

GEp analysis status

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Strategy: run through the first round of analysis before calibrations are done.

- Draw in general lines analysis procedure.
- Understand needs and major challenges.
- Get familiar with quality and status of the data.
- Write necessary software.
- Enable efficient parallel work.

First round completed on April 2013

Currently working on developing the GEp event generator for HRSMC.

Analysis Procedure

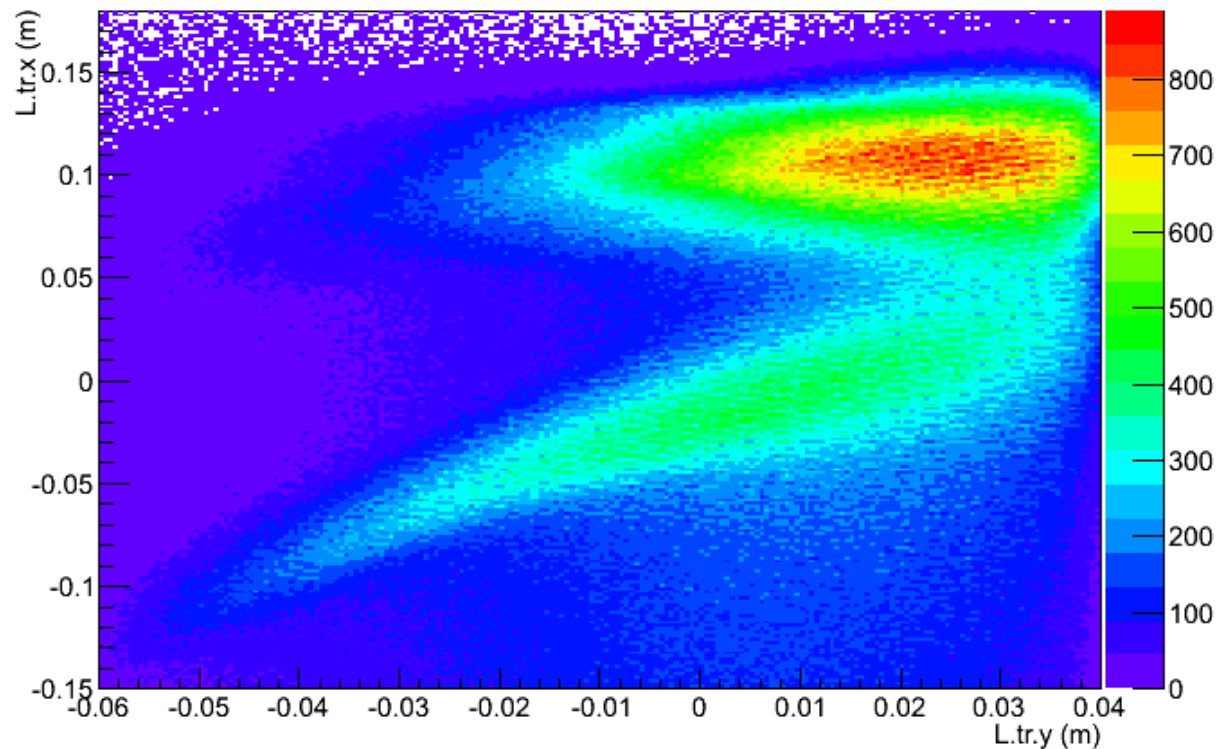
1. Determine H-elastic events.
 - Stopping power correction for background data.
 - Background subtraction with correct normalization.
2. Binning optimization.
 - Avoid highly-diluted area at low Q^2 .
 - Find binning with similar relative uncertainties.
3. Determine dilution within bin bounds.
4. Extract asymmetry.
 - Target polarization.
 - Helicity decoder.

Elastic Peak Identification

optics

- Optics are not ready yet – can't use reconstructed variables (dp, θ, φ).
- Analysis is done on focal plane variables L.tr.x:L.tr.y

