PVDIS BAFFLES AND NEW B FIELD MAP

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1. Introduction

To date the SoLID B field has been modeled with a two-dimensional model assuming continuous azimuthal symmetry. Recently Jay Benesch has modeled the SoLID B field in three dimensions and Zhiwen Zhao has created a field map file from Jay's results. The development version of solid_gemc, based on GEMC 2.7, has new code to read and interpolate this field map. Here I investigate the new field map's effect on PVDIS physics.

2. New field map

The old field map is two-dimensional, with values specified on a grid of points in r versus z space; continuous azimuthal symmetry is assumed, and bilinear interpolation is used to find the field values at arbitrary points. The new field is three-dimensional. Values are specified on a grid in r versus ϕ versus z space in the first quadrant ($0° < \phi < 90°$), with fourfold azimuthal symmetry assumed for the other three quadrants and trilinear interpolation used between grid points.

The new field could produce different results in part because of differences in the average r versus z behavior, and in part because of the ϕ dependence of the new field which might e.g. alter the acceptance of the baffles.

3. Geometric acceptance

Geometric acceptance is determined by throwing 10^6 electrons uniformly distributed in momentum $2 < p < 6$ GeV/c, polar angle $15° < \theta < 45°$, azumuthal angle $-180° < \phi < 180°$, and vertex z coordinate $-100 < z_v < 300$ mm in a simulation with Kryptonite baffles and solenoid, with virtual planes around the baffles; the acceptance then is the ratio of the number of primary electrons reaching the downstream end of the baffles to the number that reach the same z in the absence of baffles. Figure 1 shows plots of the ratio of the acceptance using the new field to that using the old field, as a function of p, θ, and z_v. The ratio is flat and consistent with unity within a few percent.

4. DIS electron positions

As a low level check of the differences in electron trajectories between the two fields, 10^6 electrons from the DIS event generator (using 11 GeV beam energy and deuterium target) were used in simulations with Kryptonite baffles and solenoid. The same primary electrons were used for both. Comparing outputs with the old and new fields, one finds

