ACQUISITION OF NEUTRON DETECTOR SPECTRA OF THE TYPE OF BF3, HE3 AND B10 USING THE WINSPECT SYSTEM IN THE ARGONAUTA REACTOR OF IEN-CNEN-RJ

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OBJECTIVES & MOTIVATION

The MTCA-166 of the GBS Elektronik GmbH Rossendorf system with WinSPECT for Inspector acquisition software was used to determine pulse height spectra of types BF3, 3He and 10B neutron detectors. Spectra of dozens of detectors were verified for future use in work in the laboratories of the Argonauta research reactor.

Simplified system for data acquisition – motivation of this work

The spectra obtained with a "workstation" show details and characteristic of the detectors allows the selection of the best ones for use in

neutron spectrometry;

reactor criticality works;

neutron registers in experiments with the subcritical assembly and

neutron registers at the monitoring stations.

INTRODUCTION

This type of detectors were developed in the 1940s under the Manhattan project and continues to be used with few modifications to pulse-forming electronics **but with modern, fast, reliable and easy-to-analyze data acquisition and recording systems**.

Nuclear reactions of this type continue to be a reason for **cutting-edge research**

$$^{10}B\ (n, \alpha)\ ^{7}Li$$

$$^{6}Li\ (n, \alpha)\ ^{3}H$$

A BF_3 Pattern Neutron Detector Pulse Height Spectrum

Gamma + noise, 2.3 Mev and 2.8Mev Peaks

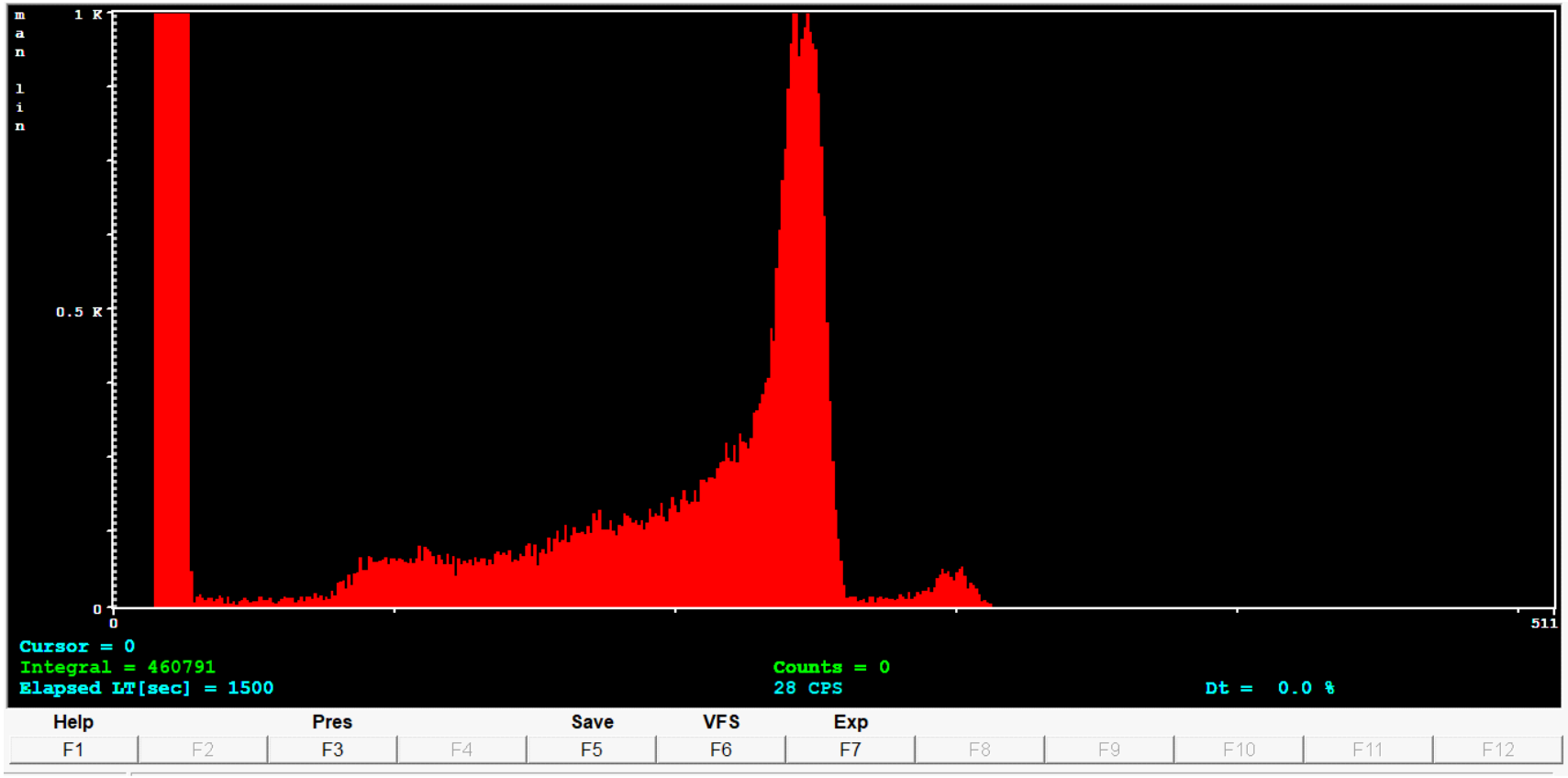


Figure 1: The BF_3 Neutron Detector Pulse Height Spectrum

PROCEDURES & RESULTS

DATA OBTAINING & SPECTRA ANALYSIS

- AmBe Source 5Ci 5Mev → Moderator Arrangement → Reproducibility

- Detector: According Pattern

  Out of Pattern → Defective

  → Others Events

Figure 2: Detectors

Figure 3: Workstation and associated system

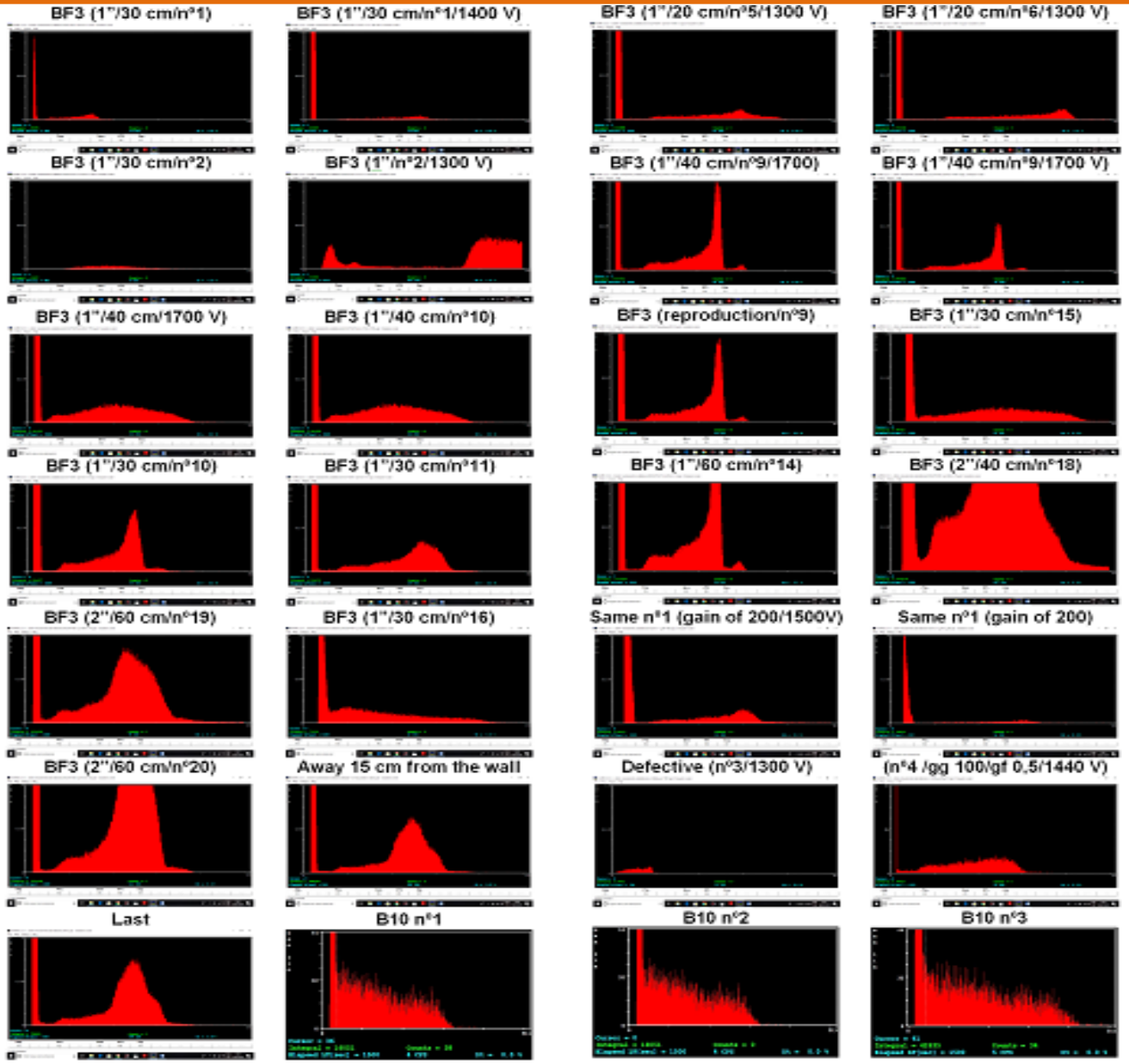


Figure 4: Neutron Pulse Height Spectra of All Detectors

- 1 and 2 inch BF3 and B10 detectors according pattern are fit for use

- He3 detector didn't show any activity

Applications of these detectors in the Argonaut reactor

- New fuel load (criticality);
- Control in reactor operation;
- Measures in IEN subcritical unit;
- Neutron spectrometry

