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SOME RESULTS ON COLD FUSION RESEARCH

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Abstract: Anomalous nuclear effects in Pd+Ti+D_2 system were investigated by means of a double liquid scintillator system. A recoil proton spectrum of 2.45 MeV neutrons was obtained from heavy water electrolysis experiment using Pd as cathode. Burst neutrons and random neutron emissions were observed in discharge experiments and temperature cycle experiments for Pd+Ti+D_2 system.

1. A double liquid scintillator system

Since Fleischmann and Pons announced that d-d fusion reactions in room temperature were found(1), some neutron physicists have being focused their attentions on searching 2.45 MeV neutrons produced by $D(d,n)^3He$ reactions(2-6). Comparing with other neutron detectors, liquid scintillator have some clear advantages: a). it can give neutron energy spectrum. b). it has excellent neutron-gamma discrimination ability, and the results with higher effect to background ratio can be expected. c). it can give fast signal with nanosecond order, and can record burst neutron events.

We have used a bouble liquid scintillator system for detecting the neutrons in discharge experiments, electrolysis experiments and temperature cycle experiments. It was shown in Fig. 1. LSD1 and LSD2 are the same liquid scintillation detectors. Every detector both is used as a single detector to analyse and record incident neutron number with time-variation (RECORDER1 and RECORDER2) and energy spectrum (ADC1.1 and ADC2.1) and operates in coincidence mode to analyse and record neutron burst nember (RECORDER12) and burst neutron enrgy spectrum (ADC1.2 and ADC2.2). The background count rate from the anode signals,

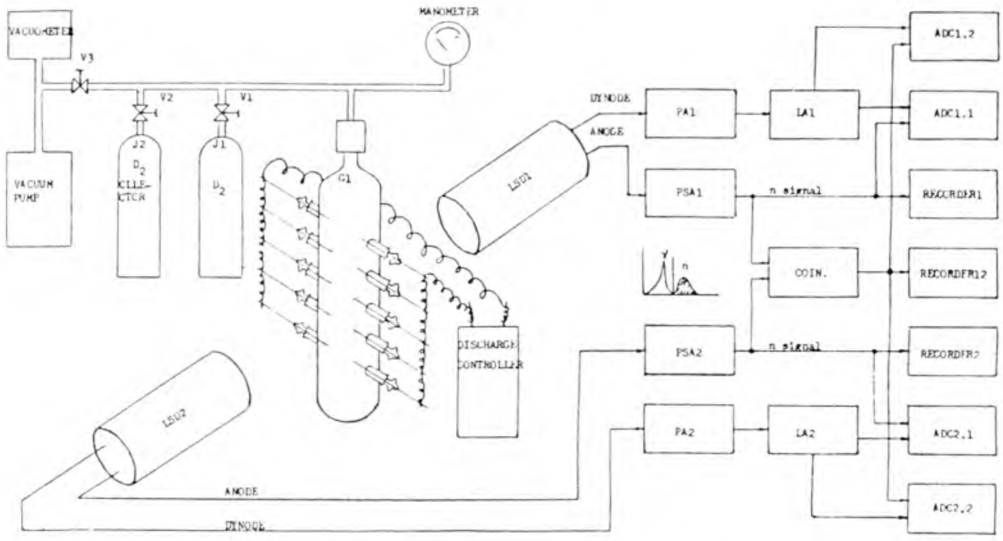

Fig. 1 The set-up and the double liquid scintillator measurement system used in the discharge activation experiment

which pass throuth the pulse shape analysis circuit, only is about 60 counts/hour. When the resolution time of the coincident circuit is 150 μs, the accidental coincident count rate is 0.001/hour, it is negligible. The efficiency of this system for 2.45 MeV neutrons is about 0.001. Maximum neutron count rate may reach 10^7 counts/sec. Some experiment results are following.

