Monte Carlo Simulation for Deuteron and He4 Elastic Measurements

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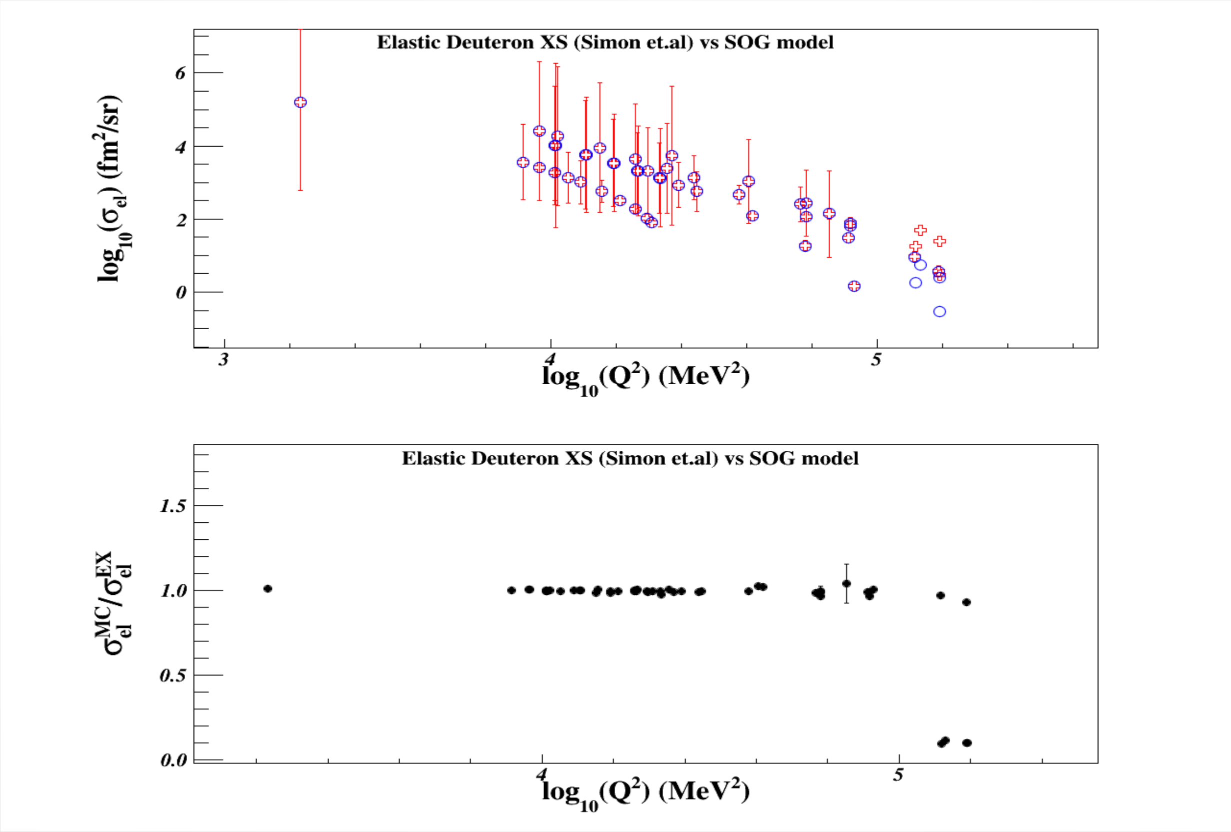
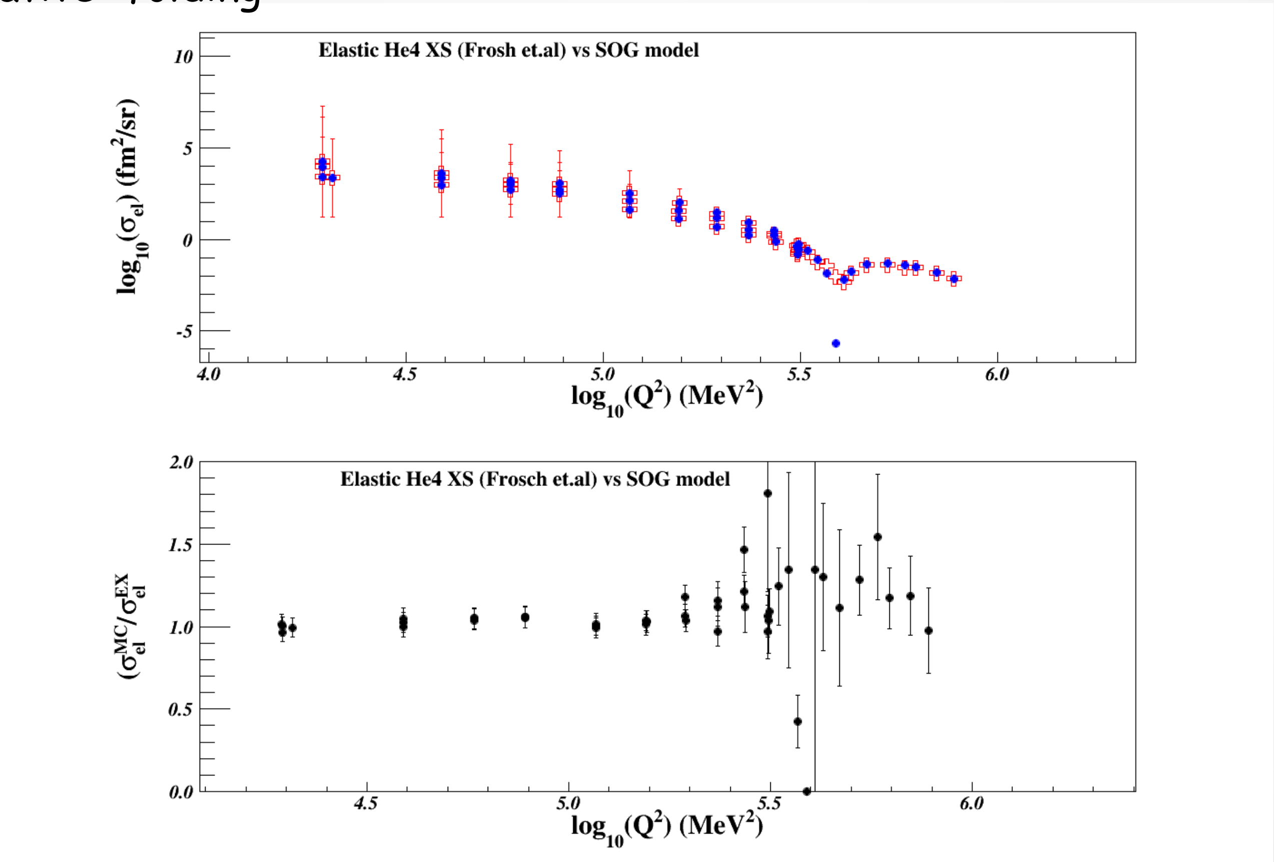
Elastic Cross Section Models

