Dear Colleagues.

During my last visit at JLab last month, Simon and I were trying to determine the missing mass spectrum from the measured data. We read our input parameters (e.g. position at MWDC1) from already analyzed root files (e04007_phys_xxxx.dat). In the end we got some results but they weren't very impressive. The calculated missing mass peak (which should correspond to the mass of a Pi0) was very broad and centered at the wrong value. We also need to analyze more than 100k events to see a distinct peak. At lower number of events the peak could not be recognized.

Because of all of these problems I have decided to work a little bit more on this problem after returning to Slovenia. This time I used raw data files for my analysis. I have created a new physical library called VertexTimeLib, which calculates the momentum of protons in BigBite. It uses a simple dipole approximation of the BigBite magnet with a constant magnetic field of 0.7T. In my program I have used a modified algorithm that I have adopted from the SRC BigBiteLib. I have added this library to the analysis script ("analiza2.C") and used it to analyze raw data.

Besides the position of the particle at the MWDC, this method also requires some other parameters to be able to calculate the particle's momentum at the target. These parameters are: the length and the height of the magnet, the inclination of the exit face of the BB magnet, the distance from the target to the front face of the magnet, and the inclination and the position of the center of the first MWDC. Values of all of these parameters are stored in the "DB_VertexTimeLib.dat".

Because I didn't know the correct values of these parameters I have tried to to determine them on my own by the procedure described in the following. For a hydrogen elastic run #2531, I slowly varied these parameters until all three components of the proton's momentum matched the components of q (calculated from electron kinematics). There is definitely more than one way to determine these parameters such that the proton momentum equals the q vector. Therefore my "cocked" parameters are probably incorrect, but for now it seems, that the method works well with these parameters.

- Figure 2531_a.pdf shows physical plots for elastic run #2531
- Figure 2531_b.pdf shows distributions of x,y,th and ph in the focal plane of the BB.
- Figure 2531_c.pdf shows 2D plot x_fp vs. y_fp
- Figure 2531_d.pdf shows 2D plot th_fp vs. ph_fp
- Figure 2531_e.pdf shows 2D plots x_fp vs. th_fp and y_fp vs. ph_fp
- Figure 2531_h.pdf shows difference between momentum \vec p and \vec q
- Figure 2531_i.pdf shows histograms of the momentum transfer \vec q
- Figure 2531_q_vs_p.pdf shows histograms of \vec p and \vec q. The momentum transfer \vec q is shown with the black line and the proton momentum \vec p with the blue line.

After I determined the values of all parameters (see fig. dimensions.pdf) I used this method and tried to analyze the production runs #3300, #4782, #4909 and #2766. I have got some interesting results. **In first three runs I get a distinct peak in missing mass spectrum at approximately 140MeV/c^2.** However, the last run #2766 didn't give me nice results.

Histograms of my results are shown in figures:

- Figure (runnum)_a.pdf shows physical plots for elastic run #2531
- Figure (runnum)_b.pdf shows distributions of x,y,th and ph in the focal plane of the BB.
- Figure (runnum)_c.pdf shows 2D plot x_fp vs. y_fp
- Figure (runnum)_d.pdf shows 2D plot th_fp vs. ph_fp
- Figure (runnum)_e.pdf shows 2D plots x_fp vs. th_fp and y_fp vs. ph_fp
- Top two histograms in figure (runnum)_f.pdf show distribution of (missing mass)^2 and missing mass, obtained with the "old algorithm". The blue line represents the accidentals

subtracted missing mass peak. The lower two histograms, however, show missing mass distributions that we obtained with the old algorithm (blue line) and with my new “dipole” approximation (red line).

– Comparison of missing mass distributions, obtained with both numerical methods is also shown in figure (runnum)_g.pdf.

To calculate the missing mass, missing energy etc. I have used the same script (“physics3c.C”) that I used at JLab when I was analyzing root files already prepared by the online replay. The only modification that I have made to this script is that I have changed the name of the variables from which the script reads the values of the proton's momentum (e.g. “BB.tr.p”----> “VertexTime.tr.momentum”).

When analyzing data I have used a cut on the trigger condition, a cut on the number of tracks in both spectrometers (HRSL and BB), a cut on the coinc time (DL.T7) [some of the histograms are accidentals-subtracted]:

(DL.evtypebits& 1<<5) ==1<<5
&&
(L_tr_n==1)
&&
(BB_tr_n==1)
&&
(coinctime7>25.0 && coinctime7<40.0) <---- This cut is not the same in all runs.

I have also tried to apply some other cuts (on tracks slopes/position), but the results haven't gotten much better.

I have put the source code of my VertexTimeLib with all root scripts for analysis on my web site: http://www.jlab.org/~miham. There is also a tarball with all figures that I got from my analysis.

Best regards,
Miha