2. Results of discharge activation experiments

The set-up of discharge activation experiments are shown in Fig. 1. together with the double liquid scintillator system. The principle and set-up are similar to Nubuhiko Wada's[4]. G1 is a glass jar, it is about 500 ml in content and has 5 pairs of electrodes. The electrodes are the Pd-Ag tube of 2 mm diameter, wall thickness 0.1 mm, which is made from about 80% Pd and 20% Ag. J1 is used for storing high pressure D_2 gas. In the experiment D_2 gas of 0.9 atm. was filled into G1, and 6000-12000V voltage was applied to between the electrodes for 3-10 minutes for every discharge. Every run experiment lasted for 3-8 days, and discharge was repeated many times.

We have completed 40 runs of discharge activation experiments, in about 20 runs of which Clear anomalous neutron counts were observed. A result is shown in Fig. 3, in which only counts recorded by recorder1 (including random neutron counts and burst neutron counts) and coincident counts recorded by the recorder12 (neutron burst number)

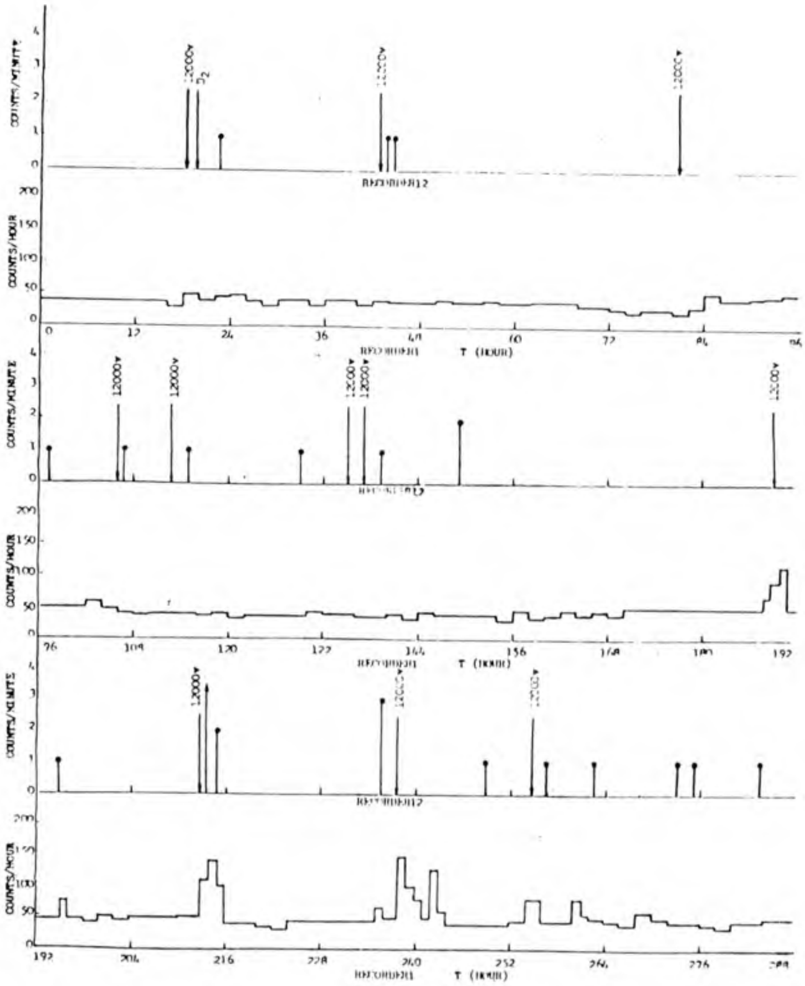

Fig. 2 Time-variation of count rate of the double liquid scintillator system in the discharge activation experiment

were shown. Clear anomalous neutron counts occur in the period of last four days, even seven neutron bursts occur in the period of one hour.

3. Results of electrolysis experiments

Our electrolysis experiment set-up was similar to Fleischmann's. The experiment was carried out in a glass jar, approximately 10 cm high x 10 cm diameter, held about 200 ml of 99.8 D_2O plus o.2% H_2O containing o.5 mol/L LiOD. A Pd tube of 10 cm long was used as cathode, a platinum wire as an anode. A DC power supplies of 0-30 volts provided electrolysis current of 100-150 ma.

