ԵՐԵՎԱՆԻ ՖԻԶԻԿԱԿԱՆ ԻՆՍՏԻՏՈՒՏ
ЕРЕВАНСКИЙ ФИЗИЧЕСКИЙ ИНСТИТУТ

ԳԻՏԱԿԱՆ ՀԱՂՈՐԴՈՒՄ НАУЧНОЕ СООБЩЕНИЕ

ЕФИ-92(74)

A.S. ALEXANIAN, T.L.ASATIANI, V.I.IVANOV

G.G.MKRTCHIAN, R.N.PIKHTELEV

DETECTOR FOR RECOIL NUCLEI STOPPING IN THE SPARK CHAMBER GAS

АРУС

ԵՐԵՎԱՆ 1974 ЕРЕВАН

YEREVAN PHYSICS INSTITUTE

Scientific Report ЕФИ-92(74)

A.S. ALEXANIAN, T.L.ASATIANI, V.I.IVANOV
G.G.MKRTCHIAN, R.M.PIKHTELEV

DETECTOR FOR RECOIL NUCLEI STOPPING IN THE SPARK CHAMBER GAS

Yerevan 1974

SU 7509242

УДК.539.1.074 /073 Научное сообщение ЕФИ-92(74)

А.С.АЛЕКСАНЯН, Т.Л.АСАТИАНИ, В.И.ИВАНОВ,
Г.Г.МКРТЧЯН, Р.М.ПИХТЕЛЕВ

ДЕТЕКТОР ЯДЕР ОТДАЧИ, ОСТАНАВЛИВАЮЩИХСЯ В ГАЗЕ ИСКРОВОЙ КАМЕРЫ

Описывается детектор, состоящий из сочетания дрейфовой и широкозазорной искровой камеры, предназначенный для регистрации ядер отдачи, останавливающихся в газе искровой камеры. Показано, что при введении соответствующей дискриминации детектор позволяет в интенсивных пучках электронов и γ -квантов надежно регистрировать ядра отдачи.

Ереванский физический институт
Ереван 1974 г.

Scientific Report ЕФИ-92(74)

A.S.ALEXANIAN, T.L.ASATIANI, V.I.IVANOV,
G.G.MKRTCHIAN, R.M.PIKHTELEV

DETECTOR FOR RECOIL NUCLEI STOPPING IN THE SPARK CHAMBER

A detector consisting of the combination of a drift and a wide gap spark chambers and designed to detect recoil nuclei stopping in the spark chamber gas is described. It is shown, that by using an appropriate discrimination the detector allows to detect reliably the recoil nuclei in the presence of intensive electron and γ-quanta beams.

Yerevan Physics Institute
Yerevan, 1974

The detection of the recoil nuclei in the elementary partic-le interactions allows to identify more reliably the reaction channel and to determine the interaction point, the range and the production angle of the recoil nucleus.

The following difficulties arise when one tries to cons - truct recoil nucleus detector:

1. The detection of the short range particles.
2. The determination of the energy of the recoil nucleus.
3. The presence of a heavy background in the case of high intensity beams ($\sim 10^8 \div 10^9$ particles/sec).
4. The formation of a signal from the recoil nucleus detec-tor in order to include it in the logic scheme.

This work in which it has been used a wide gap spark cham-ber with a drift chamber located in the former is devoted to the experimental investigation of these problems.

The application of the spark chambers for detecting α-par-ticle stopping in the chamber's gas by using the gas scintil-lation as trigger has been suggested in 1964 by Dolgoshein et al /1/. Practically, such a method has not found application since in order to reduce the chamber loading in case of high intensity beams it is necessary to decrease memory time of the chamber up to 2-3 microsecond by introducing some electrone-gative gases into the chamber which quench the scintillation. Besides, there are some difficulties connected with light col-lection from large volumes.

In the work /2/ in the first time an α-particle detector in the form of a thin layer ($\sim 30\ \mu m$) of luminofor (ZnS) coated on one of the chamber's electrode has been placed inside the chamber's volume in order to obtain a trigger pulse from the α-particle. It has been shown the possibility of the operation of the spark chambers directly exposed to high intensity beams ($\sim 10^9$ eq. quanta per second). However, such a device does not allow to measure the range of the detected particles.

A new method of obtaining trigger pulse from α-particles and their detection in wide gap spark chamber with the help of multiwire proportional chamber has been suggested in the work /3/. This method allowed to record the stoppage of α-particles in the chamber's gas and to measure their energy by means of their range. Gas mixtures $He^4 + CO_2$(13 - 14)% · H_2O(0.1 - 0.4%) have been studied in the work.

