Things to think about based on preliminary look at Run 11 (30 Runs day 95-96)

Version 6   S.H.

Note: Asymmetries discussed here are raw cross ratio asymmetries with Left/Right defined as $Cos(\theta) < -.5$ *or* $Cos(\theta) > +.5$ *except where otherwise indicated.*

Contents

Selection of Data for this Analysis

All non-LED FMS triggers are included in this analysis. Photons are reconstructed for each of 4 FMS detectors and photons are found based on clusters using the Yiqun class. Photon clusters that split between two detectors may still be counted as two photons.

For each event, any photons with energy smaller (4GeV/6GeV) in (large/small FMS detectors) are classified as "soft photons" and will be ignored. For events with more than 60 GeV total the average energy thus ignored is about 2.5 GeV. Surviving photons are grouped into localized jet like collections of photons that can be contained within an angular cone. A cone radius of 70 mRad was used in this analysis. There can be several such jet-like collections in an event.

This analysis characterizes these photon jet-like collections. The variable N12 is the number of photons in the jet-like collection. The variable M12 is the mass of the collection. The variable E12 is the summed energy of photons in the collection. The variables Eta, Phi and Pt refer to the 4 momentum of the collection.

For collections with E12>60 GeV, 40% of the collections have 1 photon and 30% have 2 photons and about 30% have more than 2 photons. More than ½ of the events have more than 1 jet-like cluster. For this energy range, the average number of photons beyond those in the first cluster is about 1.

Blue vs. Yellow Asymmetry

We expect asymmetry with respect to the blue beam and not the yellow beam. Plotted below is the raw asymmetry defined as

$$A = \frac{N_{up} - N_{down}}{N_{up} + N_{down}}$$

with the spin defined by the blue or yellow beam. This asymmetry is plotted vs Cos(Phi), where Phi is the azimuthal angle of the single photon collection. The event class is single photon collections with energy in the range 45GeV <E12 < 95 GeV.

Note that the fit to a 1st order polynomial gives a slope that is the single spin A_N and the constant term gives the ratio of up/down luminosity. The fits indicate

$$A_{N\,blue} = 0.91\% \pm 0.07\%$$
$$A_{N\,yellow} = 0.05\% \pm 0.07\%\,.$$

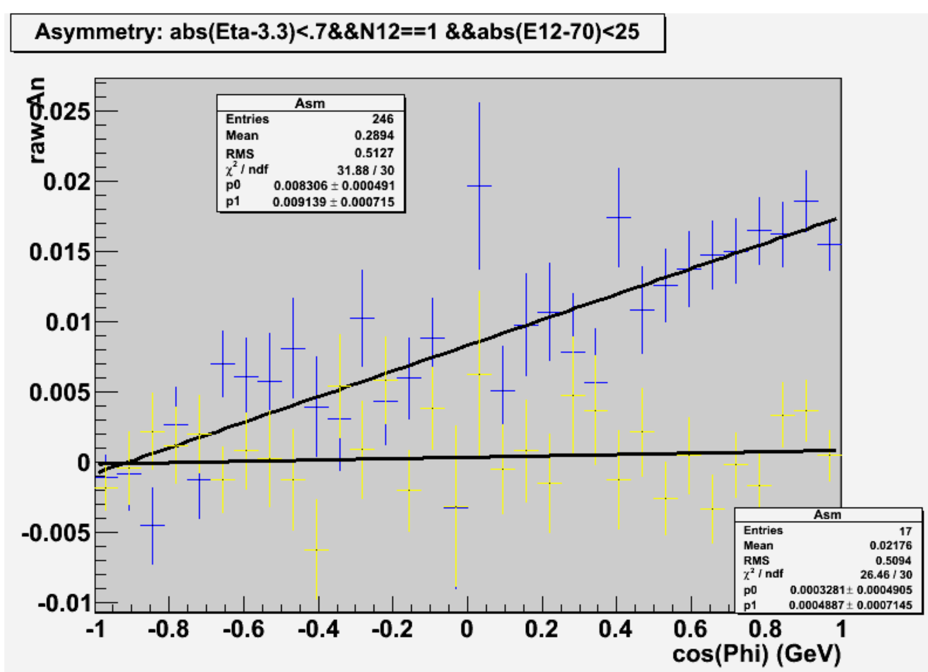

Figure 1: The cos(Phi) dependence of asymmetry is fit to a line for single photon events in the range 45GeV <E12 < 95 GeV . Blue beam Asymmetry and yellow beam asymmetry are both shown by colors. The positive

raw A_N with respect to the blue beam is about 0.91% and 13 standard deviations from zero. The asymmetry of the yellow beam is consistent with zero.

