Collins Effect for Large Mass Photon Pairs (Run 11)

S. H. Version 3

In this analysis we study events with 2 photons, with mass above the pi0 and eta region. We select 2 photon event collections in the Cos(theta) region that excludes the boundary between jet trigger coverage. In contrast to the normal event selection, we select large Z events.

- 0.7 GeV<Mass<2.5 GeV
- Number of collections = 1
- Number of photons = 2
- 60 GeV<Energy<170
- 2.6<pseudo-rapidity<4.1
- 0.1<Abs(Cos(theta))<.9
- Z>0.7

In Figure 1 we see the Cos(Phi) distribution, Mass distribution, and Cross Ratio A_N for this above cuts. We Conclude that the average raw A_N in this region is about 0.7 %.

We define a new variable called **dthx**. To define this variable we construct a unit vector $\mathbf{u_0}$ that points in the direction of the 2 photon collection. We define a unit vector $\mathbf{u_1}$ that points in the direction of the high energy photon of the cluster.

We define the variable to be the difference of the x component of these unit vectors **dthx**=$\mathbf{u_{1x}}$-$\mathbf{u_{0x}}$. We observe a slope in $\mathbf{A_N}$ vs **dthx** for $\mathbf{A_N}$ calculated with respect to the blue beam. In this context, we define $\mathbf{A_N}$ as **(Nu-Nd)/(Nu+Nd).**

If we assume that the two photons are two products of fragmentation, then the Collins effect suggests that asymmetry should depend upon **dthx.**

So, looking at Figure 2, we see that the **dthx** distribution is correlated with (left,right) and so is the raw asymmetry for the blue beam. We have not yet estimated what part of the cross ratio asymmetry in this mass region is from the correlation of these two effects.

We see that there is no significant slope in $\mathbf{A_N}$ vs **dthx** for the yellow beam as is there no slope in blue $\mathbf{A_N}$ vs **dthy.**

