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RECONSTRUCTION
OF THE DRIFT CHARACTERISTIC
BY THE INTEGRAL EQUATION

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1 Introduction

Among the well-known methods of determination of the "drift distance - drift time" relation (the $R(t)$ function) one can point out two, which are based on measured drift times alone(so-called "Autocalibration"): integral analysis of the drift times spectra [1]; iterative determination of $R(t)$ by trajectories (starting with some initial $R_1(t)$, the trajectory parameters are reconstructed that allows one to get "the" coordinate versus the drift time" correlation, subsequent statistical averaging of that correlation gives new approach of $R(t)$ and so on) (see for example ref.[2]).

Classical integral analysis supposes, however, the uniformity in the distribution of the track coordinate along the drift gap, symmetrical filling up of the time spectrum from both sides of the anode wire ("left-right ambiguity"), steady efficiency along the drift gap. Those problems are eliminated in the determination of $R(t)$ by trajectories, yet the success of this second method (number of iterations and convergence) depends mainly on the initial approach in $R(t)$. Moreover, to be logically justified this method has no clear mathematical structure and therefore is hardly controlled.

This work is devoted to specific unification of both methods in a mathematical task, which is based on analytical representation of "Chi-square" (χ^2) at the point of the minimum in the space of the trajectory parameters (χ_{min}^2) [3]. An analytical expression of χ_{min}^2 was only found for a straight trajectory and for a parabola (an approximation of the trajectory in the magnetic field), because for other types of curves this step is very straitened due to complicated mathematical transformations. The χ_{min}^2 includes both the fact of the existing of the trajectory (not random hits) and specific spectra of the drift times. Considered as a functional, the χ_{min}^2 allows one to determine both $R(t)$ and $V(t)$ (the drift velocity versus the drift time) as a solutions of the Fredholm integral equations of the first type.

In the present paper only the single track events are analyzed. All the solutions are related exactly to detectors with planar drift, but are also suitable for the drift tubes (radial drift). The problems are considered for straight trajectories in detail and statements for parabolas are given briefly.

2 Definitions

In the coordinate system $X(Z)$ the anode wires are placed at $Z = Z_n$ and $X = P_n$ ($n = 1, \dots, N$; N is the total number of wires hit by the track). Trajectories are defined as:

$$x(z) = Az + B \quad (1)$$

for the straight ones and

$$x(z) = Az^2 + Bz + C. \quad (2)$$

for parabolas. The registered drift time (t_n) is related to the track position (x_n) by:

$$x_n = P_n + s_n R(t_n), \quad (3)$$

where $s_n = \pm 1$ is the sign of the drift direction. Here $R(t)$ is "transmissive" or "calibration" function. A typical geometry of anode wires and designations are shown in Fig.1.

The next definitions will be also used: the mean value of a variable y is defined as

$$\bar{y} = \frac{1}{N} \sum_{n=1}^N y_n; \quad (4)$$

Fig.1 Typical check-order geometry of sensitive wires (marked by cross). The dashed line shows the direction of the drift electrons, $s = \pm 1$ is the sign of the direction.

the coordinate information will be interpreted in some cases in the vector form:

$$\vec{Z} \equiv \{z_n\}, \vec{X} \equiv \{x_n\}, \vec{U} \equiv \{z_n - \bar{z}\}, \vec{W} \equiv \{(z_n - \bar{z})^2\}, \vec{E} \equiv \{1\}. \quad (5)$$

The identity matrix $\hat{I}$ is defined as follows

$$I_{mn} \equiv \delta_{mn} = \begin{cases} 1 & \text{if } m=n \\ 0 & \text{otherwise.} \end{cases} \quad (6)$$

3 Analytical form of minimal Chi-square

The task of finding of the parameters of trajectories(1,2) by the least square method, i.e. the minimization by A, B (for straight line, for instance) of

$$\chi^2(A, B) = \sum_{n=1}^N (Az_n + B - x_n)^2 \sigma_n^{-2} \quad (7)$$

(σ_n is the spatial accuracy parameter of a chamber)

is more than well known: these A, B are determined by the system of linear equations, then A, B are used again in (7) and the numerical value of $\chi^2_{min}(A, B)$ determines the track quality. The analysis is usually finished at this last step.