Fill by Fill

Asymmetries discussed in the remaining sections of this note will be with respect to the blue beam.

Note that we do have the statistics within a fill (and perhaps a run) to monitor the asymmetry from fill to fill.

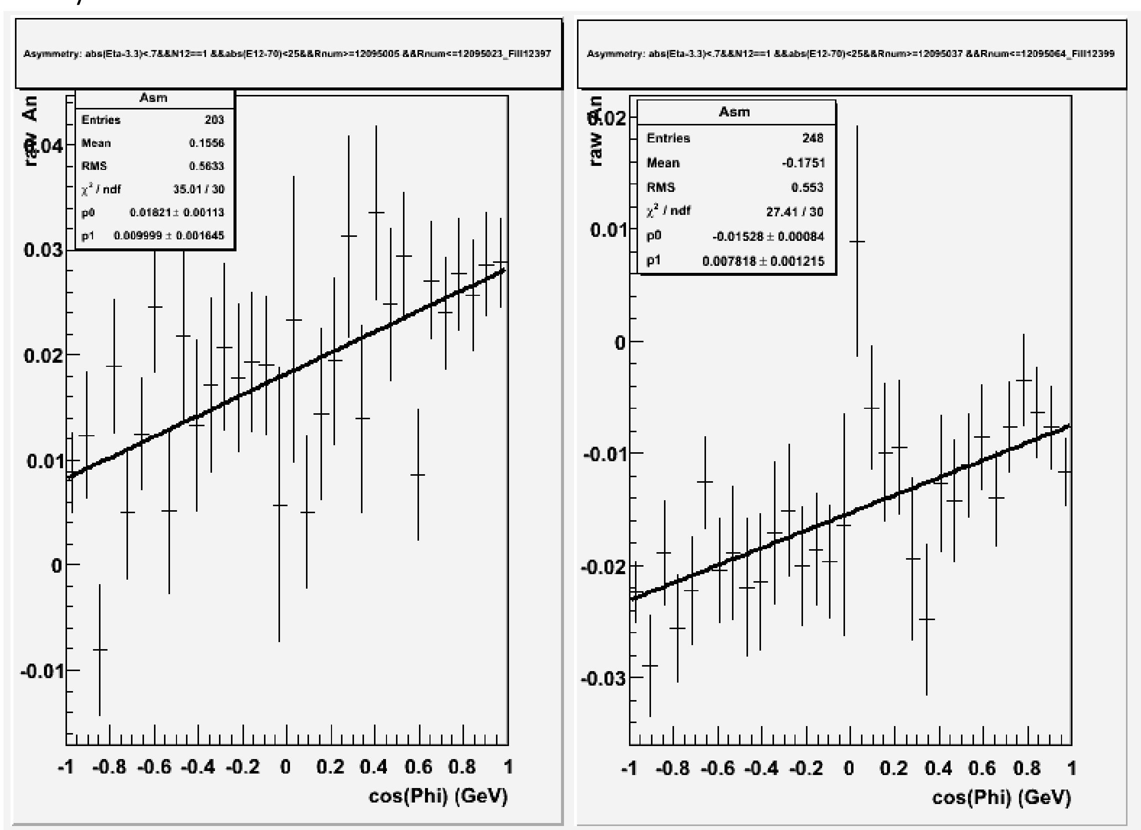

Figure 2: Similar to previous Figure (Figure 1) but separated by Fill for two day 95 fills.
Left: Fill 12397; Right: Fill12399
Note that the fit parameters (p0, p1) are the spin luminosity ratio and A_N.
We have the statistical reach to monitor this asymmetry on a fill by fill basis both for spin pattern consistency and luminosity ratio.

New Questions to think about.

