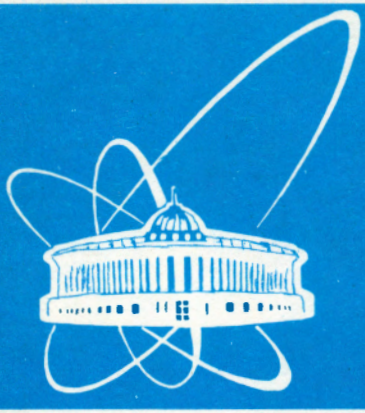

СООБЩЕНИЯ
ОБЪЕДИНЕННОГО
ИНСТИТУТА
ЯДЕРНЫХ
ИССЛЕДОВАНИЙ

Дубна

E13-98-269

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CONSTRUCTION AND PRELIMINARY TESTS OF THE LARGE AREA PROTOTYPE FOR THE COMPASS TRACKER

1998

1. Introduction

Large Area Tracker (LAT) of the COMPASS spectrometer should consist of various types of coordinate chambers having different sizes up to 3.5 x 2.5 m^2. A good lifetime of wire chambers and a good spatial resolution of drift chambers for timing from the first electron allow one to consider a straw chamber as a preferential chamber for LAT .

To check the technology of the chamber manufacturing, we have designed and constructed a straw chamber prototype to investigate the test beam. Physical-technical parameters of the prototype were agreed with prof. M. Faessler and his colleagues.

II. Design

The prototype was designed as a flat straw chamber, consisting of two straw layers in the united frame of aluminium-carbon tubes . The sensitive area of the prototype was 2.4x1.2 m^2. The central part of each straw layer consists of the straws 6 mm in diameter, left and right hand external parts consist of the straws 9.5 mm in diameter. The displacement between the straw centers for the first and second layers was equal to the straw radius. The square of 200x200 mm^2 in the central part of each layer was insensitive for particles. The straw length was 2.4 m. Fig. 1 shows the scheme of the prototype.

III. Construction

The straws manufactured by a specialized machine consist of two layers of kapton film strips wound spirally on the mandrel /1/. The straws are similar to the ATLAS TRT straws /2/, but inner diameters are 6.03 ± 5 μm or $9.50 \pm 5 \mu$m. The wall thickness is 85 μm and the surface resistivity of the coating 1.6 Ohm/square. These straws have remarkably uniform tolerances. The straws in each layer are glued together onto the high tolerance table and after are reinforced by a carbon wire (fig. 2). To exclude the influence of humidity for the prototype, each plane of the straws is coated with a thin layer of epoxy resin on both sides. During these procedures the inner volume of each straw is filled with elements of high precision diameter.

The straw planes have been tightly glued between two aluminium bars of the frame.

The 30 μm gold-tungsten anode wire is drawn through the plexiglas spacers with central holes 80 μm in diameter, then they are glued together by epoxy resin. The wires prepared this way were installed into the straw with two end-plugs and crimped to both ends of the straw. The wire tension was 55 g. The distance between spacers was 80 cm.

The chamber consists of 124 straws, each 9.5 mm in diameter, and 194 straws, each 6.0 mm in diameter. The 20x20 cm^2 central zone of the chamber is insensitive to the particles. To achieve this, we have additionally installed the mylar tubes, 20 cm long and diameter of 4 mm, into these straws /1/. The thickness of the insensitive zone of the prototype is about 0.15 % of the value X_0.

The motherboards for the consistency of the straws and for the readout of the signals have been placed into the top and bottom of inner volumes of the Al parts of the frame. These volumes are used for the gas flow of the straws.

The electrical scheme of the chamber is shown in fig. 3.

Figure 4 shows the prototype under construction.

IV. Preliminary Tests

The prototype tests have been carried out during assembly with good results on the alignment of the straws and the wire tension. The difference between the designed and measured width of the straw planes for any points is less than 0.2 %, were practically identical for the top and bottom of the planes. Fig. 5 shows the wire tension distribution for the 10 mm straws.

