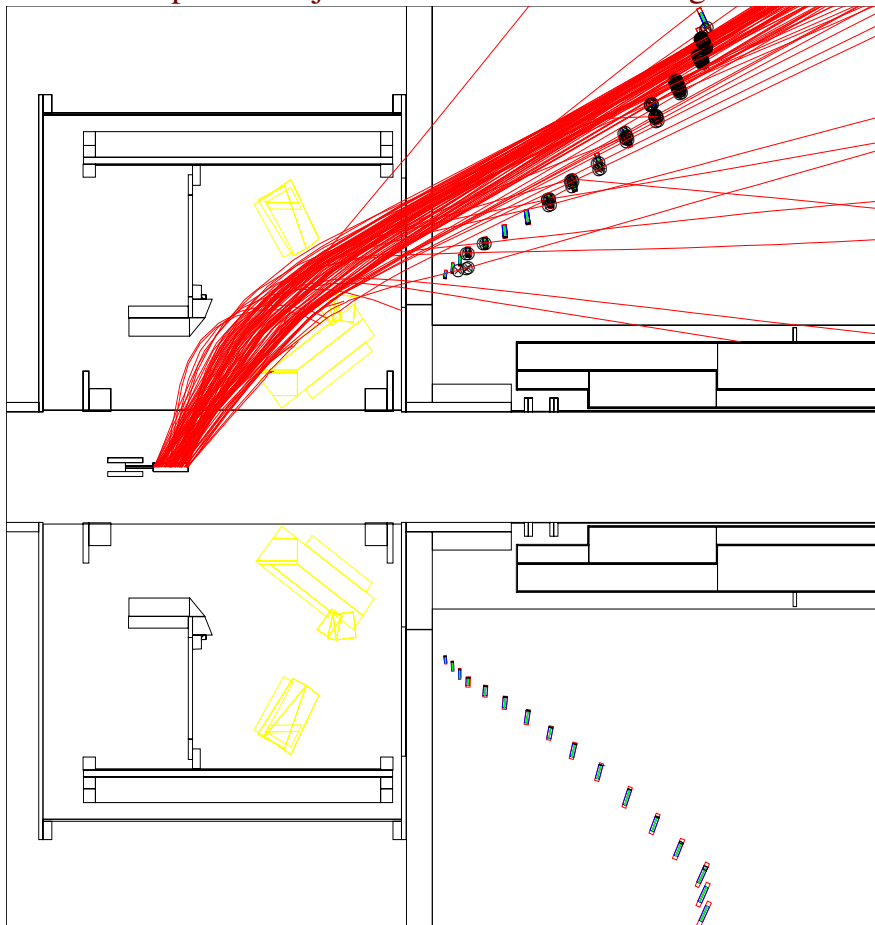


G0 Geant Simulation Update

G0 Collaboration meeting, June 1-2, 2004, Jefferson Lab

Lars Hannelius

Elastic proton trajectories from the LH2 target

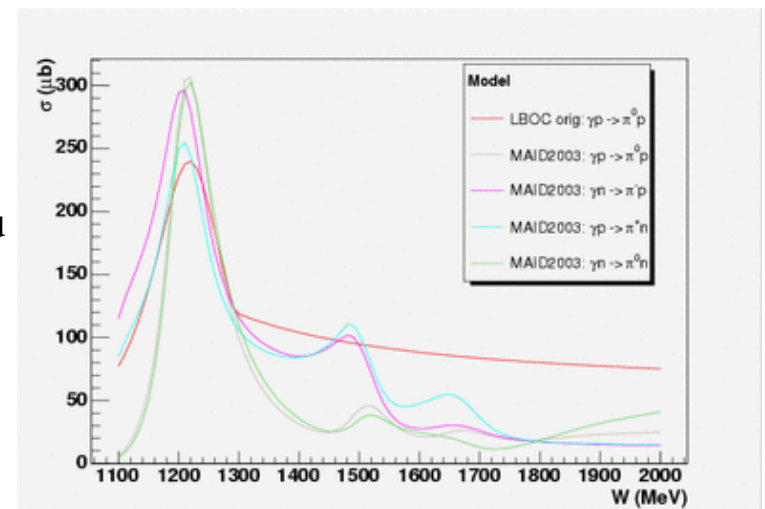


- Help understand background physics processes.
- Make modifications to reduce background.
- Estimate proton rescattering effects.
- Determine Q^2 with external+internal radiative corrections.
- Investigate detector sensitivities to beam position, misalignment, etc.