It is, however, possible to get directly an analytical expression of $\chi^2_{min}(A, B)$ [3]. For straight tracks, in particular, the recipe for getting the analytical view of $\chi^2(A, B)$ consists of few steps: solutions of the linear system mentioned above can be expressed as

$$A = \sum_{n=1}^N a_n x_n, \quad B = \sum_{n=1}^N b_n x_n, \quad (8)$$

where

$$a_n \equiv \frac{z_n - \bar{z}}{ND}, \quad b_n \equiv \frac{D - \bar{z}(z_n - \bar{z})}{ND}, \quad D \equiv \bar{z}^2 - \bar{z}^2. \quad (9)$$

The parameter of accuracy σ_n is omitted in definitions (8,9) because the accuracy of the drift detectors is determined statistically and for one particular track its value can be supposed to be a constant (general case of

$\sigma_n \neq \text{constant}(n)$ was considered in [4]). Then expressions (8) are used again in the definition (7) and after some simplification one has an analytical expression of χ_{min}^2 :

$$\chi_{min}^2 = \sum_{m=1}^N \sum_{n=1}^N x_m C_{mn} x_n \quad (10)$$

or in the matrix view

$$\chi_{min}^2 = \vec{X}^T \hat{C} \vec{X}. \quad (11)$$

The matrix $\hat{C}$ has concrete analytical form

$$C_{mn} = \delta_{mn} - \frac{1}{N} - \frac{(z_m - \bar{z})(z_n - \bar{z})}{ND} \quad (12)$$

or in the matrix representation

$$\hat{C} = \hat{I} - \frac{\vec{E}\vec{E}^T}{N} - \frac{\vec{U}\vec{U}^T}{ND} \quad (13)$$

and has the following properties:

$$\hat{C}^T = \hat{C} \quad (14)$$

$$\hat{C}\hat{C} = \hat{C} \quad (15)$$

$$\hat{C}(a\vec{Z} + b\vec{E}) = \vec{0} \quad (16)$$

(a, b are arbitrary).

The rank of $\hat{C}$ does not coincide with the dimension (N)

$$\text{Rank}(\hat{C}) = N - 2. \quad (17)$$

The most important feature of $\hat{C}$ for the calibration purposes is the orthogonality (16) to any straight line. It is obvious enough that the rank of $\hat{C}$ equals $N-2$ (2 parameters were excluded), however the detailed proof of (17) is given in [4] because the numerical inversion of $\hat{C}$ of big dimension on a computer can give positive result and therefore lead to unpredicted final answers.

Moreover $\hat{C}$ can "reproduce" a similar matrix ($\hat{C}_o$) of smaller dimension ($N - k \times N - k$) [4]:

$$\hat{C}_o = \hat{G} - \hat{B}\hat{A}^{-1}\hat{B}^T, \quad (18)$$

where $\hat{G}_{N-k \times N-k}$, $\hat{B}_{k \times N-k}$, $\hat{A}_{k \times k}$ are the block parts of $\hat{C}$

$$\hat{C} \equiv \begin{pmatrix} \hat{A} & \hat{B}^T \\ \hat{B} & \hat{G} \end{pmatrix}. \quad (19)$$

The matrix $\hat{C}_o$ is defined identically to $\hat{C}$ (12,13) only by $N - k$ values of Z . This property, which is not obvious at first glance, can have important practical significance **for solving** linear systems based on $\hat{C}$. It should be also noted that $\hat{C}$ of dimension 2×2 equals **zero identically**

$$\hat{C}_{2 \times 2} \equiv \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}. \quad (20)$$

Finally, this matrix $\hat{C}$ can be characterized as "generalized second derivation in the Chi-square sense": for 3 values $z = -1, 0, 1$ $\hat{C}$ has the form

$$\hat{C}_{3 \times 3} = \frac{1}{6} \begin{pmatrix} 1 & -2 & 1 \\ -2 & 4 & -2 \\ 1 & -2 & 1 \end{pmatrix} \quad (21)$$

and if there are 3 ordinates x_1, x_2, x_3 lying on a straight line, then one can find the well-known expression $x_1 - 2x_2 + x_3 = 0$ in the matrix product $\hat{C}\vec{X} = \vec{0}$.