The total gas volume of the straws is 36.538 cm^3, the total gas volume of the prototype is 42.540 cm^3. The test has shown that the gas leakage of the prototype is less than 5 cm^3 per min.

The prototype has been tested by the ^{55}Fe-source before its transportation to CERN for the test-beam investigation.

Fig. 6 shows that the signal amplitudes along the straws are reduced by factor 2. The tests have shown good uniformity of the gas gain value for the straws. The measurements of the crosstalks between any neighbouring channels of the chamber are less than 2 %.

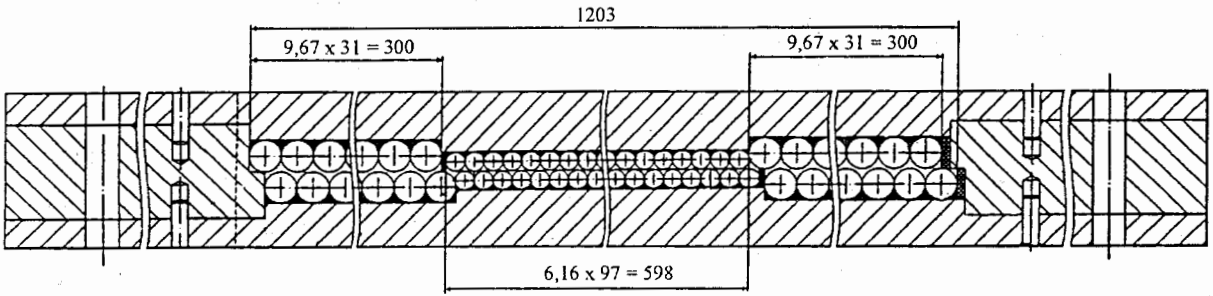

Fig. 1. The prototype scheme.

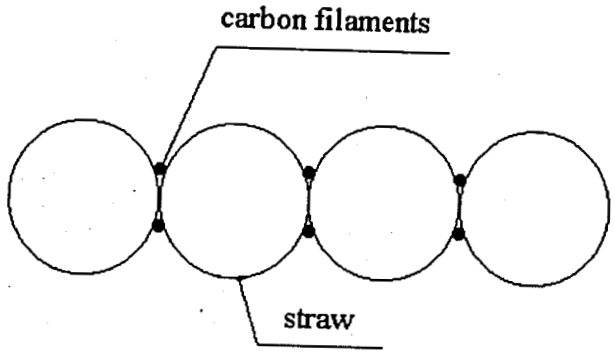

Fig. 2. Straws fitting and reinforcing of the plane.