fp, 2.2 GeV, left arm, production

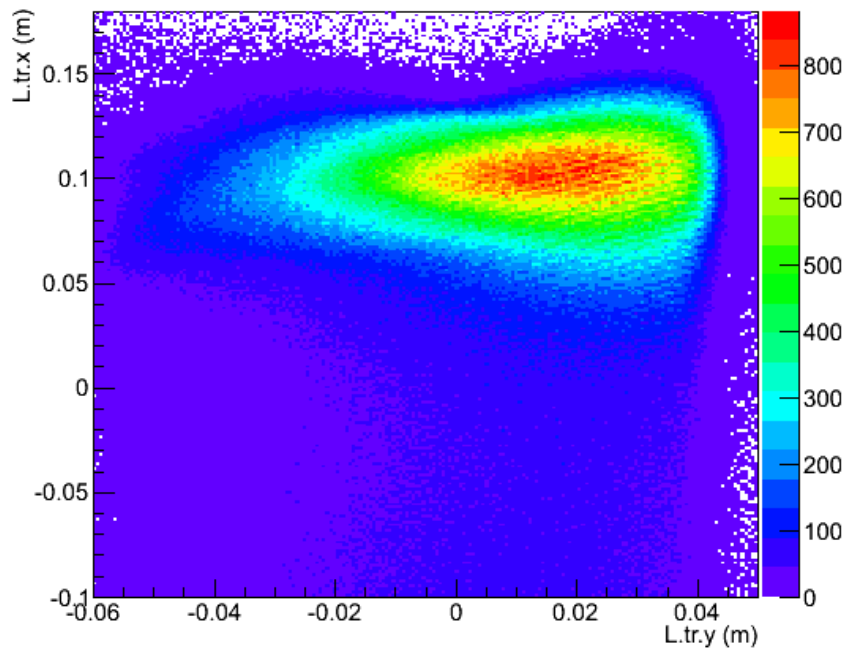


Elastic Peak Identification

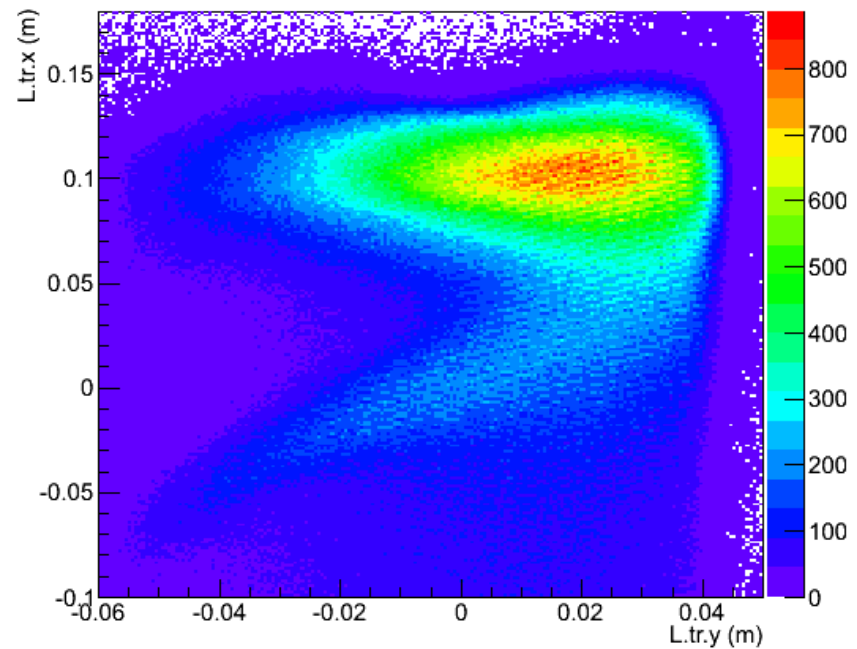
background data

- Dilution runs were taken at each configuration with carbon + He.
- 2.2 GeV background data was taken with different target field.
- For now, assume similar behavior for N + He.

