Single Arm Monte Carlo & Background Issues

Analysis Workshop
10 Dec. 2002

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Single Arm Monte Carlo

- Used for inclusive ^{3}He experiments in Hall A:
  - E94010 (GDH): Originally written for its analysis (FORTRAN)
  - E95001 (G^n_M): Rewritten in C++ by Feng Xiong (xiong@jlab.org)
  - E99117 (A^n_1)/E97104(g^n_2):FORTRAN version improved by Xiaochao Zheng (xiaochao@jlab.org)
  - E97110 (small angle GDH): Adapted to septum experiments. Raytracing.

HRS transports

- J. LeRose transport functions

- J. LeRose forward transport function +
  HRS optic database

- Xiaodong Jiang acceptance fit (for E94010 only)

- VCS (S. Jaminion/H. Fonvieille) transport functions

Comparison between the different transport versions:

Thesis:
http://www.jlab.org/e94010/thesis_deur.ps.gz

Technotes:
http://www.jlab.org/e94010/tech_note_35.ps.gz
http://www.jlab.org/e94010/tech_note_36.ps.gz

What does the Monte Carlo ?

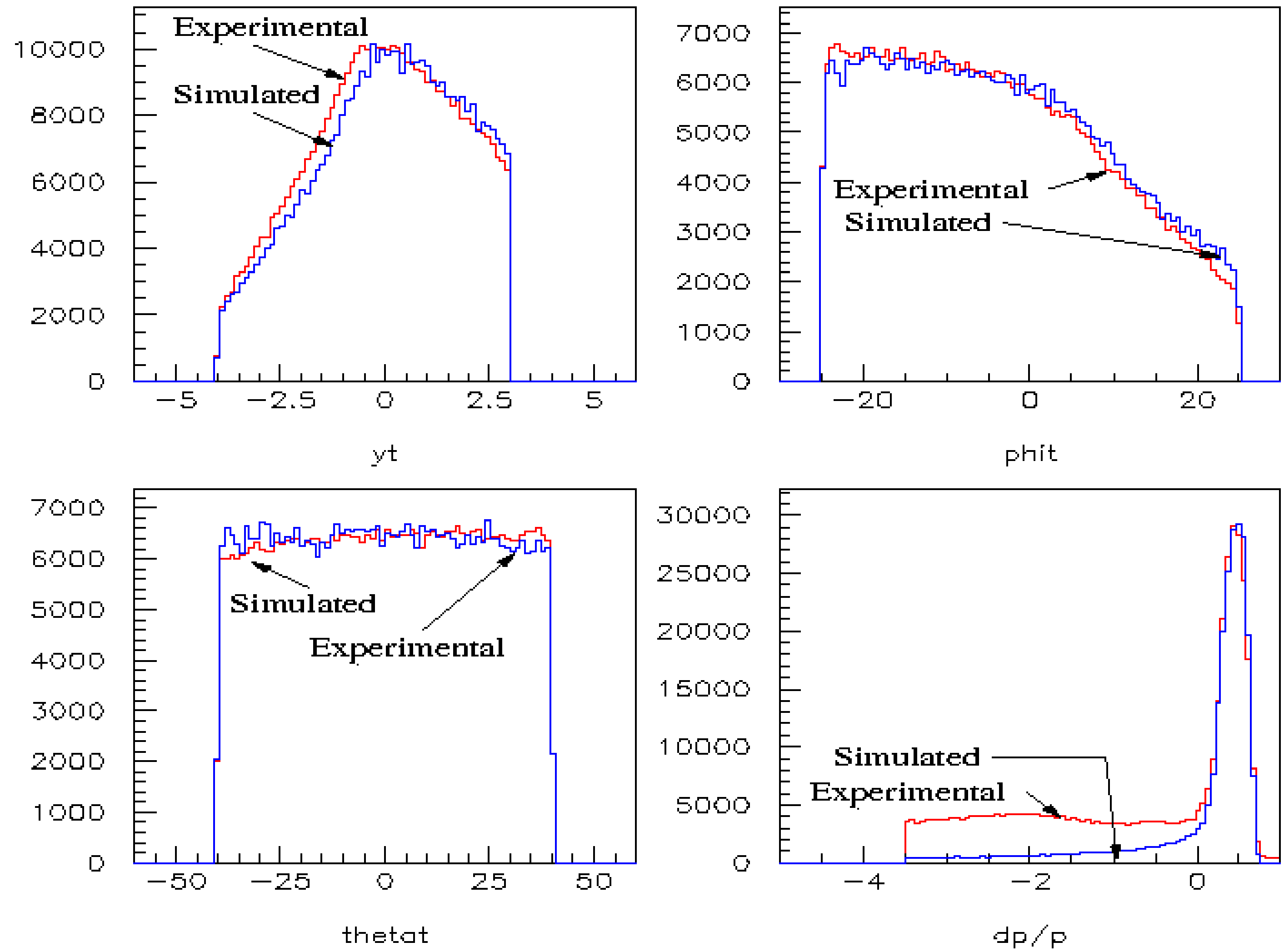
Manual: http://www.jlab.org/e94010/tech_note_33.ps.gz

