Nuclear Physics Approach

DIAGNOSIS OF NEUTRONS FROM THE GAS DISCHARGE FACILITY

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ABSTRACT

The phenomena of nuclear fusion at normal temperature have been studied using a gas discharge facility and about 10^4 neutrons per second have been detected. The neutron yield is controllable and reproduceable. The BF_3 neutron detectors, the ^{6}Li thermoluminescence films, the NE-213 organic liquid scintillation neutron spectrometer and the n- γ discrimination technique were used to diagnose the neutrons. It was confirmed that neutrons were emitted from the gas discharge facility.

There were some non beam-target neutrons among these neutrons, especially when the discharge voltages was low(<7kV).

KEY WORDS Neutrons, Gas discharge, ^{10}B (n, α)^{7}Li$^\#$ reaction, n- γ discrimination spectra, Neutron energy spectra, Thermal neutrons

On the base in principle that same activated transitional-metals or hard-melted metals have the strong capability of adsorption to active gas in certain range of temperature, the research that loading metals with deuterium by way of gas discharge and studying the anomalous phenomena of metals loaded with deuterium have been developed.[1-2] Neutrons were detected in our experiments. There were neutrons detected by way of gas discharge in experiments of former Soviet Union and Japan as well.[3-4] In order to confirm further the existence of neutrons emitted from the gas discharge facility (abbr. GD neutrons), the following methods were used to diagonosing the said neutrons.

1. Diagonosis of GD neutrons

1.1 The characteristic spectra of the pulse height distribution (abbr. CSPHDs) for ^{10}B (n, α)^{7}Li$^\#$ reaction

First we slowed part of the GD neutrons down to thermal neutrons. Thermal neutrons reacted with ^{10}B in two channels as follows:

$$^{10}B + n \rightarrow \alpha + {}^{7}Li^{\#} + 2.31\ MeV\ (93.9\%)$$

$$^{10}B + n \rightarrow \alpha + {}^{7}Li + 2.79\ MeV\ (6.1\%)$$

So thermal neutrons would produce two kinds of CSPHD which expressed characteristic of the two said reaction channels. The CSPHDs of the GD neutrons and of the Am-Be source neutrons had been measured respectively with BF_3 neutron detectors, as shownin figure 1.

1.2 The filtering of thermal neutrons

The thermal neutrons slowed down from GD neutrons were measured by the ^{6}Li thermoluminescence films. In order to differentiate this kind thermal neutrons, Cd films (0.5 mm thickness) were used as thermal neutron filters and the ^{6}Li thermoluminescence films were irradiated both in the covering cadmium and in non-the covering cadmium. For estimating influence of γ rays, those thermoluminescence films of ^{6}Li and ^{7}Li were irradiated simultaneously. The sensitivities of the ^{6}Li and ^{7}Li thermoluminescence films to γ rays were calibrated with γ source in advance. The difference coefficient of the said two sensitivities, i.e. $Nr(^{6}Li) / Nr(^{7}Li)$, was 1.13.

The thermoluminescence films were irradiated by the GD neutrons . Pb plate (5 mm thickness) was used to eliminating X rays background from gas discharge process and to increasing thermalization effect of polythene to GD neutrons.

The background counts of ^{6}Li thermoluminescence films originated from the following two aspects. one was natural background counts, which could be cut with the background counts of a set of thermoluminescence films that were not irradiated. The other was γ background counts, which could be estimated with the counts of ^{7}Li thermoluminescence films that were irraditated simultaneously.

The results of GD neutrons measurement were listed in table 1. The experimental results showed: (1) the counts of ^{6}Li thermoluminescence films in non-the covering cadmium were higher than those of ^{7}Li thermoluminescence films; (2) the counts of ^{6}Li thermoluminescence films in the covering cadmium were equal to that of ^{7}Li thermoluminescence films within the range of experiment error.

1.3 n-γ discrimination spectra

Neutrons were differentiated from γ rays by an n-γ discrimination technique with NE-213 organic liquid scintillation neutron pectrometer. This device was also used to measuring the n-γ discrimination spectra from an Am-Be neutron source, an ^{22}Na γ source and the gas discharge facility (here were the background γ rays). The results of measurement were shown in figure 2.

1.4 Neutron energy spectra

The neutron energy spectra of GD neutrons have been measured with NE-213 organic liquid scintillation neutron spectrometer by a n-γ discrimination technique . A 0.5 mm thick Cu film was placed in front of the spectrometer, for eliminating the influence of strong X rays (27 keV) from the gas discharge facility. The recoil proton

Neutron energies were calibrated with ^{22}Na source. The measurements of recoil proton spectra were shown in figure 3.

The neutron energy spectra, which were solved from the recoil proton spectra and those relevant respond functions, were shown in figure 4.

The GD neutron energy measured in experiments and the D-D neutron (90 ° direction) energy were both 2.38 ± 0.15 MeV, which agreed with the average energy 2.45 MeV of normal D-D reaction neutrons within the range of experiment error.