fp, 1.7 GeV, left arm, dilution



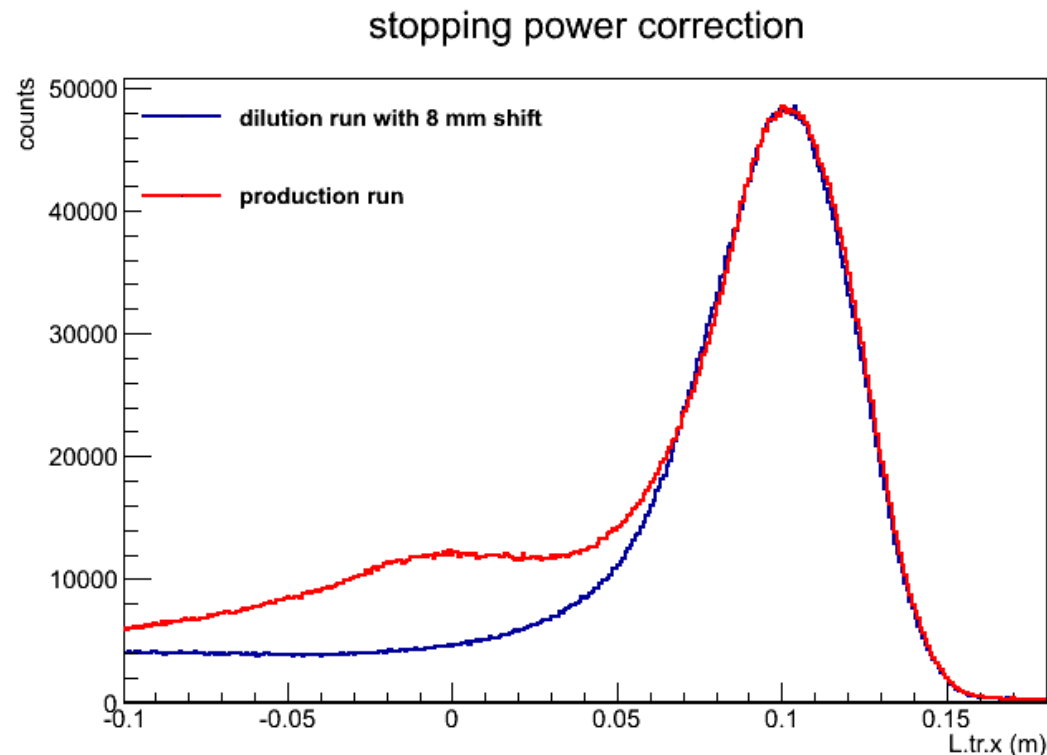
fp, 1.7 GeV, left arm, production



Elastic Peak Identification

stopping power correction for background

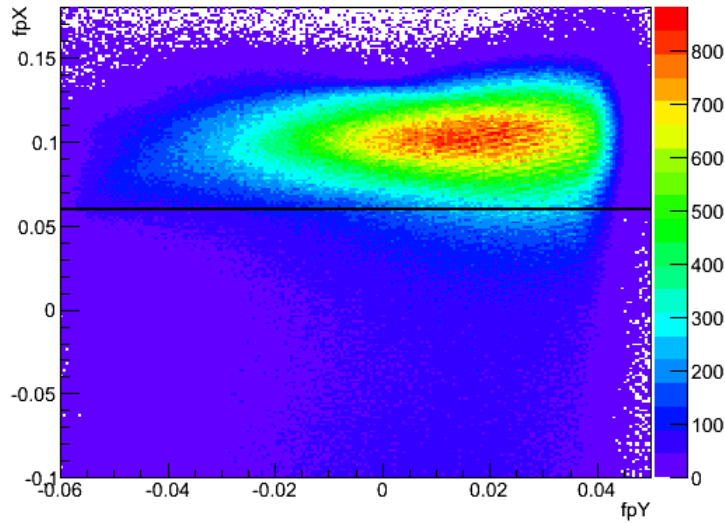
- Production and dilution targets have different materials, densities and thicknesses – hence suffer different energy losses.
- Correction is manually tuned to fit production data.



