# PhD in Energetics

**Research Title:** Design and Safety of Affordable, Robust, Compact Fusion Reactors

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## Context of the research activity

A new keystone for fusion energy has been achieved, namely high temperature superconductors (HTS), now available on industrial scale, are able to tear down one of the most concerning issues of this research field, it is possible indeed to shrink the size of a tokamak without undermine its power, this would lead to way cheaper reactors and thus electricity, someday.

The design of Affordable Robust Compact (ARC) reactor, a Tokamak concept proposed by MIT (Massachusetts Institute of Technology) and PSFC (Plasma Science and Fusion Center) scientists, relies on these premises [1]. Engineering design and safety assessment are all yet to be developed at a level that would permit the device to be licensed and built in the US as an experimental nuclear reactor before 2040, along with the intermediate-step SPARC tokamak in 2025.


## Objectives

Many studies on ARC-related challenging technological problems will be necessary in order to transform the ARC concept into a working demonstration power plant: neutronics, neutron-induced radioactivity, estimate of tritium inventory, tritium transport, accidental analysis, release scenarios, estimate of doses to population and workers, thermomechanical analyses, design and optimization of components (vessel, blanket, magnets), transport phenomena for liquid metals and molten salt in magnetic fields [2,3].
This PhD research activity, in particular, will be focused on safety analyses for the ARC project. It will deal with thermomechanical analyses, design and optimization of components (such as divertor, vessel, blanket, magnets), main load identification, thermal requirements. Radiological safety-relevant activities will be focused on the estimate of tritium inventory in FLiBe and in structures, and tritium transport and losses from the FLibe circuit. Models for tritium bulk and surface diffusion mechanisms will be adopted.

The activity should include a preliminary design of some parts of the FLiBe loop (heat exchangers and tritium extraction systems) and the project of a new vacuum vessel structure for ARC.

The research activity will be carried out in part at POLITO and in part at MIT/PSFC.