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ON A POSSIBILITY OF SOLVING RIGHT-LEFT AMBIGUITY UNDER DETERMINATION OF CHARGE PARTICLES COORDINATES IN THE MULTIPOLAR DRIFT CHAMBER

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Abstract

Kulman N.Yu., Victorov V.A. On a possibility of solving right-left ambiguity under determination of charge particles coordinates in the multipolar drift chamber.: IHEP Preprint 95-145. – Protvino, 1995. – p.5 , figs. 5, refs.: 2.

The scheme of the multipolar drift chamber (MDC) is considered . Computer simulation results of the electric field in the MDC cell are presented. Calculations have been carried out to optimize the main chamber parameters.

Аннотация

Викторов В.А., Кульман Н.Ю. О возможности разрешения право-левой неоднозначности при определении координат ионизирующих частиц в многополюсной дрейфовой камере: Препринт ИФВЭ 95-145. – Протвино, 1995. – 5 с., 5 рис., библиогр.: 2.

В работе рассмотрена схема многополюсной дрейфовой камеры (МДК). Представлены результаты моделирования на ЭВМ электрического поля в ячейке МДК. Расчеты проведены с целью оптимизации основных параметров камеры.

Multipolar Proportional Chambers were successfully used at the SPHINX setup of the IHEP accelerator for 1987-1993. During a long time exposition (more than 100 days) the stability of their characteristics and some advantages of such electrodes structure [1] in comparison with a conventional proportional chamber was experimentally confirmed.

A possibility of the multipolar chamber application to measure ionization electrons drift times and to solve right-left ambiguity while determining charge particles coordinates has been considered. With this aim the initial wires structure (Fig.1) was insignificantly changed. Namely, the number of potential wires (marked with crosses on Fig.1) was increased in order to screen the periphery region of the cell from the nearest anode wire, so that ionization electrons drift to the removed anode wire.

Thus, when a charged particle crosses such wire structure, there will appear a twin cluster with a probability close to unity. It should be expected that a varied curvature of force lines and electric field non-uniformity in the periphery region will result in a considerable nonlinearity of the MDC space-time characteristic. Taking this into account one may determine the charge particle coordinate by "early" impulse with drift time $t \leq S/2v$. The "late" impulse from the other anode wire in the time interval $S/2v < t \leq d/v$ will be used as a sign for solving right-left ambiguity, where v is a drift velocity, d is a maximum drift path. Thus it is possible to except out of calculations the region with considerable nonlinearity of the space-time relation and it will improve the accuracy of charge particles coordinates determination.

Following from these assumptions the numerical simulation of electric field in the MDC cell was carried out. Using the program GARFIELD [2] variants with three, five and more potential wires were calculated. Calculations were carried out under the following initial parameters: $S = 4/3L, H/L = 2/3$, anode wires diameter of 0.02 mm, potential wires diameter of 0.1mm, cathodes and potential wires potential is — 1, anode wires potential — 0. Calculational results are presented on Fig.2,3. As one can see from figures a full screening of the periphery region from the nearest anode wire is reached with five potential wires (Fig.3). Variations of the parameter H showed that the optimum relation was $H/L = 2/3$. When decreasing this relation the shape of force lines is getting worse. For $H/L = 1/3$ the net becomes transparent even for nine potential wires (Fig.4) and a probability of the twin cluster registration will be far less than unity.

In Fig.5 the calculated dependence of ionization electrons drift time for methane on charge particle coordinate x for the concrete geometry: $S = 16$mm, $H/L = 2/3$ and under high voltage tension 4000 V is shown. The dependence of $x = x(t)$ in the interval $|x| \leq S/2$ is nearly linear. It permits to assume that the contribution into coordinate accuracy, because of nonlinearity $x(t)$, won't be considerable.

In conclusion it should be noted that the main MDC quality is the possibility to solve right-left ambiguity under determination of particles coordinates with single coordinate plane. The computer simulation permitted to optimize the main parameters of the chamber.

