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A METHOD FOR DETERMINATION OF NEUTRAL DECAY POINTS WITHOUT TRACK RECONSTRUCTION IN SPACE

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BUDAPEST

A METHOD FOR DETERMINATION OF NEUTRAL DECAY POINTS WITHOUT TRACK RECONSTRUCTION IN SPACE[x]

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INTRODUCTION

As it is well known, the aim of using bubble chambers is to determine physical parameters such as three-momenta, energies of charged particles, decay points of neutral ones and so on, by means of coordinates on charged particle tracks measured on different stereoviews. It is however, generally a difficult task to estimate the parameters in question from the measured coordinates and one is usually forced to introduce auxiliary variables, namely the estimated values of the coordinates on particle tracks in space. The introduction of intermediate variables makes the procedure rather lengthy and, - a more serious drawback, - often leads to loss of information. Now we want to sketch a method, where in a special case we were able to estimate a physical parameter using immediately the coordinates measured on the three stereoviews.

Statement of the problem

A K^o is produced in $K^+\mathcal{N}$ charge exchange and decaying into neutral cahnnel: $K^o \to 2\pi^o$, gives rise to 3 or 4 materialized γ rays /electron-positron pairs/ in the chamber. The problem is to find the best coordinates of the decay point - in other way to determine the best estimate of the common origin of the gammas. We considered three ways of solving the problem:

1./ The classical method taking reconstructed points in space as intermediate variables.

2./ The method taking only the spatial direction of gammas as intermediate variables. /In order to extract as much information as possible it seems that a combination of method 1./ and 2., would be preferable./

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3./ The third method is to consider the projection of the common origin onto the stereoviews as auxiliary variables. This is based upon the assumption, that there is a more or less linear mapping between the spatial points and their projections to the z=0 plane which will be referred to as the "basic plane". In our case this is fullfilled up to a good approximation. /Fig. 1./

It is difficult to decide whether method 2/ or 3/ utilise the information in a more straightforward way. So without emphasizing any preference in favour of method 3/ we are now going to describe only this last one.

The program

The solution of the problem is carried out in two separate parts: first in a geometrical preparation program, and after it the decay point fitting program.

The geometrical preparation program is built-in into the geometrical reconstruction program as a subroutine named ANGEL. This subroutine ANGEL determines the coordinates of the projection point of the gamma vertex on the "basic plane" and the initital directions of the electron /positron/ tracks projected to the "basic plane". This so called projected direction is determined as follows: a parabola is fitted with the least square's method to the first five measured points of the track in each view. /Fig. 2./ The points are weighted with the weight-function:

$$W(s) = \frac{1}{G^2 + \left(\frac{s^2}{2}\right)^2}$$

where s is the track length, G is the measurement error of individual points. The second term in the denumerator ensures that the farther is the point the smaller is its weight.

The tangent of the fitted parabola at the vertex point is the projected direction on the given view. Having proceeded this way for each view the results are stored on magnetic tape.

The determination of the decay point is done by the program GEOGAM. In the first step the program determines the projected directions of the gammas from view to view still remaining on the basic plane. Assuming that the directions of the electron and positron are the same as the direction of the materialized gamma, the projected direction of the gamma is given as a weighted average of the projected direction of the electron and positron:

$$\phi_\gamma = \frac{w_-\phi_- + w_+\phi_+}{w_- + w_+}$$

where $w_{\pm}$ is obtained from the parabola fit. The variance of ϕ_γ is assumed to be:

