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Brief 66-10555

# NASA TECH BRIEF



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## A Fast-Neutron Spectrometer of Advanced Design

#### The problem:

To design and develop a fast-neutron spectrometer for spectral measurements requiring a combination of good resolution, high efficiency, and rapid response. Accurate measurements are required of fast-neutron fluxes of  $10^8/\text{cm}^2/\text{sec}$  to  $10^{10}/\text{cm}^2/\text{sec}$ , within a gamma field as high as  $1.5 \times 10^6$ R/hour and a time limit of 5 seconds.

#### The solution:

An instrument that combines He<sup>3</sup>-filled proportional counters with solid-state detectors to achieve the properties of high efficiency, good resolution, rapid response, and effective gamma-ray rejection.

### How it's done:

Using the He<sup>3</sup>(n,p)T reaction as a neutron converter, if the total energy of the secondary particles, the proton and triton, is absorbed, the recorded spectrum is easily interpreted. Since this reaction has a Q-value of 0.760 Mev, the energy of a recorded neutron is well above most background (interference), and a resolution of 30 to 50 Kev can be achieved. Neutrons whose absolute energies are 2 to 3 times this value (as low as 100 Kev), produce peaks that can be resolved from those peaks produced by thermal neutrons. A number of advantages are realized if a method that makes use of the volume of He<sup>3</sup> gas present in the solid-state sandwich spectrometer is developed. The He<sup>3</sup> gas is used as a proportional counter. Resolution is improved by adding the energy deposited in the proportional counter to that absorbed in the solid-state charged-particle detectors. Coincidence between the solid-state detector and the proportional counter results in greatly reduced background.

An extension of the above use of He<sup>3</sup> gas as a proportional counter, is to divide the volume into two proportional counters. This arrangement permits the use of particle identification techniques to eliminate gamma interactions, He<sup>3</sup> recoils, deuterons from the He<sup>3</sup>(n,d)D reaction, alpha particles from the Si<sup>28</sup>(n,a)Mg<sup>25</sup> reaction, and many of the protons from the Si<sup>28</sup>(n,p)Al<sup>28</sup> reaction.

A neutron spectrometer has been developed to incorporate the above considerations. The He<sup>3</sup> volume is divided into two proportional counters separated by a series of wires that defines the electric field. Coincidence between the two proportional counters is achieved, and a proton is identified through its  $(dE/dX) \times E$  product.

#### Note:

Inquiries concerning this invention may be directed to:

Technology Utilization Officer Marshall Space Flight Center Huntsville, Alabama 35812 Reference: B66-10555

### Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: Christopher C. Preston and Robert B. Moler of IIT Research Institute under contract to Marshall Space Flight Center (M-FS-1664)

Category 01

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