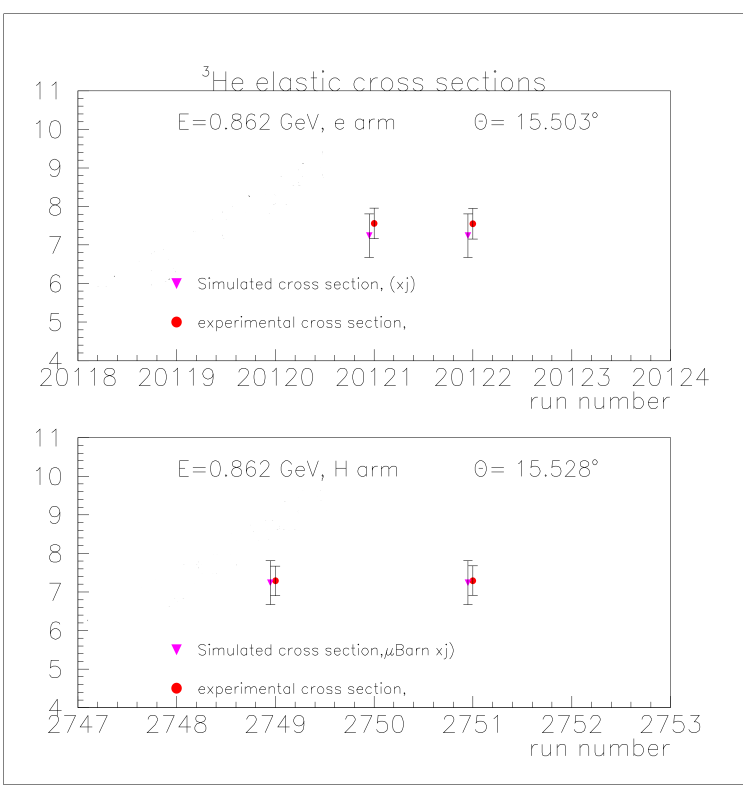
- Inclusive measurements
- Extended targets
- raster
- Elastic radiative correction (Internal + external)
- Landau Straggling
- Multiple scattering
- DIS external Radiative correction (Xiaochao version)

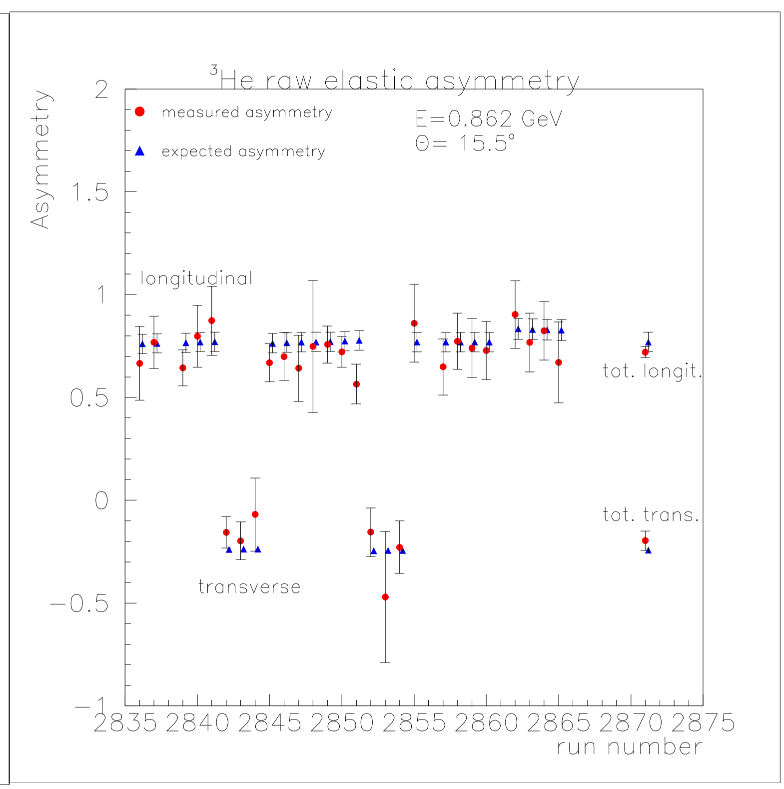
Reactions:

- Polarized elastic (^{3}He, Nitrogen)
- Polarized quasi–elastic (^{3}He)
- Mott / Phase space
- Polarized DIS (^{3}He, Xiaochao version)

Example of results (E94010 GDH exp.)







Newest version (used for A^n_1 exp.)

for elastic:
/w/work1602/e99117/xiaochao/samc/src/samcl_bpm.f
/w/work1602/e99117/xiaochao/samc/src/samcr_bpm.f

for DIS:
/w/work1602/e99117/xiaochao/samc/src/samcl_dis.f
/w/work1602/e99117/xiaochao/samc/src/samcr_dis.f

