IEDM: An Ontology for Irradiation Experiments Data Management

Blerina Gkotse[1,2], Pierre Jouvelot[2], Federico Ravotti[1]

[1] European Organization for Nuclear Research, CERN
EP-DT-DD, Geneva, Switzerland
[2] MINES ParisTech, PSL University, Paris, France

Blerina.Gkotse@cern.ch
www.linkedin.com/in/blerinagkotse

Abstract

Irradiation experiments (IE) are an essential step in the development of High-Energy Physics (HEP) particle accelerators and detectors. They are used to assess the radiation hardness of experimental devices by simulating, in a short time, the common long-term degradation effects due to energy loss in matter. Usually carried out with ionizing radiation, these complex processes require highly specialized infrastructures called "irradiation facilities". Aiming to promote knowledge sharing and digital management of IEs, we introduce **IEDM**, a new **I**rradiation **E**xperiments **D**ata **M**anagement ontology. This work presents an overview of the key concepts and structure of IEDM while discussing possible applications.

Irradiation Experiments



CERN Large Hadron Collider (LHC)





NASA spacecraft



10 MeV IBA rhodotron



Clinac® iX System linear accelerator



What is irradiation experiment?

An irradiation experiment is a process where materials (e.g., electronics, detectors, etc.) or patients are purposefully exposed to a radiation source of electromagnetic or corpuscular nature.

Why and where do we need such experiments?

Irradiation experiments are found in different domains:

- **High-Energy Physics (HEP)**: qualification of detectors or electronic components in a radiation environment equivalent to the one these devices will encounter in actual HEP experiments and accelerators, thus simulating, in a short time, long-term radiation-induced degradation effects;
- **Space Technology and Avionics:** radiation-hardness testing of components of aircraft and spacecraft avionics, subjected to radiation damage during flight;
- **Industry:** food sterilization, seed treatment, etc.;
- **Medicine:** radiotherapy treatments.

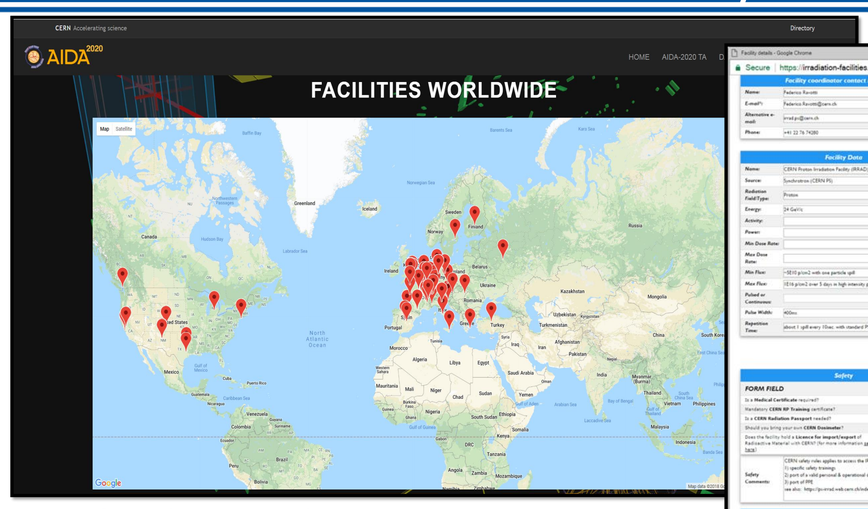
Irradiation Facilities Survey

We conducted an extensive survey of the irradiation facilities existing worldwide in order to find the **important semantic domain entities.**

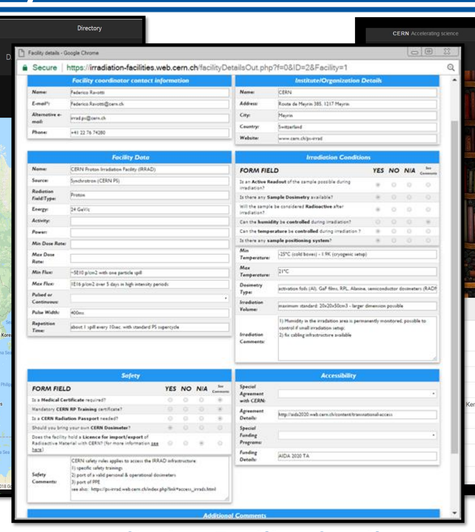
With the collected data, we developed and populated an irradiation facilities database and web application.