1) Does the Asymmetry for observed single photon clusters
    a. increase with P_T for X_F<.48
    b. fall with P_T for X_F>.48, going significantly negative at large P_T.
2) Does the **positive** asymmetry A_N gently grow with two photon mass?
3) Does the asymmetry turn **negative** as the two photon mass approaches the charm threshold?
4) Integrating over large masses, does the A_N become large for X_F>.8?
5) Is it possible that the large A_N seen in run 6 Eta production is a result of the fact the Eta Mass is the largest mass accepted by our FPD trigger in Run 6 at 100 GeV? Does the mass at which A_N gets large increase with energy?
6) Is the pi0 and Eta asymmetry A_N smaller than at s=200GeV for X_F<.5 and 3.55<Y<3.95.

Pt Dependence for 1 and 2 Reconstructed Photon Events.

We noted that the P_T dependence of A_N for observed 1 photon events is consistent with a constant value of about .015 for 0.36<X_F<0.52 but favors a positive slope in the range. The asymmetry is about 12 standard deviations above zero.

Transverse Momentum Dependence

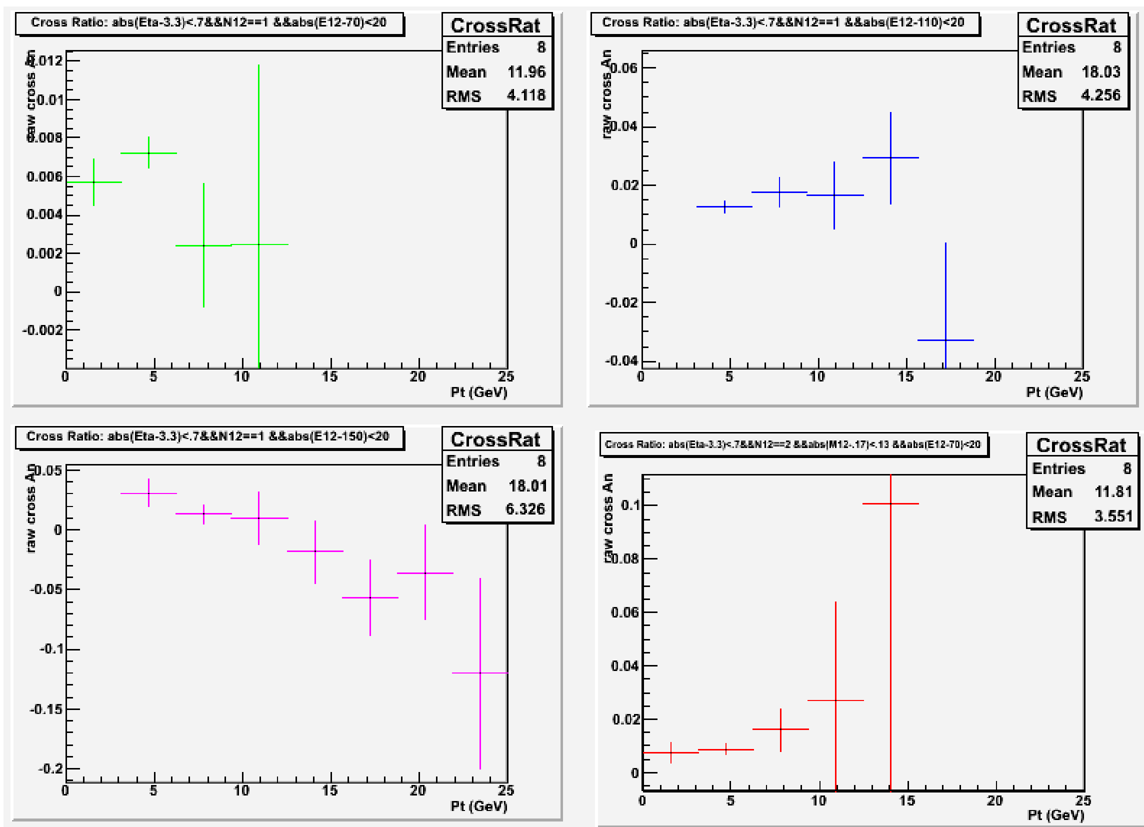

Figure 3: P_T dependence of A_N for one and two Photon cluster events:
upper left: 1 photon, 0.2<XF<0.36; upper right: 1 photon 0.36<XF<0.52;
lower left: 1 photon, 0.52<XF<.68; lower right: 2 photon (Mass<0.3 GeV) 0.2<XF<0.36.

