V0lite and tracking studies

Summerstudent Program 2007, DESY

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18th September 2007

Abstract

This report describes modifications which I made in V0lite orange block and my other tracking studies .

Contents

1 Introduction

This report is divided in sections according with topics that I studied. This topics are different but all of them are tracking related .

2 V0lite finder

2.1 How does it works - a short technical review

V0lite finder is part of ORANGE - software designed in ZEUS colaboration for low level data analysis, track and particles reconstruction. This finder is designed to search K_0, Lambda, Antilambda. First V0lite finder reads data from different ADAMO tables (ZTTRHL, VCTRHL [1] and others). Those tables contains tracks' helix parameters, vertexes, hits and other parameters for each event.

Then the finder combines pairs of tracks in all possible ways and selects pairs with small DCA (Distance of the Closest Approach).

The finder refits selected pair of tracks for more precise determination of vertex position. If vertex was determinated precisely enough finder will improve momenta of corresponding tracks using precise determination of magnetic field. It uses those improved parameters for mass calculation later.

(But, in all cases finder supposes that all tracks are tracks of pions and uses pion's mass for these calculations.)

After obtaining improved momenta finder checks for collinearity parameter - an angle between total candidate momenta and direction from primary vertex to secondary vertex. If that angle is small enought the mass of candidate will be calculated in suggestions that candidate is K0, Lambda, Alambda, e+e- system. So we obtain four masses for one pair of tracks.

Note: finder do not marks used tracks so we can use the same track for reconstruction more than one particle, in some cases up to 10-20 particles.

2.2 Changes required to use finder in forward region and to improve finder globally

V0lite finder doesn't use tracks with small transverse momenta - these tracks are forward tracks . It caused by difficulties with precise determination of primary vertexes and very hard cuts for collinearity parameters in forward region. Also V0lite finder provides some additional cuts - e.g. number of CTD hits should be more than 3. Such cuts also have strong influence for forward tracks.

To solve problems and improve the finder we need :

1. reject as many cuts in forward region as it is possible
2. improve track combination algorithm - make momenta fixing with magnetic field map mass dependent
3. do not use the same track for reconstruction more than once
4. change collinearity cuts (especially for forward region)
5. set new parameter which will show which type of particle can be reconstructed in best way from that pair of tracks *

* It would be interesting to develop algorithm which can sort all reconstructed particles to get best mass peaks. But it seems to be complicated enought...

2.3 Short review of new V0lite finder algorithms

First new V0lite finder reads data from different ADAMO tables (ZTTRHL, VCTRHL [1] and others), like original finder does that.

Then new finder combines pairs of tracks in all possible ways and stores DCA parameter of that pairs to array (I call it DCA array). In the next step my finder finds pair of tracks with smallest DCA in DCA array and put flag to array (I call it FLAG array) that tracks from this pair already used to prevent using them later. The finder refits tracks in selected pair for more precise determination of vertex position .

If vertex was determinated precisely enough finder improves momenta of corresponding tracks using precise determination of magnetic field. This procedure runs four times corresponding to four sorts of particles which will be reconstructed from one pair of tracks . Finder also calculates masses of candidates and collinearity parameters with new vertex parameters and improuved momenta. All parameters calculated in these procedures stored in special arrays (masses in "MASS" arrays, chi square of verticies in "VERTEX" arrays , collinearity parameters in "COLLINEAR" arrays and so on).

In the last step finder serch for candidates which satisfy cuts using information from "FLAG", "VERTEX" and "COLLINEAR" arrays . Found candidates are stored it in V0lite block.

There are a lot of problems related with the new algorithm

1. momenta of track depends on suggestion about sort of particle reconstructed with that track It's possible to add new variables to V0lite block which will describe all possible momenta , but it will change block too much. So I have to ask about this R. Mankel and find best solution.

2. the new algorithm rejects a lot of tracks and we need more data

3. there are problems with determination dlen3 and dlen2

All new features are in debugging/testing now. I hope my finder with them will be ready soon for including in next ORANGE[4] release and will be usefull.

3 V0lite block

3.1 Forward region analysis

Forward region analysis is an important and interesting part of analysis. Some detectors like STT detector system were designed specially for that purposes. But, there is no STT information in V0lite block. This information is useful for analysis and it would be good to add it to V0lite block.

3.2 New variables for forward region analysis

List of variables which I will include to V0lite block:

1. number of hits in STT detector system

2. track ID's in STPRHL[1] block

3. a parameter which will show which type of particle can be reconstructed in best way from that pair of tracks

4. information from STRHL[1] block

5. other variables which may be useful for analysis in forward angles region

6. also calculation of dlen2 and dlen3 may be changed

This variables (and maybe others) will be included in V0lite at the same time as V0lite finder will be released.

