Nizhny Novgorod Technical University n.a. R.E.Alekseev

AN ACCELERATOR-DRIVEN SYSTEM FOR THE DESTRUCTION OF NUCLEAR WASTE

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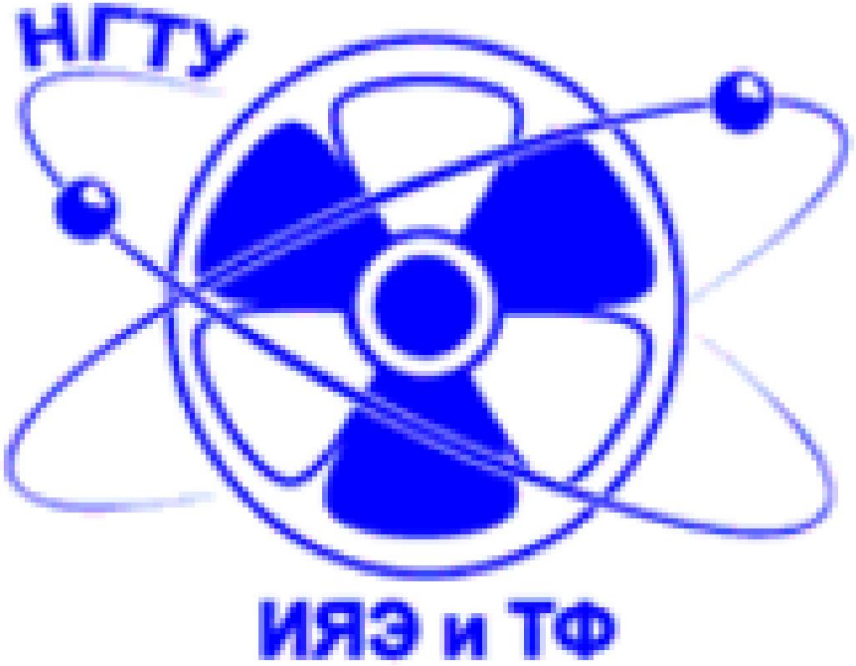
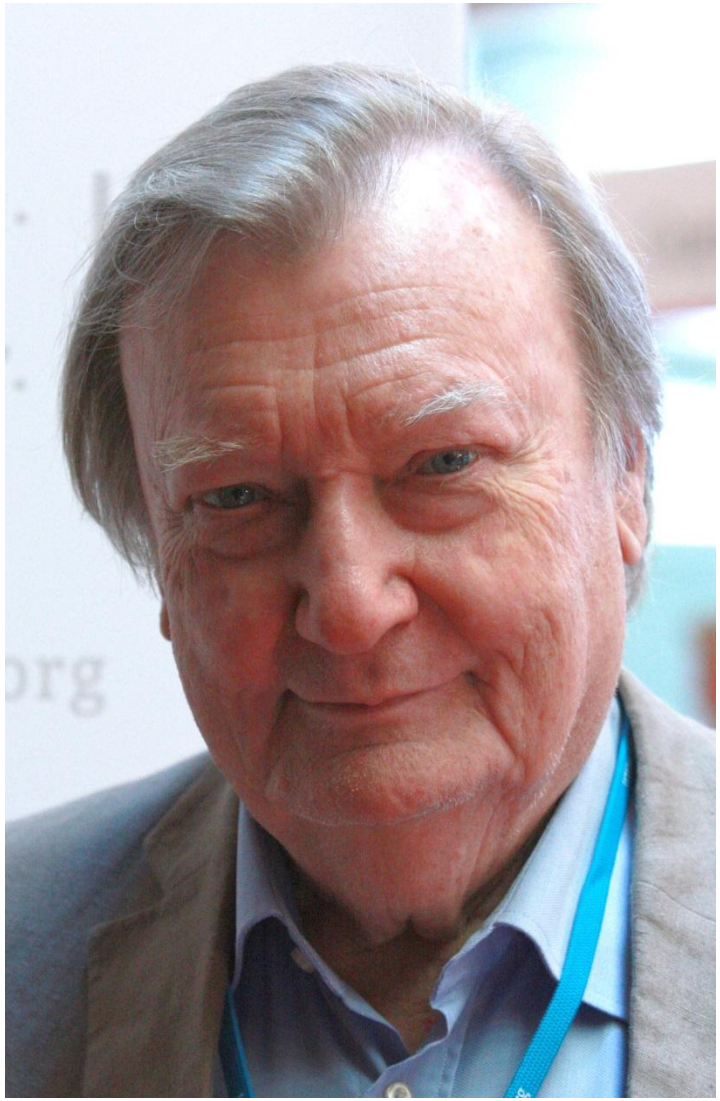
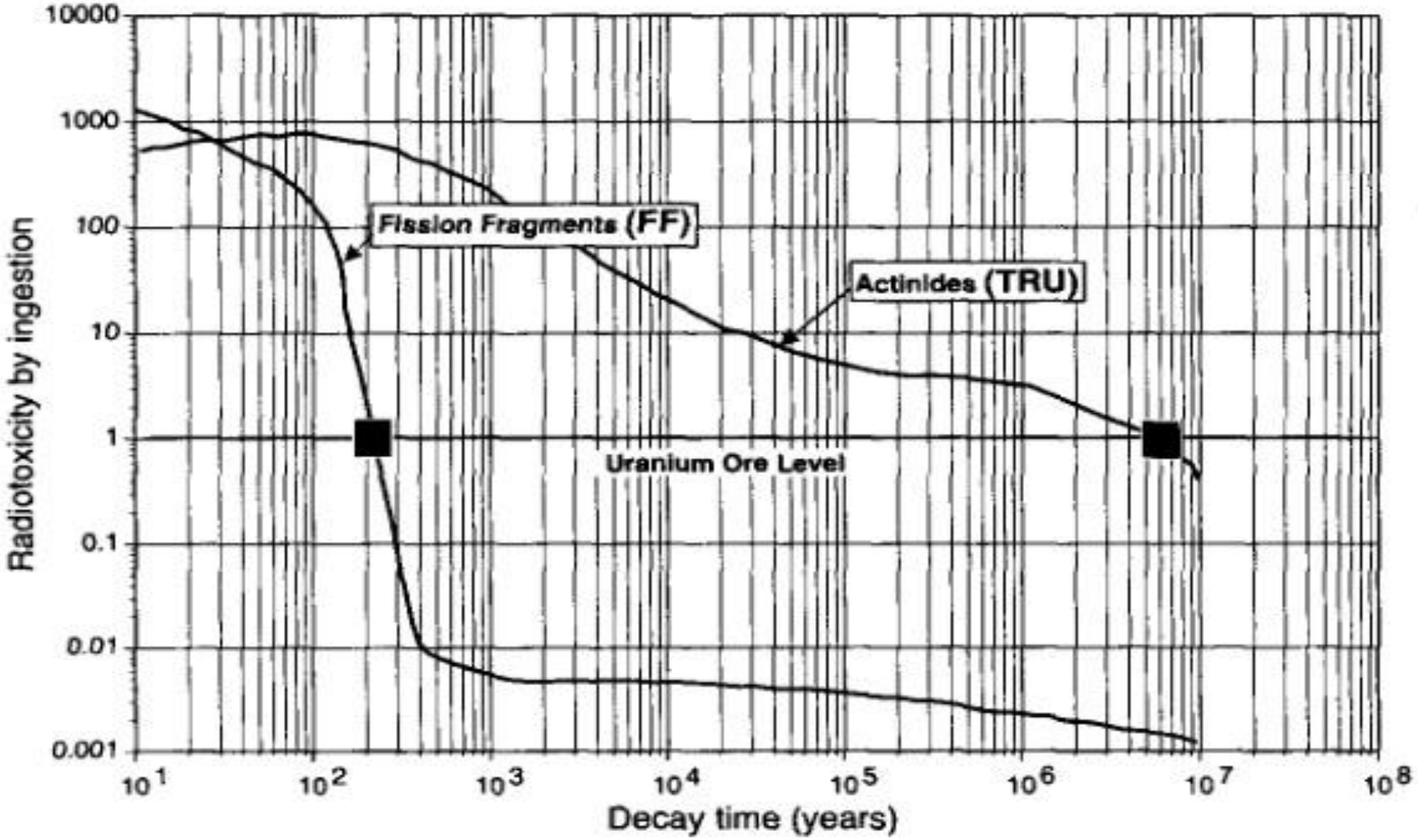