In this paper we describe a detector in which a drift chamber /4/ has been used to trigger the spark chamber. The distance between the working planes of the drift chamber is 6-7mm. The recoil nuclei are detected by the spark chamber (Fig.1). Transparency of the drift chamber is $\sim$ 95% for α-particles.

The gas mixture filling the detecter was shosen from the requirements of detection of low energy recoil nuclei, of the reliable operation of the spark chamber and of the possibility of the small quantity electronegative gas addition. As in the work /3/ it has been chosen He^4 with various admixtures which may also serve as a target for a great number of problems in photoproduction /5/. Various gas mixtures have been studied: He^4(100)%, $He^4 + CH_4$(0.5 - 5%), $He^4 + CO_2$(0.5 - 10%), He^4 + Freon-12(0.1 -2%).

Working with pure He^4 the spark chamber's memory is $\sim$80÷100 μsec while a very "narrow" working region for the voltage of the drift chamber is obtained which requires a high stabilization for the high voltage source (Fig.2). Insignificant methan and freon admixtures improve sharply the working characteristics of the drift chamber and decrease the spark chamber's memory time. In the case of He^4+1% CH_4+0,5% freon-12 admixture we have ratio of the amplitudes from α-particle and electrons obtained $\alpha/\beta \sim 30$, the pulse from an α-particle and the spark chamber's memory time being 3 mv and 3 sec, respectively.

A photograph of the tracks of α-particles from Pu^{239} (E_α = 5,2 MeV) stopped in the gas of the spark chamber is shown in Fig.3. A diffuse luminescence arises from the end of the track up to the upper electrode while recording the stoppages in the spark chamber. The measurement of the track's length allows to determine the energy of the recoil nucleus with an accuracy $\sim$ 15% at $E_\alpha \approx$ 3 MeV. The efficiency of the detection of a recoil nuclei by the drift chamber is higher than 90%.

The loading characteristics of the detector have been studied with a γ-quanta beam at an intensity $\sim 2.10^8$ eq.quanta per second. The beam with 6 x 8mm^2 cross section passed at a distance of 2cm from the cathode of the drift chamber. The pulse amplitude spectrum from the drift chamber was recorded by a pulse height analyzer. α-particles from an uncollimated Pu^{239}source passed through a 20 micron thick mylar foil and entered into the sensitive volume of the drift chamber. The results of the measurements are given in Fig.4. In order to increase the loading a 10mm aluminium plate were placed before the detector which gave $\sim 10^7$ electron-positrom pairs per second.

It is seen from Fig.4, that for the chosen conditions the pulse height from the particles with minimal ionising power are mainly in the region of the noises of the preamplifier. Choosing an appropriate registration threshold one may suppress with 100% efficiency the background of the primary beam and detect only the recoil nuclei.

Reducing the pressure in the detector's working volume one may increase the ratio α/β as well as the range of the recoil nuclei (He^4) with kinetic energy $E_\alpha \geqslant$ 0,2 - 0,3 MeV.

A new variant of the device is constructed in which the lower electrode of the spark chamber serves as a cathode for the drift chamber and beam passes through the sensitive volume of the drift chamber (Fig.1).

In conclusion the authors want to thank A.Ts. Amatuni, V.M.Kharitonov and V.M.Kukarev for useful discussions and L.A.Jirova for the help during the study of the detector with the accelerator.