Mass Dependence of A_N

If we look at the dependence of A_N on 2 photon mass, including all triggers 3.05<Y<4.05, we see a possible structure in the A_N vs Mass (Note: there is no Z cut).

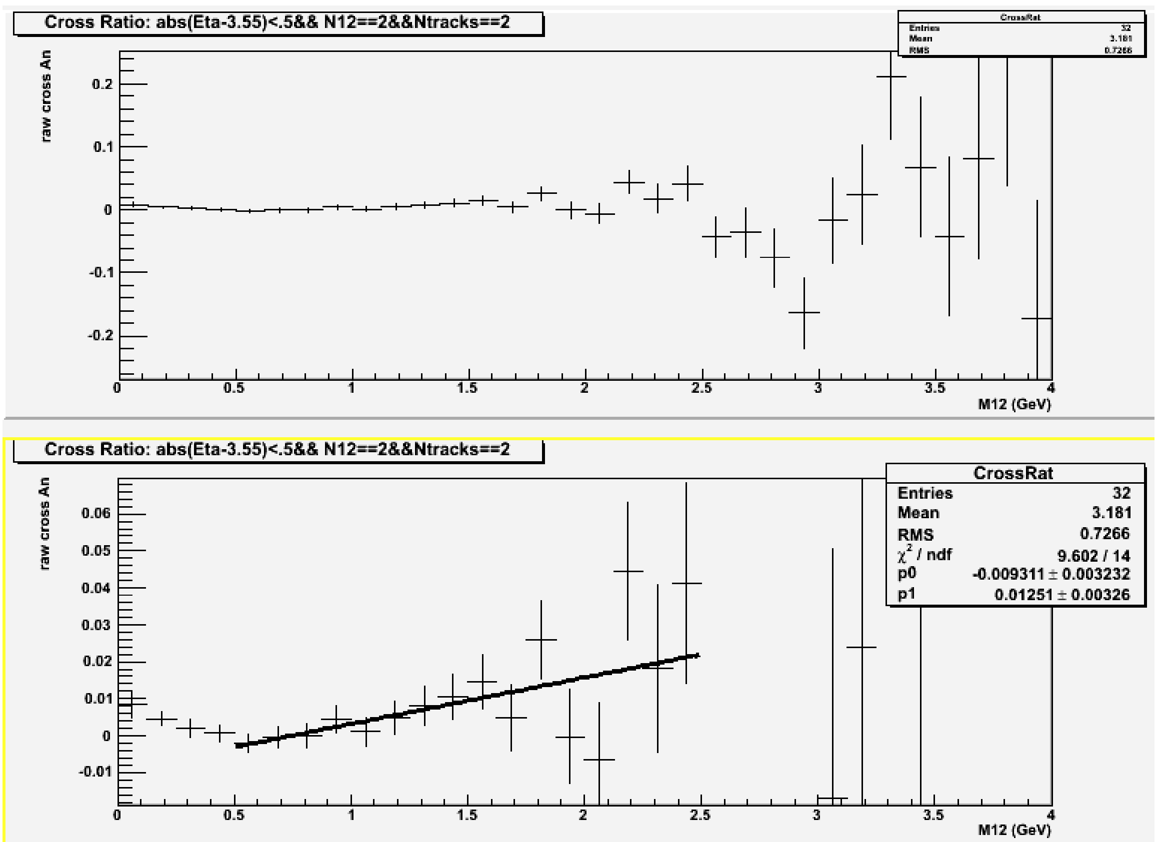

Figure 4: <u>A_N vs collection Mass for all two photon collections in the small Cell region.</u> The lower frame is just the same as the upper frame but with a different vertical scale. The positive slope is shown for the Mass region (.5 GeV <Mass< 2.5 GeV) and is 3 or 4 standard deviations above zero. There is a trend for increasing A_N with increasing Mass up to Mass of 2.5 GeV. The Chi2/DOF for a constant fit over the mass region from 2 to 4 GeV is 30/15 with likelihood of about 1%. Statistics will resolve a question about possible structure in this distribution. Around 3 GeV there may be evidence of a region of Negative A_N.

There is an indication of possible structure in A_N vs Mass with a negative asymmetry for Mass above about 2.5 GeV. Is it possible that many of the two photon events in the J/Psi region are actually e+/e- pairs?