Similarly one can get an analytical expression of χ_{min}^2 for the parabolic type of trajectory

$$\chi_{min}^2 = \vec{X}^T \hat{T} \vec{X}, \quad (22)$$

where

$$\begin{aligned} \hat{T} = & \hat{I} - [\sigma^2 \vec{W} \vec{W}^T - \gamma (\vec{U} \vec{W}^T + \vec{W} \vec{U}^T) \\ & - \sigma^4 (\vec{E} \vec{W}^T + \vec{W} \vec{E}^T) + \gamma \sigma^2 (\vec{E} \vec{U}^T + \vec{U} \vec{E}^T) + \\ & (e - \sigma^4) \vec{U} \vec{U}^T + (e \sigma^2 - \gamma^2) \vec{E} \vec{E}^T] / N D_2 \end{aligned} \quad (23)$$

and

$$\begin{aligned} e & \equiv \overline{(z_n - \bar{z})^4}, \quad \gamma \equiv \overline{(z_n - \bar{z})^3}, \\ \sigma^2 & \equiv \overline{(z_n - \bar{z})^2}, \quad D_2 \equiv e \sigma^2 - \gamma^2 - \sigma^6. \end{aligned} \quad (24)$$

The matrix $\hat{T}$ has the properties:

$$\hat{T}^T = \hat{T} \quad (25)$$

$$\hat{T}\hat{T} = \hat{T} \quad (26)$$

$$\hat{T}(a\vec{W} + b\vec{Z} + c\vec{E}) = \vec{0} \quad (27)$$

(a, b, c are arbitrary).

$$\text{Rank}(\hat{T}) = N - 3. \quad (28)$$

4 Determination of transmissive function

Taking into account parametric definition (3) of the ordinate x one can consider the obtained analytical expression of χ_{min}^2 (10,22) as a quadratic form of the transmissive function $R(t)$:

$$\chi_{min}^2(R) = \sum_{m=1}^N \sum_{n=1}^N [P_m + s_m R(t_m)] C_{mn} [P_n + s_n R(t_n)]. \quad (29)$$

This expression can be effectively used if the functional character of $R(t)$ is known. For instance, if $R(t)$ has the linear character

$$R(t) = V_0 \cdot (t - T_0) \quad (30)$$

(V_0 is the drift velocity and T_0 is the time delay which are common for all the wires) then the minimization of χ_{min}^2 (29) by these parameters V_0, T_0 for single trajectory gives a system of equations:

$$\left\{ \begin{array}{l} V_0 \sum_{m,n=1}^N C_{mn} s_m s_n t_m t_n - D_0 \sum_{m,n=1}^N C_{mn} s_m s_n t_m = - \sum_{m,n=1}^N C_{mn} s_m s_n t_m P_n \\ V_0 \sum_{m,n=1}^N C_{mn} s_m s_n t_n - D_0 \sum_{m,n=1}^N C_{mn} s_m s_n = - \sum_{m,n=1}^N C_{mn} s_m P_n \\ (D_0 \equiv V_0 T_0) \end{array} \right. \quad (31)$$

The properties of the matrix $\hat{C}$ require some conditions for the solution of the system (31):

- a) the number of the parameters of the function $R(t)$ (2 in that particular case V_0, T_0) must not be more than $N - 2$;
- b) all the centers of anode wire (P_n) should not be placed on a straight line;
- c) all the signs (s_n) should not be equal to each other;
- d) a trajectory under consideration should satisfy the condition:

$$|X(Z_1) - X(Z_N)| > R_o \quad (32)$$

(R_o is the maximal drift distance).

These results (examined successfully in experiments) can be used as an initial approximation for the reconstruction of $R(t)$ of arbitrary character.

The solution of that problem which is more general one, is based on the consideration of the statistical sum (over Q trajectories) of χ_{min}^2 , which produces a new function $\overline{\chi_{min}^2}(R)$:

$$\overline{\chi_{min}^2}(R) = \frac{1}{Q} \sum_{k=1}^Q \sum_{m=1}^N \sum_{n=1}^N [P_{mk} + s_{mk}R(t_{mk})] C_{mn} [P_{nk} + s_{nk}R(t_{nk})] \quad (33)$$

(k is the statistical index of the trajectory).

This complicated and low-promising definition can be however transformed to a more understandable form if the operation of summation "Σ" over the statistics is changed for integration "∫".

