AIDA++ Open Meeting:

Irradiation & Characterization Facilities

Fernando Arteche (ITAINNOVA), Gregor Kramberger (JSI) &
Federico Ravotti (CERN)

CERN, 04 September 2019

Outline

- Introduction
- Description of the received EoI's:
  - # 8: Wireless system of portable radiation monitors for distributed dose control
  - # 13: Upgrades of EMC test infrastructure: susceptibility and emissions test
  - # 14: GIF++ gas system development and operation
  - # 30: Integrated traceability and residual activation measurement of irradiated samples
  - # 38: Silicon detectors at fluences above 10^{17} n/cm^2
  - # 116: Upgrade of irradiation infrastructures based on micro-beams and gamma irradiation
  - # 123: Instrumentation and dosimetry upgrade for irradiation facilities
  - # 133: Development of common data management and knowledge tools for irradiation facilities
  - # 137: Self powered particle detectors for beam-on target sec. particles fluence measurement
  - # 138: Radiation-hard beam quality monitoring for hadron cancer therapy
- Summary Tables
- Conclusion

Introduction

- Topic: Irradiation & Characterization Facilities
  - 10 EoI's received
    - 3 concerning new activities
    - 7 concerning follow-up of AIDA-2020 activities (WP11, WP12, WP15)
  - 2 additional spotted as potentially relevant
- Discussions within WP15 contributed to define the framework:
  - Support existing infrastructures
    - facilities & systems
    - incentive to leverage additional support from the participating institutes
  - Upgrade instrumentation & dosimetry equipment
    - further improve AIDA-2020 deliverables with innovative solutions
  - Develop common tools
    - apply the test-beam telescopes "concept" to the irradiation facilities
  - Upgrade the test-beam telescopes
    - to meet the requirements of the next-generation detectors

test-beam facilities topic

Disclaimers

- EoI's information presented in the following slides:
  - were distributed to our topic by the PPT
  - are summarized in two lines only: apologies if not fully accurate!

- Include sensor/instrument/dosimetry technologies that might:
  - be further developed to improve the facilities operation
  - have chances to work (often) in extremely harsh radiation environments
  - … do not fit better in other AIDA++ topics (e.g. gaseous detectors, KT, etc.)

- Include Machine Learning (ML)-related activities:
  - for image and text classification, aiming to optimize the facilities & improve the users operation
  - … do not involve ML for HEP data analysis or simulations

EoI #8 - Wireless system of portable radiation monitors for distributed dose control

- Participants:
  - INRE, Bulgaria (P. Iaydjiev)
- Deliverables:
  - develop a portable wireless system for TID (RADMON) and dose-rate monitors (integrating SiPM-based scintillators in addition to Geiger probes)
- Innovative aspects:
  - evolution of a hard-wired system developed for GIF++ in AIDA-2020
  - portable, easy to position (wireless) with higher sensitivity (new sensors)
- Industrial partners:
  - none
- Budget:
  - 300 k€ (EC contribution: 100 k€)
- Possible Synergies:
  - other EoI's about wireless systems (#30) or topic for "KT and outreach" ?

EoI #13 - Upgrades of EMC test infrastructure: susceptibility and emissions test

- Participants:
  - ITAINNOVA (F. Arteche), Spain – IPHC-CNRS, France
- Deliverables:
  - develop a test bench to measure the transfer function of HEP detectors
  - portable setup to measure power supplies noise emissions under irradiation
- Innovative aspects:
  - provides new EMC test capabilities also combining EMC/radiation tests
  - improve/ensure the access to existent EMC facilities (extension of AIDA-2020)
- Industrial partners:
  - none (potential interest in the noise emissions setup development)
- Budget:
  - 215 k€ (EC contribution: 75 k€)
- Possible Synergies:
  - noise emissions setup might be used by other irradiation facilities

EoI #14 - GIF++ gas system development and operation

- Participants:
  - CERN (R. Guida), Switzerland
- Deliverables:
  - improve, operate and maintain the GIF++ gas system infrastructure at CERN: commission a new gas recirculation system, implement standardized gas interlock signals and an exhaust system for flammable gas mixtures
- Innovative aspects:
  - improves an existent facility used for R&D (extension of AIDA-2020)
- Industrial partners:
  - none
- Budget:
  - 400 k€ (EC contribution: 130 k€)
- Possible Synergies:
  - other EoI's improving service/tools for facilities (#13 or #133)

EoI #30 - Integrated traceability and residual activation measurement of irradiated samples

- Participants:
  - ENEA (S. Fiore) – CAEN, Italy – CERN, Switzerland
- Deliverables:
  - a prototype of an integrated system to manage residual activation (γ-spectra) & traceability information of irradiated objects at ENEA-FNG and CERN-IRRAD
- Innovative aspects:
  - improves facilities operation by extending SW tools developed in AIDA-2020
  - qualifies RFIDs for usage in radiation environment
- Industrial partners:
  - 1 (CAEN, Italy)
- Budget:
  - 330 k€ (EC contribution: 130 k€)
- Possible Synergies:
  - other EoI for the improvement of the IRRAD Data Manager tool (#133)