1.5 The comparative experiments of hydrogen discharge

There were not neutrons detected in hydrogen discharge under otherwise equal conditions.

2. The measurement of GD neutron yield

The GD neutron yield was measured by using BF_3 counting devices. The counting mode of the BF_3 counting devices was anticoincidence mode in order to eliminating influence of electromagnetic disturbance and high voltage sparking. For this purpose, a "simulating BF_3 neutron detectors" system was designed to cooperate with the "signal BF_3 neutron detectors" system. The two system formed an anticoincidence counting system.

The efficiency of the BF_3 neutron counting devices, which was calibrated with Am-Be neutron source, was 8.33×10^{-3}. The time dependence of GD neutron yield was shown in table 2.

Reference

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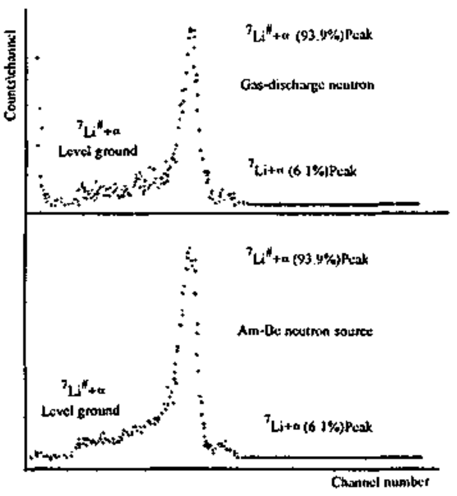

Fig 1. Characteristic spectra of the pulse height distribution for $^{10}B(n,\alpha)^7Li^{\#}$ reaction

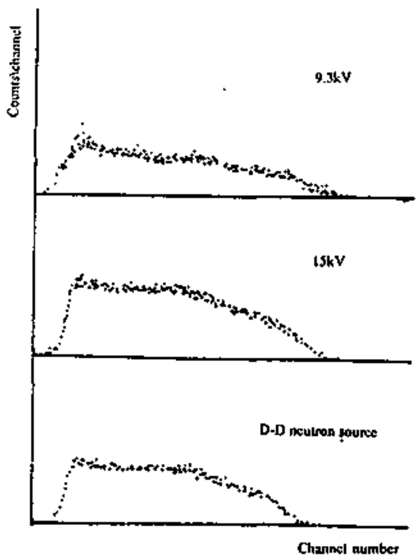

Fig 3. The recoil proton spectra produced by gas-discharge

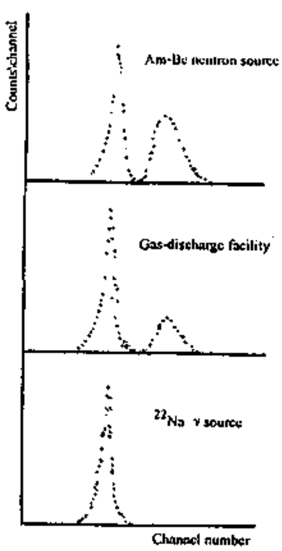

Fig 2. n-γ discriminating spectra of gas-discharge neutron

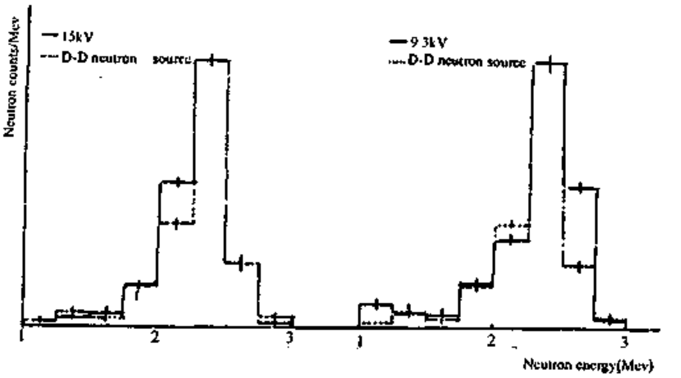

Fig 4. The neutrons spectrum produced by gas-discharge

Table 2. Time dependence of gas-discharge neutrons

order	time	counts of BF_3 detector(n/100s)	the yiedl of neutrons (n/s)
1	10:30	8276	0.993×10^4
2	11:00	8690	1.043×10^4
3	11:20	7444	0.893×10^4
4	11:40	8454	1.014×10^4
5	12:00	8305	0.996×10^4
6	12:20	8141	0.997×10^4
7	13:00	8567	1.028×10^4
8	13:30	8373	1.005×10^4
9	14:00	8615	1.034×10^4
10	14:30	8289	0.995×10^4

Table 1. The measurable result of meutron detector for ^6Li thermolaminescence

counts of ^6Li thermolaminescence			counts of ^7Li thermolaminescence		
not the covering cadmium	the covering cadmium	nature background	not the covering cadmium	the covering cadmium	nature background
0.235 ± 0.04	0.064 ± 0.02	0.045 ± 0.007	0.158 ± 0.022	0.06 ± 0.022	0.041 ± 0.005