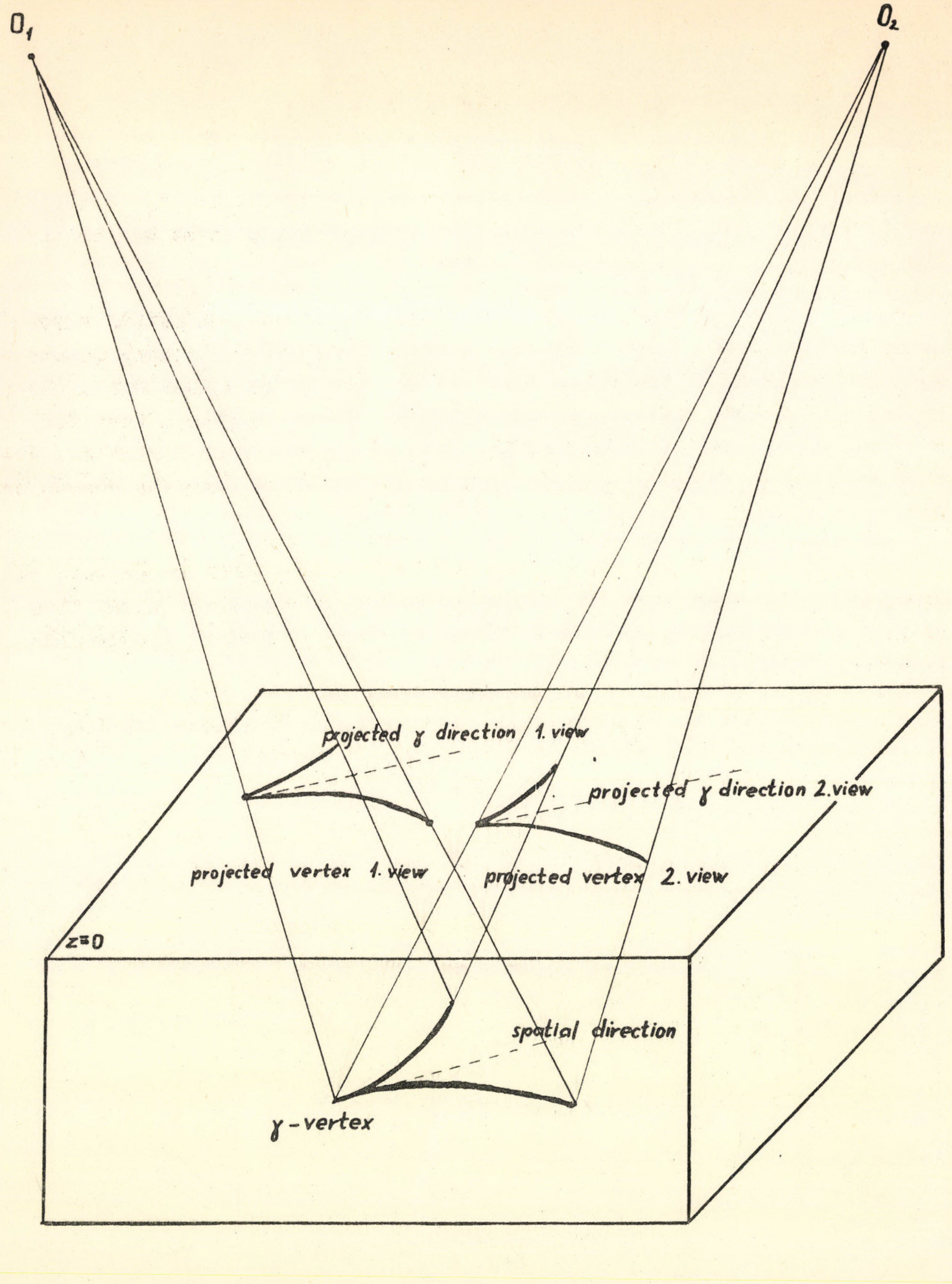
$$(\sigma_\gamma)^2 = \frac{(\phi_+ - \phi_\gamma)^2 w_+ + (\phi_- - \phi_\gamma)^2 w_-}{w_- + w_+}$$

A C cout-off parameter was determined from the empirical σ_γ distribution and if the σ_γ was greater than C the corresponding gamma was omitted /C=0.1/.

In the second step we used a special subroutine called FITGEO in order to find best fitted projected decay points of the primary gammas on each stereoviews. If the probability of the fit is less than 0.1%, the gamma having the greater partial χ^2 is rejected. There is also a test for Bremsstrahlung gammas. If two gammas have nearly the same direction, one of them is omitted namely the one having larger distance from the common origin.

At last in the third step the subroutine SIKFIT determines the decay point in space from the projected points on the basic plane. The spatial reconstruction is made as usual by using lightrays /projection lines/.

The program is written is FORTRAN for an ICT 1905 computer. It is in production run now, about 800 events were processed by this program and approximately 100 $2\pi^0$ decays were identified.



