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THE FIRST EXPERIMENTS ON NUCLEAR REACTION STUDIES AT NUCLOTRON

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The first run at the new superconducting accelerator Nuclotron has been carried out in July 1993. The experiment was prepared by SPHERE and SYaO collaborations. The beam of deuterons was accelerated up to 200 MeV per nucleon. The spectra of secondary particles were measured using TOF and $\Delta E-E$ techniques. The results of this run indicate good perspectives to carry out experiments at internal target.

The investigation has been performed in the Laboratory of High Energies, JINR.

Первые эксперименты по изучению ядерных реакций на Нуклотроне

А.М.Балдин и др.

В июле 1993 года проведен первый сеанс на новом сверхпроводящем ускорителе Нуклотрон. Эксперимент подготовлен и проведен коллаборациями СФЕРА и СЯО. Пучок дейтронов был ускорен до 200 МэВ/нуклон. С помощью времяпролетной и $\Delta E-E$ методик были измерены спектры вторичных частиц. Результаты сеанса показали наличие хороших перспектив для проведения экспериментов на внутренней мишени.

Работа выполнена в Лаборатории высоких энергий ОИЯИ.

In July 1993 the LHE performed the first experimental run at the new superconducting accelerator Nuclotron. The programme of the experiments at this machine covers a wide range of problems in relativistic nuclear physics (see ref. [1]). The main goal of experimental efforts is the study of the quark-gluon degrees of freedom in nuclei.

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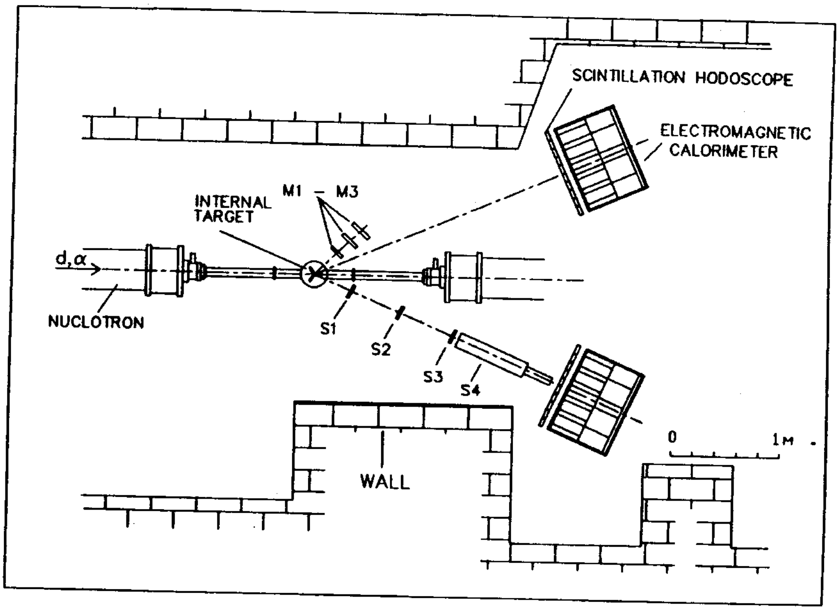

Fig.1. A schematic view of the experimental setup

In this note we report the results of the first experiment with internal target at the Dubna Nuclotron.

The experiment was prepared in the framework of SPHERE and SYaO collaborations. We measured products of interaction of a deuteron beam at the internal target. A schematic view of the setup is shown in fig.1.

The experimental arrangement includes:

— An internal target station. The station operates with polyethylene, copper and gold foils with thickness 1.57, 0.55 and 1.72 μm respectively. Relative target-beam position is controlled by means of a step motor with high precision [2].

— A beam monitoring telescope M1-M3. The telescope consists of three scintillation counters, with dimensions 3x3x0.5 cm^3, 4x4x0.5 cm^3 and 7x7x0.5 cm^3.

— Two 1x1 m^2 scintillation hodoscopes.

— 36-channel lead glass Cherenkov EM calorimeter.

