

Overview of the ISTC **SAD** Project: A **S**ub-critical **A**ssembly Driven by the **D**ubna Proton Accelerator



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Accelerator-Driven Sub-critical System (ADSS)
Experiments held 19-20 August, 2004 at Idaho
State University, Pocatello, Idaho

Tech**Source** Inc.



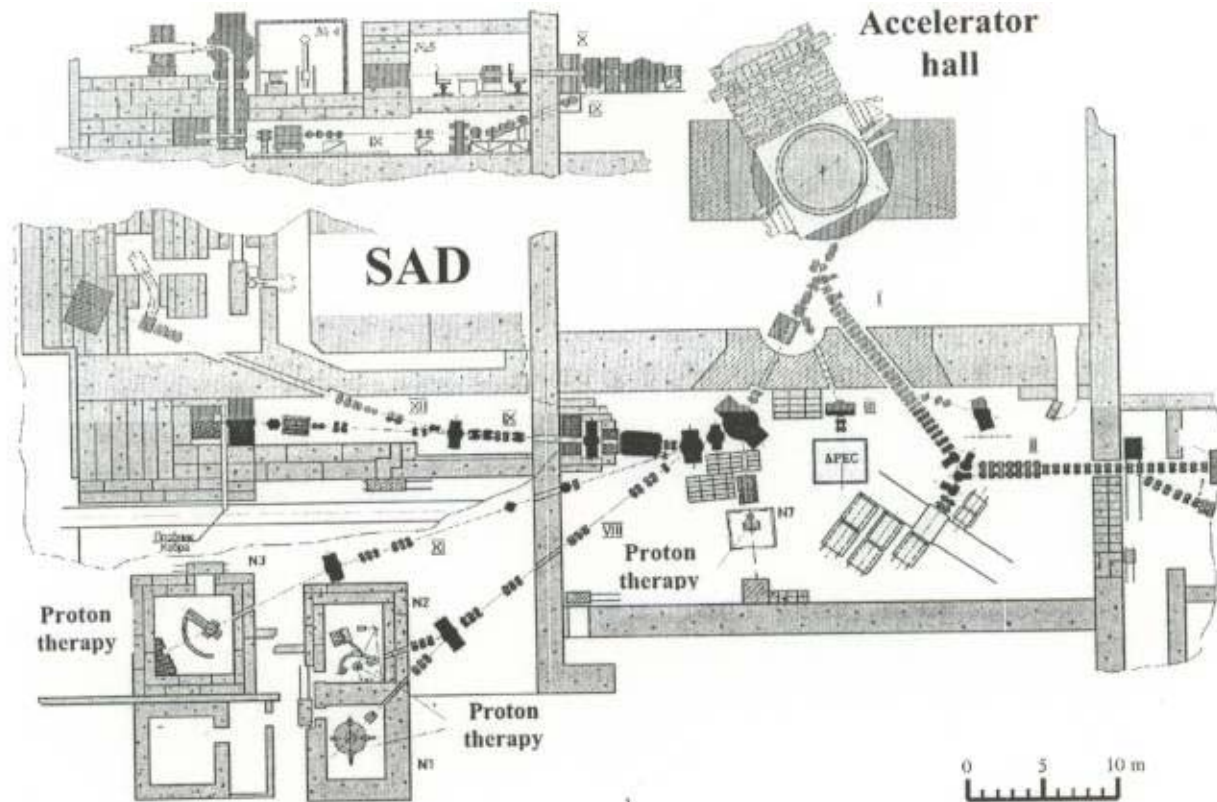
Official Project Title: Construction of a Subcritical Assembly with Combined Neutron Spectra Driven by a Proton Accelerator at a Proton Energy of 660 MeV for Experiments on Long Lived Fission Product and Minor Actinide Transmutation