Carlo Rubbia

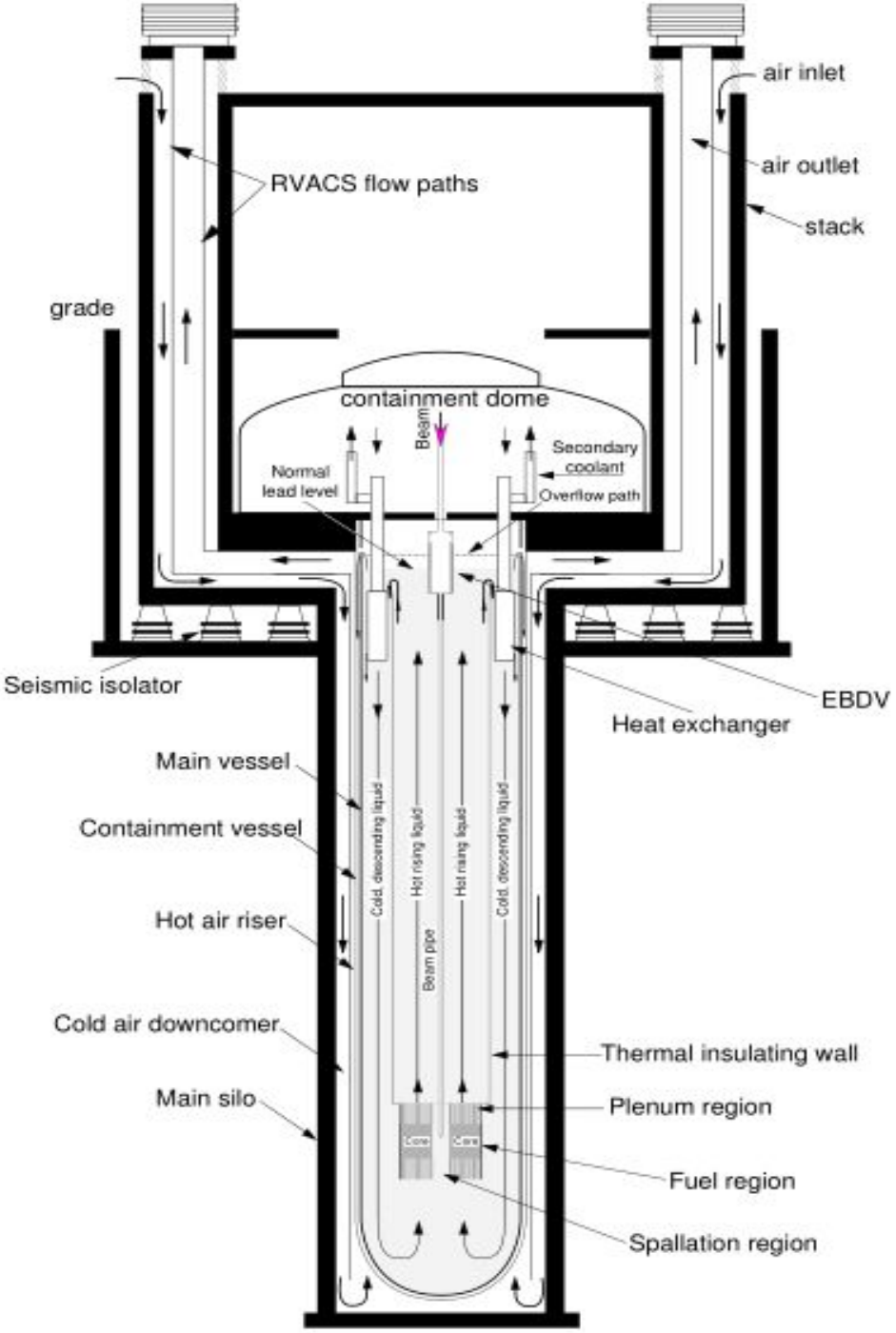


Carlo Rubbia, (born 31 March 1934) is an Italian particle physicist and inventor who shared the Nobel Prize in Physics in 1984 with Simon van der Meer for work leading to the discovery of the W and Z particles at CERN