For high statistics one can recall a known relation:

$$\bar{R} = \frac{1}{Q} \sum_{k=1}^Q R_k \equiv \frac{1}{Q} \int R \varphi(R) dR, \quad (Q = \int \varphi(R) dR), \quad (34)$$

where $\varphi(R)$ is the density of the statistical distribution of R . Then the transformation out from the coordinate distribution ($\varphi(R)$) to the distribution of the drift times ($f(t)$):

$$\varphi(R) dR = \varphi(R(t)) \left| \frac{dR(t)}{dt} \right| dt \equiv f(t) dt \quad (35)$$

allows one to operate with measured spectra of the drift times (it should be noted that for uniformly distributed $\varphi(R)$ we have a classical method [1] of the reconstruction of $R(t)$ by integration of the time spectrum).

With respect to the last relation, the definition (33) of $\overline{\chi_{min}^2}(R)$ gets a new form:

$$\overline{\chi_{min}^2}(R) = \sum_{m=1}^N \sum_{n=1}^N \overline{P_m P_n} C_{mn} + 2 \int_0^T F(t) R(t) dt + \int_0^T \int_0^T R(t) R(\tau) K(t, \tau) dt d\tau, \quad (36)$$

where: "T" is the full drift time (this value should be estimated independently, for instance, by the drift time spectra),
and

$$F(t) \equiv \sum_{m=1}^N \sum_{n=1}^N P_m(t) C_{mn} f_n(t) s_n(t) \quad (37)$$

$$K(t, \tau) \equiv \sum_{m=1}^N \sum_{n=1}^N s_m(t) C_{mn} K_{mn}(t, \tau) s_n(\tau), \quad (38)$$

$f_m(t)$ is the drift time spectrum of the "m-th" wire, $K_{mn}(t, \tau)$ is correlative matrix of the "m-th" and "n-th" wires. The signs of the drift direction (s_n) are varied statistically so they can be formally considered as $s_n(t)$; the same reasons are related to notation " $P_m(t)$ " in definition (37).

The minimization of $\overline{\chi_{min}^2}(R)$ (36) by the variation of $R(t)$ gives integral equation for $R(t)$:

$$F(t) + \int_0^T R(\tau) K(t, \tau) d\tau = 0. \quad (39)$$

Thus, $R(t)$ is determined by the geometry of the drift chamber and measured drift times.

The full drift distance of the drift tube R_o due to the wall thickness is smaller than the external radius, which determines the geometry of the detector (a setup of tubes). This kind of the boundary condition requires the determination of the drift velocity $V(t) = dR(t)/dt$ instead of $R(t)$. Defining the partially integrated correlative function

$$I(t, \tau) = \int_0^t K(\eta, \tau) d\eta \quad (40)$$

one has an integral equation for the determination of $V(t)$:

$$\int_0^T V(\tau)I(t, \tau)d\tau = F(t) + R_o I(t, T). \quad (41)$$

One can get the analogical equations (39,41) for the parabolic trajectories: the matrix $\hat{C}$ (12) is only substituted by $\hat{T}$ (23).

The conditions of the existence of solutions (39,41) are mainly determined by the angular spreading of the analyzed trajectories: which should be wide enough, i.e., as was pointed before, the requirement (32) must be satisfied for a significant part of the statistics.

This method of finding $R(t)$ requires some iterations because the signs of the drift direction (s_n) are the most significant parameters which determine the precision of the reconstruction of $R(t)$. The initial function $R_1(t)$ distorts somehow usually the set of s_n of the reconstructed trajectory, however 2-3 iterations ($R_1(t)$ is substituted by reconstructed $R_2(t)$, $R_2(t)$ by $R_3(t)$, and so on) give stable picture of the behavior of $R(t)$. At the first iteration the residual between reconstructed trajectory and the hits may have a very complicated dashed character as a function of the drift time and becomes a time-indepdent function at the final iteration, which can serve as a criterion for the termination of iterations.

5 Remarks about the alignment

Adjustment of the wire positions for all (N) the wires by the track data alone is impossible. It is evident from the rank of matrices $\hat{C}$ and $\hat{T}$ ($N-2$ for straight trajectories and $N-3$ for parabolas). This statement should be also kept in mind for all the coordinate detectors.

