 100 hours



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Seibersdorf Laboratories

Peter Beck

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DLR

Jan Budroweit

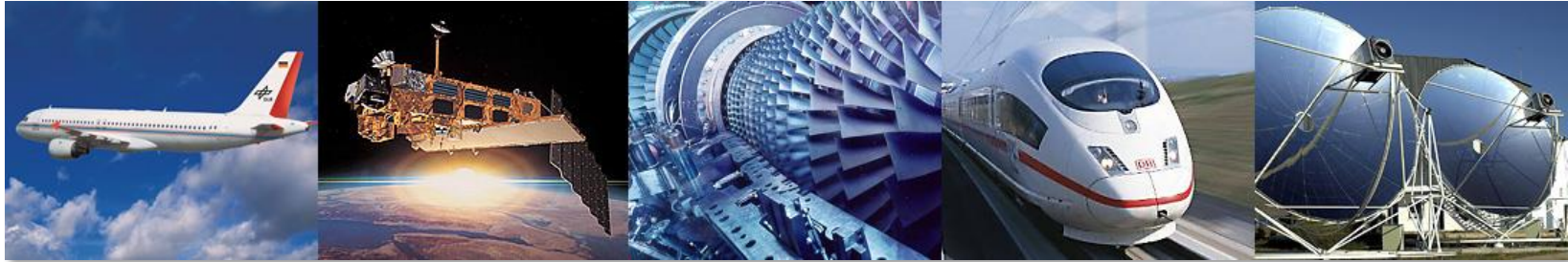
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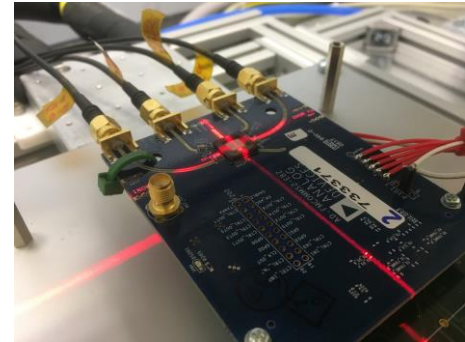
<https://indico.cern.ch/event/1029314/>

The logo for RADNEXT. The word "RAD" is in a light blue, sans-serif font. The word "NEXT" is in a dark blue, sans-serif font. The letter "X" in "NEXT" is stylized with a circular graphic element in the center, resembling a lens or a camera eye.

DLR - German Aerospace Centre



- *Research Institution*
- Space Agency
- Project Management Agency



DLR - Locations and Employees

- 9000 employees across 54 institutes and facilities at
 - 30 sites
- Offices in Brussels, Paris,
- Tokyo and Washington D.C



Contributions to RADNEXT

- Associated partner to RADNEXT
- Joint Research Activities - WP06 Standardization of system level radiation qualification methodology
 - Radio frequency integrated circuits (RFIC) and agile RF transceiver
 - System in Package (SiP) architectures (for RF Systems)
 - Integrated and hybrid technologies such as SoCs (e.g. Zynq-7000, UltraScale+)
 - Machine learning for failure detection
 - Distributed on-board-computer (OBC) architecture for satellite systems

