

Neutron Flux Measurement with a Diamond Detector System in Harsh Environmental Conditions*

K. Kaperoni¹, M. Diakaki¹, M. Bacak³, C. Weiss^{3,4}, E. Griesmayer^{3,4}, M. Kokkoris¹,
I.Kopsalis¹, J.Melbinger^{3,4}
and the n_TOF Collaboration⁵

¹Department of Physics, National Technical University of Athens, 157 80 Athens, Greece

³TU Wien, Atominstitut, Stadionallee 2, 1020 Wien, Austria

⁴CIVIDEC Instrumentation GmbH, 1010 Wien, Austria

⁵European Organization for Nuclear Research (CERN), Switzerland

Presenting author email: k.kaperoni@gmail.com

Numerous areas of nuclear physics, including fusion research, space-related technologies, and medical applications, require neutron detectors that maintain reliable performance under difficult environmental conditions. Among the available detection technologies, diamond-based detectors are regarded as particularly promising for radiation measurements in such environments, due to their exceptional electrical and physical properties [1]. In this work a diamond detector system was developed by the CIVIDEC Instrumentation [2] along with the necessary electronics. The detector consists of a single-crystal diamond sensor, produced by Chemical Vapour Deposition (CVD), with dimensions of 4 mm × 4 mm and a thickness of 50 µm. In addition, a 1.8 µm ⁶LiF foil was used as a neutron converter in order to enhance the detection efficiency for neutrons with energies below 1 MeV.

The detector was installed at the NEAR station of the n_TOF facility at CERN, where a white neutron beam is produced via spallation reactions induced by a pulsed proton beam, producing a mixed-field neutron environment. With a flight path of only 2.5 m from the spallation target, the NEAR station is characterized by a high instantaneous neutron flux ($\sim 10^{10}$ n/cm²/proton pulse) and is therefore considered a very challenging environment for active measurements. These demanding conditions offer an excellent opportunity to assess the performance of the diamond detector under high-rate irradiation. An experimental campaign was carried out using the 50 µm diamond detector at the NEAR station, during which the neutron flux was measured. The preliminary results of this campaign will be presented and discussed.

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References

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