THE MAGNETIC FIELD MEASURING OF THE EXCHARM SPECTROMETER

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Abstract

The Excharm facilities are used to study the production and decay of charmed particles and search for exotic hadron states. It is placed in a neutron channel of the accelerator U-70 (IHEP, Protvino). The electromagnet of the spectrometer has the following external dimensions: 450 x 323 x 305 cm^3 . The magnetic field was measured by the Hall Three-Channels Magnetometer in automatic regime on line PC. The working area of the measurements was 240 x 32 x 378 cm^3 . The report presents the description of the measuring devices and procedure. The results of the measurements and their precision are discussed in the paper.

1 THE BLOCK-DIAGRAM OF MEASUREMENT DEVICES

The magnetic field was measured by the Hall Three-Channels Magnetometer (M3H)[1] in automatic regime on line PC. The bloc diagram a measurements of the magnetic fields of the EXCHARM is shown in fig.1.

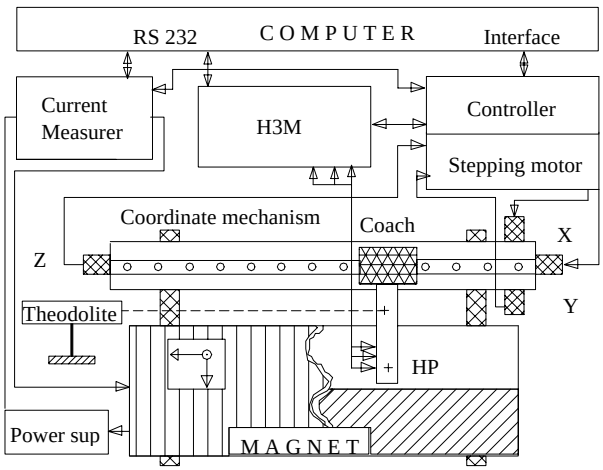

Figure1: Block-diagram of magnetic field measuring.

The magnetometer allowed us to measure the distribution of three components of any magnetic field at the same time by means of three independent measurement channels. The probes with Hall sensors were based in a special head and connected with apparatuses by cable of 5 meters long. The exit of measurement devices was connected by means of cable 15 meters long on line PC, which was based out of the neutron channel in a specialized measurement room. The data of the magnetic field were checked up and fixed on the magnetic disk of PC. The magnetometer allowed to measure magnetic fields in the range from 0 till 2 T (in 3 subranges), with maximum possible sensitivity less than 0.13 Gs. The precision of the magnetic field measurement was better than - ± 0.02% from the maximum range .

The data about the magnet current were fixed on the central desk and then - in the journal of working measurements. The stable of the magnet current in the time of magnetic measurements was better than 0.01% .

2 MECHANICAL EQUIPMENT FOR MAGNET MEASUREMENT

The head with three sensors was moved by means of a special coordinate mechanism (fig.2).

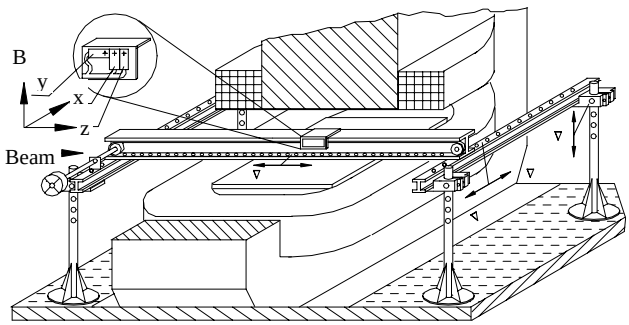

Figure2: Coordinate mechanism for magnet measurement of the Excharm spectrometer.

Two duralumin beams of the I-beam type 3.5 m long were bolted on 4 stationary handholds outside of the magnet and could be shifted along the height (Y) by 480 mm. Duralumin beam 4.3 m long was bolted on the upper developed surfaces of these beams and could be shifted across the magnet (X) by 2400 mm. A coach with its sensors was rolled on the upper processed surfaces of this beam along the magnet (Z). Perforatoring tape from stainless steel ensured a displacement of the coach in the range of 3910 mm with the accuracy not worse than 0.1 mm. A design of the coach allowed to bolt a head with HP in two extreme positions that provided the maximum

approach (of 5 mm) of the sensors to the poles of the magnet. Testing the coordinate mechanism and its connecting to the reference axises of the measuring magnet was realized by means of precision geodetic devices. The accuracy of the ties between the coordinate mechanism and the axises of the magnet was 0.2mm. A deviation was ±1mm from the line when the coach was moving along axis Z by 3910 mm. Probes with HP were bolted on the head so that X1=X2=X3, Y1=Y=Y3, Z1=Z2-10mm=Z3-20mm.

3 THE RESULTS OF MAGNETIC FIELD MEASUREMENT OF SPECTROMETER

Process of magnetic field measurement comprised the following main stages:

1. The magnetic field stability of electromagnet was checked under the nominal mode. The magnetic field measurement was done in one point with statistics 50 calculating square-average mistake. This mistake was not more then 0.02% (from the maximum subrange).
2. The detailed map of the magnetic field vector (60.000 points) under the nominal mode in 9 planes on the height of the magnet was measured. Measurements of the Bx and Bz on the background of greater components By could result in serious mistakes if the HP sensitive plane is not parallel to the main component (By) while measuring transverse components (Bx, By). Taking into account this mistake, a probe with HP was tested in the uniform field (up to 0.001%/cm) of a magnet test rig when the base plane of the probe was parallel to the field vector B. Then probes were fixed on the head and the control was repeated for all the assembly in the whole. The test has shown that the contribution of the basic component (1.6T) was 2-3 Gs, when HP was parallel to this component. The final correction of the results measuring transverse components Bx and Bz, was conducted when the coach was installed on the maximally uniform part of the magnetic field, where Bx = Bz = 0, but By = Bmax. Possible mistakes were calculated by the program method because of the mistakes in the assembly and in the result of the deviation of the coordinate mechanism as a whole when the transverse components were measured.
3. Determination of repeatability of the magnetic field vector under the frequent change of the current feeding the electromagnet was done. It was 0.1%.
4. Measurement card of the magnetic field vector under the change of the current sign of the electromagnet feeding in 9 planes on the height of magnet was done. Mode of the magnet degaussing was used by this change. The value of the magnetic field under the changed sign of the feeding current of the electromagnet differed from the value of the magnetic field under the nominal mode by 0.3%. A detailed magnetic field card was measured to eliminate this mistake (up to 0.025%) after changing the current sign.
5. The HP were installed stationary for the magnetic field monitoring in the process of the experiment in the magnet gap. The calibration of this sensor in the process of magnetic measurements under the main modes was done.

CONCLUSION

The basic parameters of the measurement device have the following characteristics:

1.The quantity of independent measurement channels - 3.
2.The range of magnetic field measurements - 0 - 2 T.
3.The precision of magnetic field measurements - ± 0.02%.
4.The working area of probes moving :
- along axis Z - 3910mm,
- along axis X - 2400mm,
- along axis Y - 480mm.

5.The precision of installing the sensors on axises Z,X,Y - 0.1 mm.

REFERENCES

[1] V.K.Makoveev. Hall Three-Channels Magnetometer (H3M). Proceedings of the 9th International Magnet Measurement Workshope IMMW-9, vol.2, Sacley, 1995.