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#11-238 Design and first tests of the S^3 detector of reactor antineutrinos

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The new experiment S^3 devoted to the study of reactor antineutrinos was designed and constructed as a common activity of IEAP CTU in Prague and JINR (Dubna). The S^3 detector (40 x 40 x 40 cm^3) is a highly segmented polystyrene-based scintillating detector composed of 80 detector elements (40 x 20 x 1 cm^3) with a gadolinium neutron converter between elements layers. A positron and a neutron are produced in an inverse beta decay initiated with an electron antineutrino in the detector. The high segmentation of the detector enables the identification of the antineutrino interaction which has a specific time, energy and spatial pattern. The signature of the signal event is an occurrence of a prompt signal from a positron and a delayed signal from a neutron interaction. Light produced by each detector element is collected via 19 wave-length shifting fibers to Silicon Photomultipliers (SiPM), which ensures transformation of light into an electric signal. A modular multi-channel fast ADC was developed for the data acquisition for the whole 80-channel S^3 detector and the 4-channel cosmic veto system. For the real-time visualization of signals and DAQ from the S^3 detector software has been developed and tested.

The detector meets very strict safety rules of nuclear power plants and can be installed in a chamber located immediately under the reactor. The close vicinity from the reactor enables to study neutrino properties with a higher efficiency, to investigate neutrino oscillations at short baselines and try to verify the hypothesis of a sterile neutrino. Since antineutrinos produced in the nuclear processes in the reactor fuel penetrate the reactor vessels and other reactor materials almost without an interaction, they can be also used as a reliable monitor of the reactor processes. Therefore, the S^3 detector can be used for the real-time measurement of the reactor power, determination of fuel burnout and control of the illegal extraction of ^{239}Pu.

The details of the design and construction of the S^3 detector, as well as properties of the modular multi-channel fast ADC will be presented. The whole detector setup was tested in an on-surface laboratory, in an underground bomb shelter (cosmic muons suppression ~ 5x), and with installed gamma and neutron shielding in order to measure signature of cosmic muon signals as well as background events. The properties of the S^3 detector will be demonstrated on the analyzed data.

Primary authors: SLAVÍČKOVÁ, Mária (IEAP CTU in Prague); SMOLEK, Karel (IEAP CTU)

Co-authors: Dr BELOV, V. (Joint Institute for Nuclear Research); Dr BRUDANIN, V. (Joint Institute for Nuclear Research); Dr EGOROV, V. (Joint Institute for Nuclear Research); FAJT, Lukáš (IEAP CTU in Prague); Dr FOMINA, M. (Joint Institute for Nuclear Research); Dr HODÁK, Rastislav (IEAP CTU in Prague); Dr KAZARTSEV, S. (Joint Institute for Nuclear Research); Dr KRULIŠ, Z. (AV ČR, Ústav makromolekulární chemie); MACKO, Miroslav (IEAP CTU in Prague); Mr MAŠEK, Petr (IEAP CTU in Prague); Dr MICHÁLKOVÁ, D. (AV ČR, Ústav makromolekulární chemie); Mr PETRO, Maros; Mr PŘIDAL, Petr (IEAP CTU in Prague); RUKHADZE, Ekaterina (IEAP CTU in Prague); Dr SHEVCHIK, E. (Joint Institute for Nuclear Research); Mr SLAVÍČEK, Tomáš (IEAP CTU in Prague); STEKL, Ivan (IEAP CTU in Prague); Dr ZHITNIKOV, I. (Joint Institute for Nuclear Research)

Presenter: SMOLEK, Karel (IEAP CTU)

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