- **Lead Russian Lab: Joint Institute for Nuclear Research (JINR, Dubna, Russia)**
- Federal State Unitary Enterprise R&D Institute of Power Engineering (NIKIET)
- Mayak Industrial Association
- Federal State Unitary Enterprise State Special Project Institute (GSPI)
- Russian Scientific Research Institute of Inorganic Materials (VNIINM)
- Nuclear and Reactor Physics, Swedish Royal Institute of Technology, Waclaw Gudowski
- IRS Forschungszentrum Karlsruhe, Germany, Cornelis Broeders
- CIEMAT, Centro de Investigaciones Energeticas Medioambientales y Technologies, Spain, Enrique Miguel Gonzalez Romero
- CEA Commissariat a l'Energie Atomique, Cadarache, France, Frederic Mellier



SAD Basic Data and Accelerator Parameters

- Thermal power: 15-20 kWt
- Proton energy: 660 MeV
- Beam power: 0.75-1.0 kWt
- Beam/target orientation: Vert
- Fuel element orientation: Vert
- Criticality coeff: $k_{\text{effective}} < 0.95$
- Fuel: MOX, UO₂+PuO₂
- Max Temp Cladding: 400 C
- Spallation Target: Pb, PbBi, W
- Reflector: Pb
- Coolant: Air
- Phasotron proton intensity: 2×10^{13} p/s
- Fast extraction: 250 Hz, 20 microsec FWHM, 8×10^{10} p/pulse
- Slow extraction: 250 Hz, 3.5 ms pulse width
- Microstructure: 10 ns FWHM with 70 ns period