EoI #38 - Silicon detectors at fluences above 10^{17} n/cm^2

- Participants:
  - JSI (M. Mikuz), SI – CERN, CH – Un. of Cantabria – CNM, ES – INFN (TO), IT
- Deliverables:
  - perform a set of systematic studies to validate the use of silicon as a sensor material in very high radiation environment (particle fluence >10^{17} n_{eq}/cm^2)
- Innovative aspects:
  - improve the knowledge about the usage of Si as material for future trackers
- Industrial partners:
  - none
- Budget:
  - 900 k€ (EC contribution: 300 k€)
- Possible Synergies:
  - with other EoI's belonging to the topic "Hybrid silicon" ?

EoI #116 - Upgrade of irradiation infrastructures based on micro-beams and gamma irradiation

- Participants:
  - RBI (S. Fazinic), Croatia – PSI, Switzerland
- Deliverables:
  - upgrade the RBI accelerator and ^{60}Co facilities for studies on MAPS sensors (provided by PSI): new micro beam control, cold box, DUT position. system, …
- Innovative aspects:
  - improve knowledge on MAPS; new services for radiation hardness studies
- Industrial partners:
  - none
- Budget:
  - 598 k€ (EC contribution: 198 k€)
- Possible Synergies:
  - MAPS studies: other EoI's belonging to the topic "Hybrid silicon" ? (facilities upgrade required to perform the MAPS studies)

EoI #123 – Instrumentation and dosimetry upgrade for irradiation facilities

- Participants:
  - CERN (F. Ravotti) – EPFL, CH – MINES ParisTech, FR – EU Irradiation Facilities(*)

(*) "collaborators" only

- Deliverables:
  - upgrade the IRRAD Beam Profile Monitor (BPM) with ML-based pattern recognition algorithms & perform NIEL (inter)calibration of CERN/EU facilities
- Innovative aspects:
  - improve BPM system (AIDA-2020) with ML-techniques (+ beam quality)
  - provide standard devices/procedures for EU facilities (+ dosimetry accuracy)
- Industrial partners:
  - none
- Budget:
  - 555 k€ (EC contribution: 185 k€)
- Possible Synergies:
  - other BI EoI's (#137, #138), ATTRACT consortium, EU Irradiation Facilities

EoI #133 – Development of common data management and knowledge tools for irradiation facilities

- Participants:
  - CERN (F. Ravotti) – EPFL, CH – MINES ParisTech, FR – NEC Labs EU, DE
- Deliverables:
  - upgrade data manager system (AIDA-2020) for other facilities (GIF++, extern.)
  - develop ML-based recommender (M&O) and data classifier tools (post-irrad.)
- Innovative aspects:
  - enhance facilities performance improving data handling & sharing test results
  - improving facilities/systems usability with new (common) software tools
- Industrial partners:
  - 1 (NEC Labs Europe, DE)
- Budget:
  - 660 k€ (EC contribution: 220 k€)
- Possible Synergies:
  - other EoI involving data management/handling/traceability (#30)

EoI #137 – Self powered particle detectors for beam-on target sec. particles fluence measurement

- Participants:
  - ENEA (S. Fiore), Italy – CERN(*), Switzerland

(*)contact person to be defined at CERN

- Deliverables:
  - design a novel Self Powered Particle Detector for mixed-fields (MC simulat.), produce prototypes and test them close to production targets of accelerators
- Innovative aspects:
  - improves existing technology: Self Powered Neutron Detectors (SPND)
  - help to diagnose targets malfunctioning/on-line fluence monitor for samples
- Industrial partners:
  - none
- Budget:
  - 520 k€ (EC contribution: 170 k€)
- Possible Synergies:
  - other EoI's about beam instrumentation/dosimetry (#123, #138)

EoI #138 – Radiation-hard beam quality monitoring for hadron cancer therapy

- Participants:
  - HEPHY (T. Bergauer) – MedAustron – Cividec – TU Wien, Austria
- Deliverables:
  - develop a profile monitor based on CMOS detectors and radhard intensity monitor based on diamond coupled to ASIC for low-intensity proton beams
- Innovative aspects:
  - improves beam quality for clinical (and non-clinical) purposes, enabling / making easier the setup, commissioning and operation of low-flux beams
- Industrial partners:
  - 2 (MedAustron and Cividec)
- Budget:
  - 1050 k€ (EC contribution: 350 k€)
- Possible Synergies:
  - other EoI's about beam instrumentation and dosimetry (#123, #137)