O_1
O_2
projected γ direction 1. view
projected γ direction 2.view
projected vertex 1. view
projected vertex 2. view
z=0
spatial direction
γ-vertex

Fig. 1

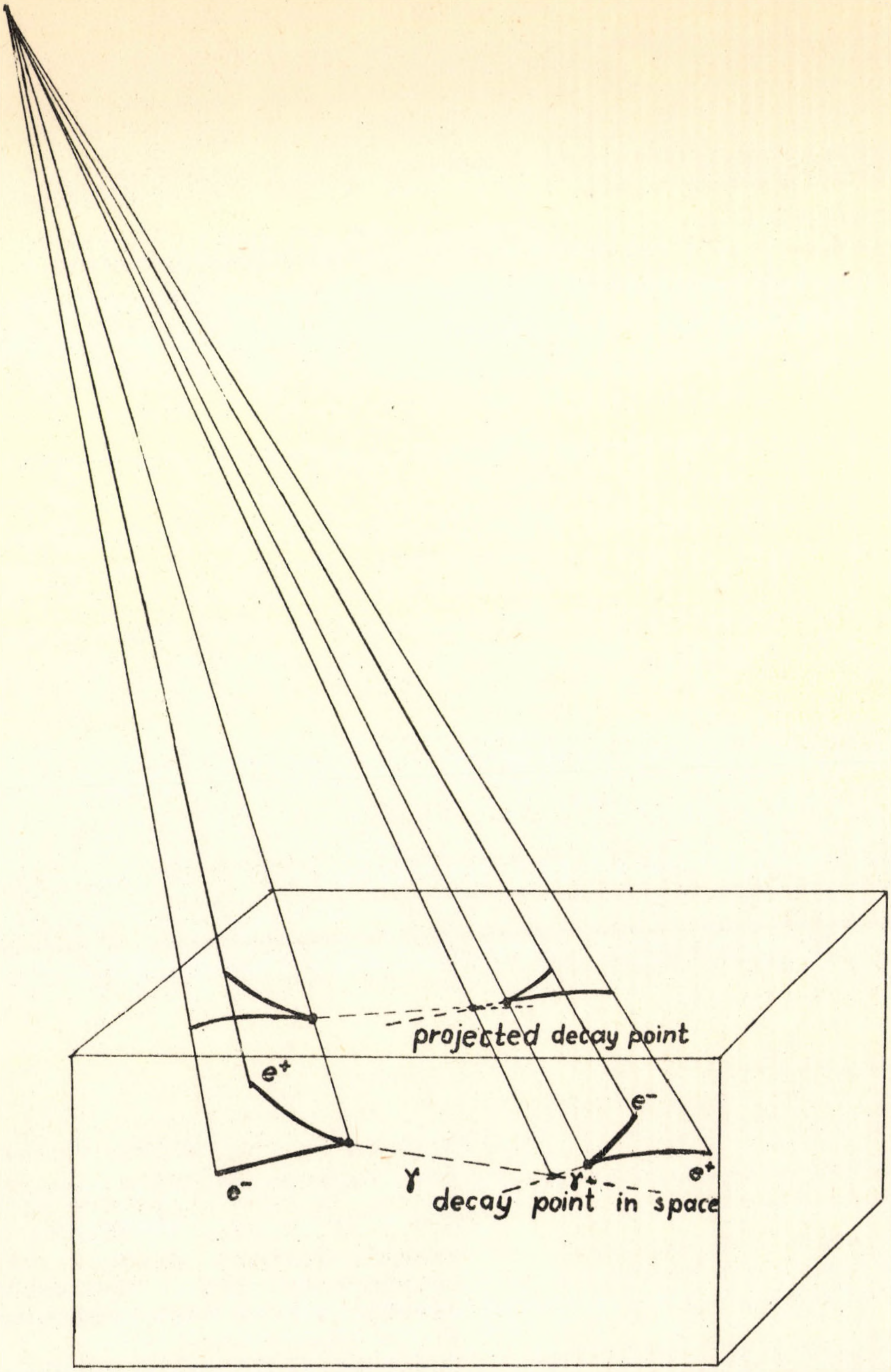


Fig. 2

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