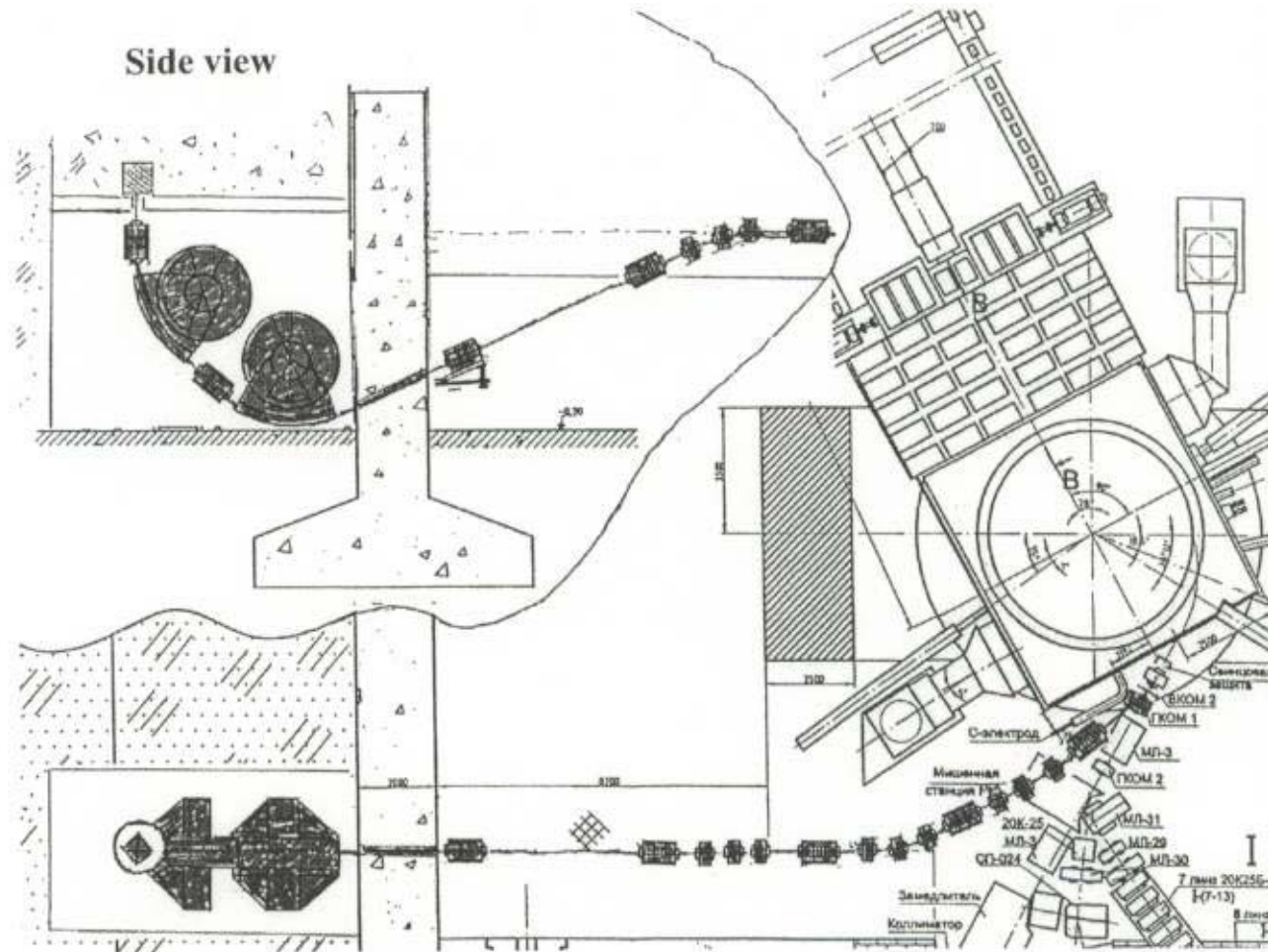
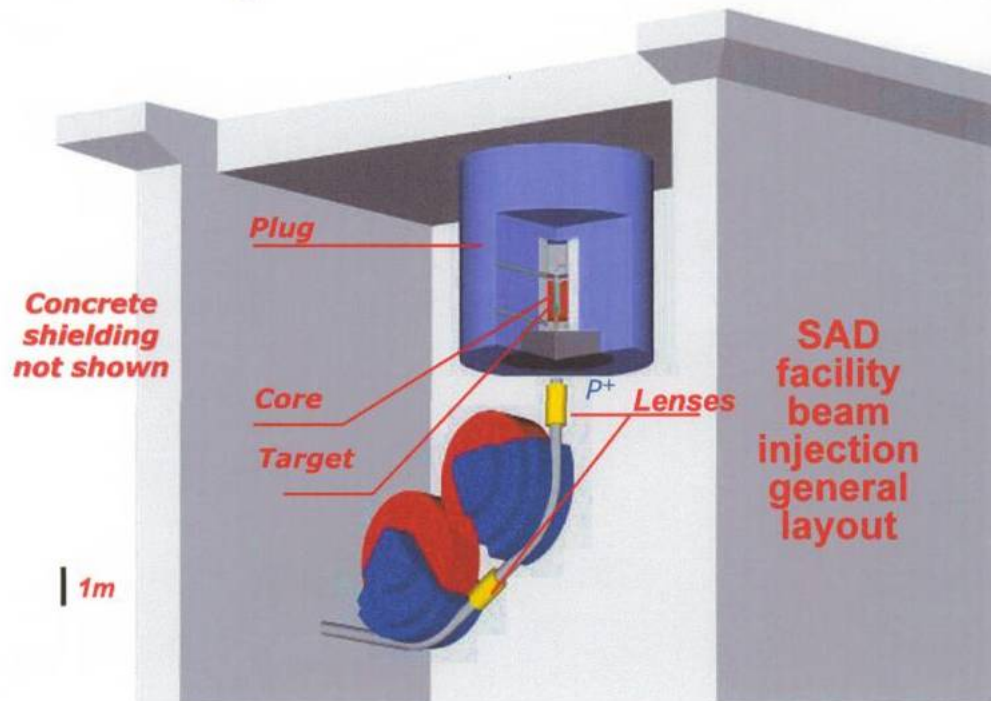