After about 20 hours of beginning electrolysis neutron counts increased rapidly, and lasted for one hour. The maximum counting rate reach 447 n/minute. Luckily, before 20 minutes of producing high neutron counts integral background counts in the period of 20 hours were cleaned. 3142 counts were collected in the period of 70 minutes. The background

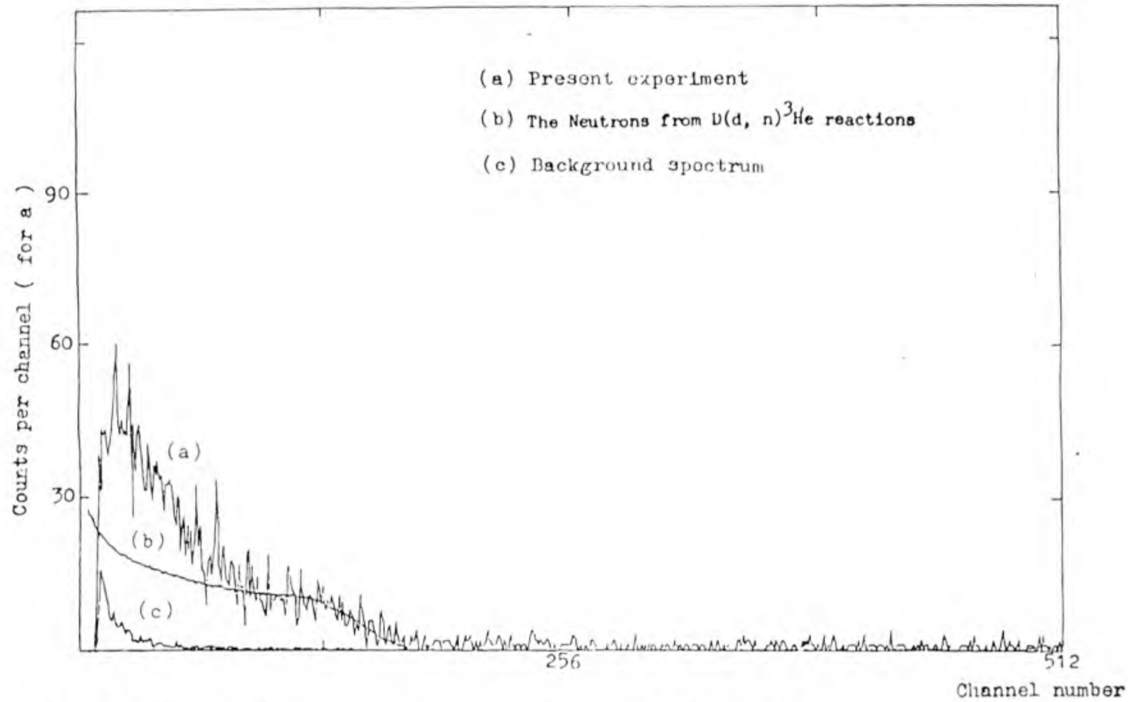

Fig. 3 A recoil proton spectrum measured by a liquid scintillator in the electrolysis experiment

counts only is about 70. Effect to background ratio reached 40:1. The recoil proton spctrum recorded by LSD1 is shown in Fig.3. This spectrum is basically coincident with the recoil proton spectrum caused by the neutrons from D(d,n)^{3}He reactions, which were produced in 400 KV high voltage accelerator in Beijing normal University. This shows that D(d,n)^{3}He reactions have occurred in the electrolytic cell.

4. Results of temperature cycle experiments

After having a steel jar S1 instead of the glass jar G1 in Fig. 1, Fig. 1 becomes the set-up used in temperature cycle experiments. When beginning experiment, a Pd sheet of thickness o.1mm and weight 0.1g. Ti chip of thickness 0.1mm and weight 50g and two CR-39 plastic sheets were put into S1 together. CR-39 was used for detecting energitic charged particles. S1 was sealed, evacuated and put into A Dewar filled with liquid nitrogen. In liquid nitrogen temperature S1 was filled with ten atm. of D_2 gas. Then the liquid nitrogen in the Dewar was evaporated in room temperature and S1 was warmed to room temperature. Then next temperature cycle was started. One run of temperature cycle experiment lasted for 6-12 days.