An attempt of simultaneous determination of P_n and $R(t)$ leads to trivial results. Inasmuch as that problem can have practical significance for large and complicated detector (for instance, like ATLAS [5]), this affirmation must be argued:

The minimization of χ_{min}^2 of general form (36), for instance, by $R(t)$ and P_n gives, together with obtained equation for $R(t)$ (39), new equations related to P_n

$$\hat{C}\vec{P} = -\hat{C}\vec{H}, \quad (42)$$

where P_n are shown in the vector form($\vec{P}$) and the vector $\vec{H}$ has components

$$H_n \equiv \int_0^T R(\tau) s_n(\tau) f_n(\tau) d\tau. \quad (43)$$

Even though $R(t)$ is already known, the rank of $\hat{C}$ (N-2) allows one only to determine N-2 values of P_n , if one sets coordinates (x, z) of two wires, defining thereby the system of coordinates of the detector (it is a typical situation for an experiment, where these reference wires are "attached" to the general system of coordinates, using additional **constraints**).

In the case where $R(t)$ is unknown such a possibility does not exist - $R(t)$ should be determined at fixed geometry of wires. Let us choose some(k) wires as reference ones (denoted formally as the vector $\vec{P}_o$) and then determine the others $P_m(m = 1, \dots, N - k)$ (the vector $\vec{P}_1$) with the help of these reference wires (the values $H_n(43)$ are also formally reproduced in vectors $\vec{H}_o$ and $\vec{H}_1$ respectively). Equations (42) give the solution for unknown P_m (in the block form)

$$\vec{P}_1 = -\vec{H}_1 - \hat{A}^{-1} \hat{B}^T (\vec{P}_o + \vec{H}_o) \quad (44)$$

and additional conditions for the reference wires

$$(\hat{G} - \hat{B} \hat{A}^{-1} \hat{B}^T)(\vec{P}_o + \vec{H}_o) \equiv \hat{C}_o(\vec{P}_o + \vec{H}_o) = 0 \quad (45)$$

where $\hat{C}_o$ is the matrix defined by (12,13) for k wires.

Applying these results to equation (39) which determines $R(t)$, one gets new equations

$$F_1(t) + \int_0^T R(\tau) K_1(t, \tau) d\tau = 0, \quad (46)$$

where

$$K_1(t, \tau) \equiv K(t, \tau) - \sum_{m=1}^N \sum_{n=1}^N f_n(t) s_n(t) Y_{mn} f_m(\tau) s_m(\tau). \quad (47)$$

In accordance with results (44,45), the matrix $\hat{Y}$ has the form

$$\hat{Y} \equiv \begin{pmatrix} \hat{A} & -\hat{B}^T \\ -\hat{B} & \hat{C}_o - \hat{G} \end{pmatrix}, \quad (48)$$

and ($F_1(t) \equiv \vec{f}_o^T(t) \hat{C}_o \vec{P}_o$)

$$F_1(t) \equiv \sum_{m=1}^k \sum_{n=1}^k P_{om} C_{omn} f_n(t) s_n(t). \quad (49)$$

The property of "reproducing" $\hat{C}$ is "catastrophically" evinced in the last expression of the free part $F_1(t)$ of the integral equation (46): if two reference wires are fixed ("a typical situation for an experiment"), $\hat{C}_o = \hat{0}$ and therefore $F_1(t) = 0$, $R(t) \equiv 0$ and all the other determined wires are positioned along a straight line defined by two reference wires (that is "trivial solution").

A special system for the determination of exact positions of 2 wires (3 in the case of magnetic field) must be foreseen for an experiment therefore.

6 Results

This method of the determination of $R(t)$ was examined by the Monte-Carlo simulation [6] of the passing of muons through "Monitoring Drift Tubes" of designed experiment ATLAS [5]. The drift times of the straight trajectories which were detected by the set (4×4) of drift tubes assembled in the check-order geometry were analyzed. A relatively complicated function $R(t) = a\sqrt{t}$ (theoretical curve) was used in the simulation and reconstructed characteristic $R(t)$ is shown in Fig.2a. This result was obtained after the **third iteration**, the initial approach of $R(t)$ was determined in linear form by equations(31). The deviation between reconstructed $R(t)$ and the theoretical curve is shown in Fig.2b, these deviations can be explained both by inevitable errors of numerical inversion of the matrix corresponding to equation (39) (the dimension was 150×150) and the accuracy of the drift tube itself. The accuracy was put on $60\mu\text{m}$ at the simulation of the data and the reconstructed value of σ was $63\mu\text{m}$. These results can be considered as positive ones because the radial character of the drift in the tubes was taken into account approximately:

$$x_n = P_n + s_n R(t_n) \cdot \sqrt{1 + A^2}, \quad (50)$$

where A is the slope of trajectory (1) reconstructed by 4 tubes.