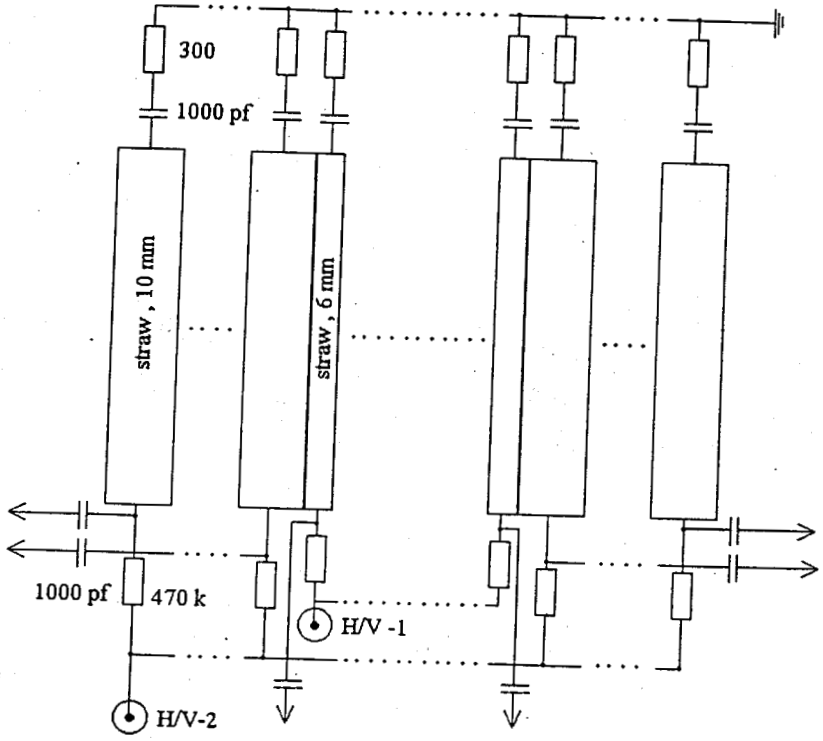

Fig. 3. Scheme of the electrical circuit of the prototype.

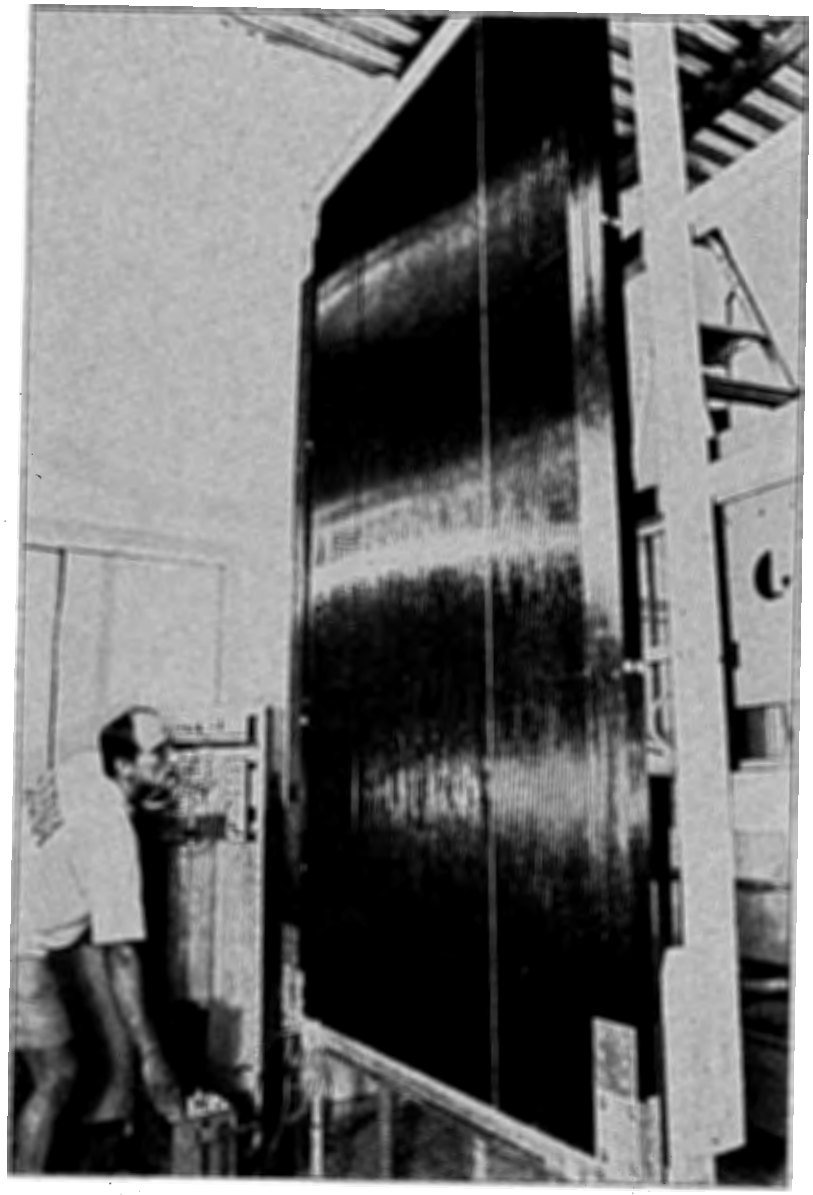

Fig. 4. Common view of the prototype.