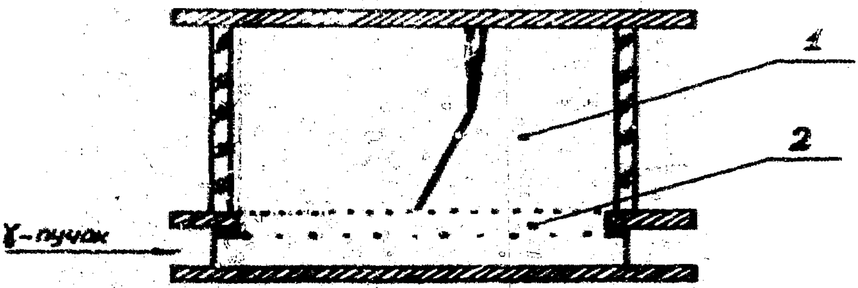

Fig.1

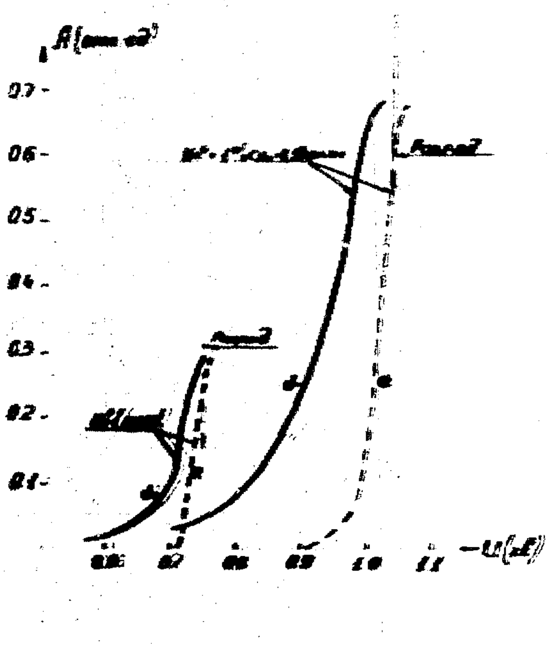

Fig.2

Fig.3

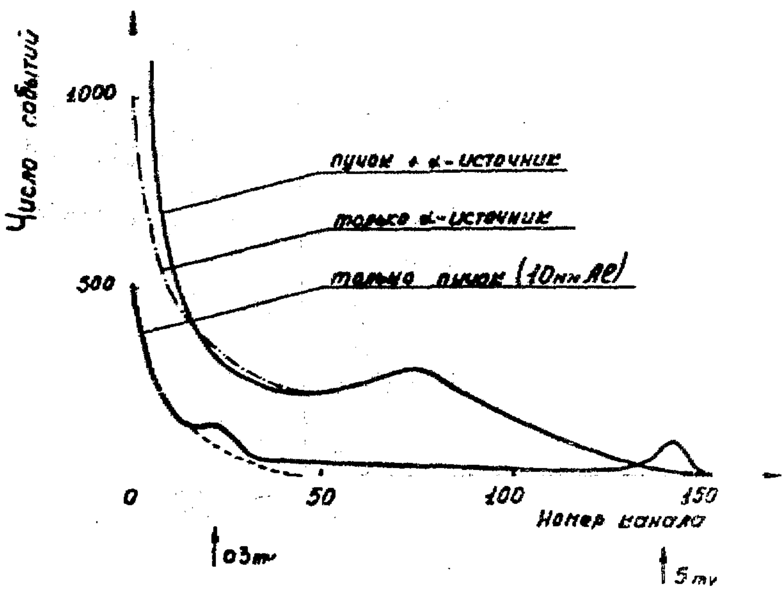
Число событий
1000
500
пучок + α-источник
только α-источник
0
50
100
150
Номер канала
5 mv

Fig. 4

Figure Captions

Fig.1. The construction of the detector for recoil nuclei.

1. Spark chamber.
2. Drift chamber.

Fig.2. The voltage dependence of the pulse heights on the signal wires of the drift chamber from α-particles and electrons for pure helium and helium with admixtures (1% CH_4+ 0,5% freon).

Fig.3. A typical photograph of the stoppage of an α-particle.

Fig.4. Pulse height spectrum from the drift chamber exposed directly to a γ-quanta beam.

REFERENCES

1. A.S.Alexanian, V.D.Bobrov, Yu.A.Batusov, B.A.Dolgoshein, B.I. Luchkov et al., Fizika Elementarnikh Chastits, Atomizdat, Moscow, p.69, 1966.
2. R.N.Pikhtelev, [illegible].A.Jireva, G.K.Bagrabian, Pribori i Tekhnika Experimenta N.5, 36 (1974)
3. F.F.[illegible]yourov, Preprint FIAN, N.52, 1974.
4. R.Astabian, V.Kukarev, G.G.Mkrtchian, R.G.Stepanov, Preprint EPI -60(74), Yerevan, 1974.
5. V.A.Tsarev, Yadernaya Fizika, 10, N.2, 367, 1969
   V.A.Tsarev, N.I.Deyon, Yu.A.Rakov, preprint FIAN, N.170, 1971.

The manuscript was received on the 26th of July 1974

Редактор Л.П.Мукаян

Заказ 0930 ВФ- 03431 Тираж 300

Подписано к печати 4/XI-74г. Формат издания 30 x 40

0,5 уч.изд.л. Ц.4 к.

Отпечатано на ротапринте

Ереванского физического института,Ереван 36, пер.Маркаряна 2