AIDA++ Open Meeting:
Irradiation & Characterization Facilities

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

CERN, 04 September 2019
• 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
Disclaimers

- Eol’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” ?
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(*)

- **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 Eol’s (#137, #138), ATTRACT consortium, EU Irradiation Facilities

(*) "collaborators" only
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

- **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)

\(^{*}\)Contact person to be defined at CERN
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

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

<table>
<thead>
<tr>
<th>EoI #</th>
<th>TITLE</th>
<th>LEADING PARTNER</th>
<th>FACILITY TYPE</th>
<th>INDUST. PARTNERS</th>
<th>RELEVANCE / INTEREST</th>
<th>INNOVATIONS / COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Integrated traceability and residual activation measurement of irradiated samples</td>
<td>ENEA (S. Fiore)</td>
<td>Irradiation</td>
<td>YES</td>
<td>Facilities in HEP / external applications (nuclear processing, medical, ...)</td>
<td>New application: qualifies RFIDs and extends integrated traceability system (SW/HW) making it available to the community/industry</td>
</tr>
<tr>
<td>133</td>
<td>Development of common data management and knowledge tools for irradiation facilities</td>
<td>CERN (F. Ravotti)</td>
<td>Irradiation</td>
<td>YES</td>
<td>Facilities in HEP &amp; worldwide / external applications involving data management</td>
<td>Improves with ML and extend an existent system (AIDA-2020) for handling facilities operation. New application: sharing irradiation experiments data</td>
</tr>
<tr>
<td>EoI #</td>
<td>TITLE</td>
<td>LEADING PARTNER</td>
<td>FACILITY TYPE</td>
<td>INDUST. PARTNERS</td>
<td>RELEVANCE / INTEREST</td>
<td>INNOVATIONS / COMMENTS</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>----------------</td>
<td>---------------</td>
<td>-----------------</td>
<td>----------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>8</td>
<td>Wireless system of portable radiation monitors for distributed dose control</td>
<td>INRE (P. Iaydjiev)</td>
<td>Irradiation (Dosimetry ?)</td>
<td>NO</td>
<td>Nuclear facilities, beyond HEP irradiation facilities</td>
<td>Improves a system developed for GIF++ in AIDA-2020. <strong>Best fits the topic “KT/outreach”?</strong></td>
</tr>
<tr>
<td>123</td>
<td>Instrumentation and dosimetry upgrade for irradiation facilities</td>
<td>CERN (F. Ravotti)</td>
<td>Irradiation</td>
<td>NO</td>
<td>HEP detector upgrades / HL-LHC, FCC and wider user community testing at EU-facilities</td>
<td>Improves an existent system (and quality of irradiation tests) by applying ML-techniques. New application: inter-calibration of EU-facilities</td>
</tr>
<tr>
<td>137</td>
<td>Self powered particle detectors for beam-on target secondary particles fluence measurement</td>
<td>ENEA (S. Fiore)</td>
<td>Irradiation</td>
<td>NO</td>
<td>HEP detector and accelerator upgrades / HL-LHC, FCC</td>
<td>Improves an existing technology (nuclear field) and applies it to accelerator facilities (new application)</td>
</tr>
<tr>
<td>EoI #</td>
<td>TITLE</td>
<td>LEADING PARTNER</td>
<td>FACILITY TYPE</td>
<td>INDUST. PARTNERS</td>
<td>RELEVANCE / INTEREST</td>
<td>INNOVATIONS / COMMENTS</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------------------------</td>
<td>--------------------------</td>
<td>---------------</td>
<td>------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>138</td>
<td>Radiation-hard beam quality monitoring for hadron cancer therapy</td>
<td>HEPHY (T. Bergauer)</td>
<td>Irradiation</td>
<td>YES</td>
<td>Facilities for components qualification, medical, beyond HEP applications</td>
<td>Improves accelerator beam diagnostic with a novel development based on existent types of detector / electronic technologies</td>
</tr>
<tr>
<td>117</td>
<td>Beam diagnostics in high radiation environments</td>
<td>CEA (L. Segui)</td>
<td>Irradiation</td>
<td>? (not clear)</td>
<td>High power future linear accelerators</td>
<td>New application of gaseous detectors and ML-techniques (for data analysis?).</td>
</tr>
<tr>
<td>EoI #</td>
<td>TITLE</td>
<td>LEADING PARTNER</td>
<td>FACILITY TYPE</td>
<td>INDUST. PARTNERS</td>
<td>RELEVANCE / INTEREST</td>
<td>INNOVATIONS / COMMENTS</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------------------------</td>
<td>-----------------------</td>
<td>-----------------</td>
<td>------------------</td>
<td>----------------------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>38</td>
<td>Silicon detectors at fluences above $10^{17}$ n/cm$^2$</td>
<td>JSI (M. Mikuz)</td>
<td>/ (project not directly linked to facilities)</td>
<td>NO</td>
<td>HEP detector upgrades / HL-LHC, FCC</td>
<td>Improves the knowledge about the usage of Si as material for future trackers.&lt;br&gt;<strong>Best fits the topic “Hybrid Silicon” ?</strong></td>
</tr>
<tr>
<td>116</td>
<td>Upgrade of irradiation infrastructures based on micro-beams and gamma irradiation</td>
<td>RBI (S. Fazinic)</td>
<td>(Irradiation)</td>
<td>NO</td>
<td>HEP detector upgrades / HL-LHC, FCC</td>
<td>Facilities upgrade primarily serving to improve the knowledge on MAPS sensors.&lt;br&gt;<strong>Best fits the topic “Hybrid Silicon” ?</strong></td>
</tr>
</tbody>
</table>
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