Figure 2: SAD proton beamline with two 60° magnets

SAD general layout

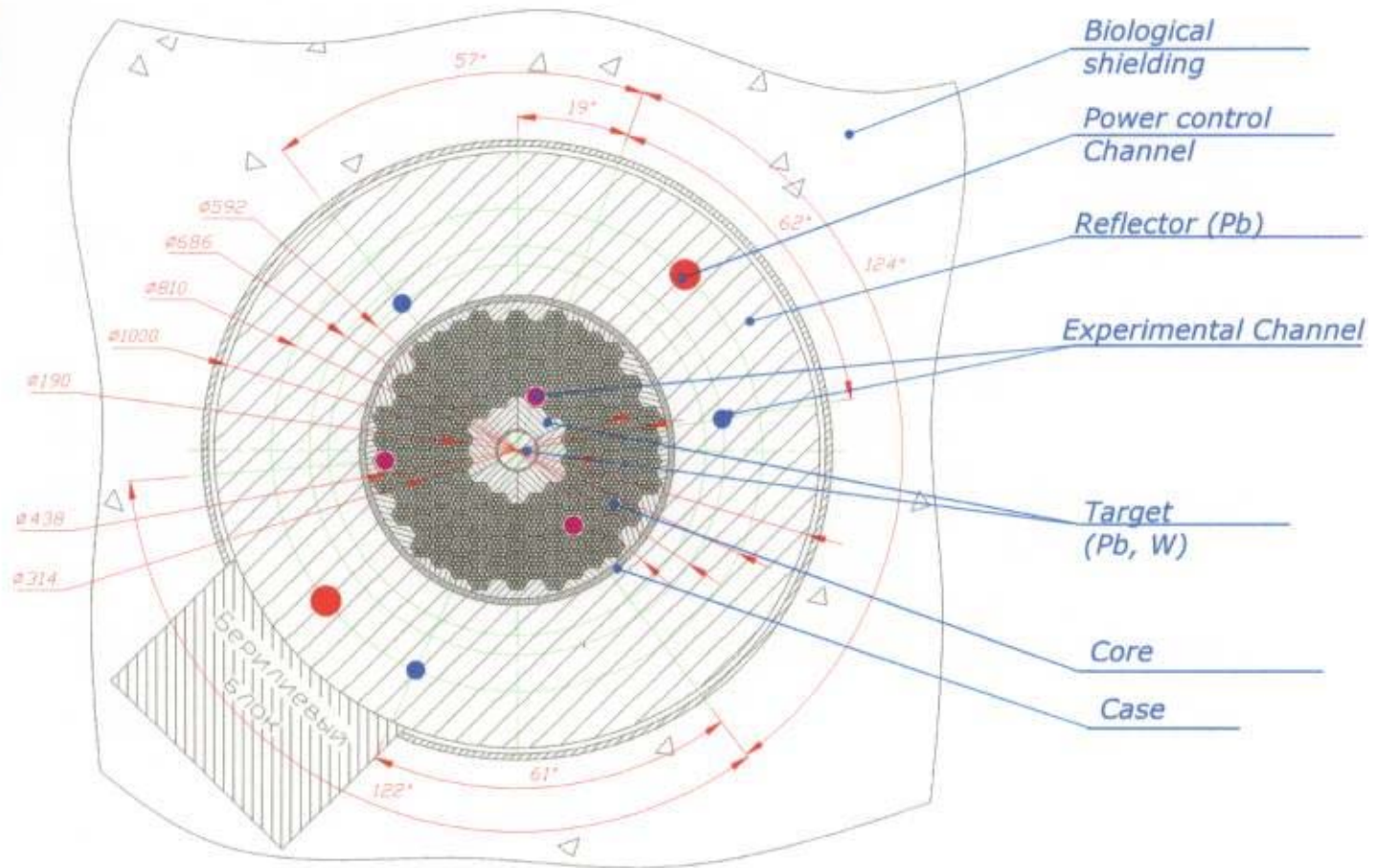




Basic Features of SAD Core Fuel

- Fuel composition: $\text{UO}_2 + \text{PuO}_2$
- PuO_2 content in fuel composition: 30% (mass)
- Pu-239 content: 95%
- Fuel density: 10.0 to 10.7 g/cm³
- Fuel pellet diameter: 5.95 mm
- 141 Fuel Assemblies with 19 fuel elements/FA
- 70 cm fuel element length, 36mm diameter FA
- Russian MOX fuel from a BN-600 reactor