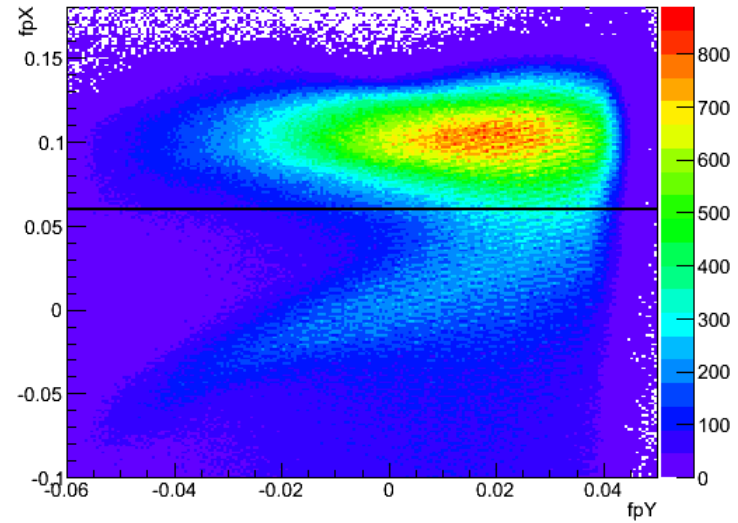
Elastic Peak Identification

Background subtraction

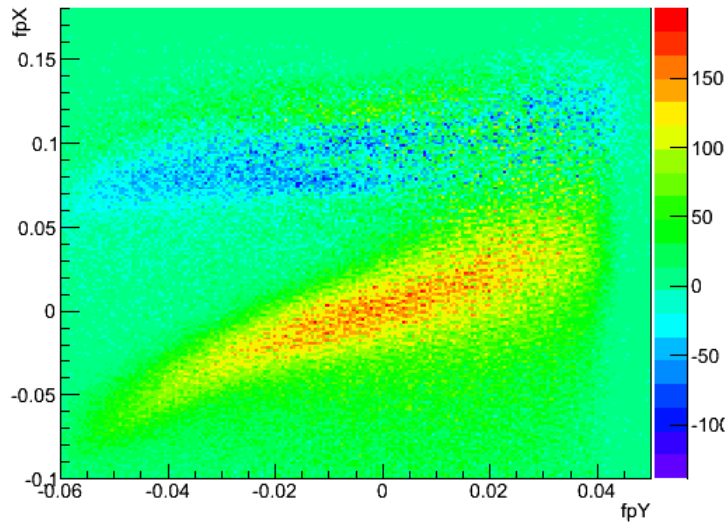
fp, 1.7 GeV, left arm, dilution



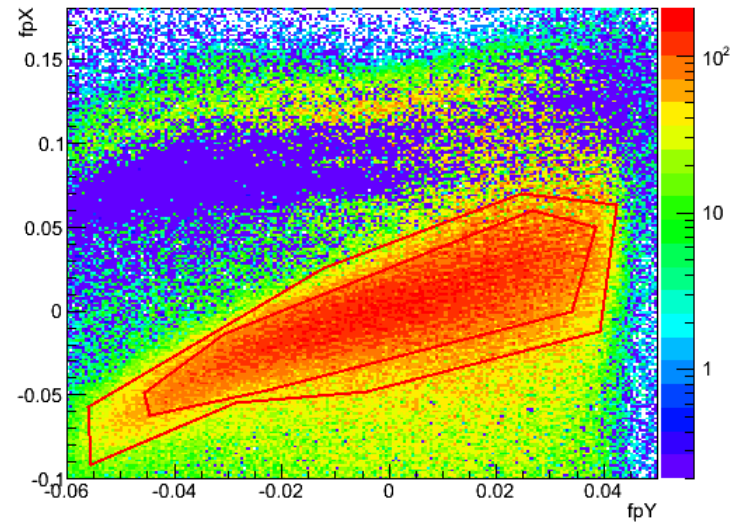
fp, 1.7 GeV, left arm, production



fp, 1.7 GeV, left arm, subtraction



fp, 1.7 GeV, left arm, subtraction



Binning Optimization

- Data is split into 5 bins X 2 arms (total 10).
- 2 Q^2 bins for 2.2 and 1.7 GeV data, and 1 for 1.1 GeV.
- Scripts are written to optimize bin range, trying to get similar statistical uncertainties - still need improvement.
- Also need to avoid highly-diluted area at low Q^2 .
- Significant overlap between Q^2 ranges of different bins.

Dilution Factor

The dilution factor:

$$f = 1 - \frac{N_B}{N_T}$$

N_B and N_T are the background and total number of events.

- Dilution factor must be calculated separately for each bin.
- Reliable background data and normalization is crucial – asymmetry (and uncertainty) is linear with dilution.
- Dilution runs are not good enough (different materials).
- Will have to rely on simulations (solely, or to correct dilution data).