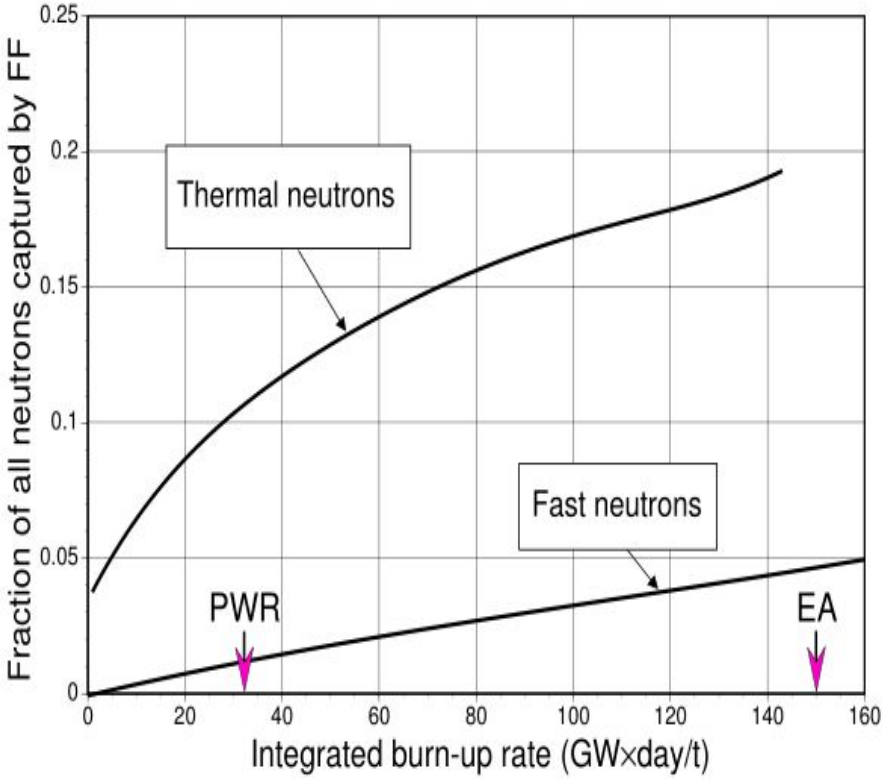
Time evolution of the potential radiotoxicity (relative to uranium ore) of the two main components of nuclear waste for PWR spent fuel