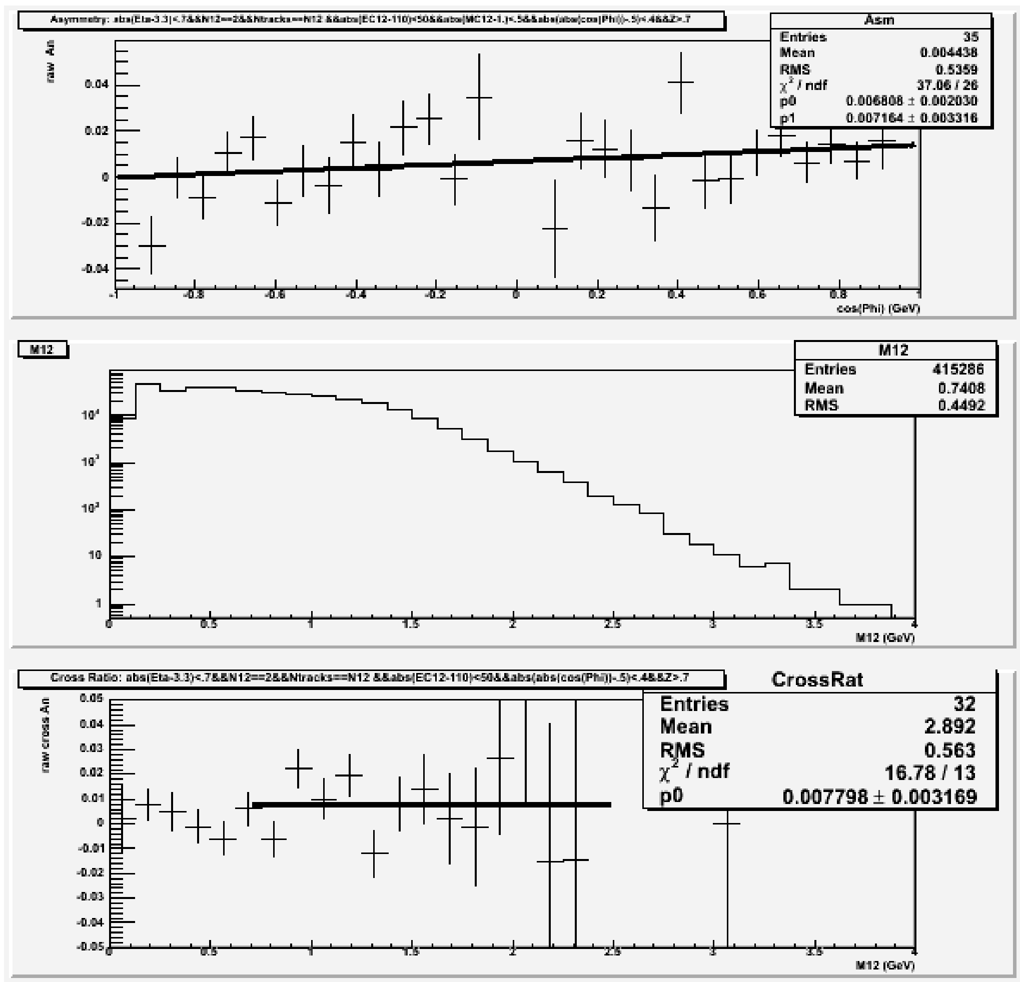

Figure 1: upper: Cos(Phi) distribution for event selection described above. The fit shown indicates a luminosity u/d ratio of about 0.7 % and and an asymmetry of about 0.7%+- 0.3%.
mid: Mass distribution for cuts indicated (except the mass cut itself).
bottom: Cross Ratio for cuts above including fit from selected mass region of 0.7GeV<Mass<2.5 GeV. Note average asymmetry from Cross Ratio is about 0.78% +- 0.3%