In Figure 5, the possible mass dependent structure is seen to only be associated with events that have exactly two photons (excluding possible soft photons as described above).

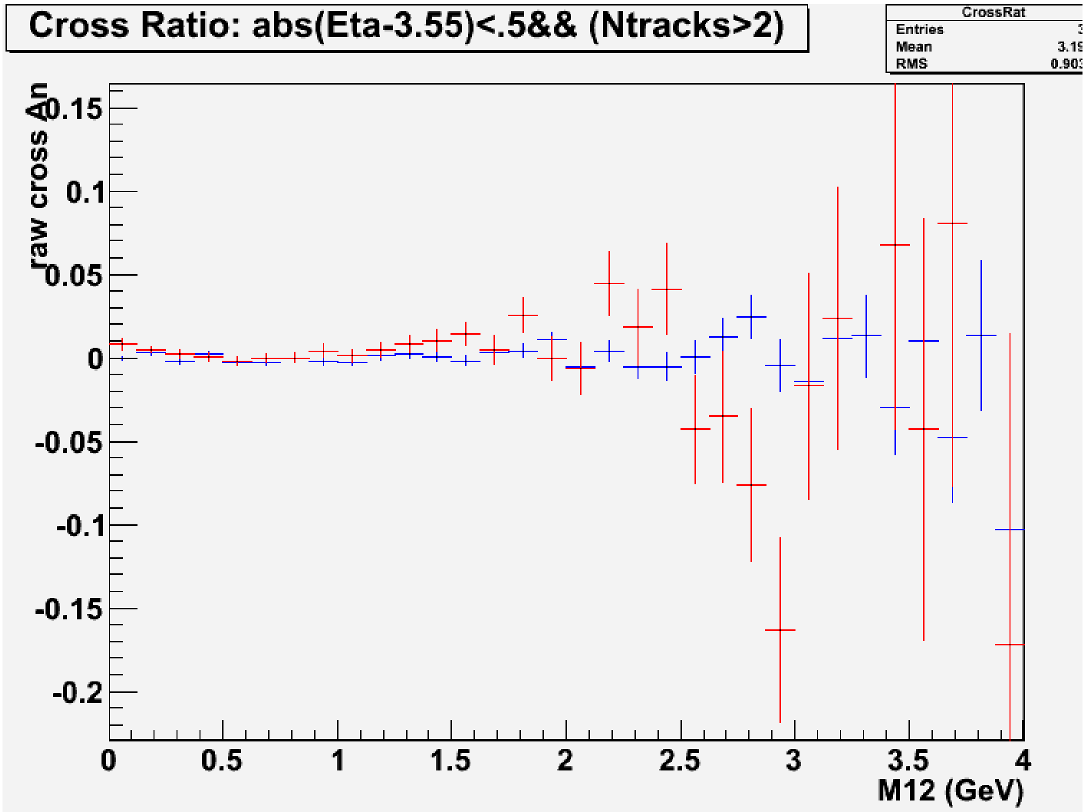

Figure 5: Similar to Figure 4 showing A_N vs collection mass. The red involves events with exactly two photons. The blue involves at least one additional photon (either a 3 photon collection or a 2 photon collection with a second collection in the same event).

