XXIV INTERNATIONAL BALDIN SEMINAR ON HIGH ENERGY PHYSICS PROBLEMS “RELATIVISTIC NUCLEAR PHYSICS AND QUANTUM CHROMODYNAMICS”
September 17 - 22, 2018, Dubna, Russia

Calculation of neutron leakage for a quasi-infinite uranium target by the Monte Carlo method

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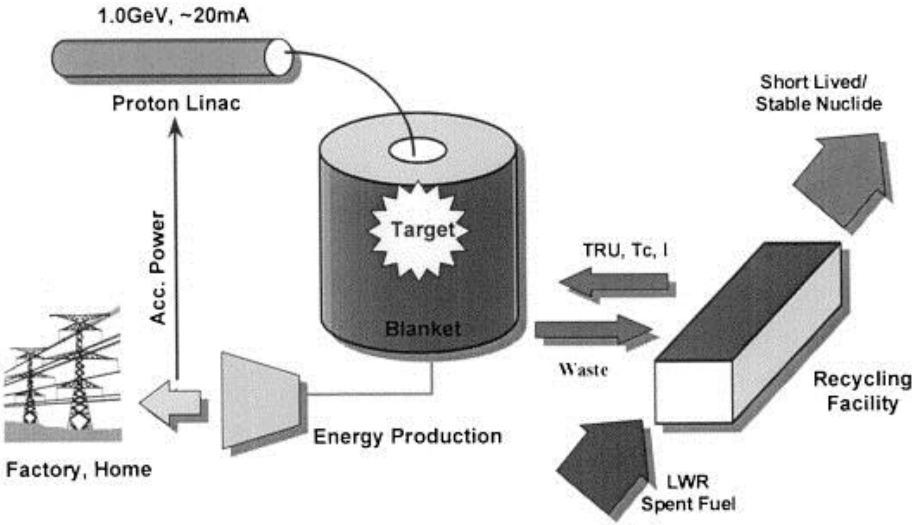
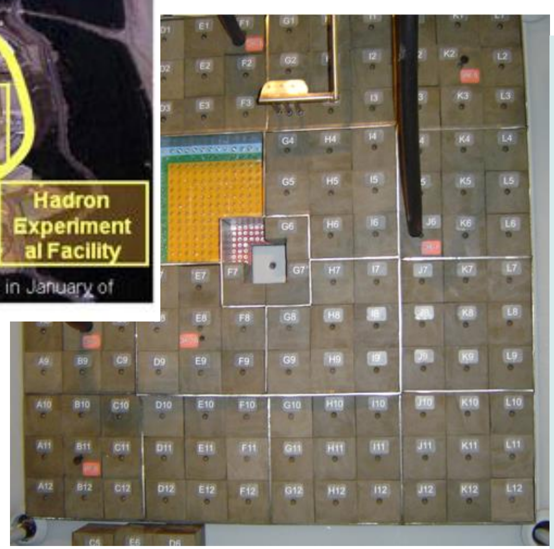
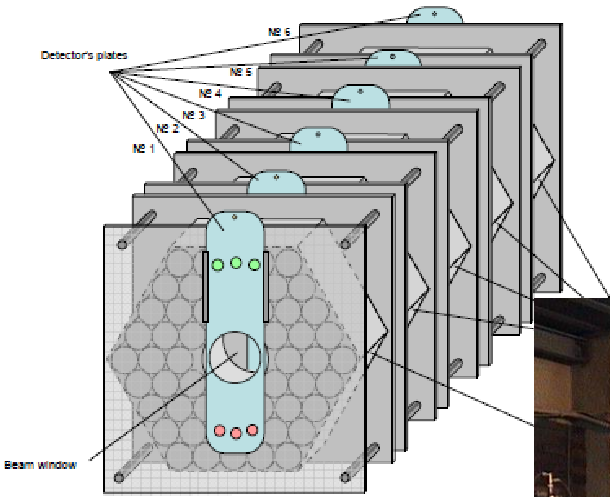
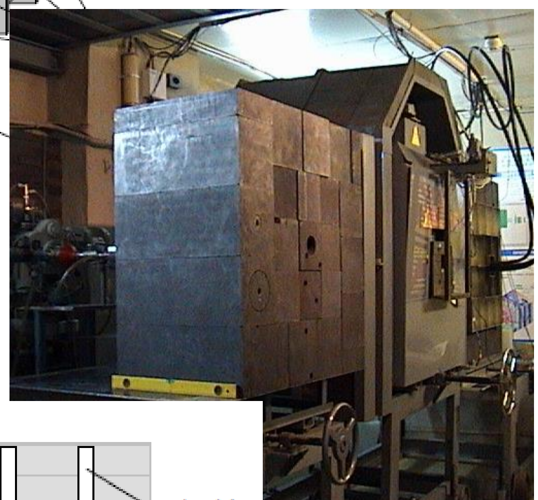
An external source (accelerator or neutron generator) driven subcritical systems (ADS) are present interest for using in transmutation of long-lived radioactive waste and for energy generation.

