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# 2-D Position-Sensitive Thermal-Neutron Detectors designed in Tajikistan

The present paper describes works carried out about designing of standard multiwire proportional chambers (MWPC) with Helium-3 gas converter with operating pressure of 4Atm and a multistep avalanche chamber (MSAC) with a solid-state natural Gadolinium foil converter. The sensitive volume of MWPS is 260x130x12 mm3, with a spatial resolution 3 mm. For long-term operation of the detector the Ni/SiO2 getter-based gas recovery system is developed. For clearing gas of electronegative impurity, gas pumped over through getter at a room temperature. The duration of purification process does not exceed 20 min. The operation time of the detector between purification processes is 2-3 months. The MWPC has been design for modernization of DN-2 diffractometer operated by IBR-2 pulse reactor of the Neutron Physics Laboratory named after I. Frank of the Joint Nuclear Research Institute in Dubna Moscow reg. The basic parameters of MSAC are sensitive volume - 200x200 mm, gaseous mixture - Ar + (2%) of acetone, operation pressure - 1 atm, detection efficiency (at λ=1.8A)-35%, spatial resolution-<1mm (FWHM), time resolution (by anode signal) - 20ns. The MSAC is now being testing in the Physical and Technical Institute of the Academy of Sciences of the Republic of Tajikistan.

## Summary (Additional text describing your work. Can be pasted here or give an URL to a PDF document):

The present paper presents works carried out about designing of multiwire proportional chambers with a 3He converter and a multistep avalanche chamber with a solid-state gadolinium converter. Both detectors are intended for a position-sensitive registration of thermal neutrons at neutron diffraction investigation.

MULTIWIRE PROPORTIONAL CHAMBER WITH A 3HE-BASED GAS
CONVERTER

The detector is designed for modernization of DN-2 diffractometer, arranged on the beams of the pulse reactor IBR-2 Laboratory of Neutron physics of the Joint Institute of Nuclear Research, Dubna, Moscow region. This diffractometer is intended for structural investigations of complex crystals. A two-coordinate multiwire proportional chamber (MWPC) consisting of three electrodes arranged one over another within a single gas volume is selected as the detector The sensitive volume of MWPS is 260x130x12 mm3. The MWPS is placed within a seal-tight box made from aluminum with a 6 mm-thick entrance window. The box's dimensions are 580 x 440 x 130 mm 3. The net gas volume of tile box is 4,5 liter.

The mixture of 3He and (10-20%) of propane is used as a gaseous mixture of the detector. The operation pressure of the detector is 4 atm. Apart from the gaseous additive of MWPS the propane is used to reduce the path of protons forming as a result of the reaction n + 3He - p + 3He + 764 KEV.

For long-term operation of the detector the Ni/SiO2 getter-based gas recovery system is developed. To purify the gas from electronegative impurities the former is pumped through the getter at room temperature by force. The duration of purification process doesn't exceed 20 min. The operation time of the detector between purification processes is 2-3 months.

The basic parameters of detectors are: Sensitive volume - 260x130x12 mm, Gaseous mixture - 3He + (10-20%) of propane, Entrance window- 6 mm Al, Operation pressure - 4 atm, Detection efficiency (at λ=1.8A)-70%, Spatial resolution-<3mm (FWHM), Time resolution (by anode signal)- 20ns, Counting rate- 105 1/s.

MULTISTEP AVALANCHE CHAMBER WITH a SOLID-STATE
GADOLINUM CONVERTER.

A multistep avalanche chambers (MSAC) consists of a conventional MWPC placed within a single gaseous volume with additional grid electrodes forming preamplification and drift spacing. Gadolinium converter settles down directly ahead of a preamplification grid. MSAC registers electrons escaping off in a back hemisphere. In the preamplification gap, there forms an electron-photon avalanche, which is transferred to MWPC for consequent amplification and registration. Due to the exponential amplification in the preamplification gap there is implemented a tie of coordinates to the entrance point of particles to the detector volume. The spatial resolution of MSAC can be improved by the amplitude analysis and the consequent mathematical processing of events up to 0,2-0,3 μm. The gas amplification coefficient of MSAC is of the order 106-7 which provides registration of single electrons with practically zero energy. Thus, the registration efficiency of the MSAC-based detector is mainly defined by converter's characteristics.

We have lead works on modeling calculations of efficiency of registration of thermal neutrons by foil converters from natural gadolinium and its 157 isotopes.
The basic parameters of detectors are: Sensitive volume - 200x200 mm, Gaseous mixture - Ar + (2%) of acetone, Operation pressure - 1 atm, Detection efficiency (at λ=1.8A)-35%, Spatial resolution-<1mm (FWHM), Time resolution (by anode signal)- 20ns, Counting rate-1061/s.

**Author:** ABDUSHUKUROV, Djamshed (Physical-Technical Institute of the Academy of Sciences)

**Presenter:** ABDUSHUKUROV, Djamshed (Physical-Technical Institute of the Academy of Sciences)