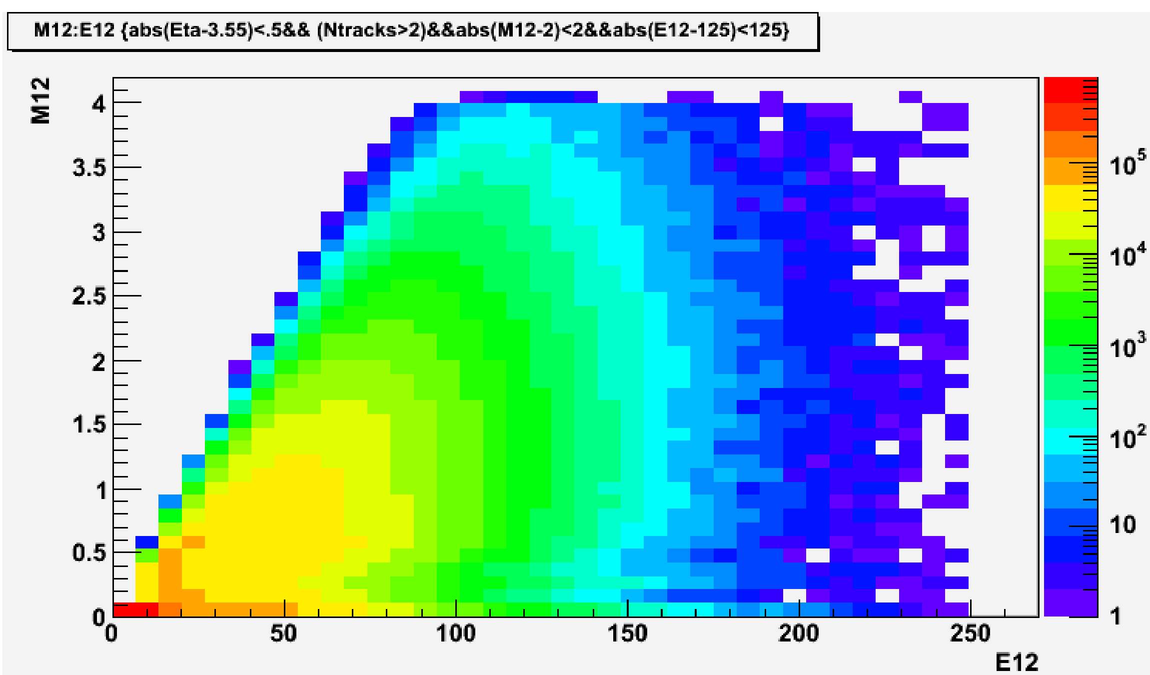

Figure 6: Mass vs Energy for Collections that have at least one extra photon, either N12>2 or more than 1 collection per event.

Energy Dependence

Energy dependence for single photon, two photon (all Mass) and two photon M~3 GeV.