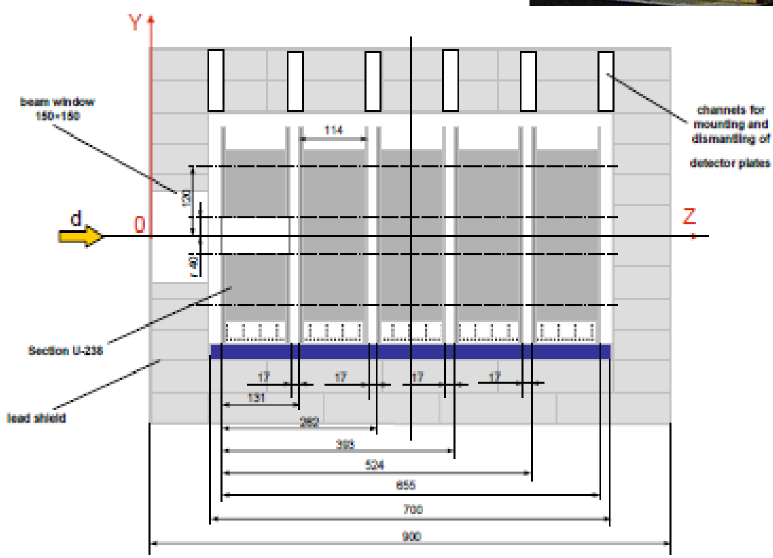




In the range of countries studying of ADS for transmutation is included in the national research programs (J-PARC project in Japan, RACE project in USA, EUROTRANS in EU, MYRRHA project in Belgium, YALINA-Booster Facility in Belarus).