Asymmetry Extraction

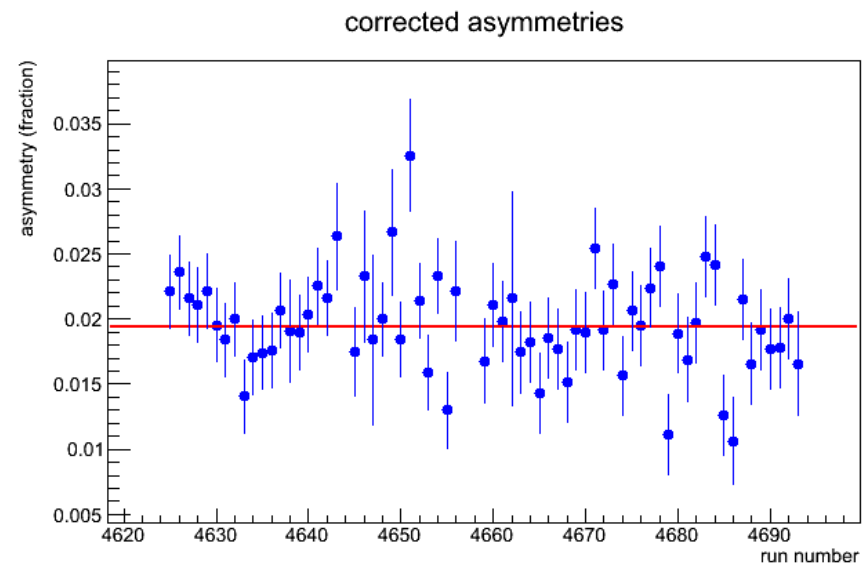
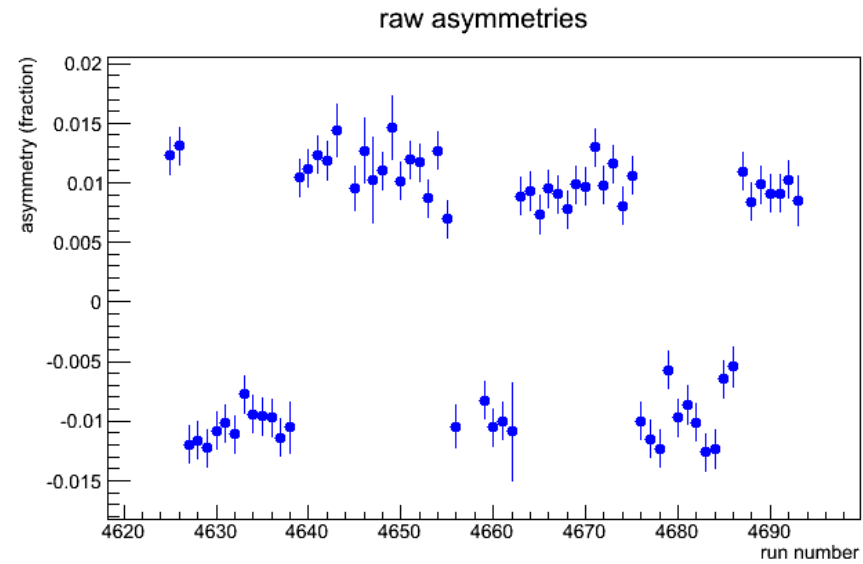
The asymmetry:

$$A = \frac{N^+ - N^-}{(N^+ + N^-) f P_B P_T}$$

N^+ and N^- are the number of events with positive/negative helicity, f is dilution factor, P_B and P_T are beam and target polarizations.

- Technical problems using Chao's helicity decoder.
- Beam polarization uncertainties $\sim 1.7\%$ (sys.)
- Target polarization uncertainties $\sim 3\%$ (D. Keller)

Asymmetry Extraction



Preliminary asymmetries

arm	bin			cut 1				cut 2			
	E_e (GeV)	Q^2 range (GeV ²)	Q^2 value (GeV ²)	dilution	A (%)	$\Delta A/A$ (%)	χ^2/ndf	dilution	A (%)	$\Delta A/A$ (%)	χ^2/ndf
left	2.2	0.045-0.080	0.057±0.008	0.74	3.03±0.046	1.52	1.57	0.68	2.96±0.042	1.42	1.53
right	2.2	0.056-0.082	0.065±0.005	0.67	3.39±0.059	1.74	0.85	0.59	3.41±0.058	1.70	1.21
left	2.2	0.028-0.050	0.037±0.006	0.75	1.56±0.021	1.35	1.20	0.70	1.48±0.021	1.42	1.34
right	2.2	0.038-0.064	0.047±0.006	0.71	1.93±0.029	1.50	1.60	0.66	1.74±0.029	1.67	1.39
left	1.7	0.020-0.045	0.028±0.006	0.71	1.93±0.038	1.97	1.25	0.66	1.95±0.035	1.79	0.96
right	1.7	0.031-0.050	0.037±0.004	0.78	2.17±0.071	3.27	0.79	0.73	2.20±0.055	2.50	0.87
left	1.7	0.017-0.027	0.020±0.003	0.54	1.24±0.071	5.87	0.90	0.48	1.18±0.066	5.59	0.82
right	1.7	0.023-0.033	0.027±0.003	0.67	1.68±0.056	3.33	1.23	0.64	1.53±0.047	3.07	1.38
left	1.1	0.009-0.020	0.012±0.0027	0.26	1.78±0.060	3.37	0.79	0.23	1.72±0.052	3.02	0.80
right	1.1	0.010-0.022	0.014±0.0026	0.18	2.33±0.120	5.15	0.74	0.15	2.78±0.097	3.49	0.70

Table 1: Preliminary asymmetries for the GEp experiment. All numbers should be taken with caution. See text for details.

Do not rely on these numbers!

Table source: M Friedman, Interim Analysis report, E08-007 experiment, private communication, April 2013

GEp event generator

- In order to improve background study, an event generator is being developed for HRSMC.
- Should take into account elastic, quasi-elastic and inelastic scattering from hydrogen, helium and nitrogen, with correct relative contributions as expected by the targets used in the GEp experiment.
- More details in the next meeting.