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MODELLING OF THE NEW FLNR MAGNETIC ANALYSER VACUUM CHANNEL

1998

The new magnetic analyser for the FLNR U-400M cyclotron have a Q3D configuration [1] (not to be confused with the famous Q3D spectrometer of H. Enge [2]). The quality of any magnetic analyser directly depends on the area of radial cross-section of its volume filled with the ions trajectories [3]. The correct correlation of the aperture of the vacuum channel with durability, engineering and ease of handling characteristics combined with ion-optical properties of spectrometer determines its construction in the whole.

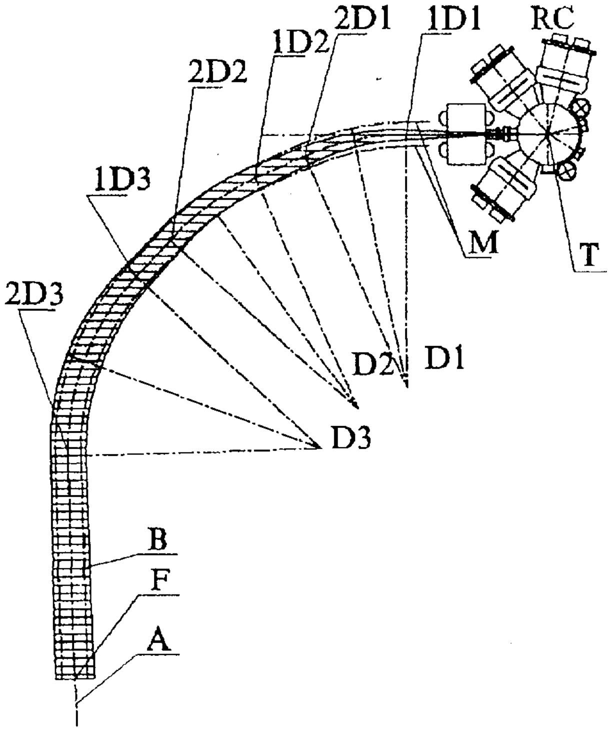

Fig.1 The preliminary ions trajectory

The conception of new magnetic spectrometer vacuum channel is based on computer modelling of the maximum filling of the spectrometer acceptance with given pole pieces width and the gap height of the magnetic dipoles together with the maximum transmission of undeflected in magnetic field emission from the target at the angle of measurements.

Accepting the main path of ions trajectory (Fig.1) as the axis of the spectrometer vacuum channel - the line "A", and the lines "M" as the pole pieces width, then the spectrometer horizontal acceptance

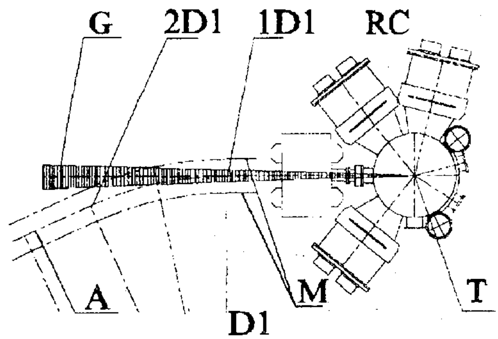

Fig.2 The plot of neutrons trajectories

filling is emulated as hatched area "B" visible after target "T" placed in the reaction chamber "RC". Calculated values are defined according to the input ("1D1", "1D2", "1D3") and output ("2D1", "2D2", "2D3") edges of poles, correspondingly of the first "D1", the second "D2" and the third "D3" dipoles. The point "F" marks the valve chamber input. The valve chamber and the focal plane detector form the last section of

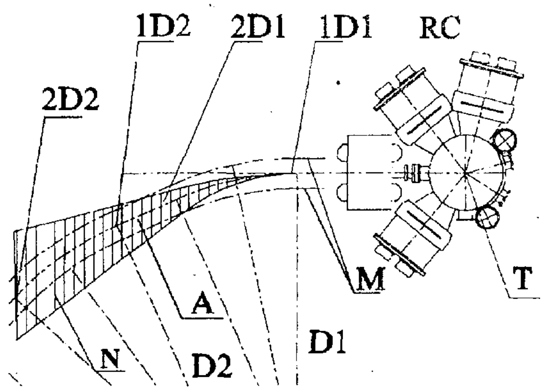

Fig.3 The +/- 60% limits of the beam trajectory change

the spectrometer channel.

The hatched area "G" (Fig.2) emulates the acceptance of underfected in magnetic field trajectories at angle of measurements, that is limited by the aperture of the first magnet "D1".

The boundaries of the +/- 60% change of the primary beam deflection on response to the reference trajectory at very forward angles of measurements - area "N" (Fig.3) advance the special demands for section between the first and the second magnets.