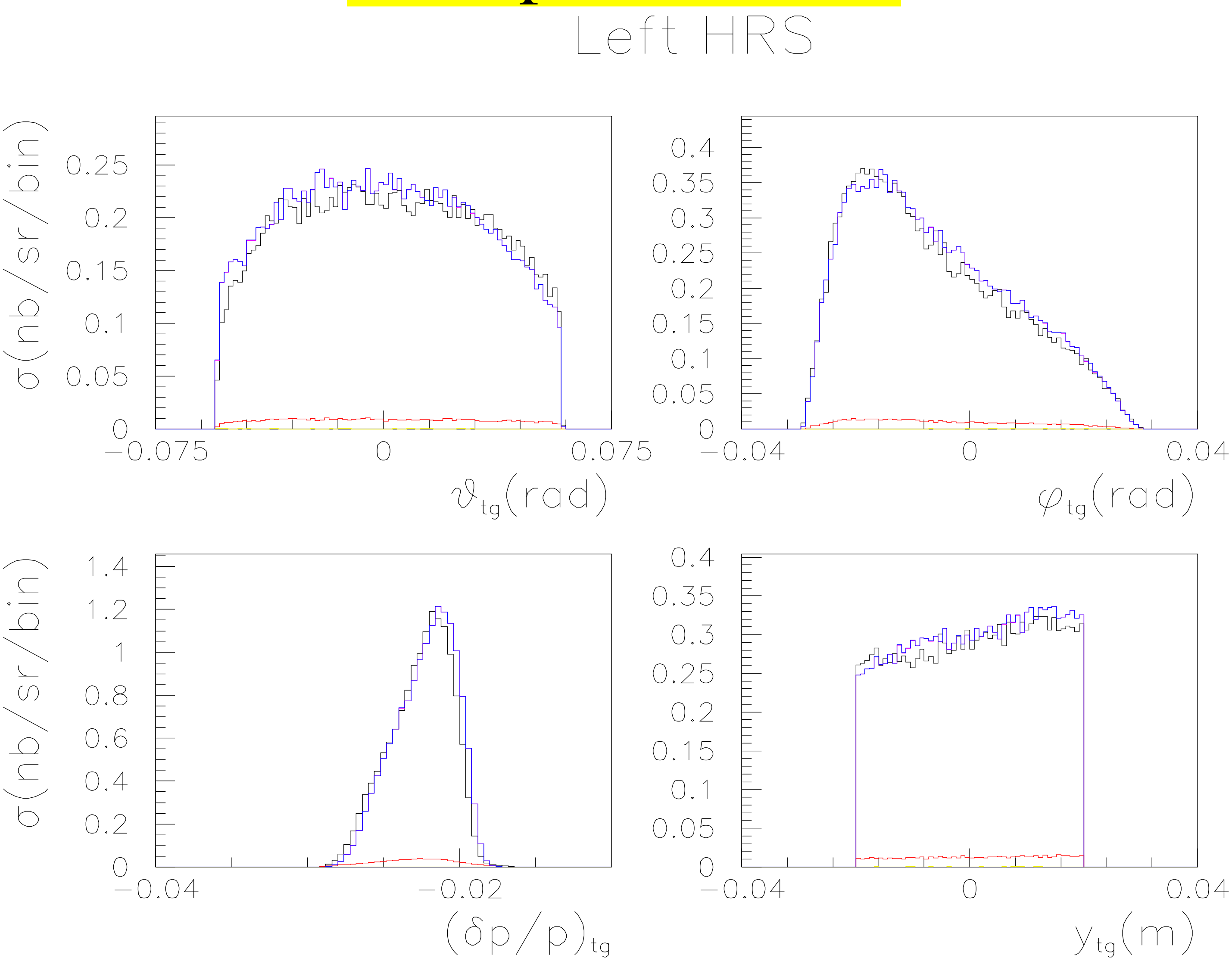
Major improvements:

