Towards a Unified Environmental Monitoring, Control and Data Management System for Irradiation Facilities: the CERN IRRAD Use Case

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**ABSTRACT**

The qualification of materials, electronic components and equipment for the CERN High Energy Physics experiments and beyond requires testing against possible radiation effects. These quite complex tasks are performed by specialized teams working in irradiation facilities such as IRRAD, the CERN Proton Irradiation Facility. Building upon the details of the overall irradiation control, monitoring and logistical systems of IRRAD as a use case, we introduce the motivations for and the general architecture of its new data management framework, currently under development at CERN. This infrastructure is intended to allow for the seamless and comprehensive handling of irradiation experiments in IRRAD and to help manage all aspects of the facility. Its architecture, currently focused on the specific requirements of IRRAD, is intended to be upgraded to a general framework that could be used in other irradiation facilities within the radiation effects community, as well as for other applications.

**IRRAD Data Management System**

- **IRRAD Tables**: The IRRAD tables are used to remotely control and position samples of different types and shapes in a beam. They can move along the transversal beam direction (X, Y) and rotate around it (θ).
- **Beam Instrumentation**: The fixed-BPM detector is composed of arrays of 4x4 mm² Cu pads and it is used to control the position and the alignment of the beam. When the beam impinges on the detector, the charge generated due to the Secondary Electron Emission is recorded by a DAQ unit. The acquired data are then sent to a server and, after processing, they are stored in an Oracle database. The data are then visualized on a website.
- **Environmental monitoring**: The data acquired are used in daily operation and displayed in dedicated status panels.

**Towards a Unique irradiation Facility Framework**

- **Motivations**: After an extensive survey about the irradiation facilities worldwide, we found:
  - Manual operations or even on paper
  - Autonomous operations, with specific technologies
  - Outdated systems
  - Poor or absence of data management
  - Lack of a common knowledge base shared among irradiation facilities

  The irradiation facilities need to share the same knowledge base and follow a common model.

  For this reason we propose an irradiation facility ontology.

  An ontology is an assembly of definitions, properties and interrelations among entities of a specific domain, in this case the irradiation facilities.

  Irradiation Facility Framework (IFF)
  - Adaptive
  - Multi-profile
  - Platform-independent

**IRRAD Tables**

The IRRAD tables are used to remotely control and position samples of different types and shapes in a beam. They can move along the transversal beam direction (X, Y) and rotate around it (θ).

**Beam Instrumentation**

- **Fixed-BPM**
- **Mini-BPM and single-pad BPM**

The mini-BPM and single-pad BPM are smaller detectors than the fixed-BPM, but of the same composition and DAQ system. They are used to align the IRRAD Tables in the beam.

**Environmental monitoring**

For monitoring the environmental conditions of the facility, IRRAD is equipped with a complete monitoring system. 500 channels are monitored for each spill:

- Temperature
- IRRAD tables and shuttle positions
- Radiation
- Beam intensities

The data acquired are used in daily operation and displayed in dedicated status panels.