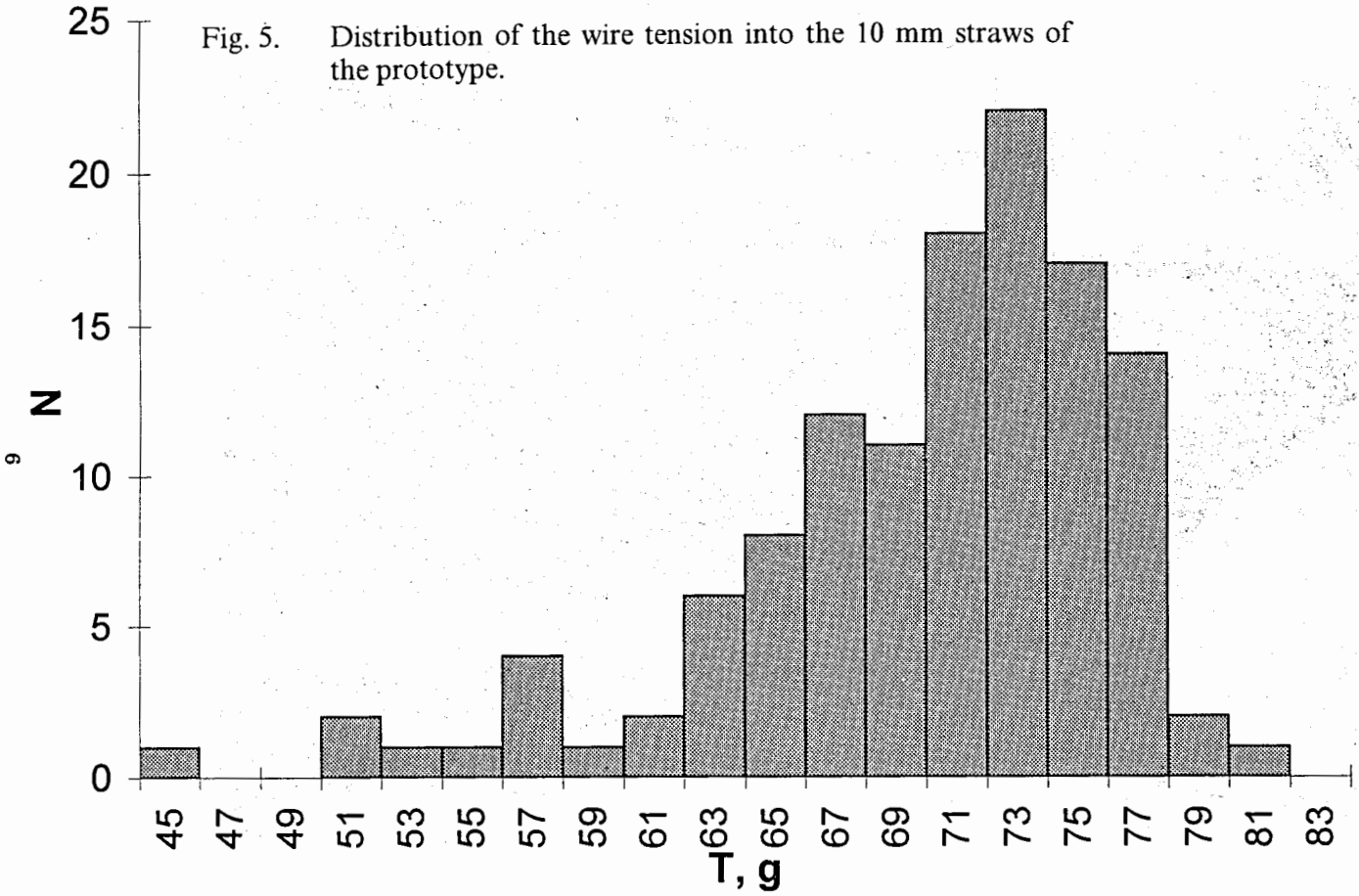

Fig. 5. Distribution of the wire tension into the 10 mm straws of the prototype.