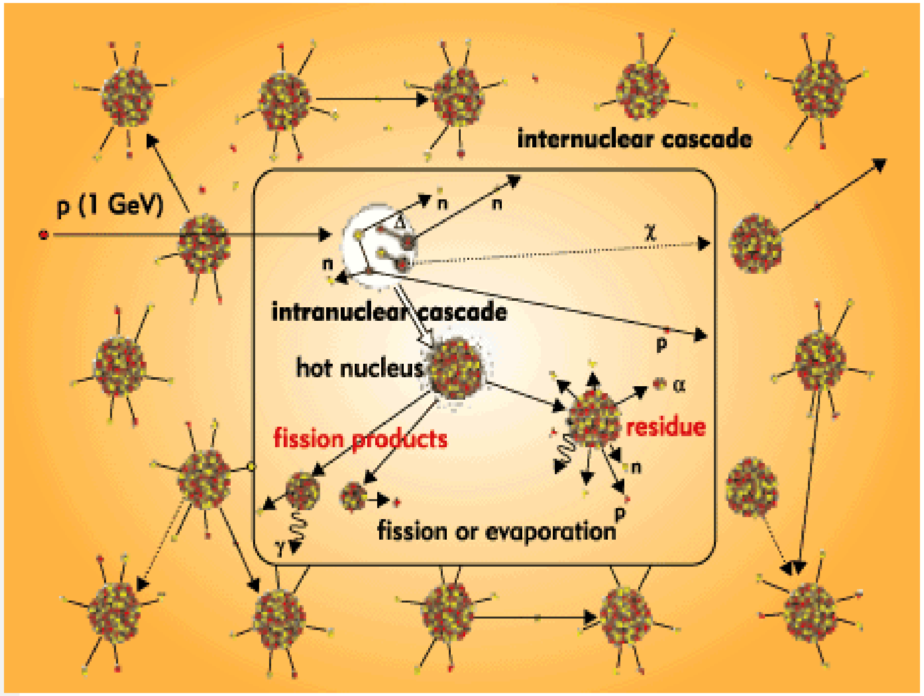






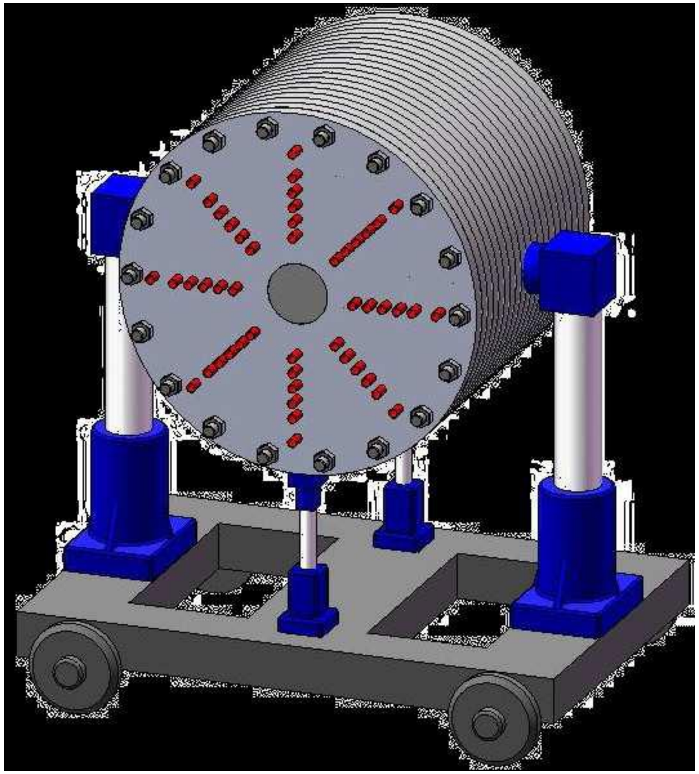
Since 2010 project “Energy and Transmutation of radioactive waste” carried out in Joint Institute for Nuclear Research (Dubna, RF). In the frame of the project investigations are conducting on studies of different subcritical assemblies physics characteristics driven by protons and deuterons beams with 0.6–12.0 GeV energies; multiplicities and spatial distributions of energy-time of neutron spectrum; possibility to energy production and utilization of radioactive waste studies on massive natural uranium (depleted uranium) and thorium targets based on the relativistic nuclear technologies (RNT).

The accelerated high energy particles penetrate the target and initiate a secondary particles cascade - neutrons and charged hadrons.
The secondary particles have rather high energy. Their loses energy through inelastic interaction with nuclei of target and slowed down to thermal and resonance energies.



Part of neutrons can leave the target through Pb-shield, beam input window etc. This parameter – neutron leaking – is significant to estimate of efficiency of using ADS.