Recent updates to the simulation code

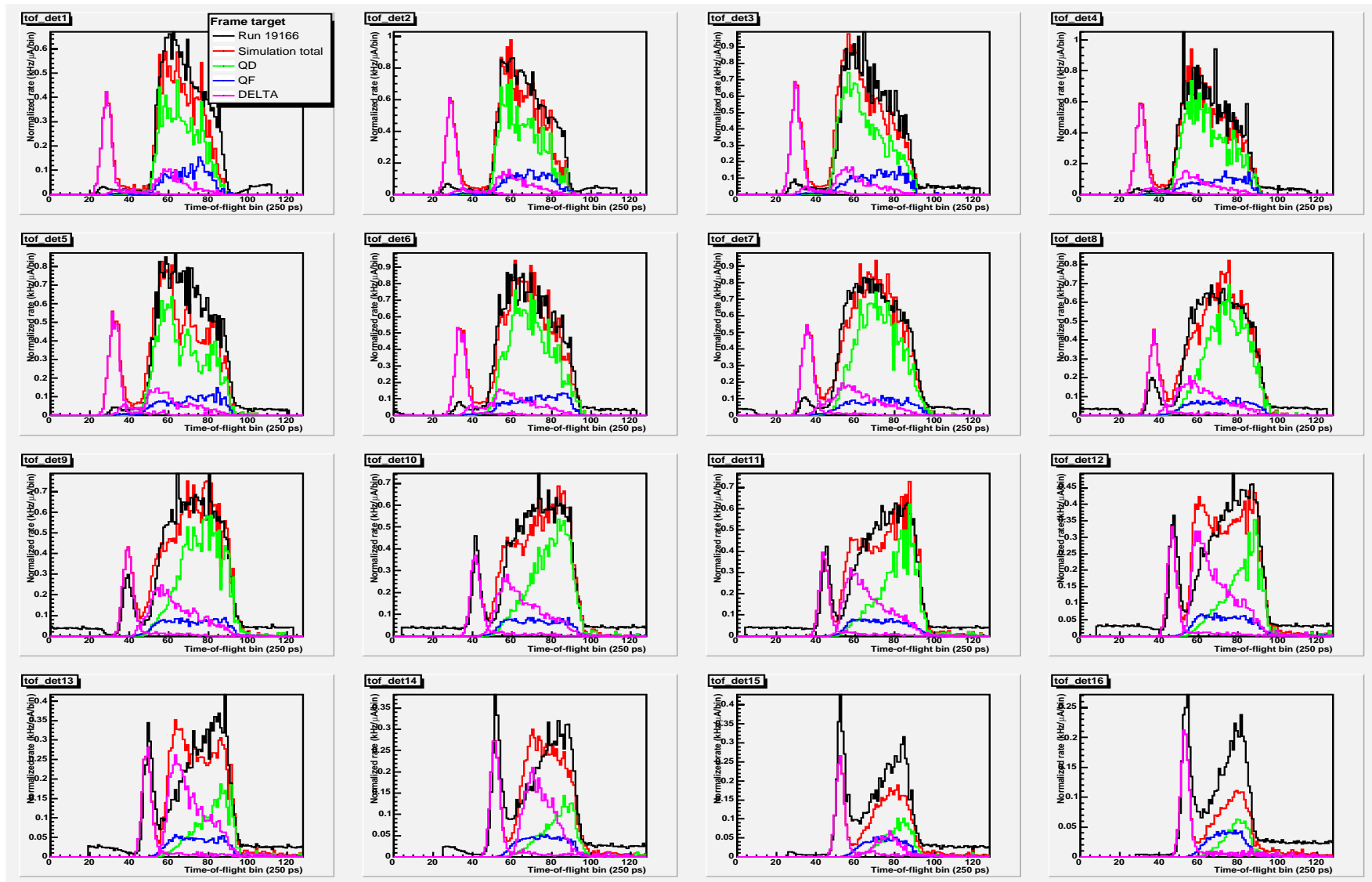
- Geometry file updated to include SMS Ti exit windows and air volume between SMS and FPDs.
- All G0 forward angle targets supported.
- Model for electron energy loss in target (with straggling) due to Bremsstrahlung and ionization. Elastic generator only.
- Proton energy loss handled by standard GEANT particle transport routines.
- No internal r.c. yet, but see Orsay code.
- Modified Lightbody & O'Connell model for inelastic electro/photo-production (MAID 2003 inspired). Full MAID 2000 implementation by J. Liu and J. W. Martin. Also available: the GRAAL generator (J.-S. Real) and the 'Orsay' generator.
- Caltech code available from <http://www.jlab.org/~lars/g0geant/>