- Deuteron: Sum of Gaussians (SOG) Parameterization
  - G_C, G_Q and G_M are fitted from experimental data with SOG function
    (I. Sick, Pro. Part. Nucl. Phys. 47 (2001))
  - Fitting Parameters are obtained from I. Sick indirectly
  - I coded the model in a C++ subroutine
  - The model has been compared with several experiental data
  - No Radiative “folding”



Elastic Cross Section Models

- He4:
  - Fit of C. Ottermann et al, Nucl. Phys. A436 (1985)
  - Obtained from Doug Higinbotham's MCEEP in Fortran, I converted it into C++
  - The model has been compared with several experiental data
  - No Radiative "folding"

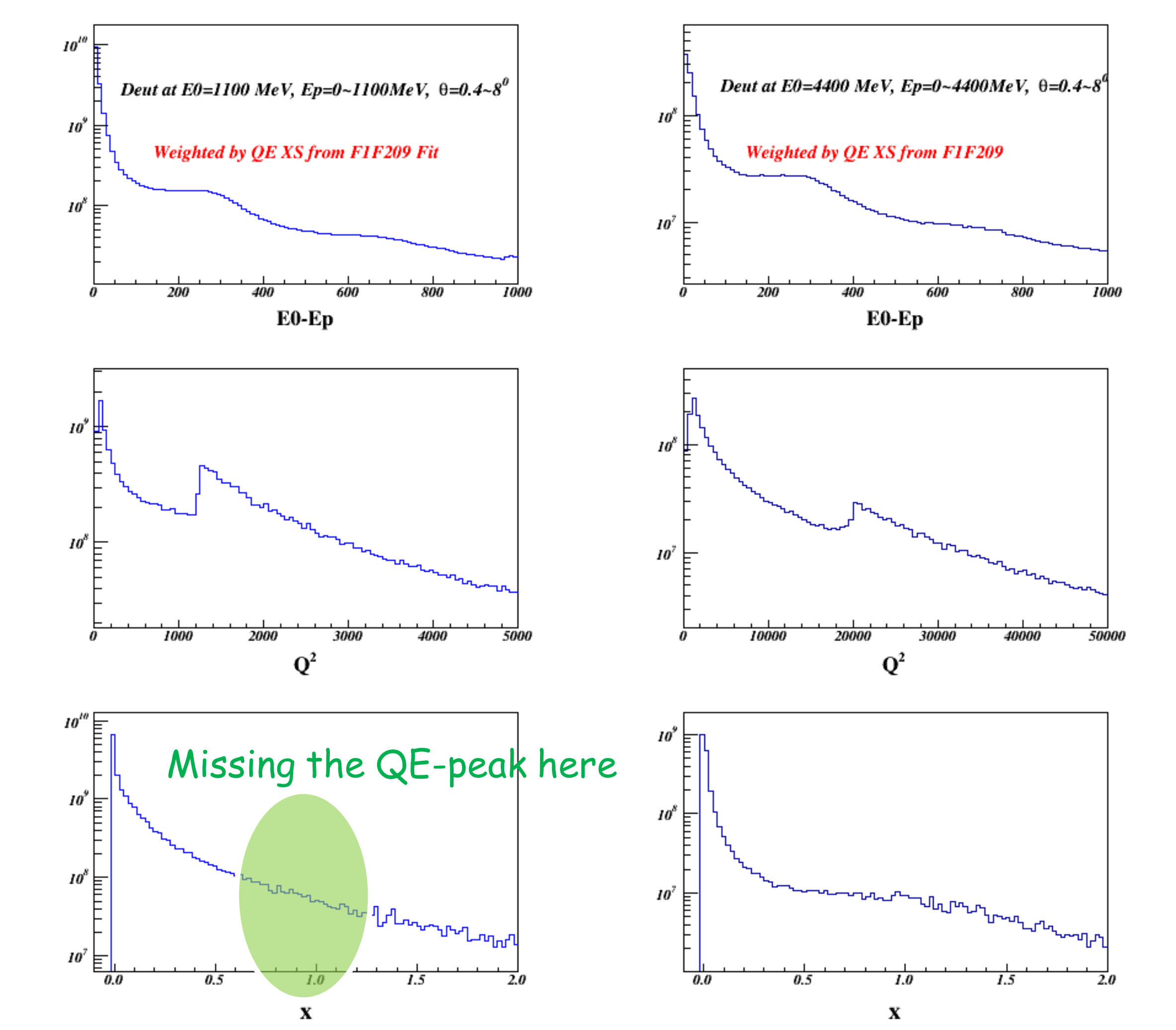


Quasi-Elastic Cross Section Model

- I have my own code with three different models:
  1, XEM: Fy-scaling function to discribe the QE peak
  2, F1F2QE09: Peter Bosted's 2009 fit
  3, QFS: a very old QE model