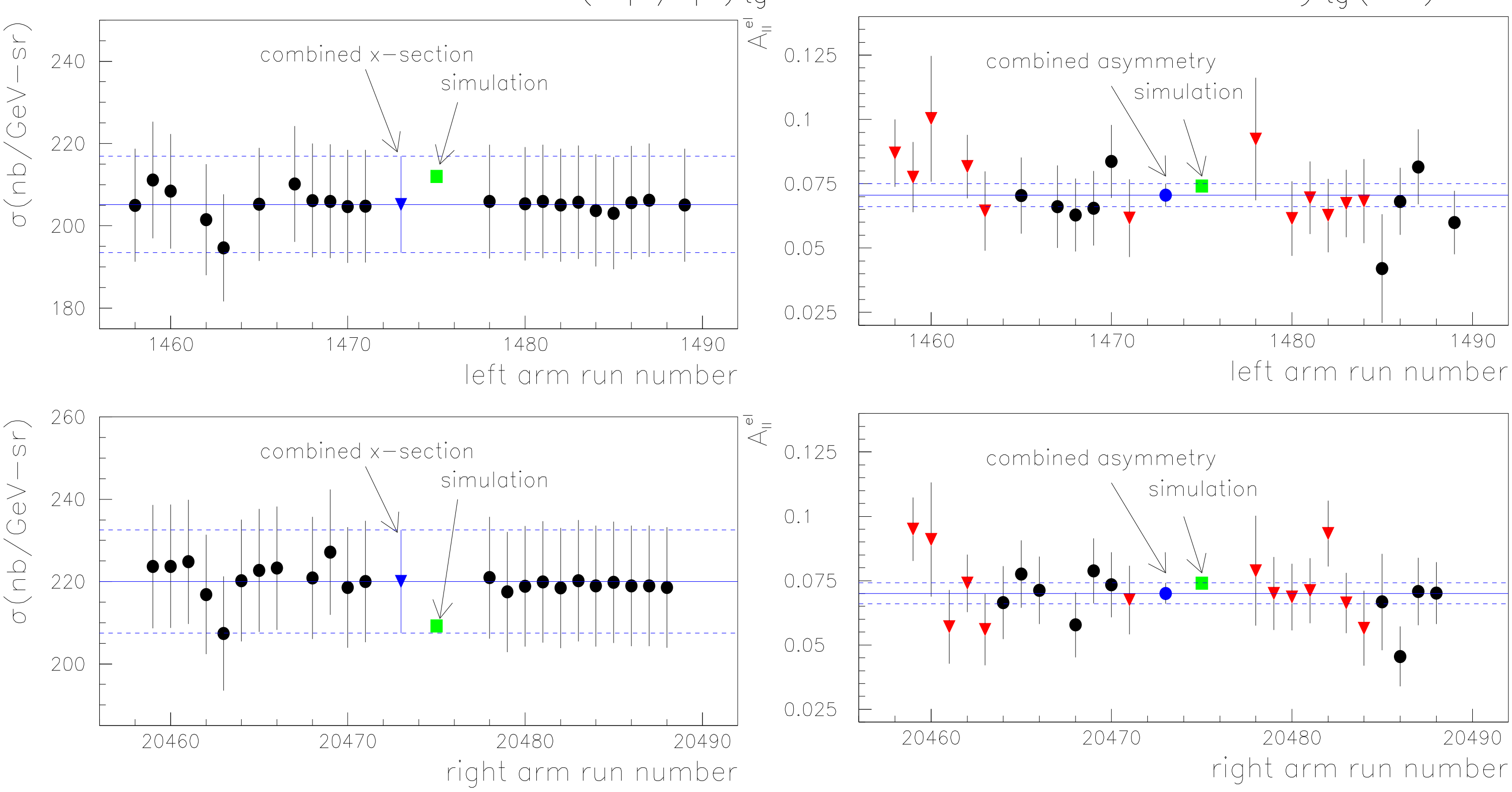
– R functions

– Polarized DIS scattering (A^n_1 only)

Documentation: Xiaochao's thesis (coming soon: 3 days)

Example of results





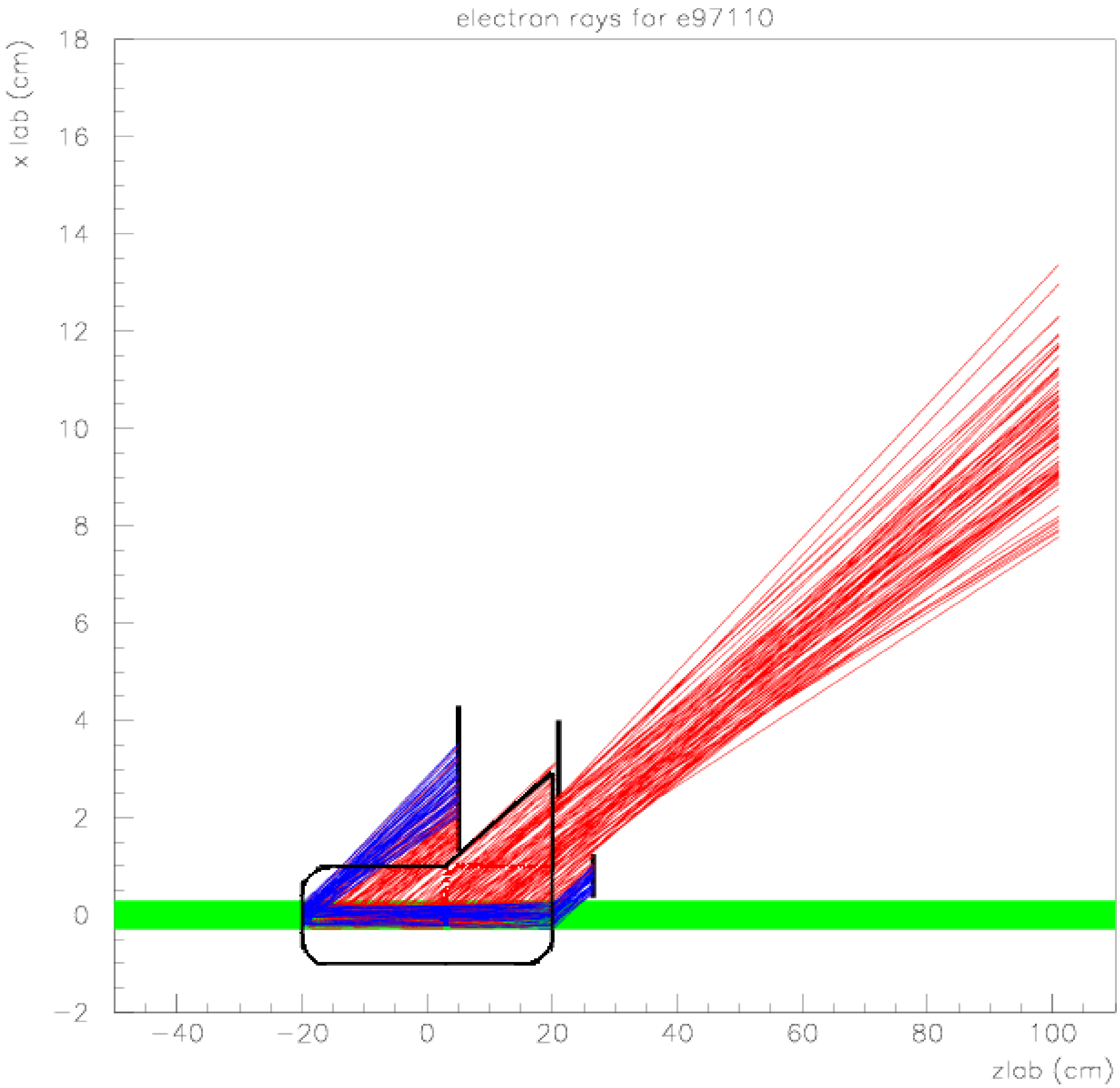
→ Simple tool. Easy to modify and adapt.