Other applications

Neutron monitoring stations & neutron metrology

Figure 5: Argonauta Reactor

Figure 6: Sucritic tank and the neutron flow mapping system at the back

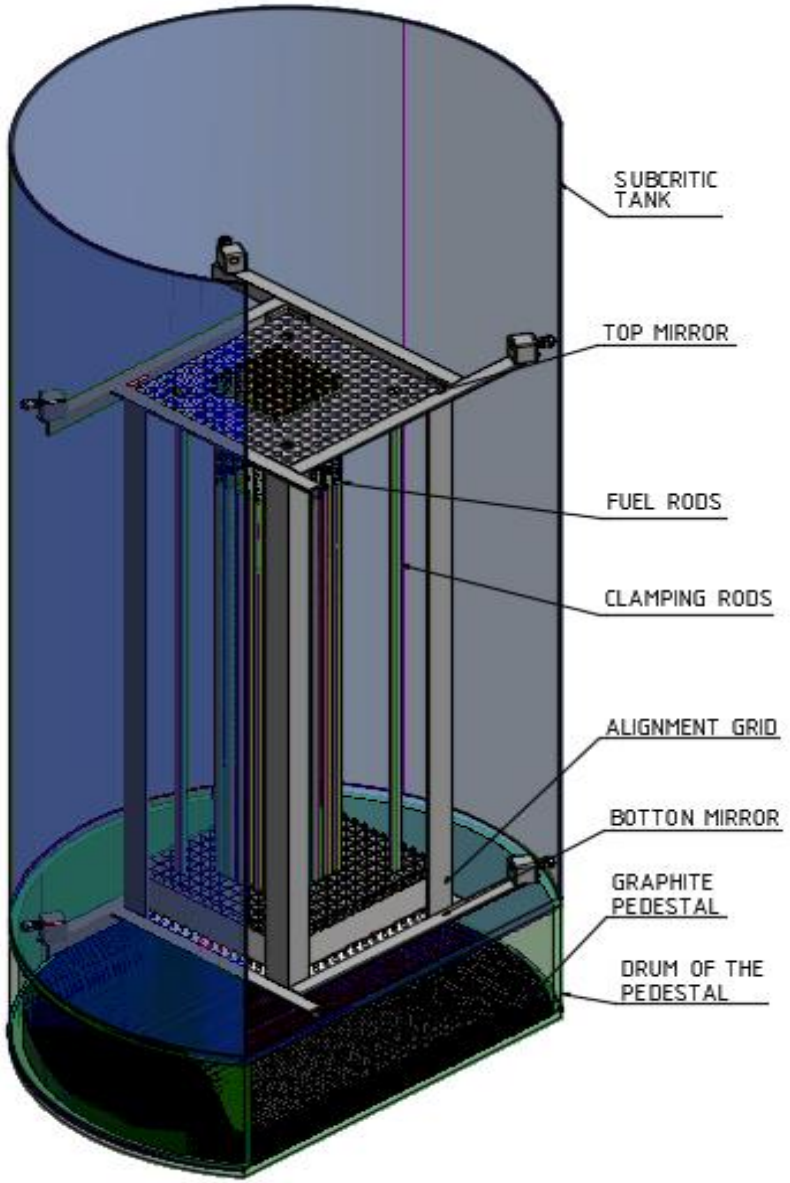


Figure 7:Perspective subcritic assembly

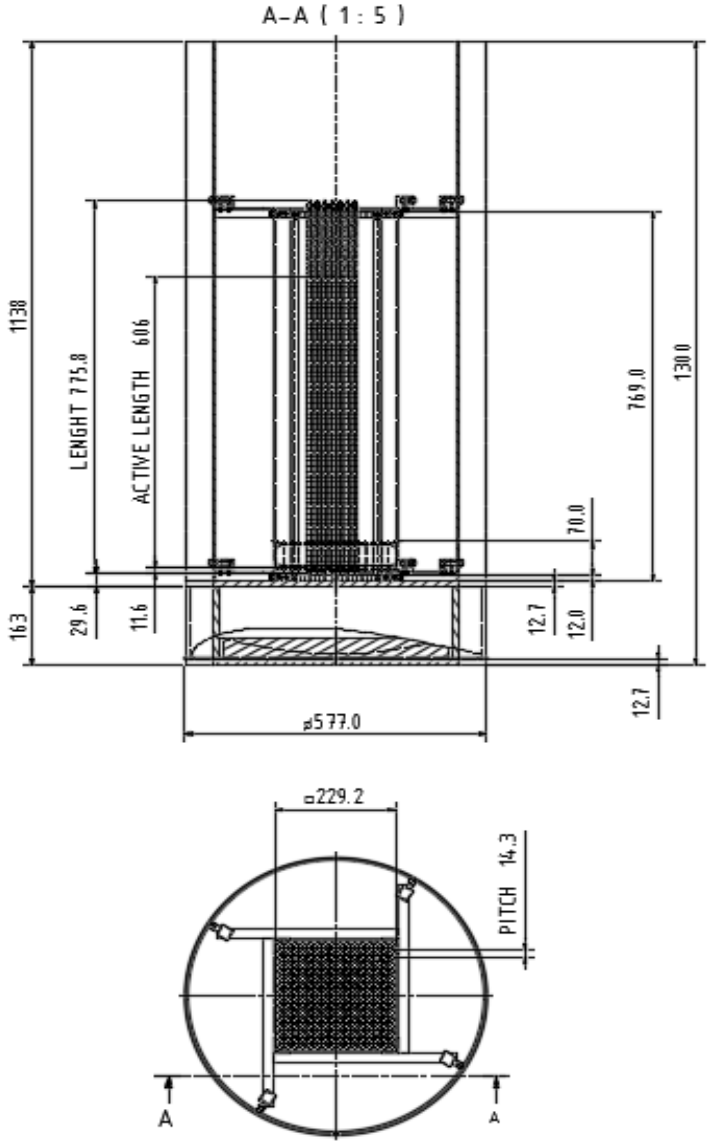


Figure 8: Top view of subcritic assembly

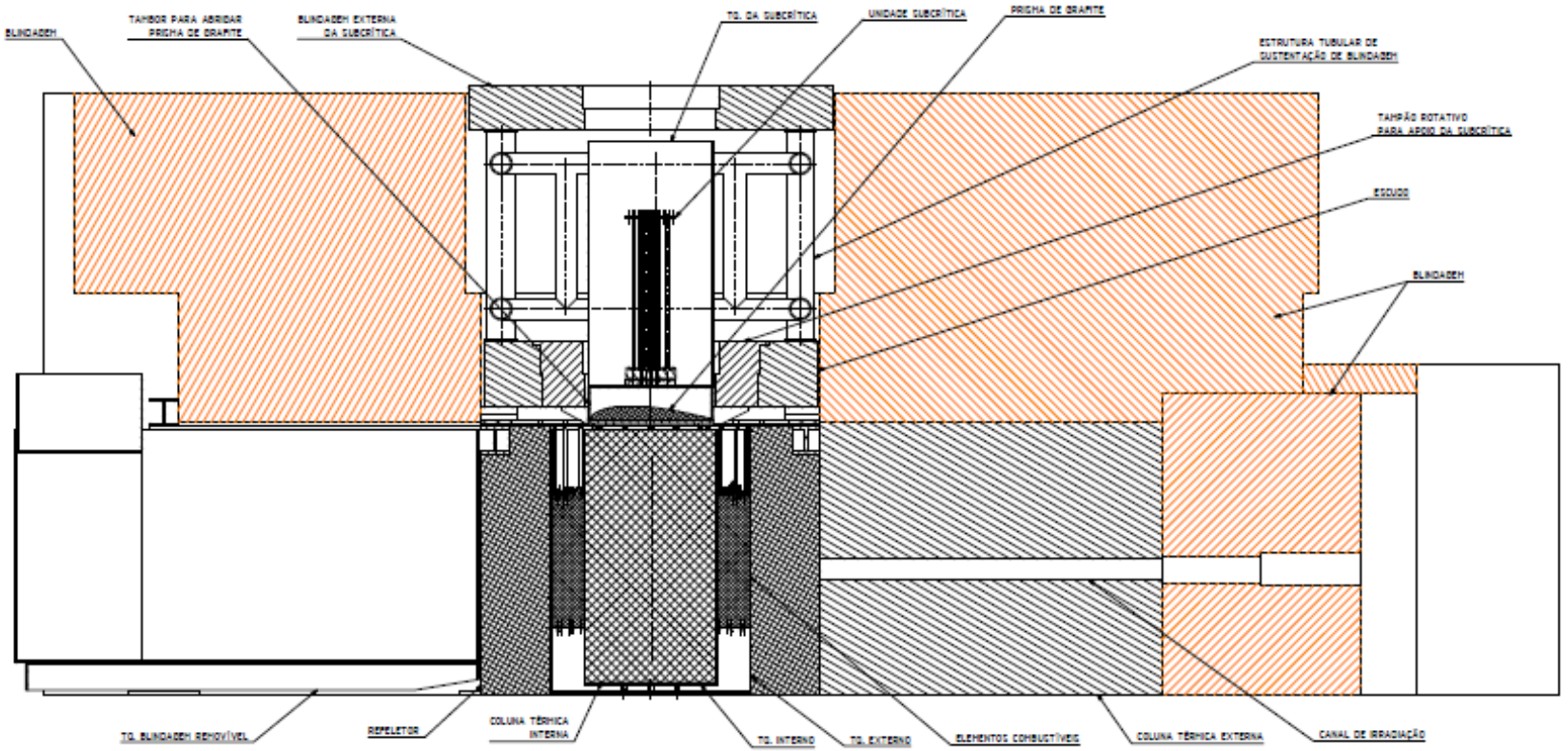


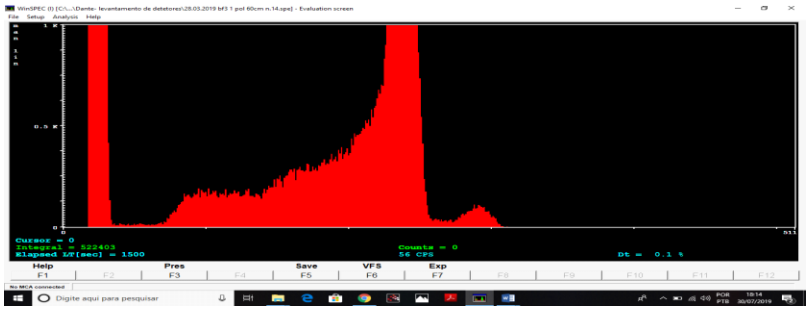
Figure 9: Profile view of the installation of subcritic assembly on the Argonauta reactor

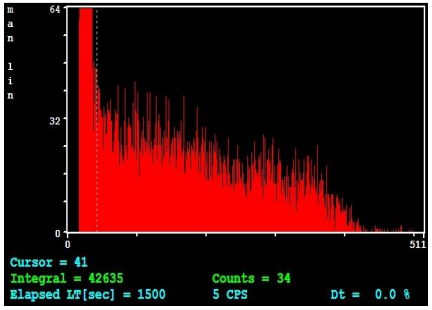
Causes that are not yet explained in the literature

- Other effects occur in the pulse height spectrum of these types of detectors and their causes are not explained, between them:

In a transmission experiment on neutron-absorbing materials such as boron, cadmium, silver, gold, gadolinium, in addition to decreasing the intensity of the entire spectrum, the main peak of 2.39 MeV always shifts to the right of the spectrum.

Correlations between the BF_3 and ^{10}B detector spectra





Wall effect on BF3 corresponds to the
1.39MeV and 1.80Mev steps of Li and alpha particles, respectively

More detailed studies about these spectra may provide good information about the characteristic nuclear reactions that occur in these detectors, of great interest even in nuclear physics in odd-parity asymmetry questions.

Cutting-edge in physics research continues with the using the nuclear reactions $^{10}B\ (n, \alpha)\ ^{7}Li$ and $^{6}Li(n, \alpha)^{3}H$ in experiments with polarized cold nêutrons.

Groups of scientists from Grenoble's Institut Laue-Langevin (ILL) in France and PNPI, Gatchina from Russia are behind the emission angle of alpha particle appearing in these reactions .

Thank You