**Discussion of the estimate of the spin axis electric field from the two dimensional electric field measurement in the spin plane-- estimate of error sources and criteria for accurate measurement**

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This discussion uses the mGSE system as defined on the UMN RBSP EFW website. Note the x mGSE component for RBSP is along the spin axis and the y mGSE and z mGSE are in the spin plane and therefore directly measured by the long rotating booms. I drop the mGSE notation for ease of notation.

Suppose the parallel component of E is zero, (that is much smaller than the perpendicular electric field), then:

Ex Bx +EyBy +EzBz = 0.

The spin axis electric field (Ex) is:

Ex= -(By/Bx)Ey + - (Bz/Bx) Ez

It is clear that a small error in Ey is multiplied by the factor (By/Bx) in producing an error in Ez .

Similarly a small error in Ez produces an error in Ex which is larger by a factor of Bz/Bx.

So generally, the lowest errors in |Ex| are produced by small ratios in |By/Bx| and |Bz/Bx|.

Under this assumption of the parallel component of E ~ 0, a small ratio of those quantities corresponds to a large component of B along the spin axis. In the limit that B points along the spin axis, the error is zero.

We generally use |Bz/Bx|<4 and |By/Bx/<4.

This means an error of 0.25 mV/m in the spin plane electric field will be ~1 mV/m in the spin axis component.

But really the “correct ratio” depends on the specific situation and more specifically the magnitude of the electric field measured by the spin plane sensors, what we think the errors in Ez and Ey are, and the nature of the analysis.

Finally, the assumption that the parallel electric field is zero is typically not true during intervals of double layers, electrostatic shocks (at auroral altitudes) and other strong small scale non-linear structures.