Example for the upcoming GDH experiment:

Study of multiple scattering & collimator optimization

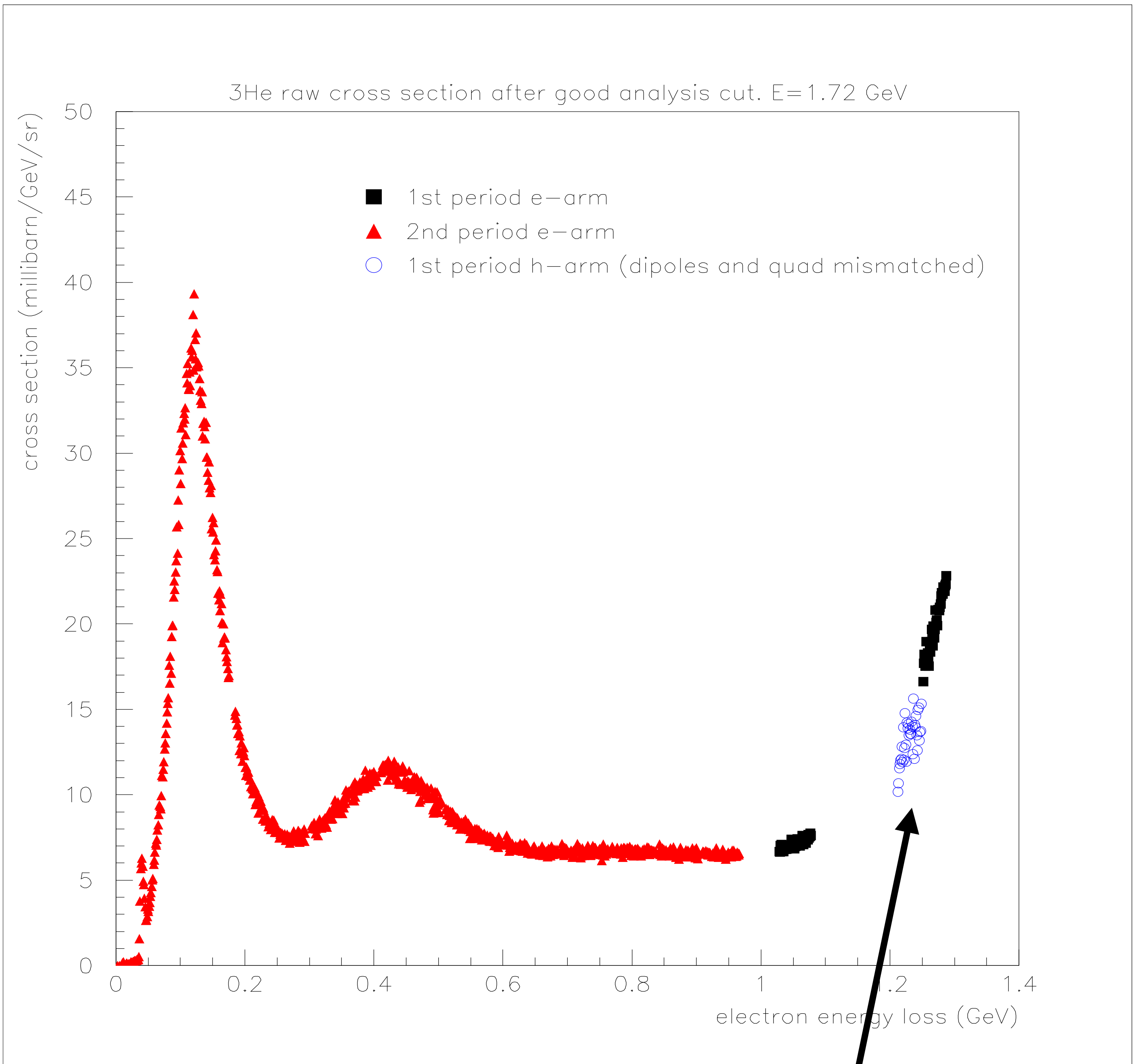
Problem: Where to put the collimators cutting the cell windows, accounting for the multiple scattering and without reducing the Z_t acceptance too much ?

Solution: Implementation of raytracing.



BACKGROUND STUDY

The study of possible multiple scattering background for the small angle GDH experiment led to the understanding of a long standing problem in the first GDH experiment:



Unpolarized !