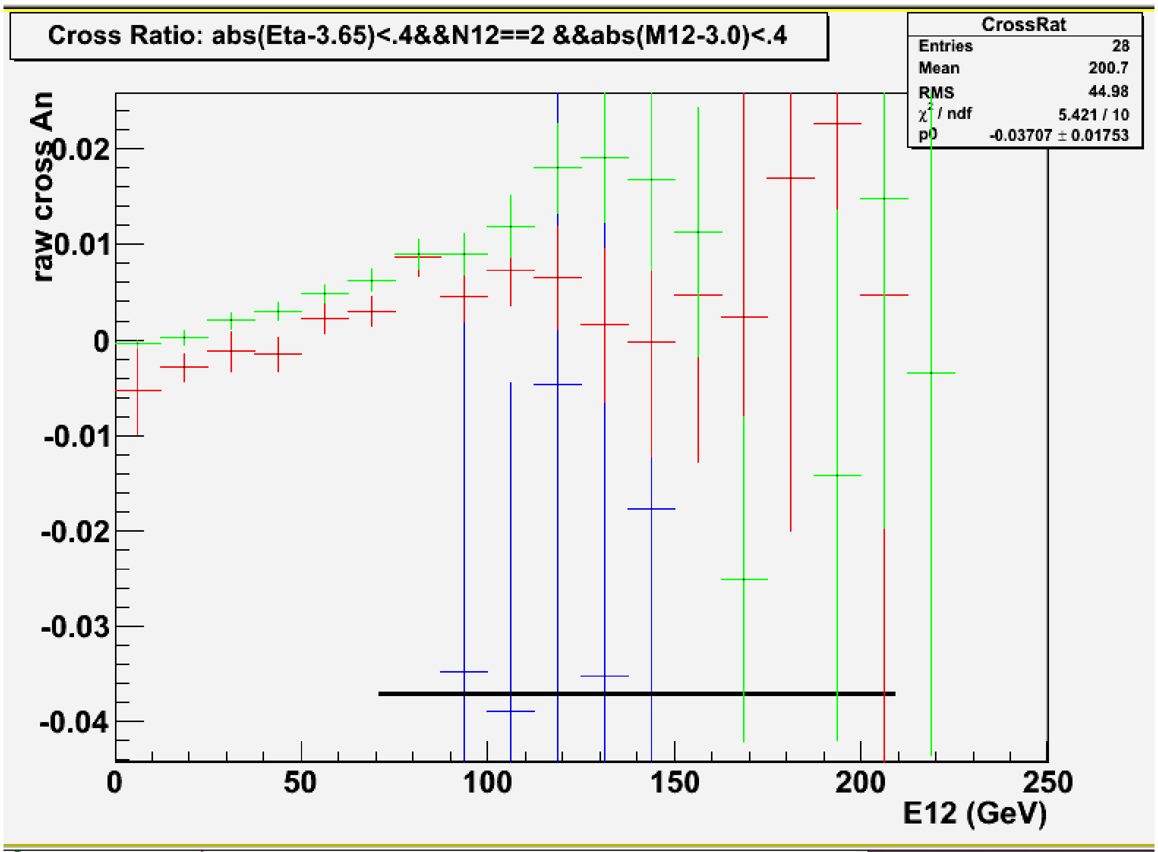

Figure 7: Energy dependence of A_N for 3 event samples.
green: single photon cluster;
red: two photon clusters (0 GeV< Mass < 4 GeV);
blue: two photon clusters (2.6 GeV <Mass < 3.4 GeV).

Does the asymmetry become negative for masses around the charm threshold? Nominal value of A_N for (2.6 GeV <Mass< 3.4 GeV) is $A_N \sim$ -.04 ? This value is a little more than 2 standard deviations from zero.

Energy Dependence for all Masses and large X_F.