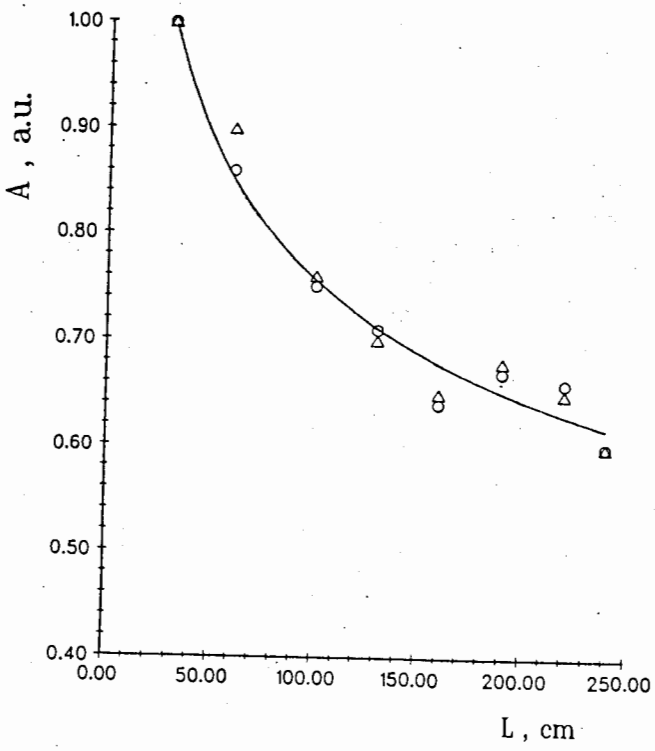

Fig. 6. Ratio of anode amplitudes vs the position of the ^{55}Fe-source along the straw.
(o) – straws with 10 mm in diameter;
(Δ) – straws with 6 mm in diameter.

V. Conclusions

We have a 2.4 m long, 318 straws prototype using a special assembly method to align the straws throught. We conclude that the technique of constructing a high precision coordinate chamber with very long straws completely meet the requirements of our experiment for a wide range of tracking applications in high radiation environment.

References

1. V.N. Bytchkov et al., E13-98-209, 1998
2. T. Akesson, V. Bondarenko, V. Bytchkov et al., CERN-PPE/94-224, Dec. 1994

Received by Publishing Department
on September 25, 1998.

Бычков В.Н. и др. E13-98-269

Изготовление и предварительные испытания детектора большой площади для трекера COMPASS

Показаны конструкция и результаты испытаний прототипа трекера на основе тонкостенных дрейфовых трубок. Размер рабочей поверхности прототипа 2,4 × 1,2 м. При изготовлении трекера использовались современные конструкционные материалы (композиты) и интересные технологические решения. Тестирование прототипа показало хорошую работоспособность конструкции и ее пригодность для широкой области трековых экспериментов в различных условиях.

Работа выполнена в Лаборатории сверхвысоких энергий ОИЯИ.

Сообщение Объединенного института ядерных исследований. Дубна, 1998

Bytchkov V.N. et al. E13-98-269

Construction and Preliminary Tests of the Large Area Prototype for the COMPASS Tracker

The construction of the tracker prototype based on the straw drift tubes and results of its testing are shown. The size of the working surface of the prototype is 2.4 × 1.2 m. While manufacturing the tracker, construction materials advanced (composides) and original technological solutions have been used.

The investigation has been performed at the Laboratory of Particle Physics, JINR.

Communication of the Joint Institute for Nuclear Research. Dubna, 1998