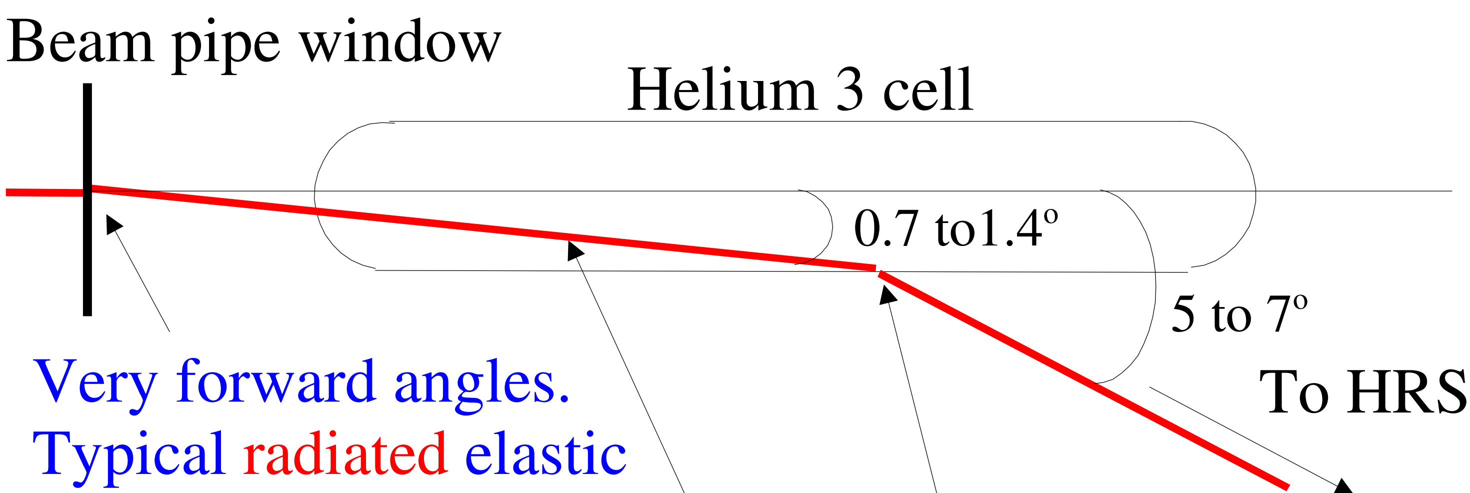
Elastic tails are order of magnitude less than this tail !

The origin:

The beam passing the window develops a non–Gaussian halo due to nuclear scattering.

This non–Gaussian halo goes into the glass wall and creates a contaminating signal in the HRS:

Crude Model & Estimation:



Very forward angles.
Typical radiated elastic cross section: several tenth of barn/GeV/Sr.
Window thickness:0.05 g/cm^2

Few hundreds MeV e$^-$

6 cm of glass crossed: 15.4 g/cm^2
(for the regular process:
10 cm of ^{3}He@12 atm:0.01 g/cm^2)
Dominant reaction: elastic:10^4 μb/sr
(regular process: DIS: 10 μb/sr)

Putting these numbers together (for E97−110):

1)Yield toward the wall:

Y=(Elastic Xs) × (wall solid angle) × (window thickness)

$Y=(20\times10^{-24}\ \mathrm{cm}^2/\mathrm{GeV}/\mathrm{Sr})\times(3.5\times10^{-4}\ \mathrm{Sr})\times(2.5\times10^{21}\ \mathrm{cm}^{-2})$

$Y=1.75\times10^{-5}\ \mathrm{GeV}^{-1}$

2) Background to the HRS

B=Y× (elastic Xs)× (glass thickness)

$B=(1.75\times10^{-5}\ \mathrm{GeV}^{-1})\times(10^4\ \mu\mathrm{barn}/\mathrm{Sr})\times 15.4$

B=2.7

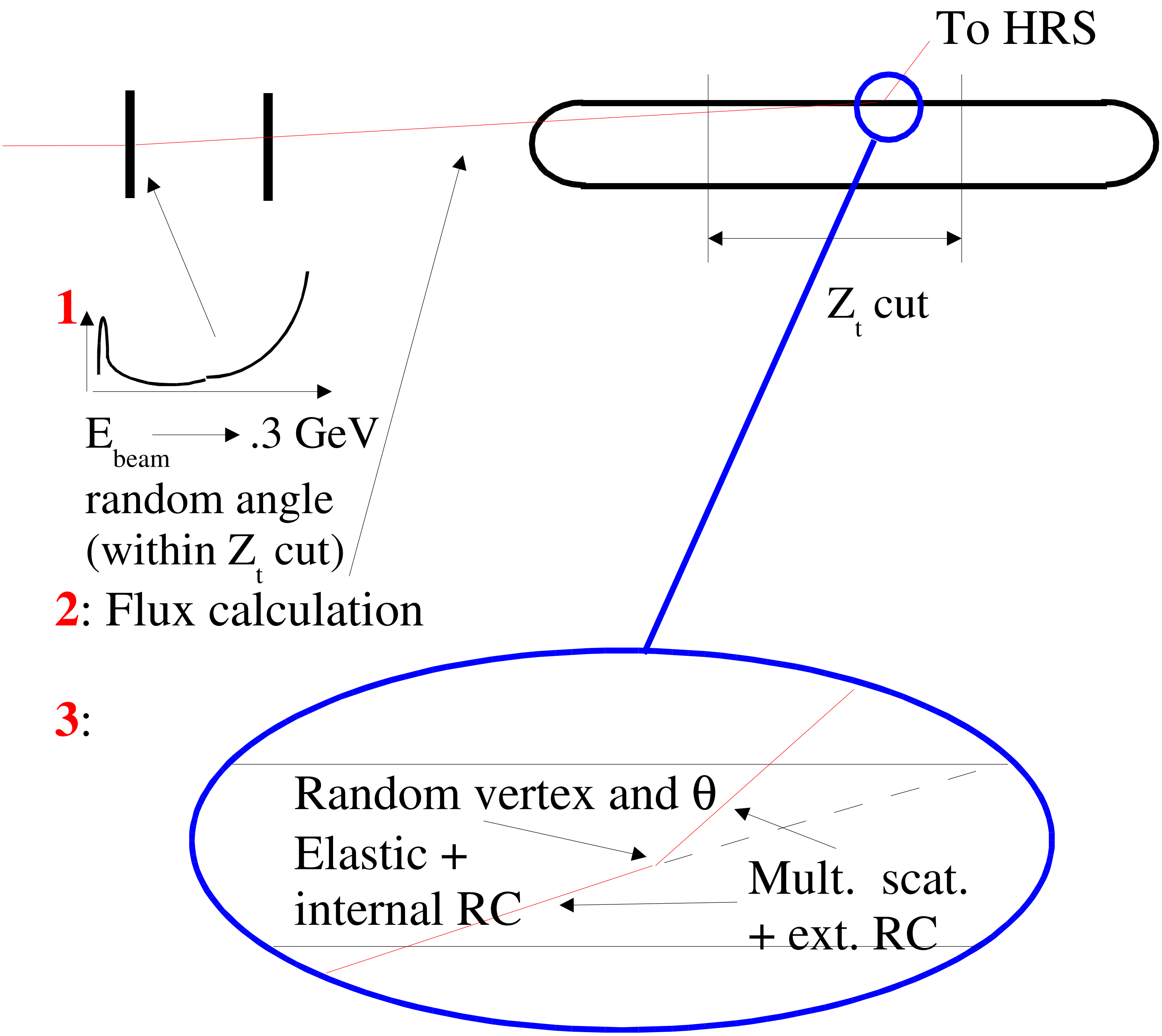
3) To compare to the wanted DIS signal:

