3.9 EURopean Illicit Trafficking Countermeasures Kit – EURITRACK Project

by T.Batsch, M.Gierlik, M.Moszyński, D.Wolski

The international collaboration within EURITRACK project was continued in the year 2005. The activity of our group was concentrated on the tests and design of the Tagged Neutron Inspection System TNIS which is the central detecting unit used in the project (task WP3).

Altogether 22 big 5 inch x 5 inch x 10 inch gamma ray NaJ(Tl) scintillator detectors and one 5 inch x 5 inch liquid scintillator neutron detector are used. The detectors are mounted in three groups shown schematically in Fig. 1. The detectors of the top set and transmission set are shielded by lead collimators having the total weight of 4 tons.

The design of the detector arrays is carried out in close collaboration with Dr G. Sannie (CEA Saclay, France), the chief designer of the prototype of the whole set-up and Dr B. Perrot (CEA Cadarache, France) responsible for Monte Carlo simulations.

Results of the detectors tests are reported elsewhere.

Our periodic management report covering the first year of work was accepted.

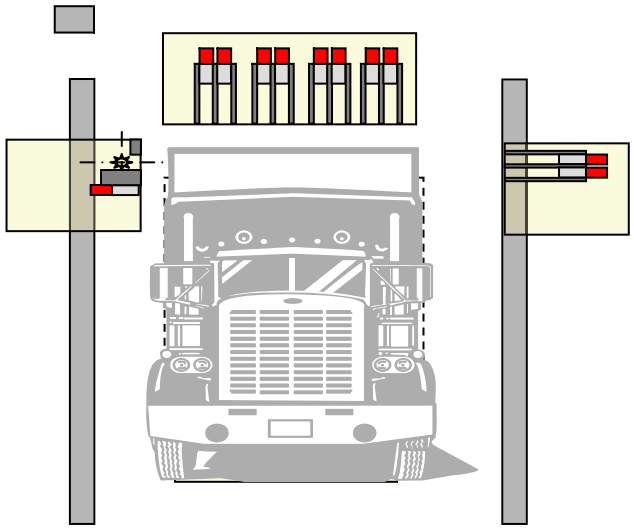

Fig. 1 Schematic view of the detector arrays used in the EURITRACK project (left: generator set, right: transmission set, over the truck: top set).

3.10 Neutron Detector for EURITRACK

by M.Moszyński, D.Wolski, T.Batsch, M.Gierlik

Selection criteria

The main criteria taken into account for the detector selection are:

- Capability of the n-γ pulse shape discrimination,
- Intrinsic time resolution,
- Detection efficiency for neutrons related to the size of the scintillator,
- Cost.

It is generally recognized that the best method for fast neutron detection is the use of liquid scintillators with enhanced pulse shape discrimination capabilities. It is associated with large neutron detection efficiency due to the large cross-section for the elastic scattering of neutrons on protons and excellent timing with organic scintillators. At present, the selection of a liquid scintillator is limited only to BC501 and BC501A. The last ones have higher light output.

Neutron detection efficiency, related to the size of the liquid cell, was inspected for the 4”x4” INFN neutron detector at the beam line of IRB neutron generator. It showed that the liquid cell of 5”x5” represents the best compromise between the detection efficiency and counting rate.

Intrinsic time resolution is a key parameter for neutron time-of-flight measurement. The velocity of 14 MeV neutrons is approximately 5cm/ns and, therefore, a few nanoseconds time resolution is required to define inspected volume element of a few dozen centimetres. Time resolution properties of liquid scintillators are excellent due to a fast light

pulse; however, specific fast PMT with low electron transit time spread must be used.

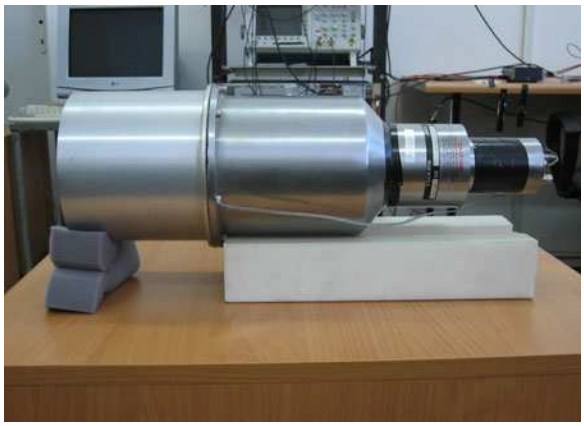

Fig.1 Tested detector.

Detector characteristics

Based on the above criteria, the 5"x5" BC501A liquid bubble-free cell, type MAB-1 was selected, coupled to the 5" diameter XP4512B photomultiplier. Because of expected high count rate of neutrons and γ rays there is used transistored type C divider VD105K/01.

For this detector we have obtained

N=1400phe/MeV.

It is well established that the most effective method of fast neutron detection is the use of BC501A liquid scintillator cells coupled to a photomultiplier together with n-γ discriminator based on zero-crossing techniques.

As front-end electronics we have used a dedicated electronics piggy backdesigned for the neutron wall used in EUROBALL project.

3.11 Assembling and Testing of 512 Microstrips 3 Inch Silicon Detector*

by T.Batsch, A.Dziedzic, M.Kisieliński, K.Leśniewski, M.Moszyński, D.Wolski

The work concerning testing and assembling of the 512 strips 3 inch silicon detector was continued in the year 2005. The new version of the detector assembly was designed and built accordingly to the results of previous tests performed in our laboratory and the discussions with the Jülich side. Several improvements were introduced in the new set-up:

- shielding of the laminated detector support was improved
- unshielded flat cable connections were eliminated
- HV distribution was modernized
- the unit was made more compact by changes made in the preamplifiers housings.

The complete pilot unit together with 32 sets of cables was delivered to FZ Jülich. It is planned to use it in "frozen target" experiment on beam of the COSY accelerator.

To enable for construction of the "Erlangen" version of the detector assembly that is planned soon the new method of manufacturing of large format printed circuit boards that are not available commercially was worked out.

A group of workers capable to assemble modern thin coaxial cables was organized and trained.

*) work contracted by FZ Jülich