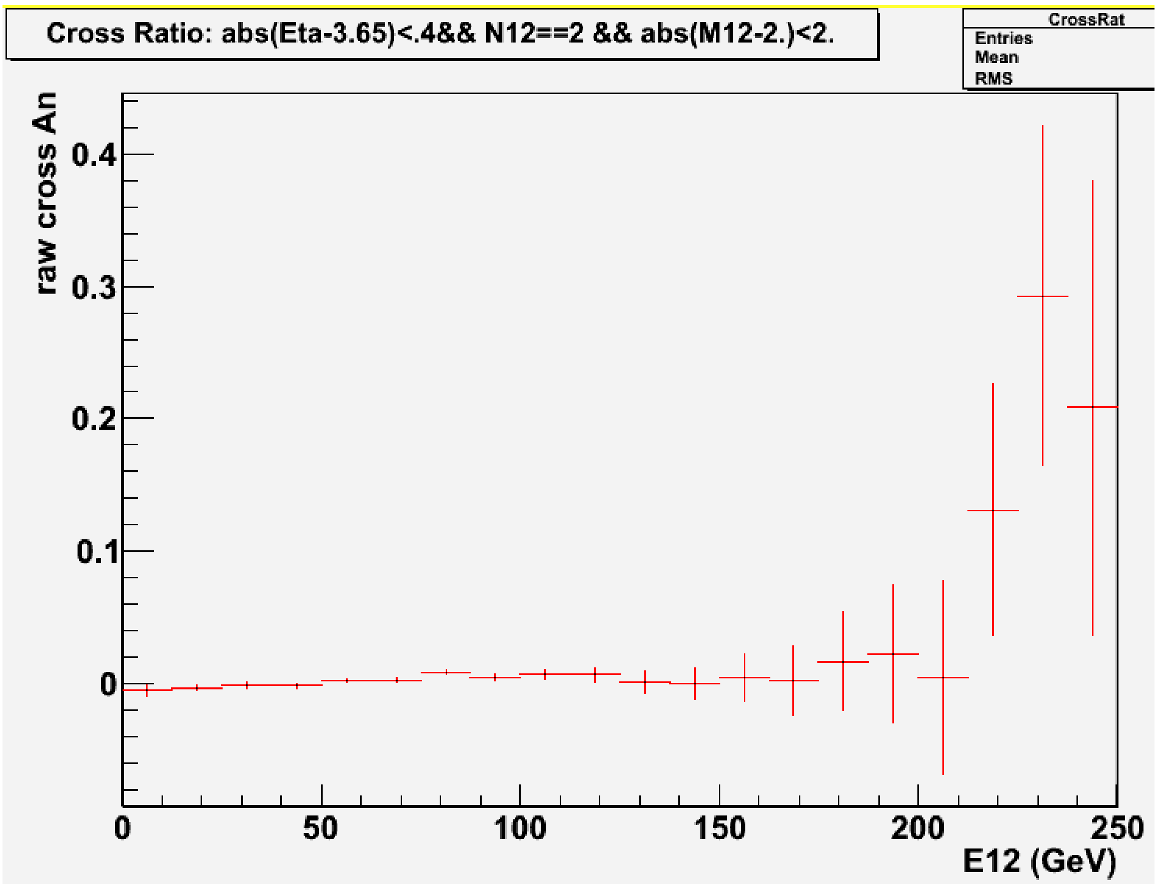

Figure 8: 2 Photon clusters (0. GeV < Mass<4 GeV). Here we see the gentle increase of A_N with energy up to about 125 GeV. The result is consistent with a large value of A_N for X_F>0.8 but statistics will resolve the question.

Question: Will the rise at large X_F hold up with additional data?

Analysis of Eta Meson

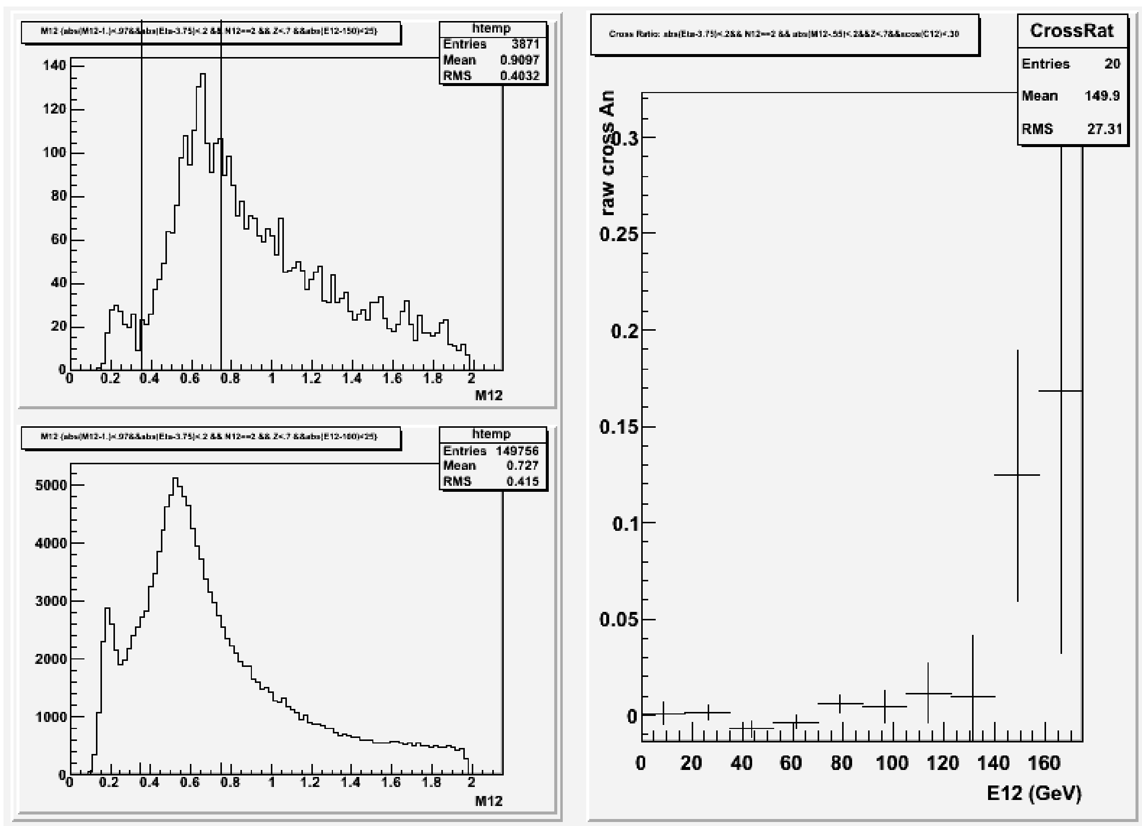

Figure 9: The Eta is analyzed in the region (3.55<Y<3.95; Z<.7; N12==2) ;
Lower Left: Mass for 75GeV<E12<125GeV; Upper Left: Mass for 125GeV<E12<175GeV (with mass cut shown);
Right: Raw A_N vs Energy