Goals and objectives

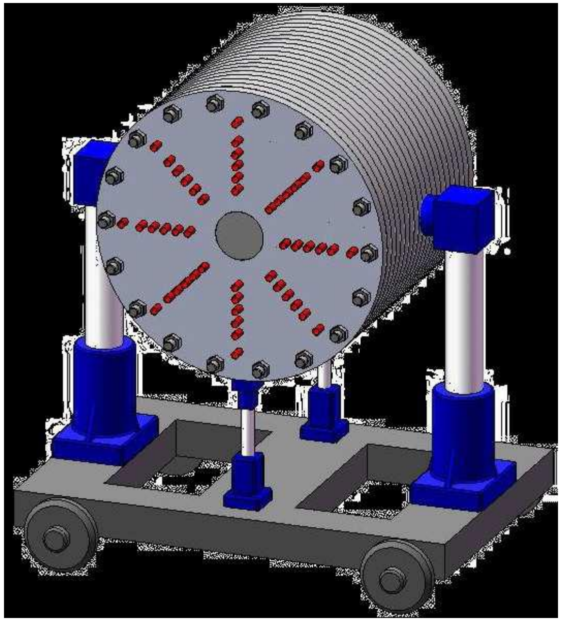


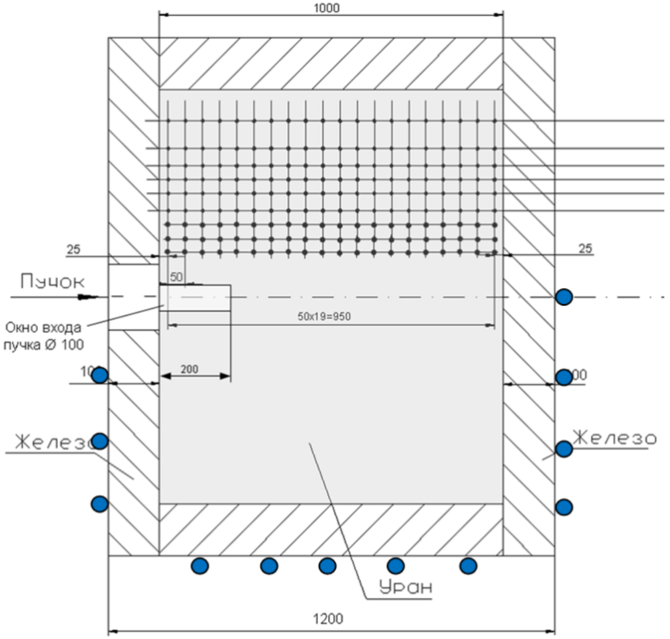
Obtaining calculating value of neutron leaking for big uranium target by Monte Carlo method

Average secondary neutron flux through target surface.

The ratio of leaking secondary neutrons to total number of secondary neutron.

Description of calculating experiment





The big uranium target is cylinder from uranium (0/3% 235U). The length of target is 1000 mm, the diameter is 1200 mm. The target put into steel shell with thickness in 100 mm.

For calculating was chosen 12 measurement positions on surface of target.

Incident particles – 2 AGeV deuterons.

Calculation was done by FLUKA.

Table of results

Big Uranium Target	Average secondary neutron flux through target surface (from uranium to steel) neutr./deutr./cm²	Average secondary neutron flux through target surface (from steel to air) neutr./deutr./cm²	The ratio of leaking secondary neutrons to total number of secondary neutron (from uranium),%	The ratio of leaking secondary neutrons to total number of secondary neutron (to air),%	The ratio of leaking secondary neutrons to total number of secondary neutron ,% For QUINTA
TOP	3,07E-03	8,19E-04	13,57	4,92	2,2 ?
BOTTOM	7,08E-04	1,63E-04	3,13	0,98	2,7
SIDE	3,40E-04	7,20E-05	5,01	1,48	19,6

For QUINTA was calculated value of neutron leaking for 2 AGeV and 4 AGeV. It was shown that neutron leaking does not depend from deuterons energy.
The next step – real experiment on BUT.

We would like to think

our ex-collegues, Andrei Patapenka and Mikhail Kievets, for help in calculatings.

Veksler and Baldin Laboratory of High Energies (VBLHEP), Joint Institute for Nuclear Research (JINR), Dubna, Russia for supporting work.

Thank you for attention!