S= (DIS Xs)×(He3 cell thickness)

S=0.1

→ Problems expected

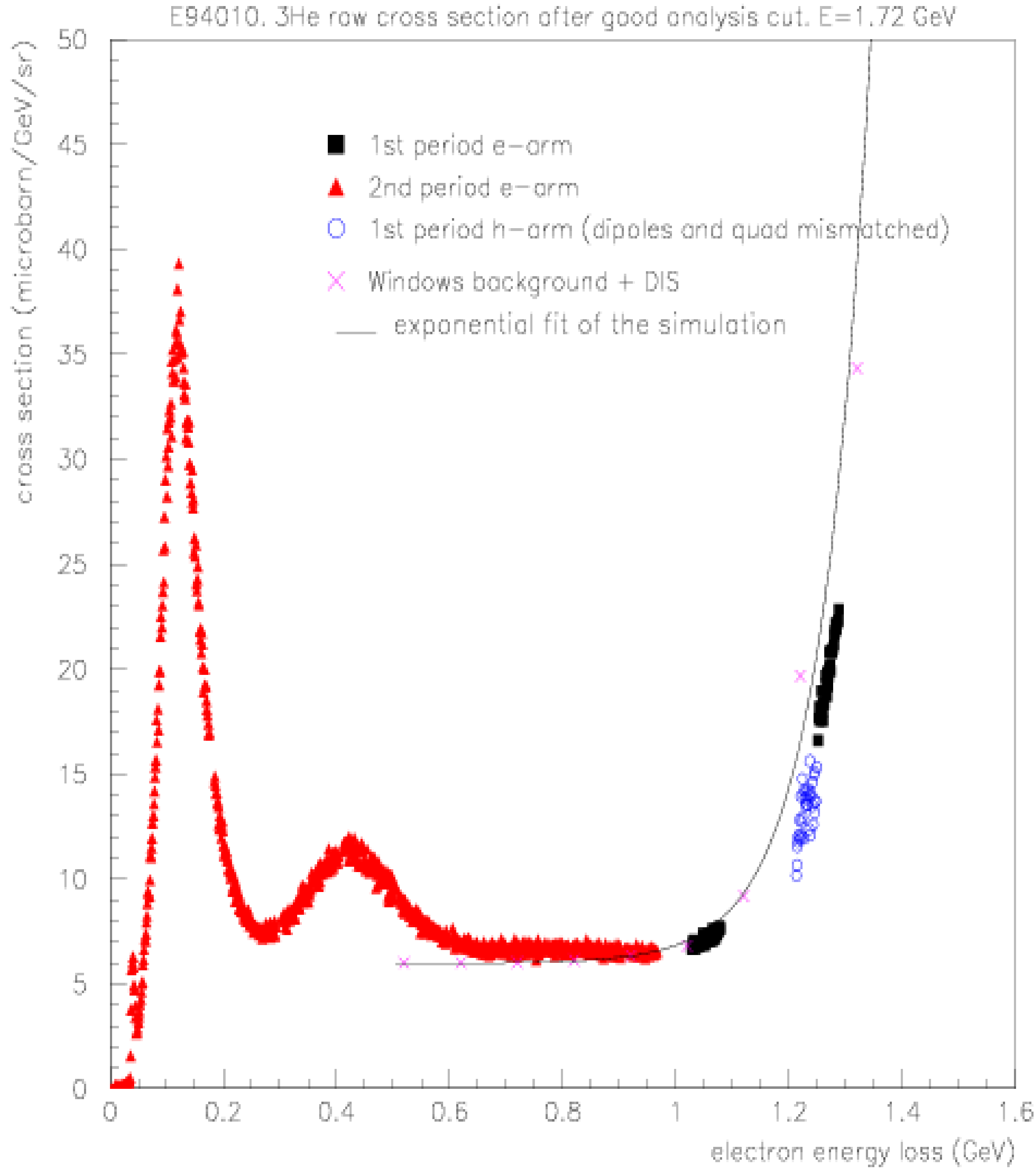
To validate the idea, a more careful simulation has been done and compared to the E94010 data:

