NEUTRON SPECTROMETER
BONNER SPHERE SPECTROMETER

MAIN FEATURES

- Compact and high-performance system
- Worldwide standard
- Fully customizable (moderator diameters, material and number)
- Detectors: He-3 proportional counters
- Moderators: HD polyethylene, spherical, from Ø 3” to Ø 18”
- Accessory set for energy range extension up to 10 GeV
- Exportable archived data (ASCII files)
- Optional special electronics for use in pulsed fields

DESCRIPTION

The Bonner sphere spectrometer consists in an array of thermal neutron detectors (He-3 proportional counters), each housed in a spherical polyethylene moderator of different diameters. Upon request, the moderators can be designed to host a different type of thermal neutron detector.

Through the comparison between the counts detected by each sphere, it is possible to determine the incident neutron energies. These data must be processed by an unfolding code to calculate the neutron spectrum.

An accessory set is available upon request to extend the energy range up to 10 GeV.

The proportional counter is connected to a compact electronic module, housed in 2.5 cm diameter aluminum cylinder with a length of 7.6 cm, having the following main characteristics:

- Precision wide band charge sensitive pre-amplifier followed by an amplifier
- Twelve-turn trim pot to finely tune the amplifier sensitivity to the desired level to obtain a good high voltage plateau
- Discriminator circuit that produces, when a charged event is detected, a TTL pulse (width adjustable from 40 to 500 ns)
- Threshold control trim pot allowing to control the discriminator level
- Analog monitoring test point allowing direct monitoring of amplified charged events using an oscilloscope
- High performance high voltage generator, adjustable over a range of 0-2200 V
- Test point to measure and adjust the high voltage setting

The central acquisition box is based on 8-CH TTL hi speed DIO modules, a real-time processor and a reconfigurable field-programmable gate array. The central box is connected to a PC through an Ethernet cable, and is programmed to continuously acquire the counts coming from the detectors, also when the acquisition PC is off.

A user-friendly dedicated acquisition software is installed on the PC; it allows to start and stop the measurements, to modify the parameters and to visualize the saved data.
TECHNICAL SPECIFICATIONS

Detectors
- He-3 Spherical proportional counter
- Typical sensitivity: 0.25 cps/µSv/h (when housed in the 8” sphere)
- Housing: HD polyethylene cylindrical inserts for fitting the detectors in the spheres

Bonner spheres
The standard set (which reproduces the worldwide standard PTB NEMUS configuration) includes the following moderators for the proportional counters:
- HDPE moderator: Ø 3”, Ø 3.5”, Ø 4”, Ø 4.5”, Ø 5”, Ø 6”, Ø 7”, Ø 8”, Ø 10”, Ø 12”, Ø 15”, Ø 18”

Operational acquisition & display software
- Independent data acquisition from each electronic module
- Visualization of each detector counts and status, real-time updating (every second)
- Either manual or automatic Start/Stop with user-settable integration time
- Synchronized Start/Stop commands for all the acquisition inputs
- Graphical display of acquired/archived data
- Data export and storage in ASCII format files

OPTIONS
- Special electronics (with no dead time) for use in pulsed fields around particle accelerators

ACCESSORIES AVAILABLE UPON REQUEST
1. Bonner sphere set for extension to 10 GeV
   - Ø 3” HD polyethylene inner moderator, 1” lead shell, Ø 7” HD polyethylene outer moderator
   - Ø 4” HD polyethylene inner moderator, 0.5” lead shell, Ø 7” HD polyethylene outer moderator
   - Ø 4” HD polyethylene inner moderator, 1” lead shell, Ø 8” HD polyethylene outer moderator
   - Ø 4” HD polyethylene inner moderator, 0.5” copper shell, Ø 7” HD polyethylene outer moderator
2. Unfolding code for automatic spectra calculation
3. Response functions obtained via Monte Carlo simulations
4. Flight case
5. Warranty extension from 12 months to 24 months