

Radiofrequency superconducting cavities and high-power proton Linacs



Myrrha Multipurpose Hybrid Research Reactor For High-Tech Applications

Demonstrating the feasibility of particle accelerator driven nuclear reactors (ADS) for nuclear waste reprocessing

Scientific leader: Luc Perrot (IJCLab) *

Laboratories involved: IJCLab (Orsay), IPHC (Strasbourg), LPSC (Grenoble)

Nature: research infrastructure

Status: project under construction, supported by the Belgian Nuclear Research Centre (SCK CEN)

Website: <https://myrrha.be/>

Scientific objectives

The MYRRHA project aims to build a hybrid research reactor (or ADS for Accelerator driven system) in Mol, Belgium, to study the incineration of certain highly radiotoxic nuclear waste products. Accelerated protons will be projected onto a target to produce a flow of fast neutrons through the phenomenon of spallation. This will sustain the chain reaction in the subcritical core of the reactor. The maximum power of this hybrid reactor will be 100MWth.

Resources deployed

The maintenance of nuclear reactions requires an accelerator with very high power (2.4MW with a continuous flow of protons accelerated to 600MeV) and remarkable beam stability (no more than three interruptions per quarter). The chosen solution is a superconducting linear accelerator with redundant accelerator cavities to compensate for failures. The accelerator will also have a backup injector in operation to take over immediately in case of failure of the main injector. Phase 1 of the project (called MINERVA) will aim to test these failure compensation methods based on the principle of redundancy.

400m length of the Linac	2,4MW continuous beam power
600MeV proton energy	€ 2 to 3Bn total estimated cost
10 beam stops longer than 3 seconds every 3 months tolerated at most	

IN2P3 CONTRIBUTIONS

- Main player in the accelerator design studies.
- Development, construction and testing of the spoke cryomodule prototype (30 such cryomodules will make up the first part of Linac).
- Beam dynamics studies.
- Participation in the qualification of the injector.
- Design of magnetic elements.
- Modelling of vacuum systems and development of beam diagnostics (position and profile monitors) essential for accelerator settings.

Other french laboratories involved

ACS company (Orsay)

2002-2004 First designs of an ADS demonstrator	2005-2010 GUINEVERE project to build an ADS model	2010 The project is included in the ESFRI roadmap as a European priority	2016 First prototypes of the accelerator cavities at the IJCLab	2017 First prototypes of the accelerator cavities at the IJCLab	2019 Launch of phase 1 of the project, MINERVA	2036 Commissioning of the reactor planned
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* Since 2020