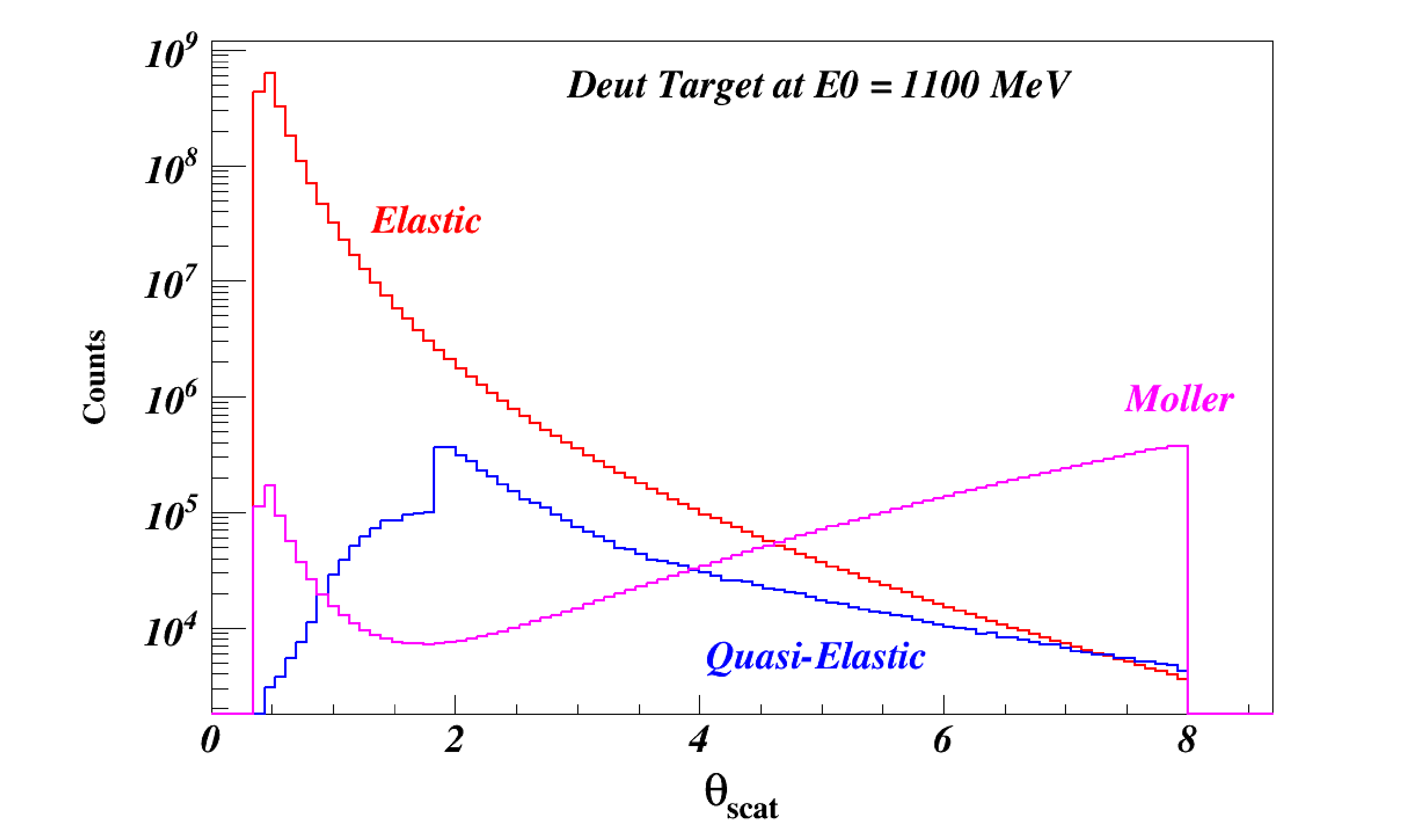
- Radiative Effects are "folded" by the Peaking Approximation

- Problem: all these models don't work *at all* at very low Q2 (e.g., <0.01GeV^2)