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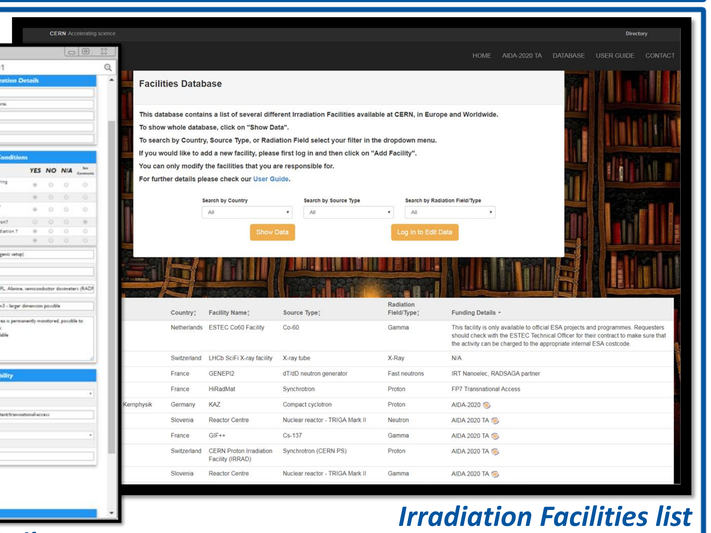
http://cern.ch/irradiation-facilities



Map of Irradiation Facilities



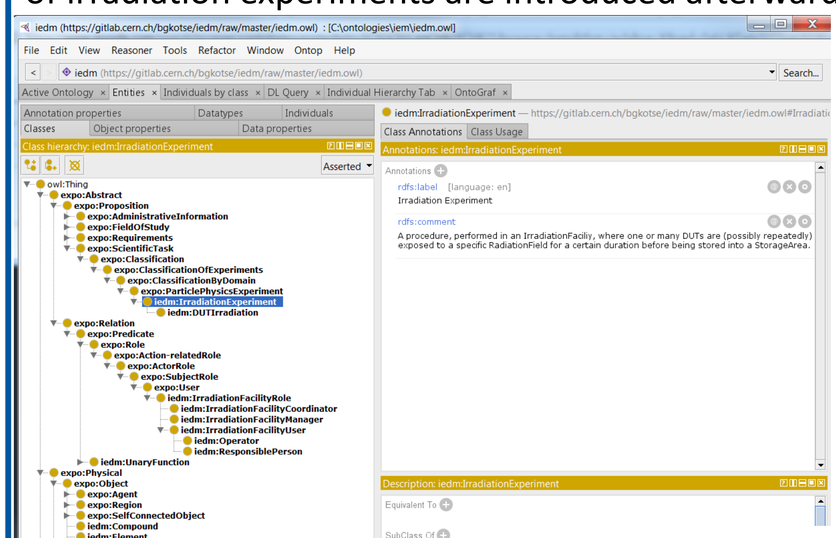
Irradiation Facility details



Irradiation Facilities list

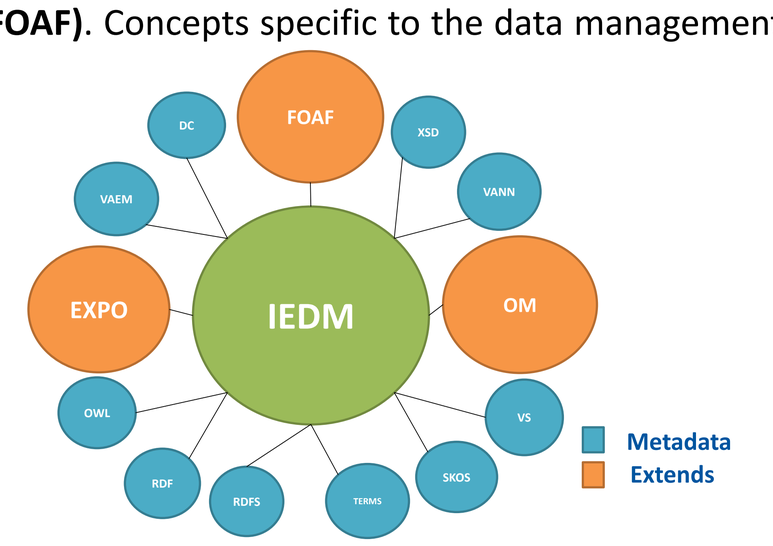
IEDM Ontology

IEDM reuses classes from the **Ontology of Scientific Experiments (EXPO)**, the **Units of Measure ontology (OM)** and the **Friend-of-a-Friend ontology (FOAF)**. Concepts specific to the data management of irradiation experiments are introduced afterwards.