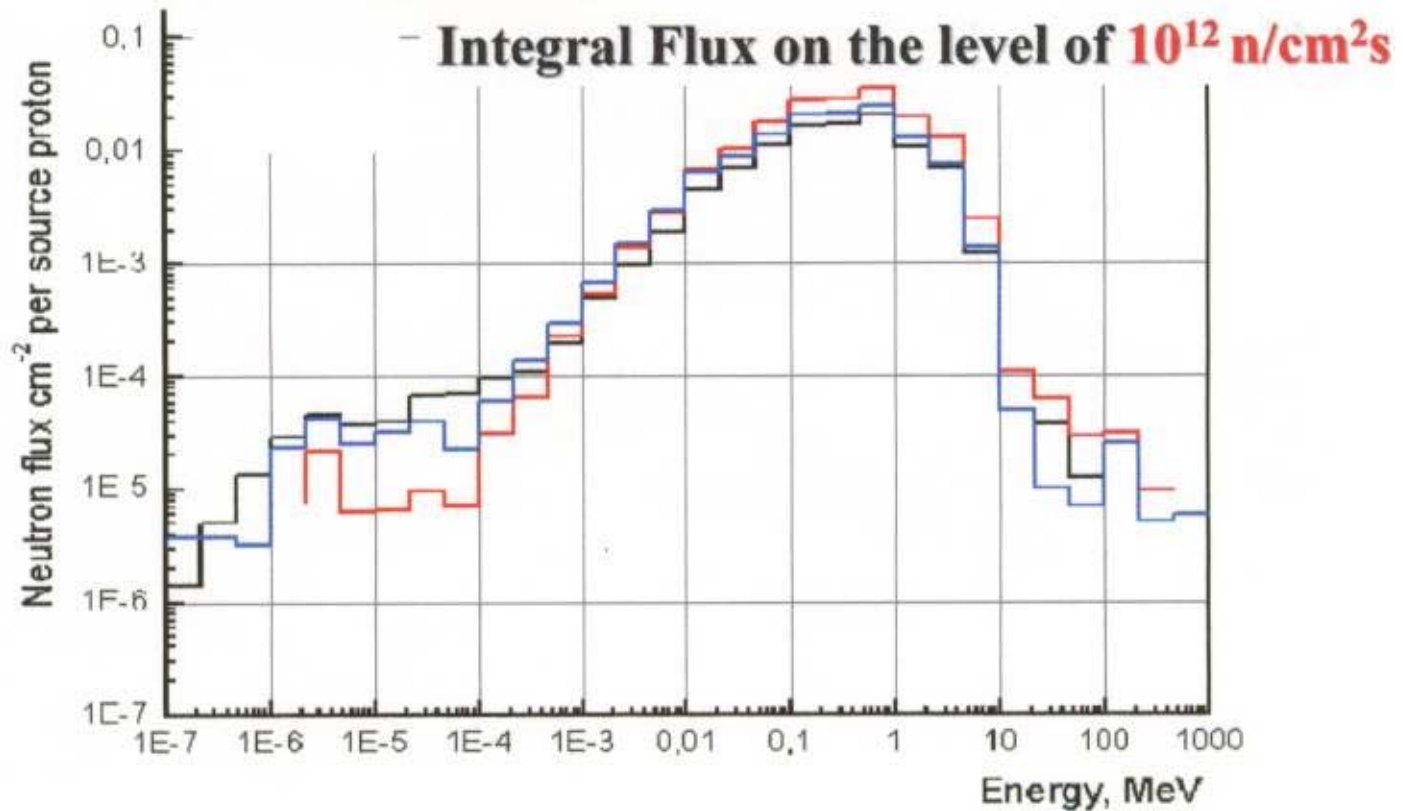
SAD Core



SAD Neutrons



Neutron spectra at the experimental channel in the middle of core (red - in the center, blue, black - top and bottom correspondingly)





SAD Scientific Program

- Coupling an accelerator with a subcritical core: spallation target and core integration, optimization of target size and position
- Measurements of absolute value of the SAD power gain, reactivity, subcriticality, and kinetic properties of the core
- Validation of physics and engineering computer codes
- Spatial distribution and spectra of neutron field in target and core
- Measurements of transmutation rate for MA and LLFP in different neutron fields of use for code validation
- Studying the spallation product yields in target using He-jet technique
- Radiation protection measurements-radiation shielding from proton beams



Cost and Schedule of SAD Experiment

- Total Cost \$1,750,000
- ISTC funding \$1,200,000
- EC funding \$ 400,000
- JINR funding \$ 150,000
- Other funding \$ 150,000*
- Schedule 3 yr project (design&construct)
start June 2004
operational 2007