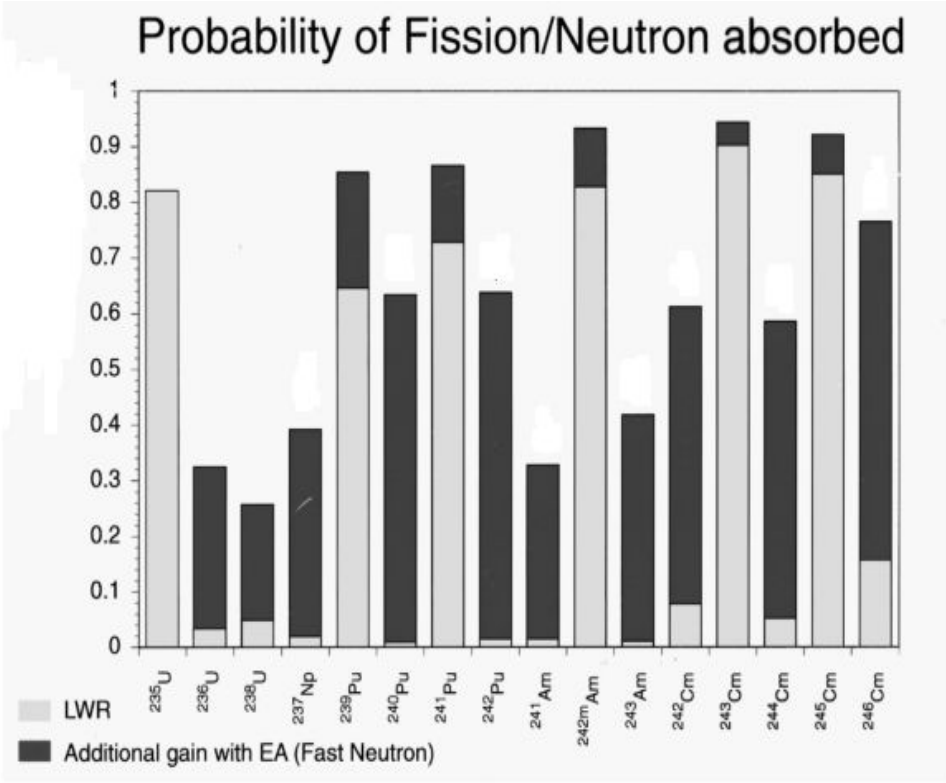


Schematic of the Energy Amplifier unit



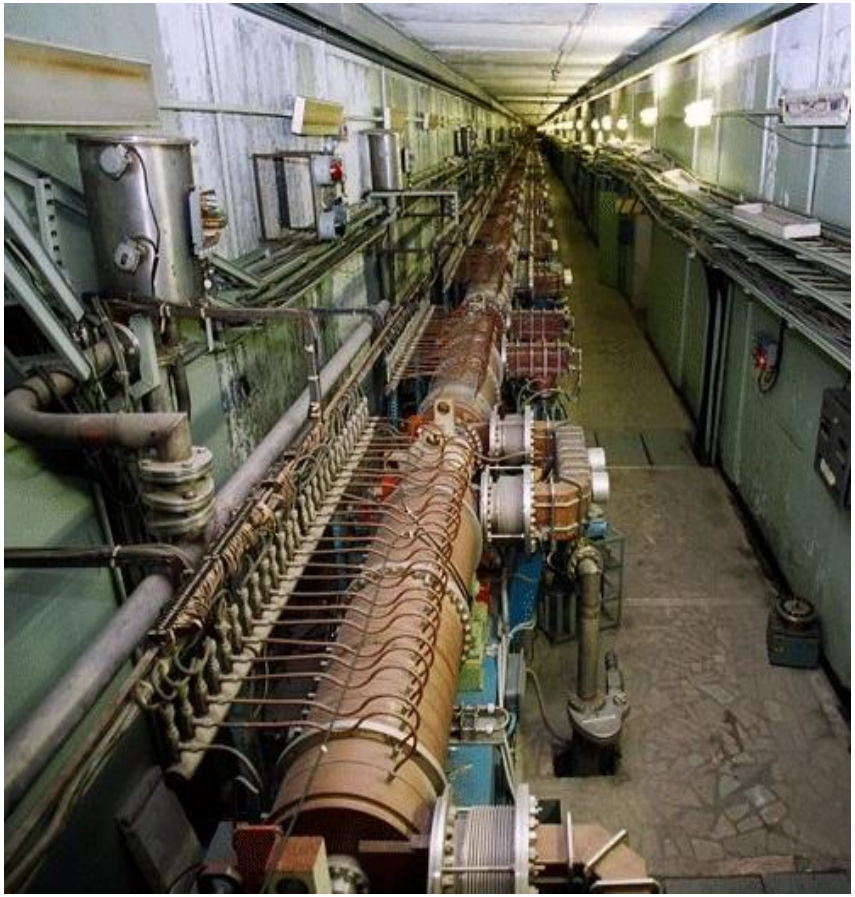
Why fast neutrons?