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ALTER TECHNOLOGY TÜV NORD

Gonzalo Fernandez-Romero

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ALTER
TECHNOLOGY

RAD
NEXT

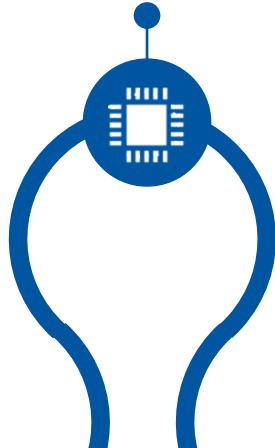
ALTER Group Services

ALTER TECHNOLOGY

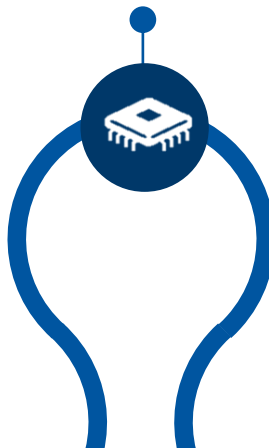
PARTS
ENGINEERING



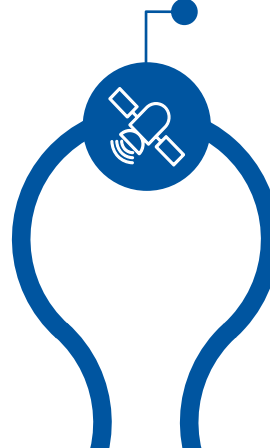
COMPONENTS
TESTING



PACKAGING
DESIGN



PROCUREMENT
OF ELECTRONIC
COMPONENTS



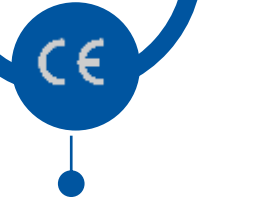
DIGITAL
SERVICES



EQUIPMENT &
SYSTEMS TESTING



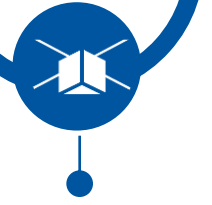
CERTIFICATION



CE MARKING



R&D



SMALL SATS
TESTING

Experts in radiation testing on components and systems: engineering, plans development, test set-up, sample preparation, test execution and data analysis.

Performed test:

- TID at RadLab (
- TNID / DD
- SEE, all kind: SEU; SEL; ...
- SEE-Laser Test
- Neutron test
- Test at system / equipment level

Test performances:

- RadLab
- Wide and advance electrical test capabilities
- Virtual Lab
- Several accreditation, including DLA laboratory suitability for TID Test





ALTER TECHNOLOGY in supporting the RADNEXT network providing experience in the radiation field and its industrial perspective on the topic.

ALTER
TECHNOLOGY

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SPAIN

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FRANCE

ALTER
TECHNOLOGY
UK

gonzalo.fernandez@altertechnology.com

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INTA Space Radiation Laboratory

Maite Alvarez

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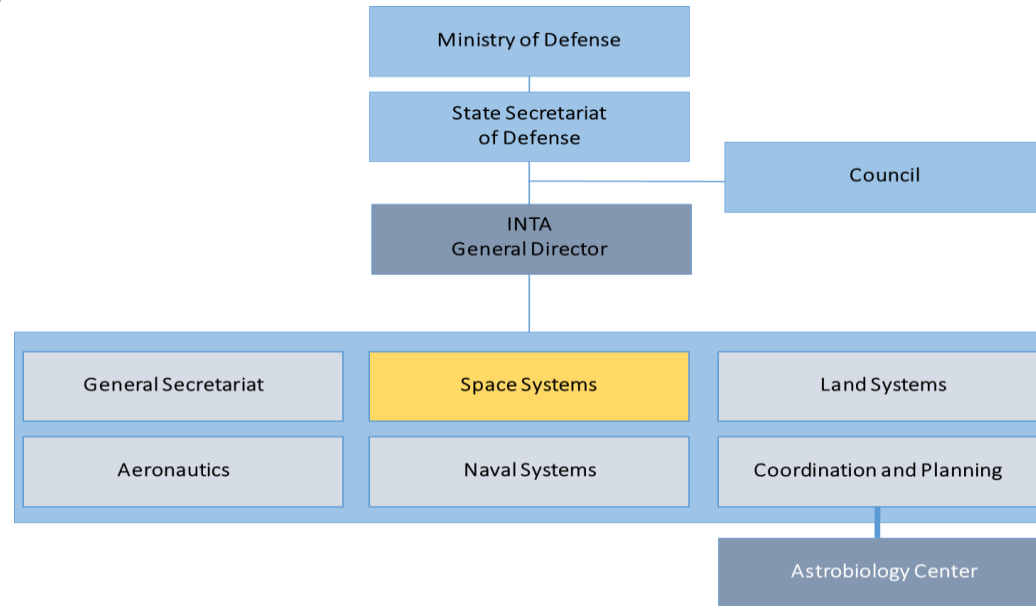




The National Institute for Aerospace Technology (**INTA**), founded in 1942, is a Public Research Organization (OPI) specialized in aerospace Research and Development. INTA has more than 1,500 employees, of which more than 1,000 are dedicated to R+D+i activities.



The **Space Radiation Laboratory** involved in RADNEXT project belongs to the Payload and Space Science Department in the Space Systems Directorate.



EXPERTISE in RHA

- Space Radiation Group has performed more than 20 radiation test on more than 80 components in national and international facilities. Results have been presented in Space Radiation Conferences (RADECS, NSREC).
- Design and calibration of radiation monitors for Space missions

MAIN ACTIVITIES

- Space mission radiation environment specification & requirements.
- Radiation effects on **COTS** (Commercial off the shelf), materials and emerging technologies:
 - Risk assessment and Mitigation Techniques (shielding, design techniques, redundancy,..).
 - Radiation testing: Total Ionizing Dose (TID), Single Event Effects (SEE) & Displacement Damage (DD).