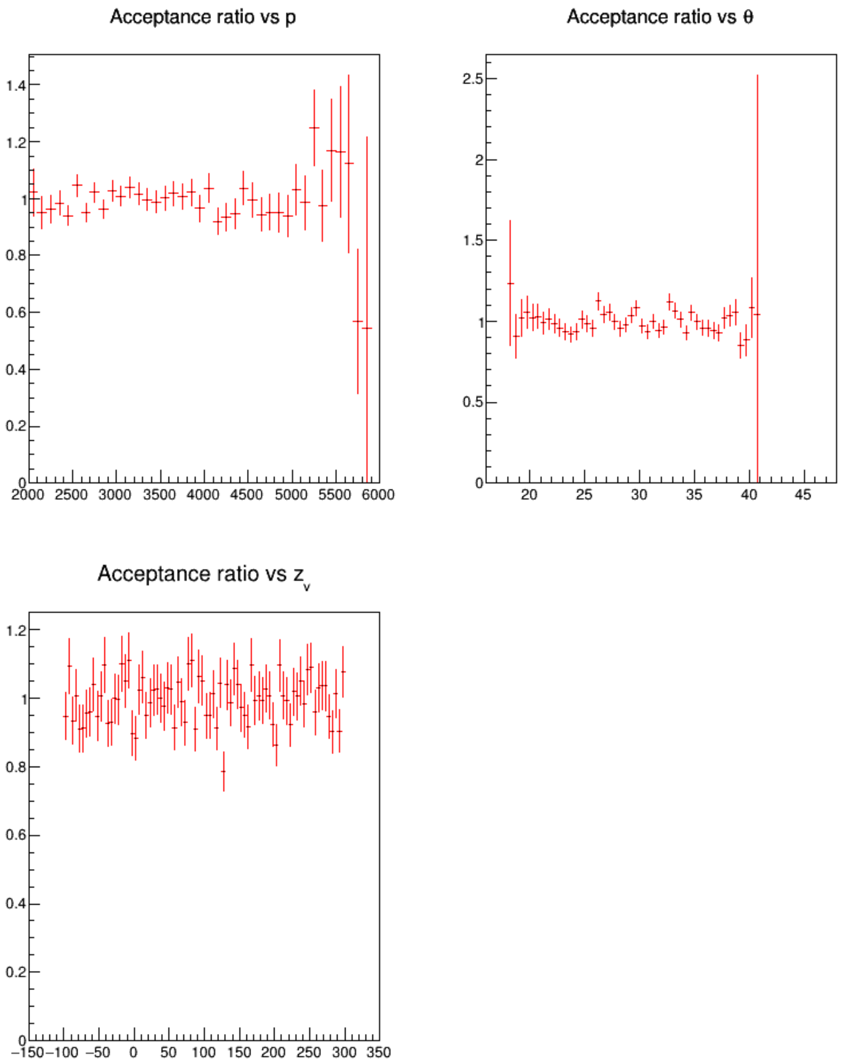

FIGURE 1. Ratio of geometric acceptance obtained using the new field map to that using the old field map, as a function of p (in MeV/c; top left), θ (in degrees; top right), and z_v (in mm; bottom left)

that in most events there are the same number of hits in the same virtual planes. For these events, one can compute the difference of the 2-dimensional position vectors at a z position downstream of the baffles, $\vec{\Delta} = \vec{x}_{new} - \vec{x}_{old}$. The top row of Fig. 2 shows the average value of Δ_r, the radial component of $\vec{\Delta}$ (that is, the component in the direction of the radial unit vector), as a function of radial coordinate r (left); a 2-dimensional plot of Δ_r

versus r (middle); and the average value of Δ_r versus azimuthal coordinate ϕ (right). The bottom row is similar but for Δ_t, the transverse component of $\vec{\Delta}$ (that is, the component orthogonal to the radial unit vector). There are small systematic shifts in both radial and

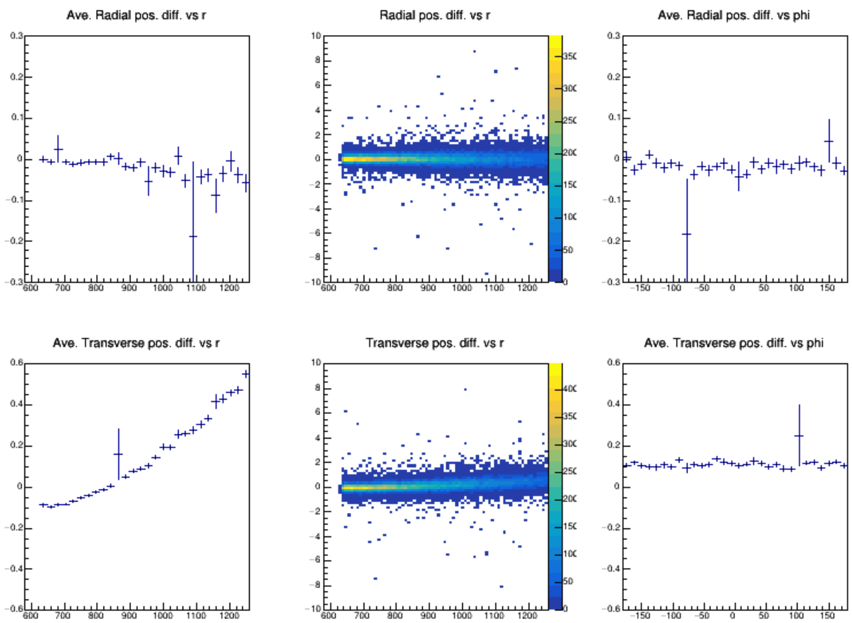

FIGURE 2. Top left: Average value of radial component of position difference, Δ_r (in mm) between new and old fields, for DIS electrons at the downstream end of the baffles, versus radial coordinate r (in mm). Top middle: Δ_r versus r. Top right: Average value of Δ_r versus azimuthal coordinate ϕ (in degrees). Bottom row: Same but for transverse component of position difference, Δ_t (in mm).

transverse position as functions of r, with maximum average position differences around 50 μm in the radial direction and about 450 μm in the transverse direction at $r \sim 1250$ mm. There is no significant azimuthal variation in average position differences.