— A detecting telescope. It is composed of four scintillation counters S1—S4 with dimensions of 2x2x0.5 cm^3, 3x3x0.5 cm^3, 4x4x0.5 cm^3 and 7.5x7.5x65 cm^3, respectively. The telescope axis is rotated with respect to the beam direction by 29±1°. The distance between S2 and S3 is 0.5 m, the angular acceptance is about 10^{-3} sr.

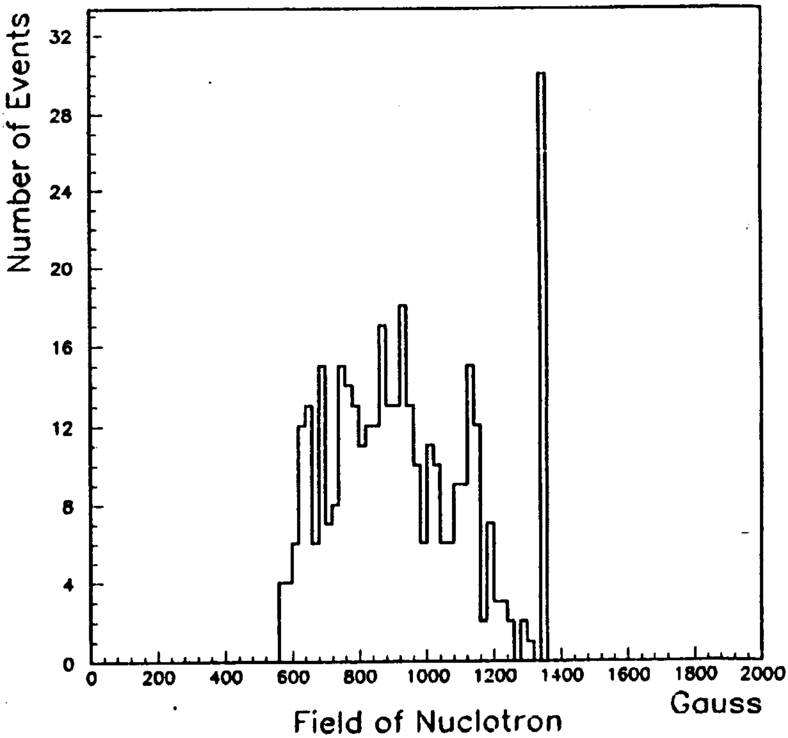

Fig.2. An example of a beam spill of NUCLOTRON at internal target

The power supply of detectors was provided by means of the special high voltage power subsystem [3].

4200 triggers were recorded on polyethylene and empty targets. The statistics of events on copper and gold targets is very small due to a dramatic decrease in the primary beam lifetime for targets with large atomic weight, A. The measurements were taken on increasing the magnetic field of the accelerator at the maximum beam energy 100 and 200 MeV per nucleon. The intensity of the primary beam was $(2\div3)\cdot10^9$ deuterons per spill. An example of a beam spill is shown in fig.2. The rate of beam interactions as a function of magnetic field of the accelerator is presented here.

Secondary particle identification is performed using the TOF information between S2—S3, ΔE-energy loss in S2 and total energy loss in S4. Fig.3 presents the measured $\Delta E-E$ spectrum of secondary particles emitted in the collisions of deuteron beam with polyethylene target. Each event contains two kinematic characteristics for a secondary particle — velocity and kinetic energy, therefore we can reconstruct the mass containment of secondaries. The mass distribution for the first run with the