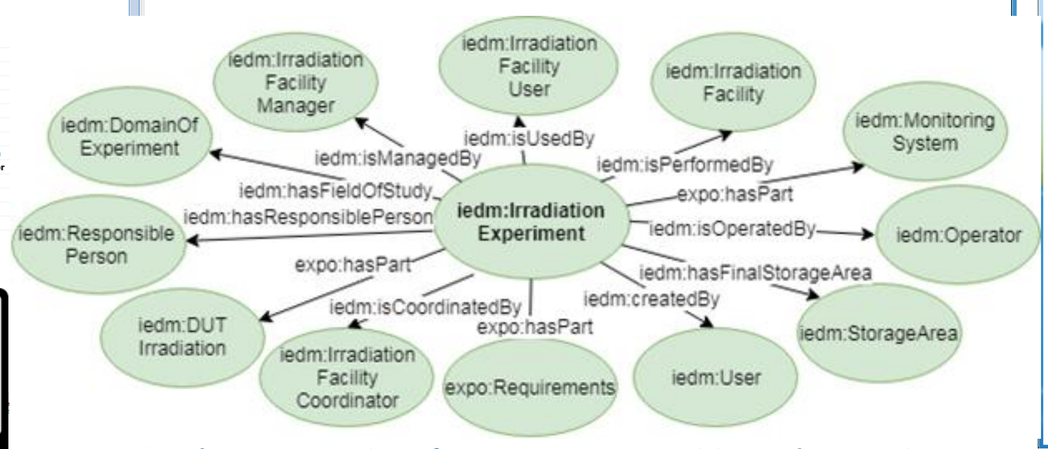


Ontology representation with Protégé
https://gitlab.cern.ch/bgkotse/iedm

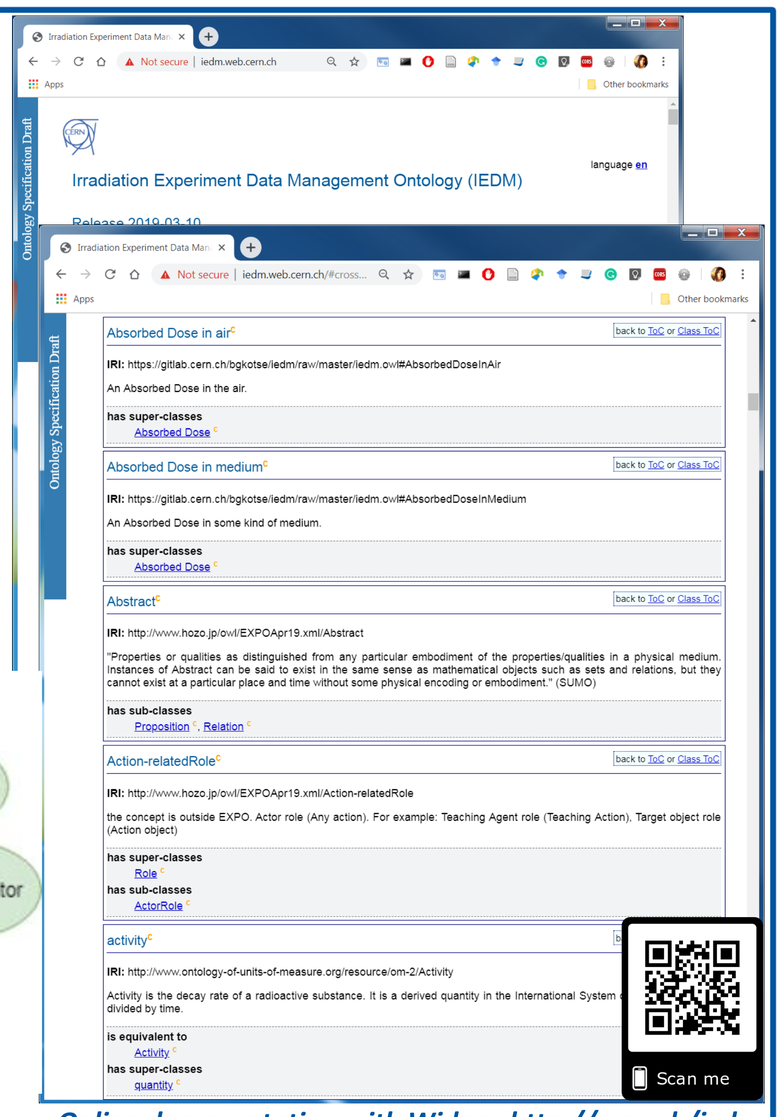
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IEDM outgoing links to other base ontologies



Graph representation of some core IEDM entities and properties



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Online documentation with Widoco http://cern.ch/iedm

http://cern.ch/iedm

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