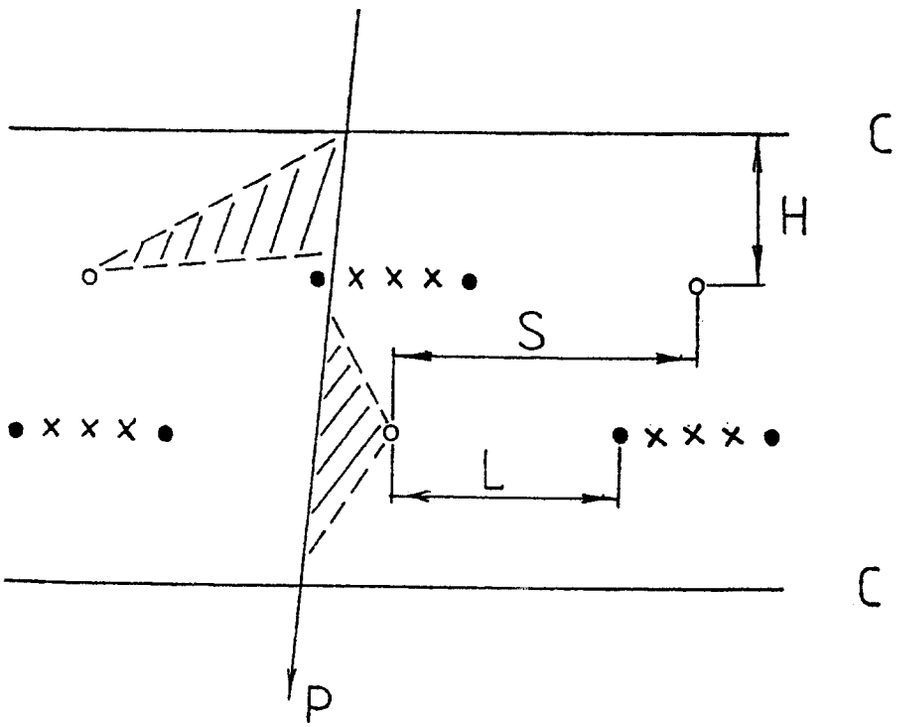

Fig. 1. MDC electrodes structure. o — anode wires; •, × — potential wires; C — cathodes; P — an ionization particle; S — the anode wires step; L — the distance between anode and potential wires in the layer; H — the distance between layers.