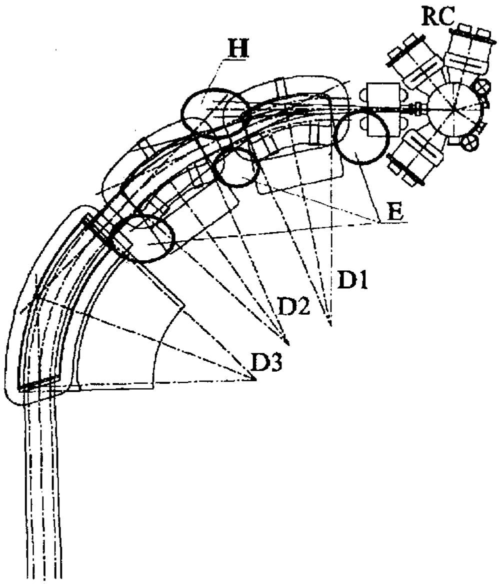

Fig.4 The composed model of spectrometer

The computer modelling of the above-mentioned parameters (Fig.1-3) determines the main, but non-sufficient characteristics for design conception and, in particular, for the vacuum channel design. Only combination of the emulated areas with models of magnets (Fig.4) allows to define the optimum location of the vacuum channel, available places for diagnostic devices installation and uncomfortable for service sections "E". The crossing of the neutron trajectory and axis for the dipoles alignment - area "H", complicates the assembling of research and service devices at this part of channel.

The geometric parameters of the first and the second magnets are similar and this circumstance allows to design this part of the vacuum channel inside of the magnets as a common chamber. But the fabrication tolerance must be on the +/- 0,5 mm level at the main path of the ions trajectory that complicates the manufacturing of the vacuum channel. In this case the spectrometer channel (Fig.5) must consist of separable vacuum chambers ("K1", "K2", "K3"), according to the magnets number, and drift chamber ("K4") between the third dipole and the valve chamber with focal plane detector "FD". It's worth to say, due to the lack of space for the bellow between the first "K1" and the second "K2" chambers the use of the rigid compensator seems more reasonable.

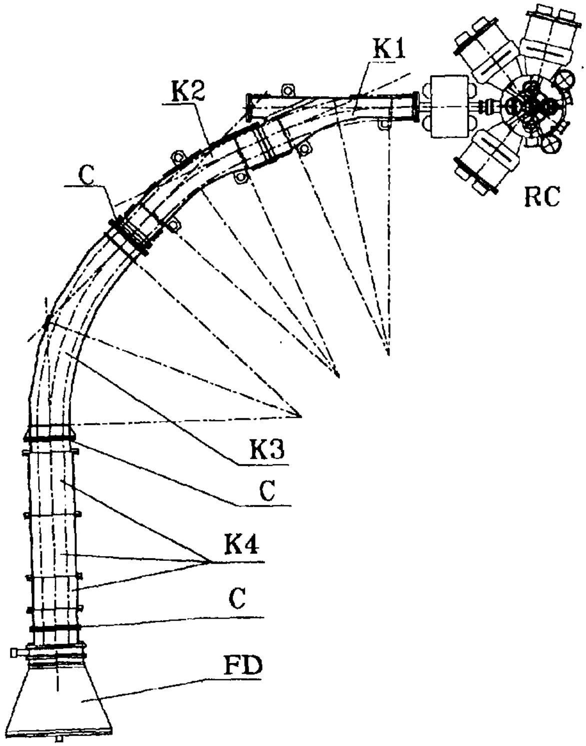

Fig.5 The plot of the vacuum chamber of Q3D spectrometer

The rectangle bellows "C" could be used for compensation of the manufacturing and assembling deviations between components of the vacuum channel.

The spectrometer vacuum components were designed for the operation in the vacuum of 10^{-7} Torr and must be manufactured of the non-magnetic stainless steel.

Computer modelling of described characteristics of the vacuum channel were performed on SUNSPARCstation [4] in the AutoCAD environment [5]. For emulations of the ion trajectories in the spectrometer authors have used the TRANSPORT computing code [6].

REFERENCES

1. Yu.E. Penionzhkevich et al., "FLNR Scientific Report 1995-1996", Dubna, 1997, p.201

2. Harald A. Enge, Nucl. Instr. and Meth. A162 (1979) p.161 and elsewere

3. H. Wollnik, Nucl. Instr. and Meth. A95(1971) p.453

4. Sun Microsystems Inc. Site, http://www.sun.com

5. AutoCAD Reference Manual, AutoDesk, June 1992

6. K.L. Browne, D.C.Carey, Ch.F.Iselin, F. Rothacker, CERN Report 80-04, 1980

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on March 6, 1998.

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Моделирование вакуумного канала нового магнитного анализатора Лаборатории ядерных реакций им. Г.Н.Флерова

С помощью компьютерной графики проведен анализ основных параметров вакуумного канала, непосредственно влияющих на качество нового магнитного анализатора. Концепция вакуумного канала базируется на моделировании максимального заполнения аксептанса анализатора с учетом технологичности изготовления, прочностных характеристик элементов канала и эргономичности при эксплуатации анализатора. Результаты моделирования легли в основу разработки технической документации.

Работа выполнена в Лаборатории ядерных реакций им. Г.Н.Флерова ОИЯИ.

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Modelling of the New FLNR Magnetic Analyser Vacuum Channel

The quality of any magnetic analyser directly depends on the area of radial cross section of its volume filled with the ions trajectories. The conception of new magnetic spectrometer vacuum channel is based on computer modelling of the maximum filling of the spectrometer acceptance with given pole pieces width and the gap height of the magnetic dipoles together with the maximum transmission of underflected in magnetic field emission from the target at the angle of measurements. The correct correlation of the aperture of the vacuum channel with durability, engineering and ease of handling characteristics combined with ion-optical properties of spectrometer determines its construction in the whole.

The investigation has been performed at the Flerov Laboratory of Nuclear Reactions, JINR.

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