4 Searching for the momentum correction coefficients for 2006e data

4.1 About corrections

Ordinary algorithm of mass calculations gives result with a small shift from PDG values. For example this shift is approximately 2 MeV for K_0. It is caused by wrong measurement

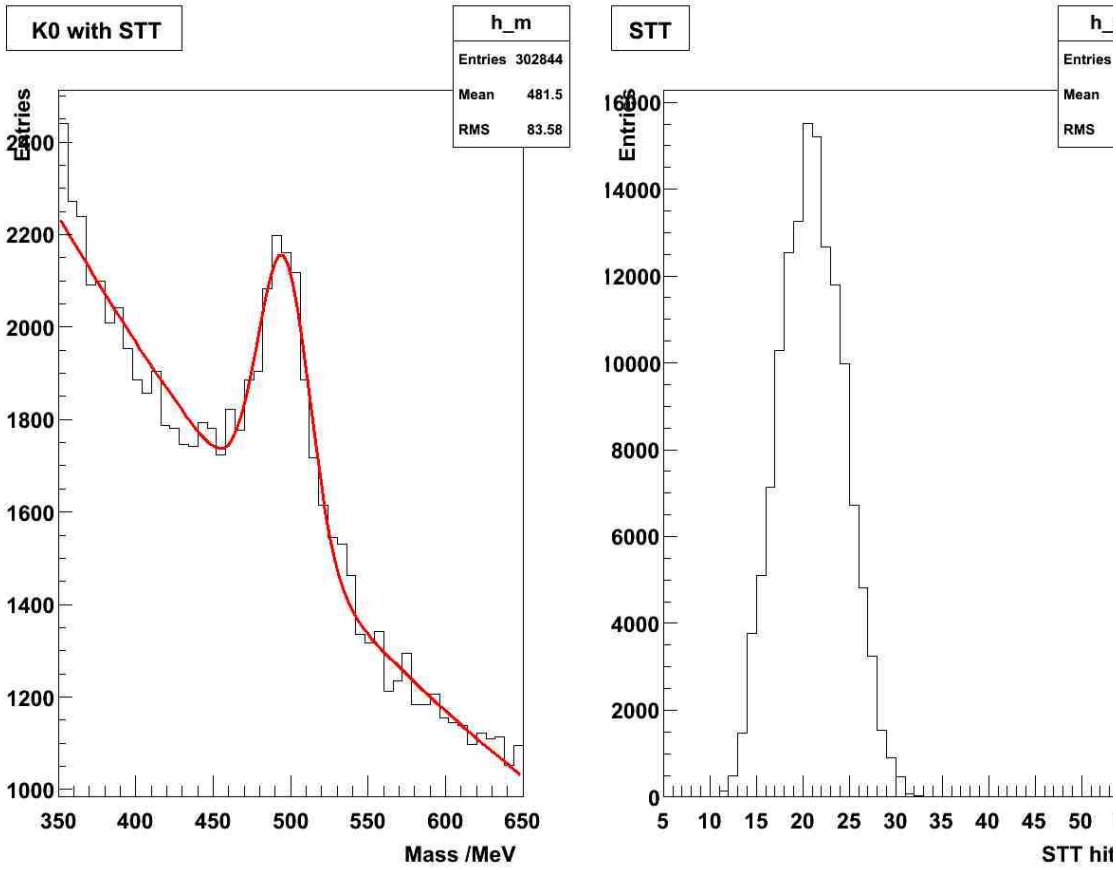

Figure 1: *Distribution of K_0 mass and number of STT hits from V0lite.*

of momenta of tracks. (We do not know exactly magnetic field and maybe dE/dx .) An easiest way to obtain good mass is to multiply momentum of each track by some number. If it's close to one then our measurements of momenta are good enought.

4.2 Short description of calibration

1. masses of particles were calculated from tracking block , without using V0lite/V0 blocks and finders.

2. momentum of each particle was multiplied by (1+ α). So α is named here *correction coefficient.*

3. correction coefficient strongly depends on kinematic cuts.

There are some dependencies α on different parameters below. *Parameters decryption*