Comparing *old* LBOC with MAID



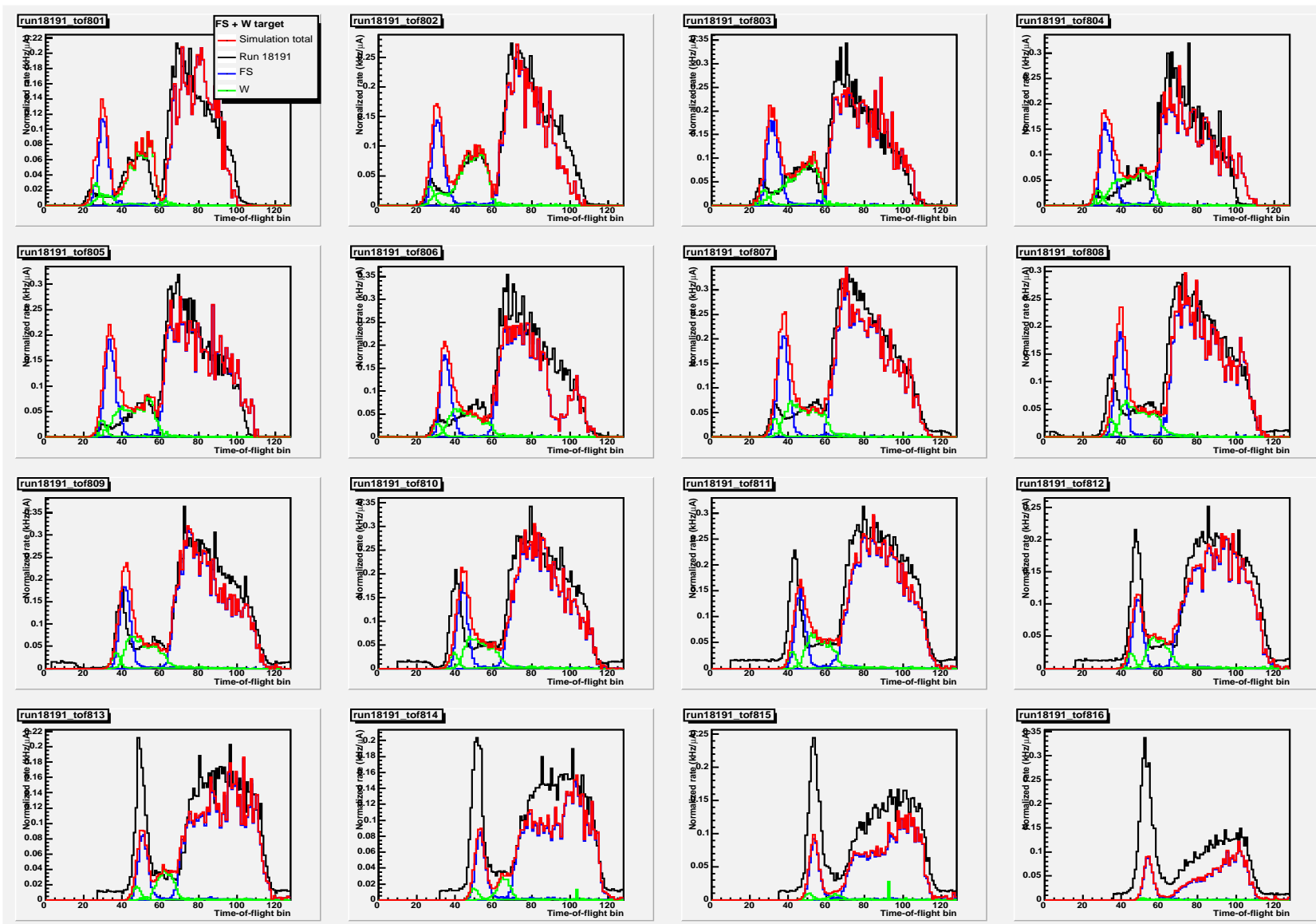
3.175 mm aluminum frame target

