

# Proposed General Scheme for Systematic Errors in EG1b Analysis

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The following is mostly geared towards the inclusive analyses of EG1b data on the proton and the deuteron; however, with some additions and changes the general scheme could also be applied to exclusive data.

## *General idea*

Our goal is to produce tables (and plots) of various physics quantities ( $A_1$ ,  $g_1$ ,  $\Gamma_1$ ) averaged over various bin sizes in  $W$  and  $Q^2$ , based on all of our data (see my previous note on combining data sets). Ideally, each analysis should have a program that reads the DSTs and calculates all necessary corrections and transformations to get these results. The program may have to read in some tables with pre-determined parameters (for instance for radiative corrections), but it should do all the steps from  $A_{\text{raw}}$  to  $A_{\text{II}}^{\text{born}}$  (in our standard bins in  $W$  and  $Q^2$ ) to all the final quantities we want to tabulate and/or plot.

This program would call in turn several subroutines to execute all necessary steps; different people are responsible for these different subroutines (e.g., Nevzat for pion and e+/e- contamination, Rob for dilution factor and proton polarization, Sharon for deuteron polarization, Keith for radiative corrections, Sebastian for models, and so on...). Each subroutine in turn should have several execution modes that will return either the “best estimate” for the correction/transformation required, or “the best estimate plus/minus one standard systematic error” (a guess for the possible 1-sigma deviation from the best estimate). This mode should be controlled by an array of indices; each subprocess should be passed this array and look at the index specific to the subprocess to determine its mode. (I propose that all coders define an integer array named “errindex[20]”. The meaning of each index will be discussed further down.

The purpose for this arrangement is so we can quickly calculate systematic errors on any quantity we are interested in, even if the errors are correlated from bin to bin in our basic  $W$ - $Q^2$  grid. This would be done by simply executing the analysis program within a big do-loop that systematically varies all indices “errindex” over all their possible values, recalculating the final results each time, and then adding the deviations from the “best estimate” (all errindex=0) in quadrature to get the total systematic error.

## *List of systematic errors and proposed indices*

<b>Type of Error</b>	<b>Proposed Index</b>
pi- background	errindex[1]
e+/e- background	errindex[2]
dilution factor	errindex[3]
PbPt	errindex[4]
isotopic impurities in NH3/ND3	errindex[5]
Models of F1, R, A2	errindex[6]
radiative corrections	errindex[7]
Bin migration and smearing	errindex[8]

Note that some indices would affect more than one sub-issue: For instance, when we vary the dilution factor, the resulting PbPt will also vary (so the author of the PbPt subroutines must make sure that they use the dilution factor compatible with the current value of `errindex[3]`). Similarly, the radiative corrections depend on `errindex[6]` because they use models.

### *Specifics*

I'll go through each of the 8 indices (so far) to highlight what my present understanding of the necessary variations is. This is subject to significant change once the experts for each subsystem weigh in with their expertise.

- 1.) pi- background. 2 possible values: 0 (do nothing) and 1 (modify raw asymmetry to correct for possible remaining background).
- 2.) e+/e- correction. 2 possible values: 0 (apply standard correction) and 1 (add error to standard correction).
- 3.) Dilution factor. Several values (to be determined by Rob) for variations in total target length, model uncertainties, etc.
- 4.) PbPt: 0 for standard calculation and 1-14 to replace PbPt for each of the 14 data sets with its value plus the statistical and systematic (2-3% relative) errors added in quadrature for just that one data set. PbPt is also sensitive to `errindex[3]` since it uses the dilution factor for the (quasi-) elastic region for the inclusive method.
- 5.) Contamination. This correction is usually in the form  $A_{\text{corr}} = A_{\text{uncor}} * C1 + C2$ . In the case of an  $\text{NH}_3$  target, the factor C1 corrects for the unpaired proton in  $^{15}\text{N}$  while C2 corrects for any  $^{14}\text{N}$  contamination. For  $\text{ND}_3$ , C1 corrects for  $^{14}\text{N}$  while C2 corrects for protons and  $^{15}\text{N}$ . `errindex[5]=0` should correspond to the standard values of C1 and C2, `errindex[5]=1` should vary C1 within reasonable errors, and `errindex[5]=2` should vary C2.
- 6.) Models. These enter both the conversion from  $A_{||}$  to  $A_{\perp}$  or  $g_1$  and radiative corrections. I will write a wrapper similar to "strucfunc.f" that takes W,  $Q^2$  and `errindex` as input and returns values for  $F_1$ ,  $F_2$ , R,  $A_1$ ,  $A_2$ ,  $g_1$  and  $g_2$ . `errindex[6]=0` will return the standard model values. Presently I foresee the following variations:
  - 1 – modify  $A_{1p}$  in the DIS region
  - 2 – modify  $A_{1n}$  in the DIS region
  - 3 – modify  $A_{1p}$  in the resonance region
  - 4 – modify  $A_{1n}$  in the resonance region
  - 5 – modify  $A_2$  in the DIS region
  - 6 – modify  $A_2$  in the resonance region
  - 7 – modify  $F_{1p}$  in the DIS region
  - 8 – modify  $F_{1p}$  in the resonance region
  - 9 – modify R
  - 10 – modify  $\sigma_n/\sigma_p$  in the DIS region
  - 11 – modify  $F_{1n}$  in the DIS region.
- 7.) Radiative corrections. In addition to variations 1-11 of the previous item, there should be also some error on the radiative correction procedure itself (including radiation lengths assumed etc.). Keith should