Moller Cross Section Model

Basically use the same one as Chao's but I do the calculation in the Lab frame

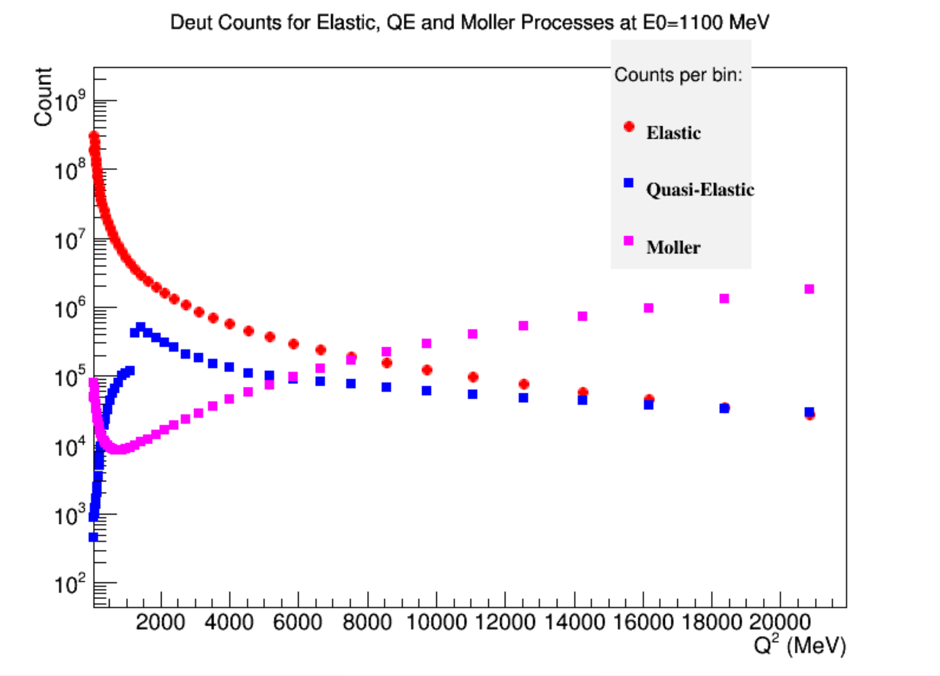


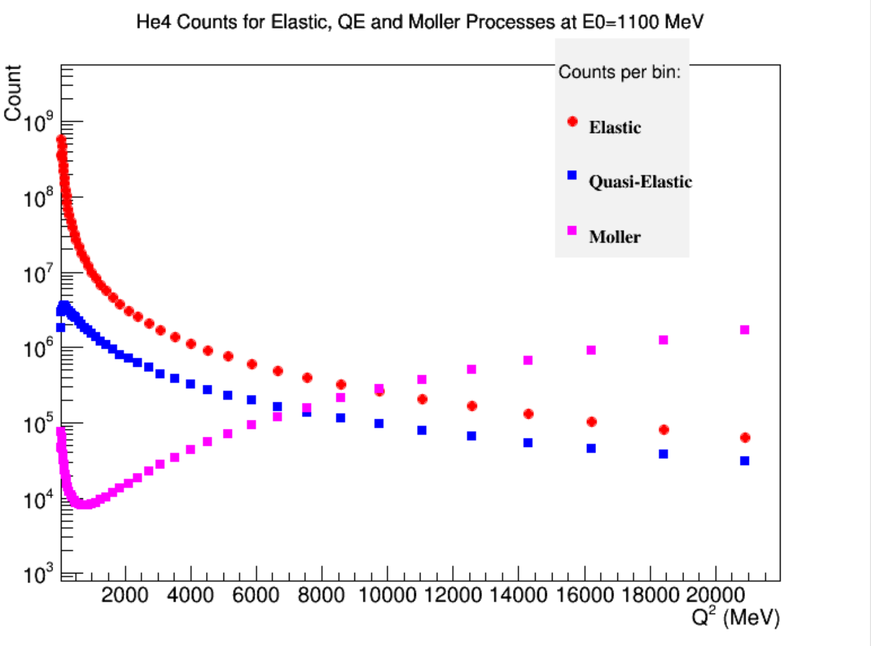
The Monte Carlo Simulation

- Use the PRAD Setting: 0.4<Theta<8.0, E0 = 1100/2200/3300/4400 MeV
- Generate Elastic, QE and Moller events separately
- Project the position (x,y) of the scattered electrons on the HyCal with randomly generated Theta & Phi at the target.
- Smear the position by the GEM resolution (0.1mm), recalculation Theta & Phi
- Smear the scattered electron momentum by HyCal resolution → 27MeV/sqrt(E')

Binning: (no resolutions are included yet)

- Calcualte “weight” of each event with the cross section, phase space, target luminosity, beam charge (assuming 1 day), detector efficiency (90%).
- For Elastic data, binning on log10(Theta) for each energy setting
- Choose the bin-range by requring the statistically uncertaincy to be 1%
- Once the bins are determined by the elastic data, use the same bins to calculate the stastistics of QE and Moller events in each bins.





To do:

- Include radiative effects in the Deutron and He4 Elastic models
- Find a right QE model (with radiative effect) working at very low Q2
- Includ the detector resolutions and optmize the binning
- Evaluat the QE contamination and the ways to suppress it (e.g., kinematic variable cuts, calibration runs, and/or experimental techniques)
- Feed the generated events to the PRAD-Geant4 simulation to evaluate backgrounds

My codes can be found at:

www.jlab.org/~yez/Work/prad/cross_section_model.tar.gz