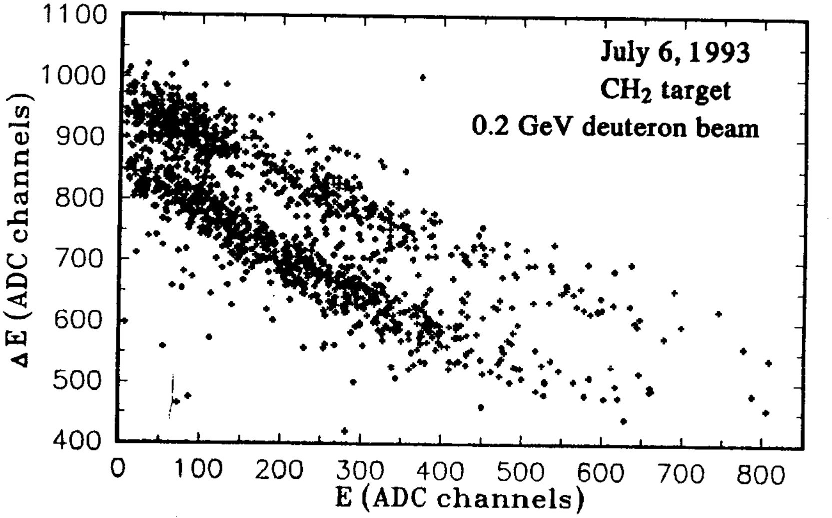

Fig.3. $\Delta E - E$-spectrum of secondary particles on internal target of the Nuclotron

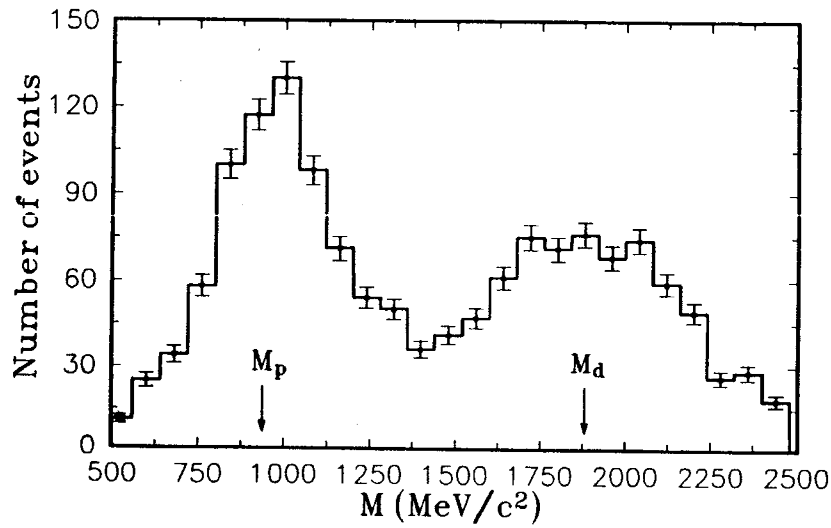

Fig.4. Mass distribution of secondaries

beam energy 100 MeV per nucleon is presented in fig.4. Secondary protons and scattered deuterons are identified in a quite reliable way. Fig.5 shows the experimental spectra for protons and deuterons. The detection thresholds were approximately 25 MeV for protons and 38 MeV for deuterons.

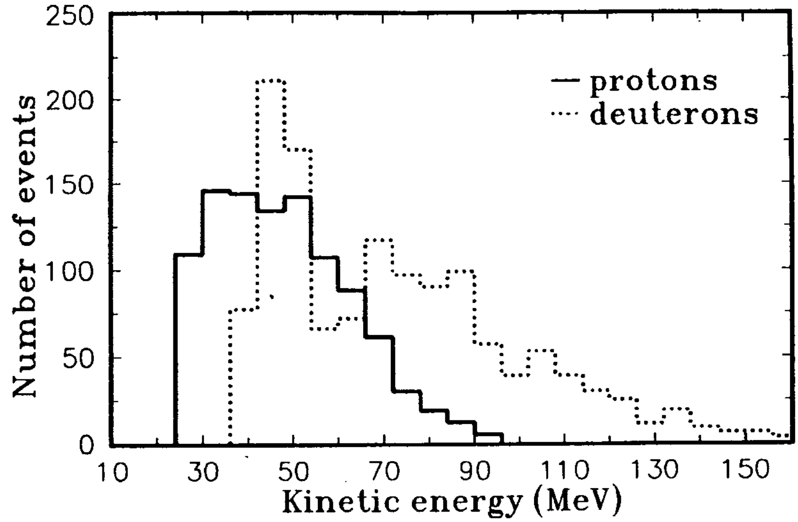

Fig.5. Energy spectra of secondaries

We conclude that homogeneous interactions of an internal beam with a thin target are available now at Nuclotron. This indicates also at the possibility of carrying out future experiments at internal targets simultaneously with the active beam extraction facility.

References

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