5. DIS flux

Using the same DIS data we can examine the flux of DIS electrons versus various kinematic variables downstream of the baffles. Flux ratios between the new and old fields are shown in Fig. 3 for electrons with $x_{bj} < 0.55$ and in Fig. 4 for electrons with $x_{bj} > 0.55$; ratios are plotted versus θ, z_v, Q^2, x_{bj}, and y. Error bars shown are too large because the two data sets are correlated, having the same primaries, but it is clear in all cases the ratios are flat and consistent with unity within statistical fluctuations.

We may conclude that the position shifts between old and new fields are too small to produce significant differences in DIS electron fluxes that would affect the experiment's physics reach.

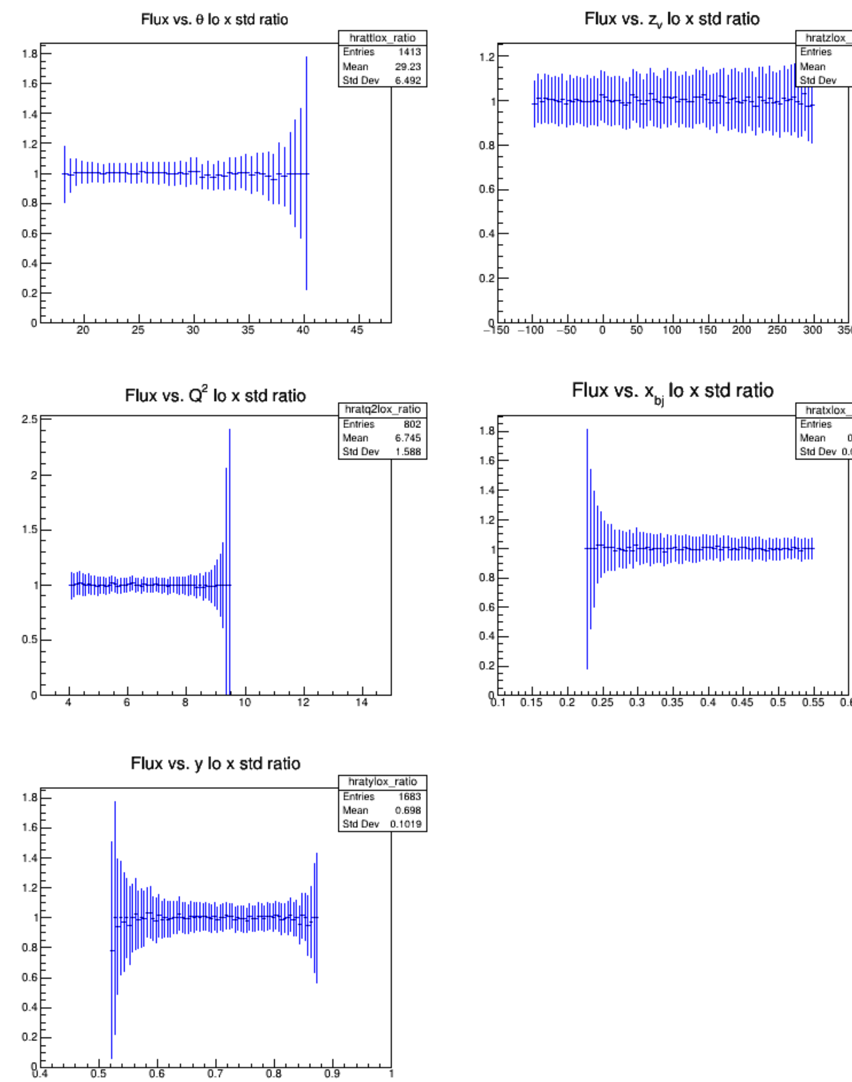

FIGURE 3. Ratio of DIS electron flux downstream of baffles for new versus old field maps, for electrons with $x_{bj} < 0.55$, plotted versus θ (top left), z_v (top right), Q^2 (center left), x_{bj} (center right), and y (bottom left).

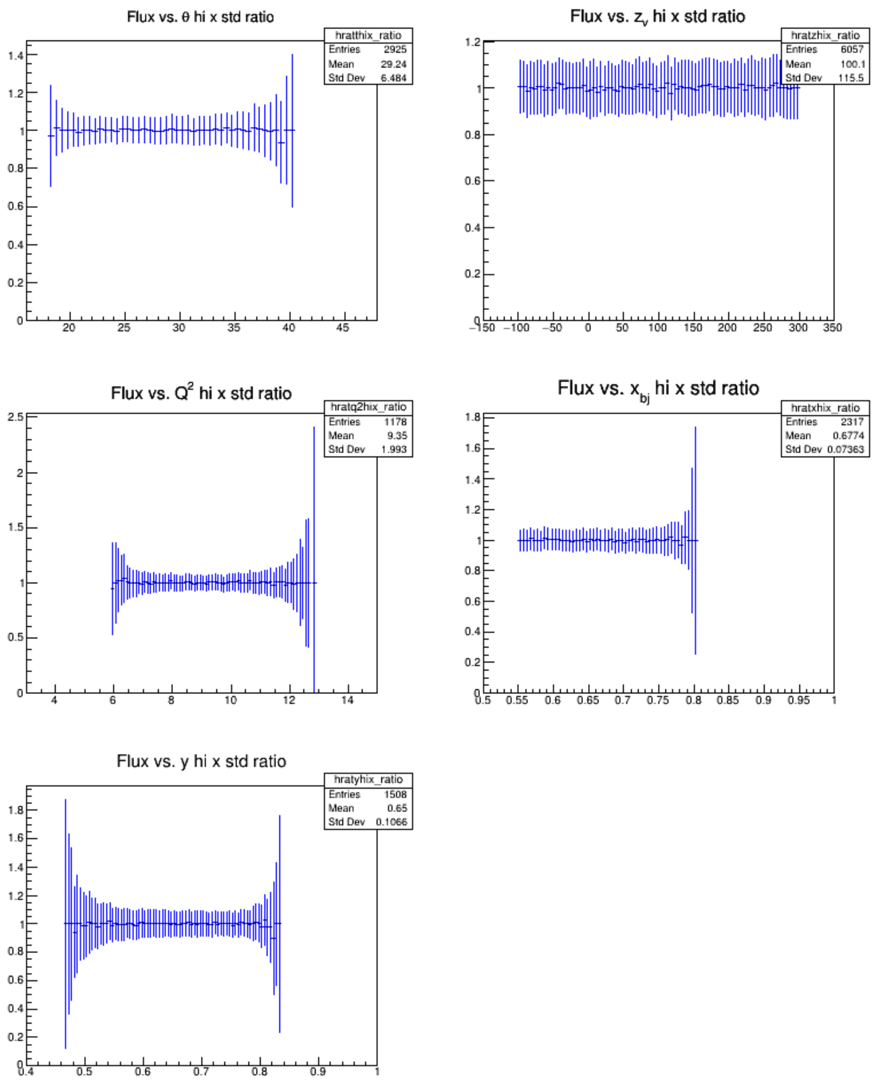

FIGURE 4. Same as Fig. 3, but for electrons with $x_{bj} > 0.55$.