Support Existing Infrastructures

EoI #	TITLE	LEADING PARTNER	FACILITY TYPE	INDUST. PARTNERS	RELEVANCE / INTEREST	INNOVATIONS / COMMENTS
13	Upgrades of EMC test infrastructure: susceptibility and emissions test	ITAINNOVA (F. Arteche)	Characterization	NO (might be)	HEP detector upgrades & external communities	Improves existent facilities with new test capabilities. Access to EMC tests beyond AIDA-2020
14	GIF++ gas system development and operation	CERN (R. Guida)	Characterization (Irradiation)	NO	HEP detector upgrades / HL-LHC, FCC	Improves an existent facility widely used in HEP for detectors R&D
66	A novel tool for 3D semiconductor sensor characterization: two-photon absorption TCT	CERN (M. Moll)	Characterization	YES	HEP detector upgrades (new detectors & simulation tools)	Improving existing technology Belonging to another topic

Develop Common Tools

EoI #	TITLE	LEADING PARTNER	FACILITY TYPE	INDUST. PARTNERS	RELEVANCE / INTEREST	INNOVATIONS / COMMENTS
30	Integrated traceability and residual activation measurement of irradiated samples	ENEA (S. Fiore)	Irradiation	YES	Facilities in HEP / external applications (nuclear processing, medical, ...)	New application: qualifies RFIDs and extends integrated traceability system (SW/HW) making it available to the community/industry
133	Development of common data management and knowledge tools for irradiation facilities	CERN (F. Ravotti)	Irradiation	YES	Facilities in HEP & worldwide / external applications involving data management	Improves with ML and extend an existent system (AIDA-2020) for handling facilities operation. New application: sharing irradiation experiments data

Upgrade Instrument. & Dosimetry Equipment

EoI #	TITLE	LEADING PARTNER	FACILITY TYPE	INDUST. PARTNERS	RELEVANCE / INTEREST	INNOVATIONS / COMMENTS
8	Wireless system of portable radiation monitors for distributed dose control	INRE (P. Iaydjiev)	Irradiation (Dosimetry ?)	NO	Nuclear facilities, beyond HEP irradiation facilities	Improves a system developed for GIF++ in AIDA-2020. Best fits the topic "KT/outreach" ?
123	Instrumentation and dosimetry upgrade for irradiation facilities	CERN (F. Ravotti)	Irradiation	NO	HEP detector upgrades / HL-LHC, FCC and wider user community testing at EU-facilities	Improves an existent system (and quality of irradiation tests) by applying ML-techniques. New application: inter-calibration of EU-facilities
137	Self powered particle detectors for beam-on target secondary particles fluence measurement	ENEA (S. Fiore)	Irradiation	NO	HEP detector and accelerator upgrades / HL-LHC, FCC	Improves an existing technology (nuclear field) and applies it to accelerator facilities (new application)

Upgrade Instrument. & Dosimetry Equipment

... / ...

EoI #	TITLE	LEADING PARTNER	FACILITY TYPE	INDUST. PARTNERS	RELEVANCE / INTEREST	INNOVATIONS / COMMENTS
138	Radiation-hard beam quality monitoring for hadron cancer therapy	HEPHY (T. Bergauer)	Irradiation	YES	Facilities for components qualification, medical, beyond HEP applications	Improves accelerator beam diagnostic with a novel development based on existent types of detector / electronic technologies
117	Beam diagnostics in high radiation environments	CEA (L. Segui)	Irradiation	? (not clear)	High power future linear accelerators	New application of gaseous detectors and ML-techniques (for data analysis?). Belonging to another topic

Other EoI's

EoI #	TITLE	LEADING PARTNER	FACILITY TYPE	INDUST. PARTNERS	RELEVANCE / INTEREST	INNOVATIONS / COMMENTS
38	Silicon detectors at fluences above 10^{17} n/cm^2	JSI (M. Mikuz)	/ (project not directly linked to facilities)	NO	HEP detector upgrades / HL-LHC, FCC	Improves the knowledge about the usage of Si as material for future trackers. Best fits the topic "Hybrid Silicon" ?
116	Upgrade of irradiation infrastructures based on micro-beams and gamma irradiation	RBI (S. Fazinic)	(Irradiation)	NO	HEP detector upgrades / HL-LHC, FCC	Facilities upgrade primarily serving to improve the knowledge on MAPS sensors. Best fits the topic "Hybrid Silicon" ?

Conclusion

- Irradiation & Characterization Facilities
  - Support existing infrastructures
    - EoI #13 (EMC testing), EoI #14 (GIF++ gas system)
    - EoI #66 (two-photon absorption TCT) ?
  - Develop common tools
    - EoI #30 (traceability/res. activation), EoI #133 (data managem./knowledge tools)
  - Upgrade instrumentation & dosimetry equipment
    - EoI #123 (CERN-IRRAD), EoI #137 (BDF/high-flux facilities), EoI #138 (MedAustron)
    - EoI #117 (high-power linear accelerators) ?
  - Others
    - EoI #8 (wireless dosimetry system) → "KT/outreach" topic ?
    - EoI #38 (Si studies at very high fluence) → "Hybrid Silicon" topic ?
    - EoI #116 (MAPS sensor studies) → "Hybrid Silicon" topic ?
- Total Estimated Budget
  - ~5.5M EUR (1.8M EUR – EC contribution) for the 10 assigned EoI's
  - ~5.0M EUR (1.6M EUR – EC contribution) for the proposed EoI's classification