The reconstruction of $R(t)$ for a parabolic trajectory was examined by the simplest Monte-Carlo simulation (the parameter "*Lorenzangle*" was not considered). These results look also positively: the mean value (along the full drift distance) of the deviation between reconstructed $R(t)$ and theoretical curve $R(t) = a\sqrt{t}$ had $11 \pm 10 \mu\text{m}$.

Fig.2 (a) Reconstructed characteristic $R(t)$ for the Monte-Carlo simulation of straight trajectories passing through the set of drift tubes; (b) deviation between reconstructed $R(t)$ and the theoretical curve $R(t) = a\sqrt{t}$ used in the simulation.

Similar geometry of drift tubes was used for the analysis of the drift characteristics with the 200 GeV/c muon beam at CERN. Fig.3a shows reconstructed $R(t)$ (after the third iteration) for gas mixture $Ar(0.96)CO_2(0.03)C_2H_6(0.01)$ at 3050V and pressure 3tor. It should be pointed out that the procedure of the determination of the drift velocity is very sensitive to statistical fluctuations, and Fig.3b shows the partially averaged function $V(t)$:

$$V(t) = \frac{1}{10} \sum_{m=n}^{n+10} V_i \quad (51)$$

where $V(t_n)(n = 1, \dots, 240)$ are the solutions of equation (41).

Fig.3 (a) Reconstructed $R(t)$ as the result of the analysis of the experimental data; (b) the drift velocity as a function of the drift time.

Fig.4a shows the behavior of the residual between reconstructed trajectory and the hits as a function of the drift time at wrong $R(t)$ and the same function is shown in Fig.4b after the third iteration of the finding of the drift characteristic. Such a modification of the residual indicates the termination of iterations for the determination of $R(t)$. Unfortunately, the instability of the delay time of the start of the Time-to-Digital Converter (which was determined somehow by the electronics) made it only possible to get the accuracy of the drift tube $\sigma = 110 \mu\text{m}$ and results shown in Fig.3 demonstrate rather the ability of the suggested method of the determination of $R(t)$, rather than the intrinsic chamber accuracy.

Fig.4 (a) Residual between the reconstructed trajectory and the hits at wrong $R(t)$ as a function of the drift time; (b) the same residual at $R(t)$ shown in Fig.3a.

7 Conclusion

The reconstruction of the drift characteristics ($R(t)$, $V(t)$) in the table form (by "direct" solution of integral equations) is formally the most exact representation of the unknown function. However, those sought for functions may be defined *a priori* in the power series, for instance, the parameters of that can be determined by the similar integral equations. Nevertheless, the program DEQN [7] allows one to solve the corresponding linear system of equations up to the dimension 500×500 for the *direct* determination of $R(t)$, i.e. in the table form.

It should be pointed out that the formalism of $\hat{C}$ and $\hat{T}$ matrices has clear and simple possibilities for the determination of other parameters (if $R(t)$ is already known), for example, the signs of the drift direction[3] (for "huge" number of detectors in the magnetic field this problem is in progress now).

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Определение дрейфовой характеристики
методом решения интегрального уравнения

Предложено определение $R(t)$ -характеристики дрейфовых детекторов как решение интегрального уравнения Фредгольма первого рода. Математической базой этого подхода является аналитическое представление χ^2 в точке минимума по параметрам траектории (прямые и параболы), которое, при статистическом обобщении, рассматривается как функционал от $R(t)$. Изложены результаты Монте-Карло испытаний и экспериментальные результаты для дрейфовых трубок.

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Reconstruction of the Drift Characteristic by the Integral Equation

The $R(t)$ function of the drift detector is reconstructed in the Fredholm integral equation of the 1st type. Mathematical formalism is based on the analytical expression of χ^2 at the point of the minimum of the trajectory parameters (straight line and parabola) which is considered in statistical generalization as a functional of $R(t)$. The Monte-Carlo examination and the analysis of the experimental data for the drift tubes are given.

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

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