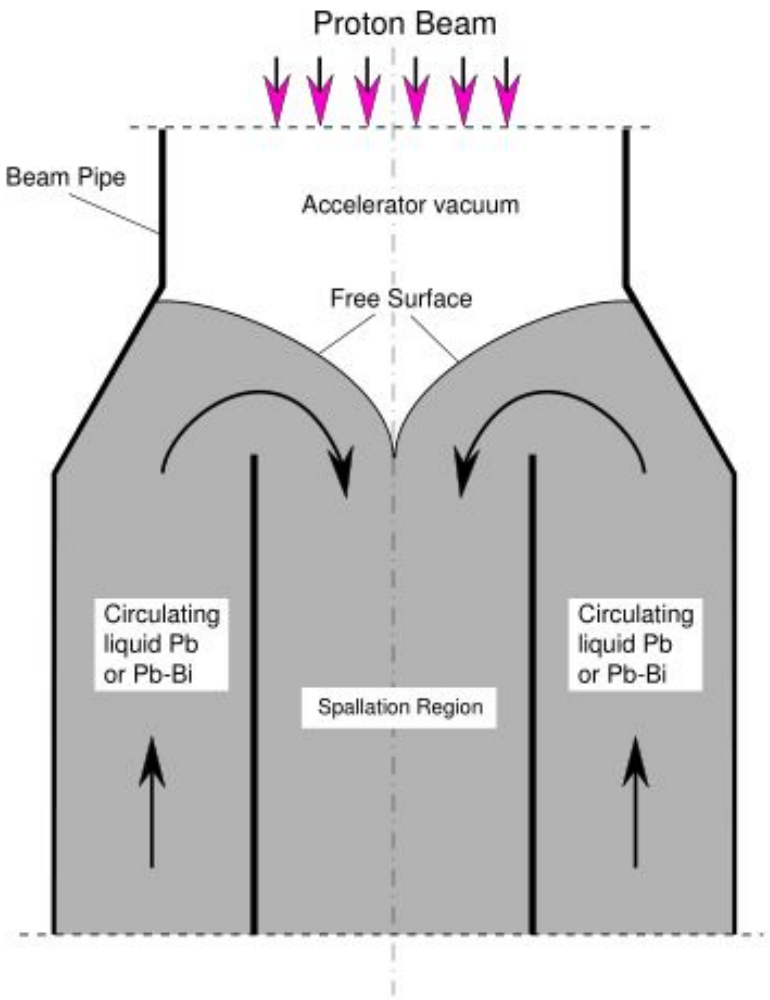
The accelerator

linear accelerator



cyclotron

Target for the protons



Application area

Destruction of nuclear waste

Medical applications

ABSTRACT

- The concept of the EA was proposed by C. Rubbia and his group specifically as an answer to the concerns raised by current nuclear energy production.
- Transuranic elements (TRU) and fission fragments (FF) are the two main components of nuclear waste. TRU can only be destroyed by fission, while FF can only be destroyed by neutron capture. As the long-term radiotoxicity of waste is clearly dominated by TRU, the EA has been designed to destroy them with the highest efficiency.
- The Energy Amplifier is a subcritical, fast neutron system, driven by a proton accelerator. In the fast neutron flux provided by the EA all TRU can undergo fission, a process which eliminates them, while in a PWR thermal neutron flux many TRU do not fission and thus accumulate as waste. The proposed system has a neutron multiplication coefficient (k) of 0.98. The sustainability of the nuclear fission reactions is made possible because of the presence of an external source of neutrons provided by the proton beam. Experts agree that present accelerator technology can provide the required beam power with either linac or cyclotron solutions. The spallation target has to provide the highest possible neutron yield, be transparent to neutrons, and at the same time sustain a large beam power of 10 to 20 MW. In this respect, molten lead is almost an ideal candidate. The general strategy consists of using as fuel thorium mixed with TRU.
- An Energy Amplifier could destroy TRU through fission at about twice the rate at which they are produced in PWRs. LLFF such as ^{129}I and ^{99}Tc could be transmuted into stable elements in a parasitic mode, around the EA core, making use of the ARC method. A second important application domain of ARC is the production of radioisotopes for medical applications. ARC which is very efficient for destroying fission fragments can also be used to induce any other type of nuclear transmutation (i.e. radioisotope production).
- Fundamental research is a strong driving force in innovation and can lead to potential solutions of some of the most difficult problems facing our society at the beginning of the third millennium.

- Thank you for attention.