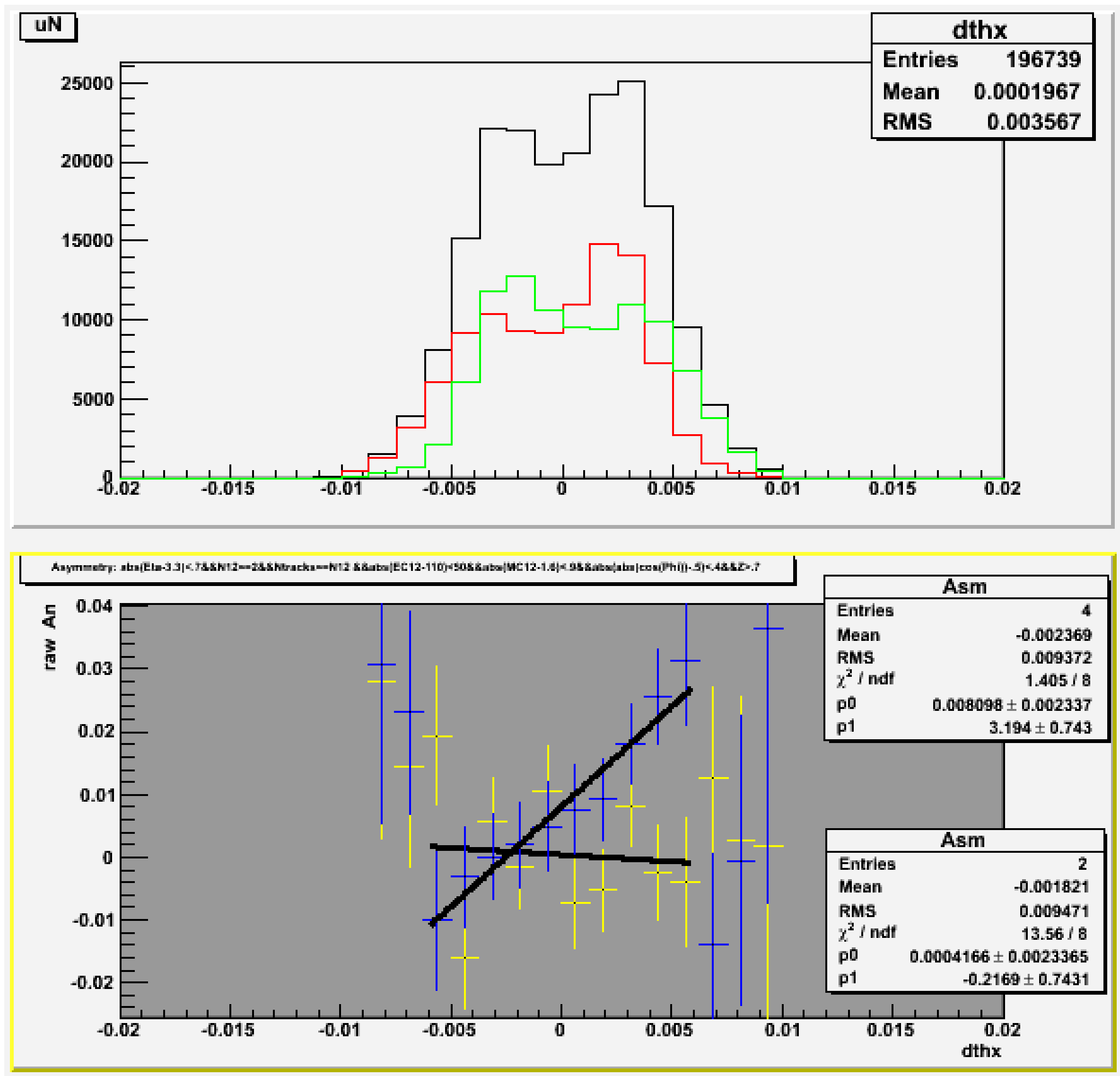

Figure 2: top: Distribution of dthx variable defined above. (black =all events; red= North events; green=South events) bottom: Simple asymmetry as a function of dthx with results shown for both yellow and blue beam asymmetry. For the blue beam, the slope is more than 4 standard deviations from zero. For the yellow beam, the slope is consistent with zero.

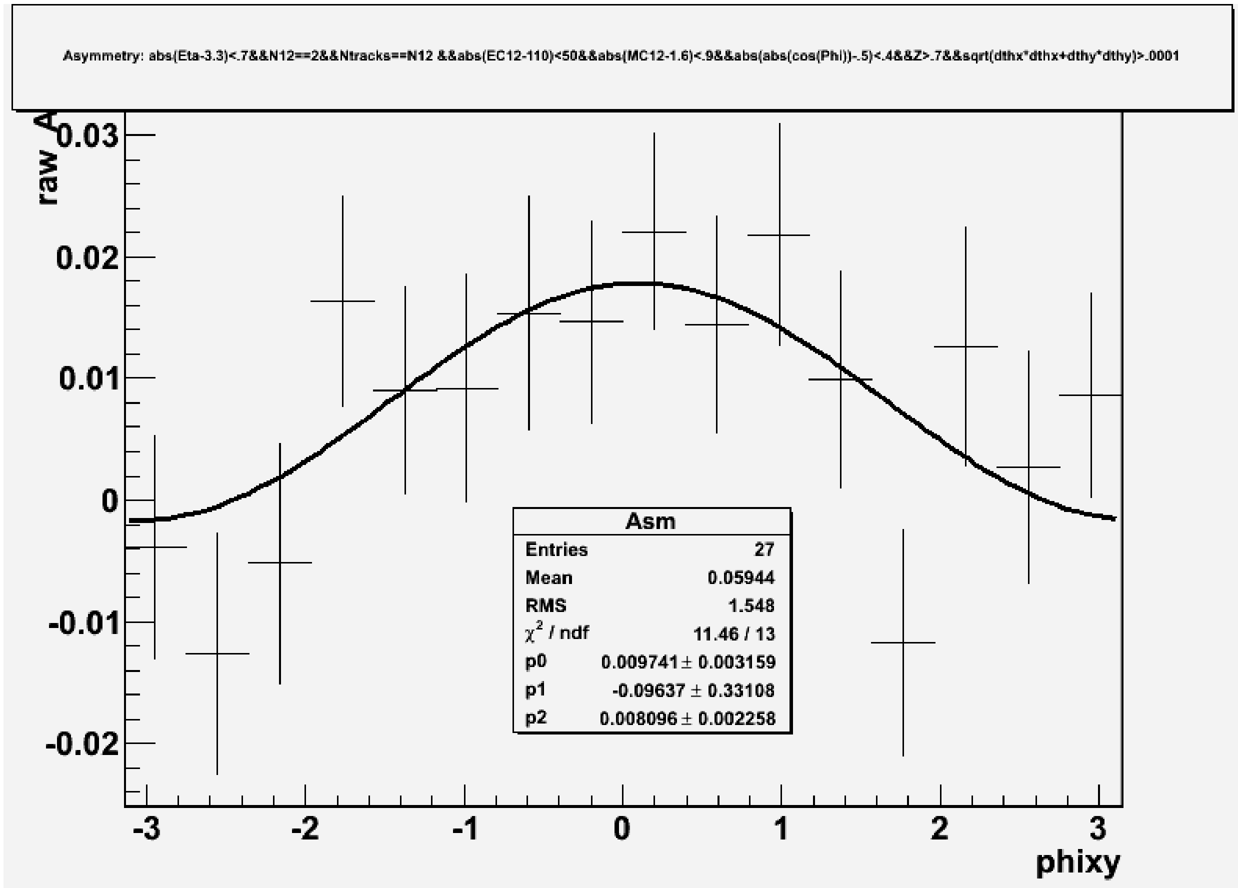

Figure 3: We plot the asymmetry ratio with respect to the blue beam vs. the angle phixy=atan2(dphy,dphx). The fit is to p0*Cos(phixy +p1)+p2. The amplitude p0 = .0097 +- .0032 implies a 1% amplitude about 3 standard deviations from zero. The fitted phase p1 ~= 0 is consistent with the nominal beam polarization direction. The offset p2 suggests an overall luminosity ratio of 0.8 % as seen earlier for the blue beam.

