Dear 5 MeV Mott Perpetrators:

I want to clarify my comments made towards the end of the teleconference yesterday (after Charlie got off the line) regarding strategic planning for Run 2. These ideas are probably obvious to all, but it will help me to write them down.

1) If our 5 MeV Mott polarimeter had no temporal drift in its response, we would still observe a variation of Ao from Run 1 to Run 2 because of, e.g., changing photocathode conditions.

2) Ao = αSPe, where Pe is the incident electron polarization, Ao is the experimental asymmetry extrapolated to zero foil thickness, S is the Sherman function corresponding to single-collision elastic scattering, and α is a numerical factor that accounts for imperfections in the polarimetric measurement (see below). Note that the oft-quoted “effective Sherman function,” Seff (which is basically the polarimeter’s analyzing power) is equal to αS. The values of Ao and Seff are uncertain for the following reasons.

Seff

a) There is a theoretical and numerical (calculational) uncertainty in S which we will take to be 1% for the purpose of discussion.

b) There is uncertainty in the incident beam energy and energy spread in the beam. This uncertainty is incorporated implicitly in the uncertainty of our knowledge of S.

c) There is uncertainty due to non-ideal geometric factors such as non-point-like detector sizes, finite beam spatial width, etc. This uncertainty contributes to the uncertainty in α.

The uncertainty in Ao is more complicated and is due to:

d) Random statistical error associated with the target thickness fitting and extrapolation procedures. This includes the Poissonian count √N uncertainties for data taken with each target, uncertainties in the *relative* target thicknesses, ambiguity regarding the appropriate function to use in fitting the asymmetry *vs*. thickness data, and temporal drifts that occur during data acquisition.

e) Uncertainty due to data cuts based on our attempts to ensure that only elastic events are considered.

3) Any uncertainty in the incident electron energy of Run 1 essentially results in an implicit additional uncertainty in S that must be added in quadrature to the 1% theory error.

4) In order to use the calculated, “theoretical” S in the equation Pe = Ao/αS, we must consider only those detector counts that correspond to single, elastic scattering. This requires, first, the interpolation of asymmetry data to zero foil thickness, which formally meets the single-scattering requirement. Secondly, cuts must be made to the accumulated detector counts that, to the best we can manage, eliminate only inelastic events. What is the basic metric one should use to choose between different cuts? I believe it should be that whatever cut gives the highest asymmetry is the most appropriate one. This is based on the assumption that inelastic scattering processes always reduce the left-right asymmetry for a given Pe.

5) Run 2 must focus on minimizing the uncertainties in our determination of α and Ao, and testing theory to the extent practicable. A set of runs in Run 2 with varying foil thickness will give us improved information about the uncertainties and reproducibility associated with the target thickness extrapolation procedures. One would hope that in Run 2 we would obtain the same γ, within statistics, as that obtained in Run 1. *Such measurements will tell us nothing about uncertainty in S*.

6) A systematic measurement of Ao as a function of incident energy from 3 MeV to 8 MeV, assuming that Pe doesn’t change, does provide a useful test of theory because a correct theory should get the right energy dependence of S. Such a measurement also helps us to understand the experimental uncertainty in our determination of the incident energy.

7) We will need GEANT to make the most reliable calculations of α.

CONCLUSION: I support Joe’s Run 2 plan:

Asymmetry vs.

* + - repeat target thickness KE=5.0 MeV, get same result twice (2 shifts)
    - energy dependence (2 shifts)
    - spot size – measure with OTR + beaminizer, may need camera (1 shift)
    - energy spread – change w/o E shift and measure (1 shift)

with the caveat that we try to combine the last two bullets into one shift to give plenty of time for the first two bullet points.

Tim