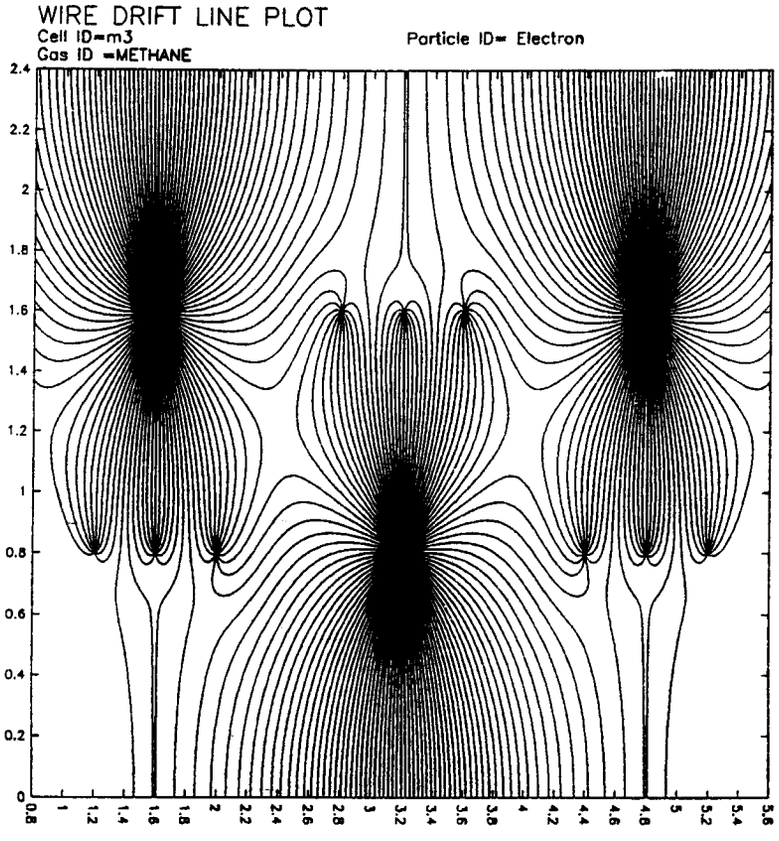

Fig. 2. The electric field shape in the MDC cell with three potential wires.

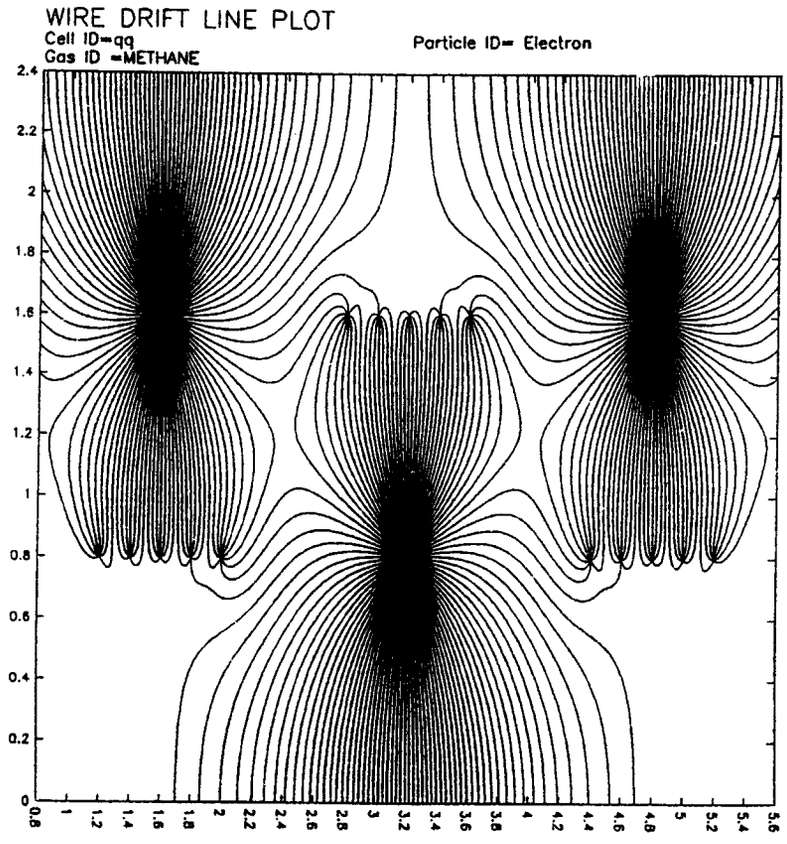

Fig. 3. The electric field shape in the MDC cell with five potential wires.