1. *MAXIMPULS - maximal magnitude of pions momentum (both)*

2. *MINIMPULS - minimal magnitude of pions momentum (both)*

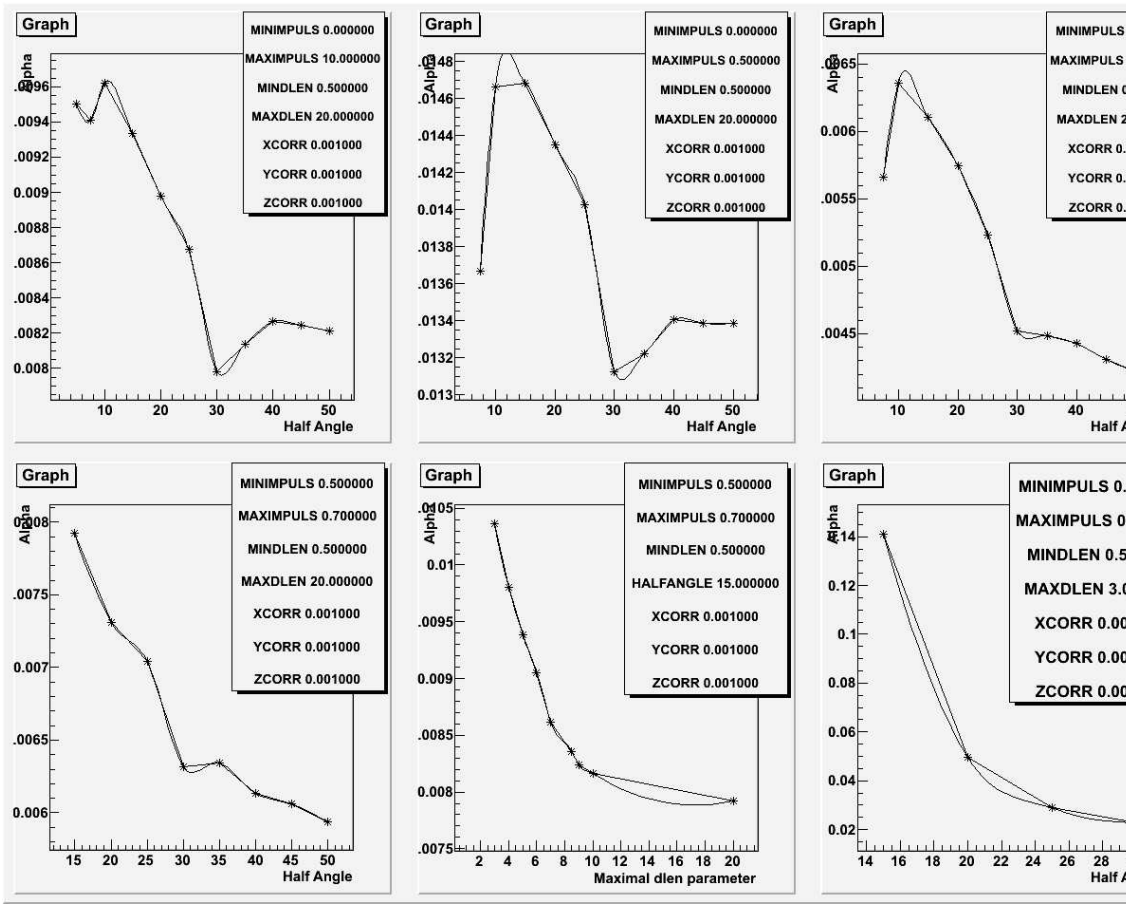

Figure 2: *Dependence of α on different parameters. Cuts described in top right corner of each histo.*

3. *MAXDLEN - maximal dlen3 for candidate vertex*

4. *MINDLEN - minimal dlen3 for candidate vertex*

5. *HALFANGLE - corresponds to angle region θ = [π/2-HALFANGLE, π/2+HALFANGLE]*

6. *XCORR, YCORR, ZCORR -internal parameters which correspond to correction of X,Y and Z component of momenta. Equal to zero for not corrected component.*

5 Alignment

A lot of time I spend to understand alignment of MVD/CTD, corresponding codes and software for it (Millipede [3], ORANGE[4] analysis code written by Silvia Miglioranzi and Monica Turcato, etc.). I started work with this topic from scratch and it's interesting for me , I know a lot about it now, but I need more time to get good results.

6 Conclusion

- Modified V0lite finder has been proposed (in debug/testing now).
- Modified V0lite block has been proposed which includes forward detector and new parameters.
- Momentum calibrations has been done.
- Alignment studies in progress.
- A further develop and support V0lite finder code is planned.

7 Acknowledgements

I would like to thank

1. Volodymyr Aushev, Silvia Miglioranzi, Monica Turcato , Ryuma Hori, Achim Geiser, Rainer Mankel and all tracking group for help and advices.

2. Elisabetta Gallo , Tobias Haas , Joahim Meyer and all ZEUS collaboration for inviting me to participate in so exiting summer student program!

References

[1] ADAMO table descryption *ADAMO developers*

[2] VCTRACK Briefing: Program and Math *G.F. Hartner* ZEUS-Note 98-058

[3] Linear Least Squares Fits with a Large Number of Parameters *Volker Blobel* Institute of Experimental Physics, University of Hamburg

[4] ORANGE documentation and code *Many people from ZEUS* $http://www-zeus.desy.de/ZEUS\_ONLY/analysis/orange/index.html$

8 My reports on Tracking Developers Meetings during Summer Student program

1. Momentum tuning with K0 for 2006e- data (22.08.2007)

2. Modified V0lite (11.09.07)