Total Ionizing Dose (TID) test performed at Universidad de Santiago de Compostela (USC, España).



Heavy Ion test performed at Université Catholique Louvain (UCL, Bélgica).



Low energy proton radiation test performed at Centro Nacional de Aceleradores (CNA, Sevilla).



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3DPlus

Pierre Wang

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AIRBUS

Renaud Mangeret

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AIRBUS

**RAD
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Airbus in RADNEXT

- Airbus is Europe's largest and most innovative defence and space company.
 - Airbus Defence and Space is part of Airbus Group, which also has a strong interest in the monitoring of radiation effects linked to atmospheric radiations
- Airbus, as a space systems provider, shall implement a strong Radiation Hardness Assurance (RHA) process
 - RHA is strongly relying on accelerator ground testing to demonstrate the usability of electronic devices in space programs
- Airbus intends to bring industrial needs and knowledge of a space and avionics system provider to the consortium, at any stage when this is requested.
 - Can provide its fitting needs in terms of accelerator characteristics, accounting for the most modern RHA methodologies which now include testing at board and/or system levels,
 - Can review/contribute in the list of test candidates delivered by the various members of the consortium, and,
 - Provide with support to test plans / test reports thanks to its extensive heritage in terms of radiation expertise in general and testing in particular.

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ATRON

Arnaud Chapon

RADNEXT Kick Off Meeting – 19-21 May 2021

<https://indico.cern.ch/event/983095/>

<https://indico.cern.ch/event/1029314/>



RAD NEXT

ATRON METROLOGY

Calibration of radiation survey meters:



Patented method, without radioactive source,
Use the braking rays of electrons accelerated
at few MeV as the source of calibration.

- ✓ High metrological requirements,
- ✓ Compliance with ISO 17025 standard,
- ✓ Realistic continuous spectrum at MeV-scale.

Various irradiation services (e-beam and X-rays)

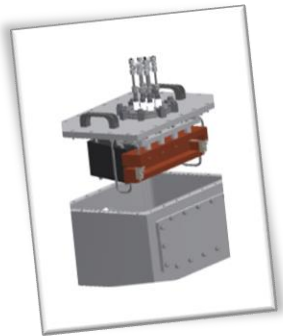
ATRON METROLOGY

e-beam

From 0.2 to 3.5 MeV

From ~1 pA to 1 mA
(Up to 6×10^{15} e-/s)

Beam spot size ~1 mm²



X conversion target

X-rays

From 10 μ rad/h to 50 krad/h
= 0.1 μ Gy/h – 500 Gy/h

Volumes up to few m³
(irradiation room size is 3x6 m²)



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Mines ParisTech

Pierre Jouvelot

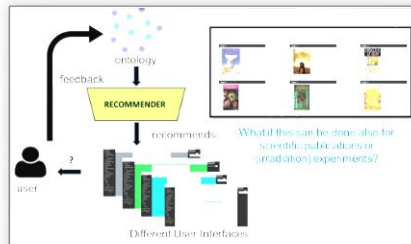
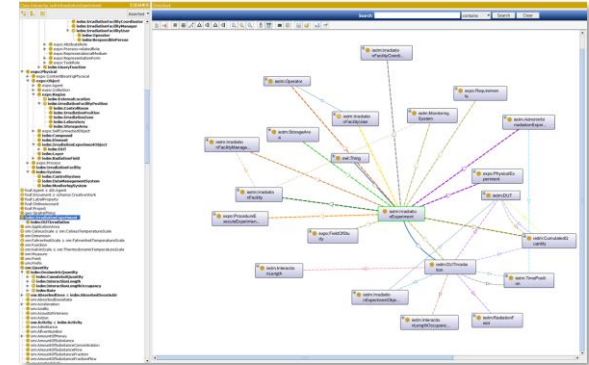
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- Top French engineering school for its research activities, created in 1783
- Fields of interest: energy, material sciences, maths, finance, social sciences,...
- Computer Science, including:
 - Modelling, data management, software systems (ontologies, DSL, Machine Learning, formal methods)
- CERN / IRRAD collaboration, since 2017:
 - Ontology for Irradiation Experiment Data Management
 - Ontology-based automatic Web applications generation
 - Recommender systems for UI personalization



Thanks for your attention!



Image Source: CERN