Fig. 4 shows a neutron measurement result. In the period of eighth temperature cycle 184 neutron bursts were recorded. It means that about 200000 reaction events occurred in the samples. Two CR-39 sheets recorded also charged particle signals in the same experiment.

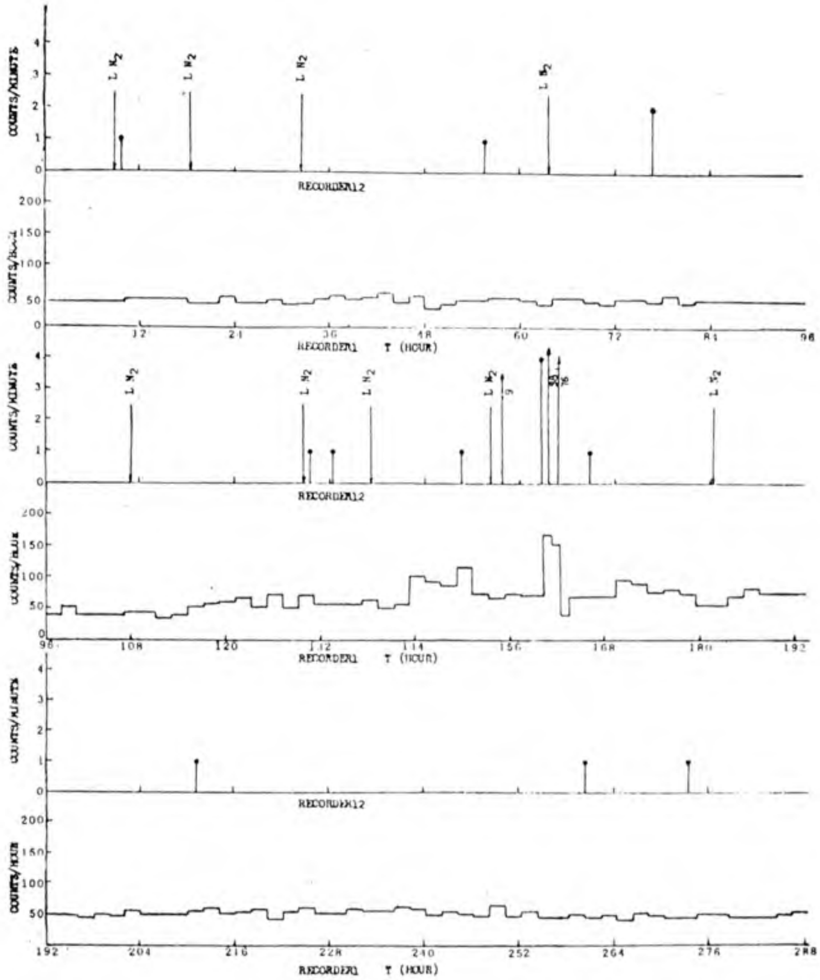

Fig. 4 Time-variation of count rate of the double liqu scintillator system in a temperature cycle experiment

Reference:

1) M. Fleischmann, S. Pons, J. Electroanal. Chem., 261, 301(1989)
2) S. E. Jones et al., Nature 338, 737(1989)
3) Nubuhiko Wada and Kunihide Nishizawa, Japanese Journal of Applied Physics, Vol. 28, No. 11, 2017(1989)
4) A. Takahasi et al., submitted to conference on anomalous effects in deuterium/solid systems (1990)
5) A. De Ninno et al., 'Evidence of Emission of Neutrons from a Titanium-Deuterium system', submitted to: Europphysics Letter (1989)
6) H. O. Meulove et al., 'Measurement of neutron emission from Ti and Pd in Pressurized D_2 gas and D_2O electrolysis cells', submitted to: Nature (1989)

EDITORIAL NOTE TO THE PAPER " SOME RESULTS ON COLD FUSION RESEARCH" BY Z. HONGYU ET AL.

The decision to publish these Proceedings as soon as possible did not allow any revision of the English presentation of the text originally submitted. This paper is particularly lacking in this respect, however due to the interest of the results presented we have decided to include it in the original form, asking the readers' forbearance.