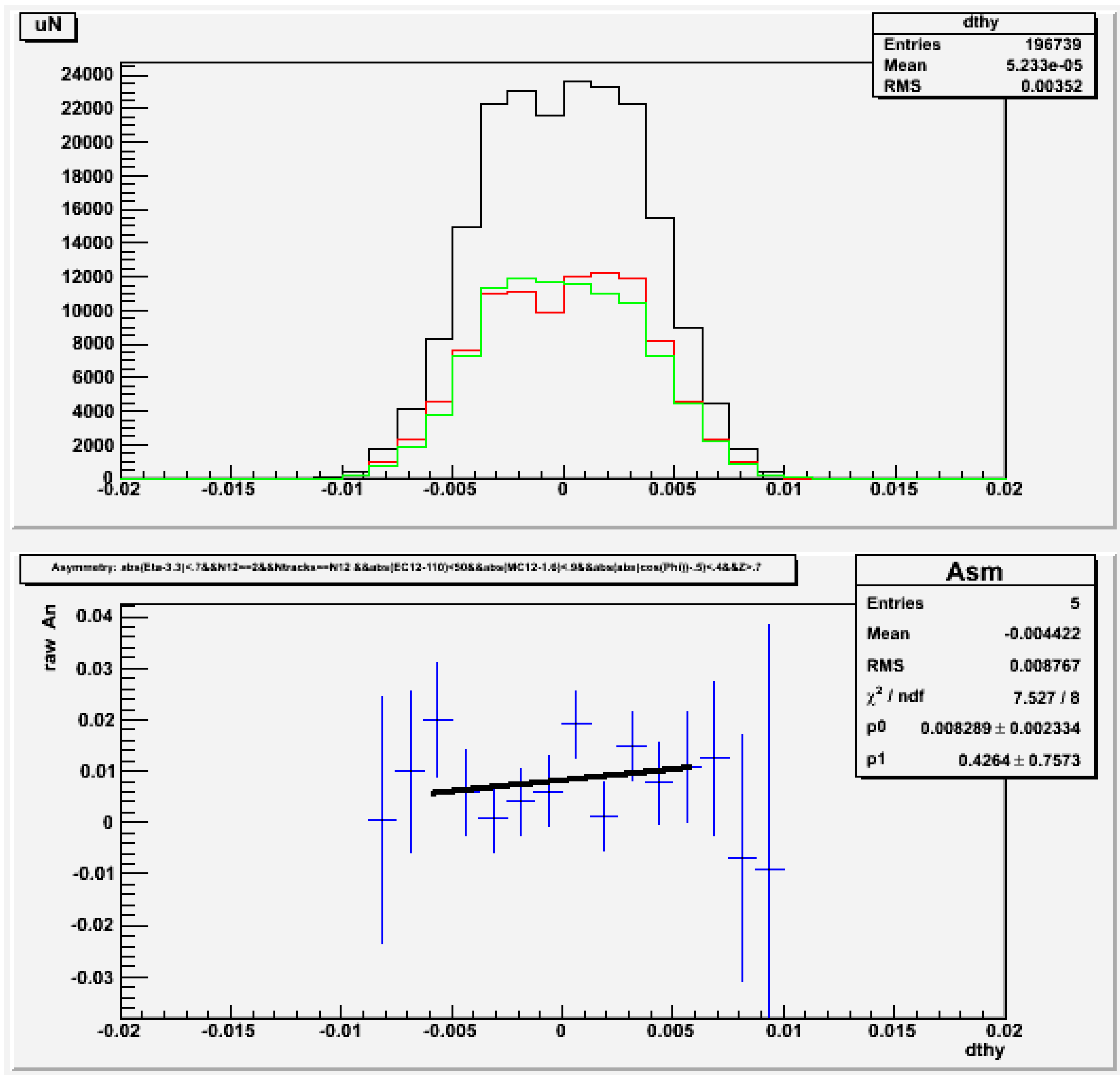

Figure 4: This is the direct analog to Figure 2 but the horizontal axis is dthy, the y component of the angular separation. Asymmetry is calculated with respect to the blue beam. In the upper frame, red and green correspond to north and south going collections. Again, the slope is consistent with zero.