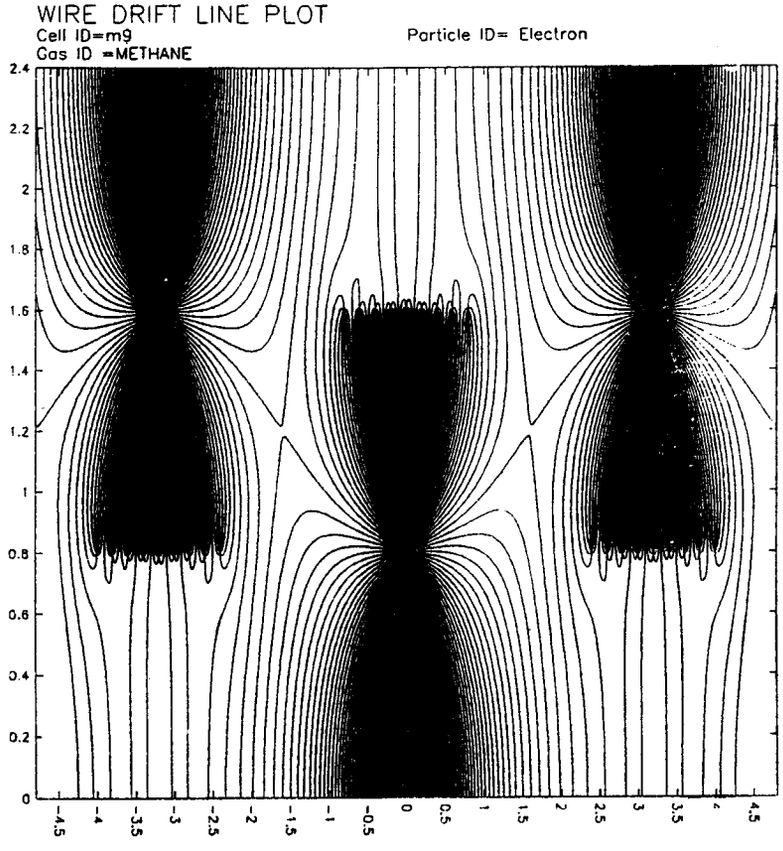

Fig. 4. The electric field shape in the MDC cell with nine potential wires. H/L=1/3.

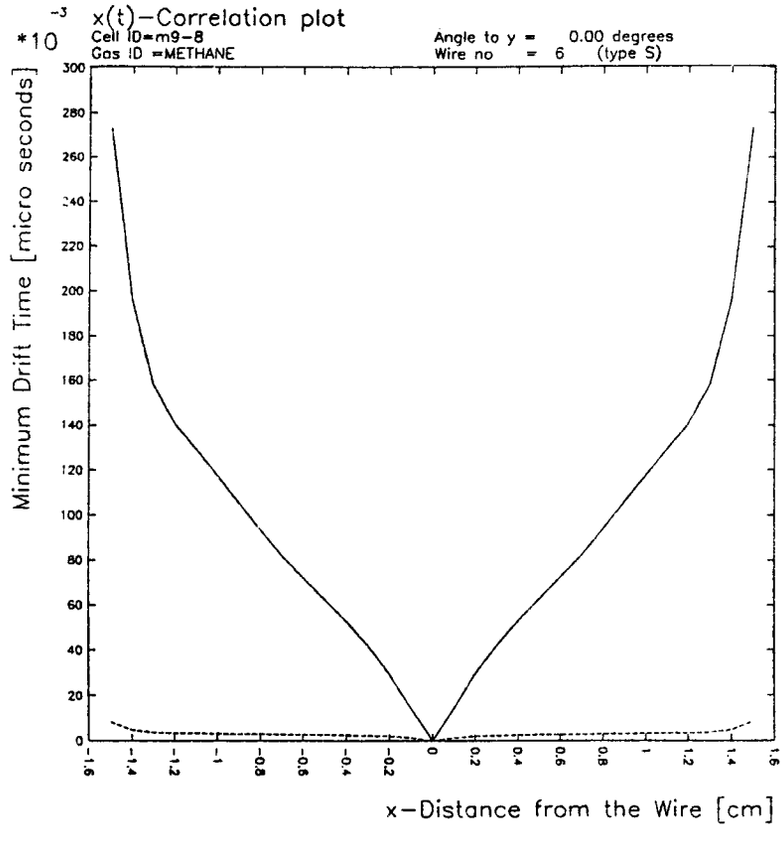

Fig. 5. The MDC space-time characteristic for methane.

References

[1] Victorov V.A. — Preprint IHEP 91-147, Protvino, 1991.

[2] Veenhof R. GARFIELD, a Drift Chamber Simulation Program. GARFIELD Manual. — May 31, 1990, CERN.

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