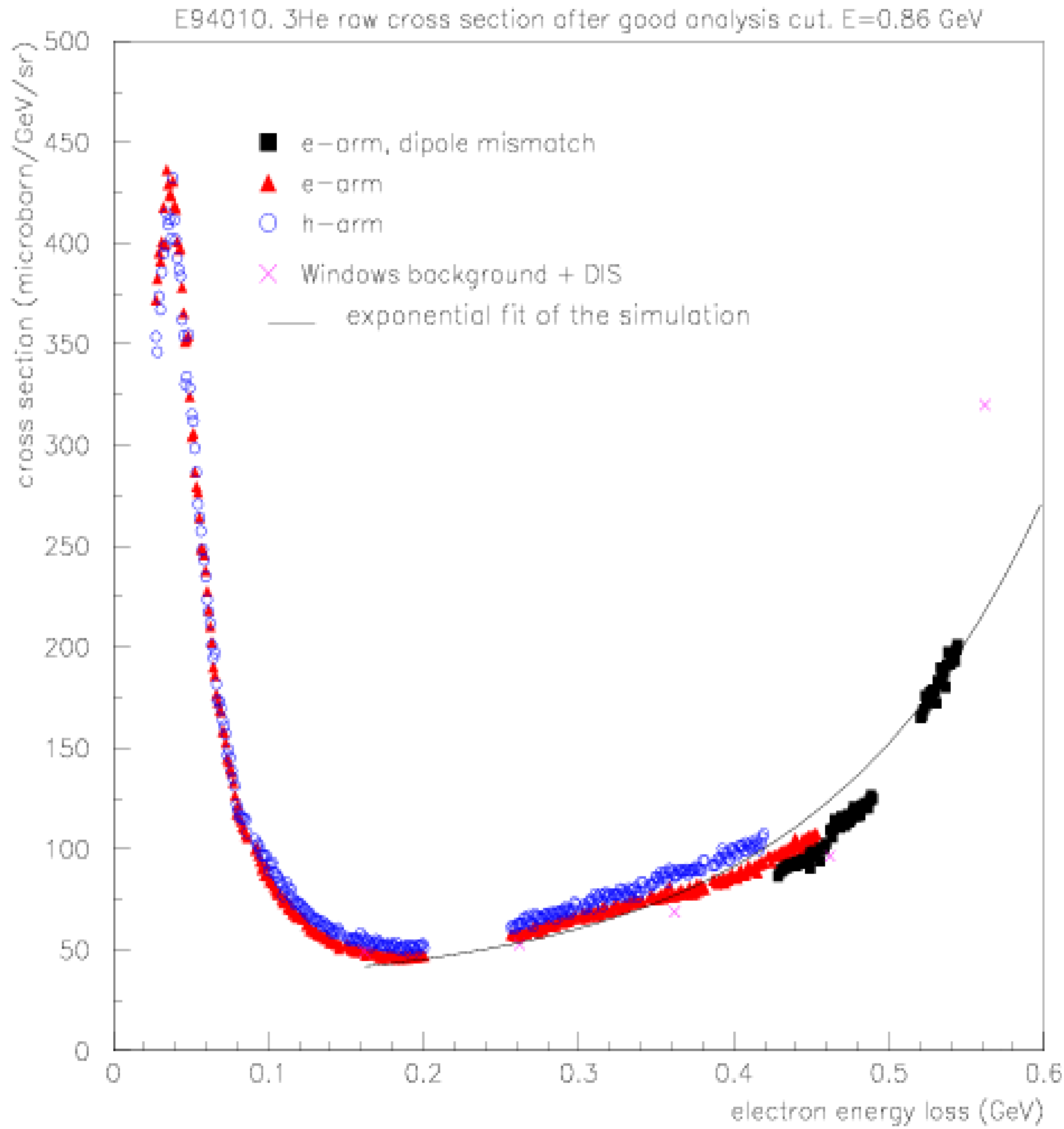


4: Cross section calculation

Catch:

- In both case, used Nitrogen FF (ok only for step 1).
- Use thin radiator approximation (ok only for step 1).


E94010. 3He row cross section after good analysis cut. E=1.72 GeV
cross section (microbarn/GeV/sr)
electron energy loss (GeV)
1st period e-arm
2nd period e-arm
1st period h-arm (dipoles and quad mismatched)
Windows background + DIS
exponential fit of the simulation
0
5
10
15
20
25
30
35
40
45
50
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6


E94010. 3He row cross section after good analysis cut. E=0.86 GeV
cross section (microbarn/GeV/sr)
e-arm, dipole mismatch
e-arm
h-arm
Windows background + DIS
exponential fit of the simulation
0
50
100
150
200
250
300
350
400
450
500
0
0.1
0.2
0.3
0.4
0.5
0.6
electron energy loss (GeV)

We are happy to have figured out the source of the background and confirmed that it is unpolarized.

But:

This is a potential problem for experiment E97−110 (small angle GDH): lower angles and lower energy losses make the problem much worst.

I shall say more on this problem during the status report for E97−110 at the Hall A collaboration meeting (12 Dec 02)