Dual analyzer in Hall A FPP

Efforts have been undertaken to increase the figure-of-merit (the efficiency times the square of the analyzing power) of the focal plane polarimeter (FPP) in the Hall A left arm spectrometer. In E99-007, which extended the measurement of $\mu G_{Ep}/G_{Mp}$ to $Q^2 = 5.6$ GeV^2, polyethylene (CH_2) was used instead of carbon as the analyzer for the FPP. CH_2 (about 56 cm thick) was placed between the carbon doors and ,in addition, CH_2 (about 44 cm thick) was mounted on a holder in front of the carbon doors. This gave a 100 cm thick CH_2 analyzer between front and rear FPP chambers. The increased figure-of-merit made it possible to do a measurement of *ep* elastic polarization observables at proton momentum of 3.8 GeV/c .

Subsequent to this experiment, it was proposed to build a FPP in Hall C to extend the measurement of $\mu G_{Ep}/G_{Mp}$ to larger Q^2 [1]. The new FPP will consist of two analyzers in series with chambers before and after each analyzer , a dual analyzer. Measurements at Dubna proved that the analyzing power and efficiency were relatively constant when the CH_2 thickness was increased from 40 to 86 cm at a proton momentum of 3.8 GeV/c [2], which supported the idea that it was better to have two analyzers in series rather than one very thick analyzer.

One part of E99-114, the Real Compton Scattering experiment, was measuring the polarization of the outgoing proton at one kinematics. To improve the figure-of-merit of the FPP, it was decided to try the dual analyzer approach by moving the 44 cm thick CH_2 between the VDC and the front FPP chambers while still using the carbon for the second analyzer. The ESPACE software was modified so that scattering angles of the protons in the first CH_2 analyzer could be determined from the VDC track and the track in the first set of FPP chambers while retaining the ability to determine the scattering angles of the protons in the second carbon analyzer. An *ep* elastic measurement was done at $Q^2 = 4.1$ GeV^2 (momentum of 2.98 GeV/c) to calibrate the analyzing power of the carbon and CH_2. In the top plot of Fig. 1, the analyzing power of CH_2 and carbon are plotted as a function of the proton scattering angle. In the middle plot in Fig. 1, comparison is made to analyzing powers measured during e99-007 using 100 cm thick CH_2 at about the same proton momentum. The analyzing power is the same for both thickness which confirms what was measured at Dubna. In the bottom plot, the comparison is made to earlier measurements of the analyzing power of carbon from E93-027 at lower proton momentum. The analyzing power for carbon is dropping off with higher proton momentum. For the carbon scattering events, a cut was placed to restrict the scattering angle in the CH_2 to be smaller than one degree (these events should mainly be multiple scattering in the CH_2). Studies have to be undertaken to determine whether this is the optimal cut to maximize the FPP's figure-of-merit. A more thorough offline analysis is almost complete.

Recently, in E00-007, "Proton Polarization Angular Distribution in Deuteron Photodisintegration", the dual analyzer FPP system was used for a wide range of proton momentum. Therefore, there should be a database of figure-of-merits for the dual analyzer FPP over a range of proton momentum to help plan future experiments.

References

[1] Proposal E01-109, C. F. Perdrisat, V. Punjabi, M. K. Jones and E. Brash.

[2] L. S. Azghirey *et al.*, to be published in the proceedings of SPIN 2002 at BNL.

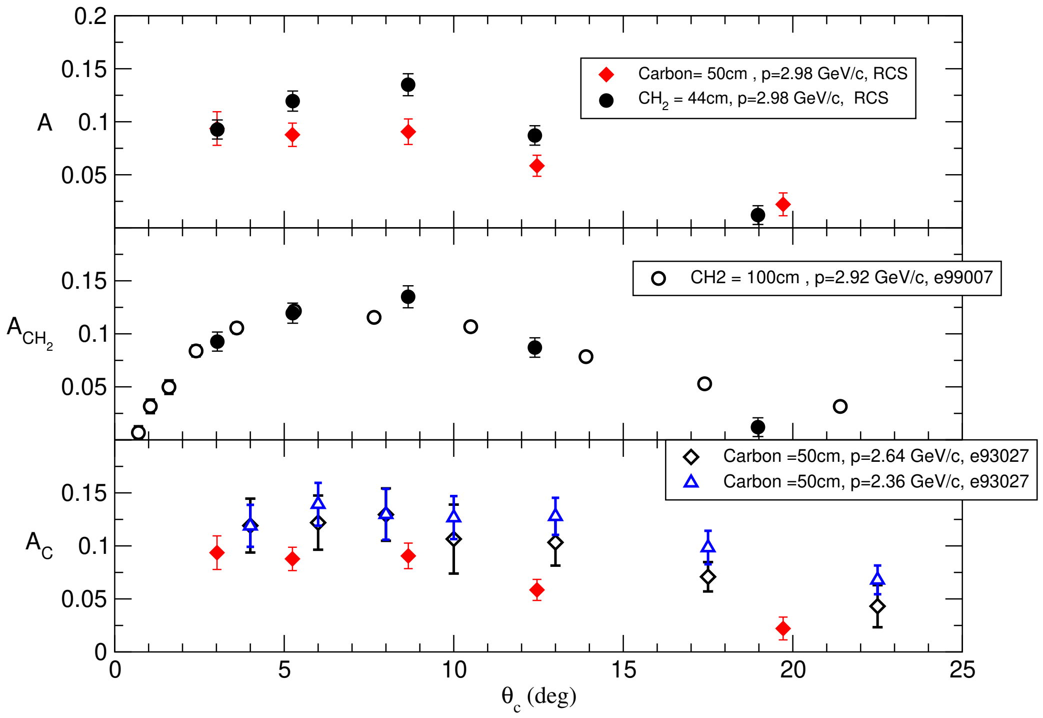

Figure 1: Online, preliminary analyzing power data for e99-114. The top plot shows the analyzing power for CH_2 (carbon) versus scattering angle of the proton in the CH_2 (carbon) with the dual analyzer in RCS. The middle plot compares the analyzing power for CH_2 measured in RCS to previous measurement during E99007. The bottom compares the analyzing power for carbon measured in RCS to previous measurement during E93027.