

NEUTRON SPECTROMETER

BONNER SPHERE

MAIN FEATURES

- Detectors: ^3He proportional counters
- Moderators: HD polyethylene, spherical, from $\varnothing 3''$ to $\varnothing 12''$
- Ethernet connection between central box and PC
- User-friendly operational software
- Settable measuring parameters
- Data storage and graphic/numeric display
- Exportable archived data (ASCII files)
- Energy range extension up to 5 GeV (optional)
- Special electronics for use in pulsed fields (optional)

DESCRIPTION

The **Bonner sphere spectrometer** consists in an array of thermal neutron detectors (^3He proportional counters), each housed in a spherical polyethylene moderator of different dimensions. Through the comparison between the neutrons detected by each sphere, it is possible to determine the incident neutron energies. These data are processed by an unfolding code, which provides the neutron spectrum.

A special set is available upon request to extend the energy range up to 5 GeV. Each sphere is connected to a specifically designed pre-amplification and adjustment module (PREAMP-N-HV) that provides a TTL pulse output completely compatible with the connected digital counting system. 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.



Bonner Sphere set

A user-friendly dedicated acquisition software is installed on the PC; it allows to start and stop the measurements as defined by the set parameters, and to store them in tabulated text files. The software allows also to modify the parameters and to visualize the saved data.

The status indicator displayed in the main panel shows the following main information for each channel (sphere):

- Detector name (adjustable as a parameter)
- Activation (selectable as a parameter), i.e.: green → activated
- Counts: shows the integral counts value during the measurement, updated every second
- Average CPS: shows the average cps during the measurement, updated every second

The data are stored in the main folder of the archives, which includes a sub-folder for every year.

TECHNICAL SPECIFICATIONS

Detectors

- Spherical proportional counter
- Filling gas: ^3He
- Body material: Stainless Steel
- Electrode: 17.5 μm Tungsten
- Insulation: Alumina
- Diameter: 33 mm
- Length: 134 mm
- Filling pressure: 200 kPa
- PET137 connector for counter
- Typical sensitivity: 0.25 cps/ $\mu\text{Sv/h}$ (when housed in the 8" sphere)
- Housing: HD polyethylene cylindrical inserts for fitting of SP9 detectors in the spheres

Bonner spheres

- The set includes the following moderators for the proportional counters:
- HD polyethylene moderator: \varnothing 3", \varnothing 4", \varnothing 5", \varnothing 6", \varnothing 7", \varnothing 8", \varnothing 9", \varnothing 9.5", \varnothing 10", \varnothing 12"

Analyzer

- PREAMP-N-HV modules, one for each sphere, containing Pre-Amplifier and discriminators boards
- EHT supply adjustable via external trimmer up to 2000V
- 220 VAC/24 VDC power supply adapter
- Multi-input acquisition system connected via Ethernet to the PC

Operational acquisition & display software

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

OPTIONS AVAILABLE UPON REQUEST

In addition to standard supply, the following options are available upon request:

- Bonner sphere set for extension to 5 GeV
 - \varnothing 3" HD polyethylene inner moderator, 1" lead shell, \varnothing 7" HD polyethylene outer moderator
 - \varnothing 4" HD polyethylene inner moderator, 1" lead shell, \varnothing 8" HD polyethylene outer moderator
 - \varnothing 4" HD polyethylene inner moderator, 0.5" lead shell, \varnothing 7" HD polyethylene outer moderator
 - \varnothing 4" HD polyethylene inner moderator, 0.5" copper shell, \varnothing 7" HD polyethylene outer moderator
- Special electronics (with no dead time) for use in pulsed fields



Moderators (above) and software panel (under)



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