Data – Simulation tot – QD – QF - Delta



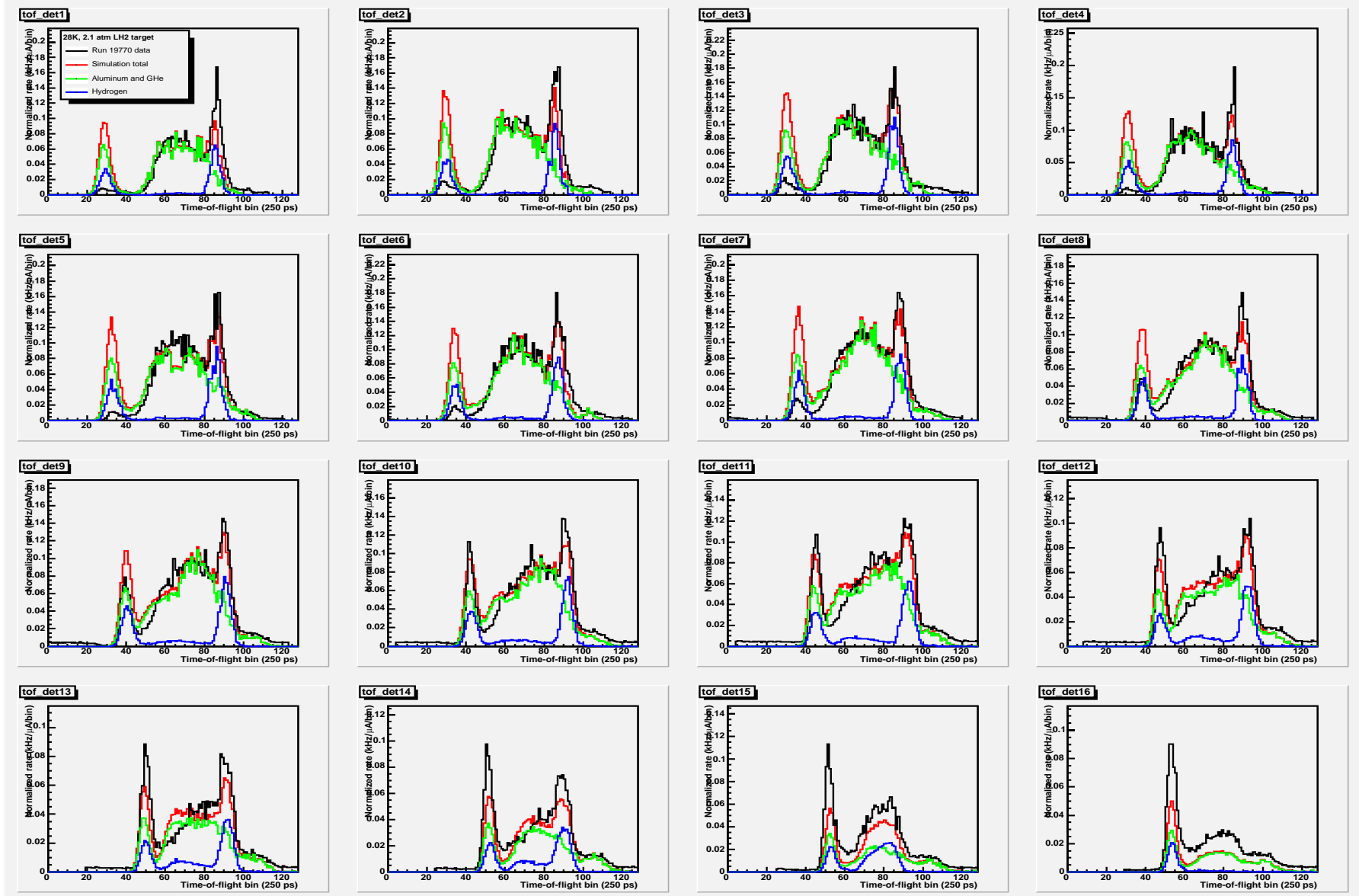
Flyswatter + W radiator

Data – Simulation tot – W – FS



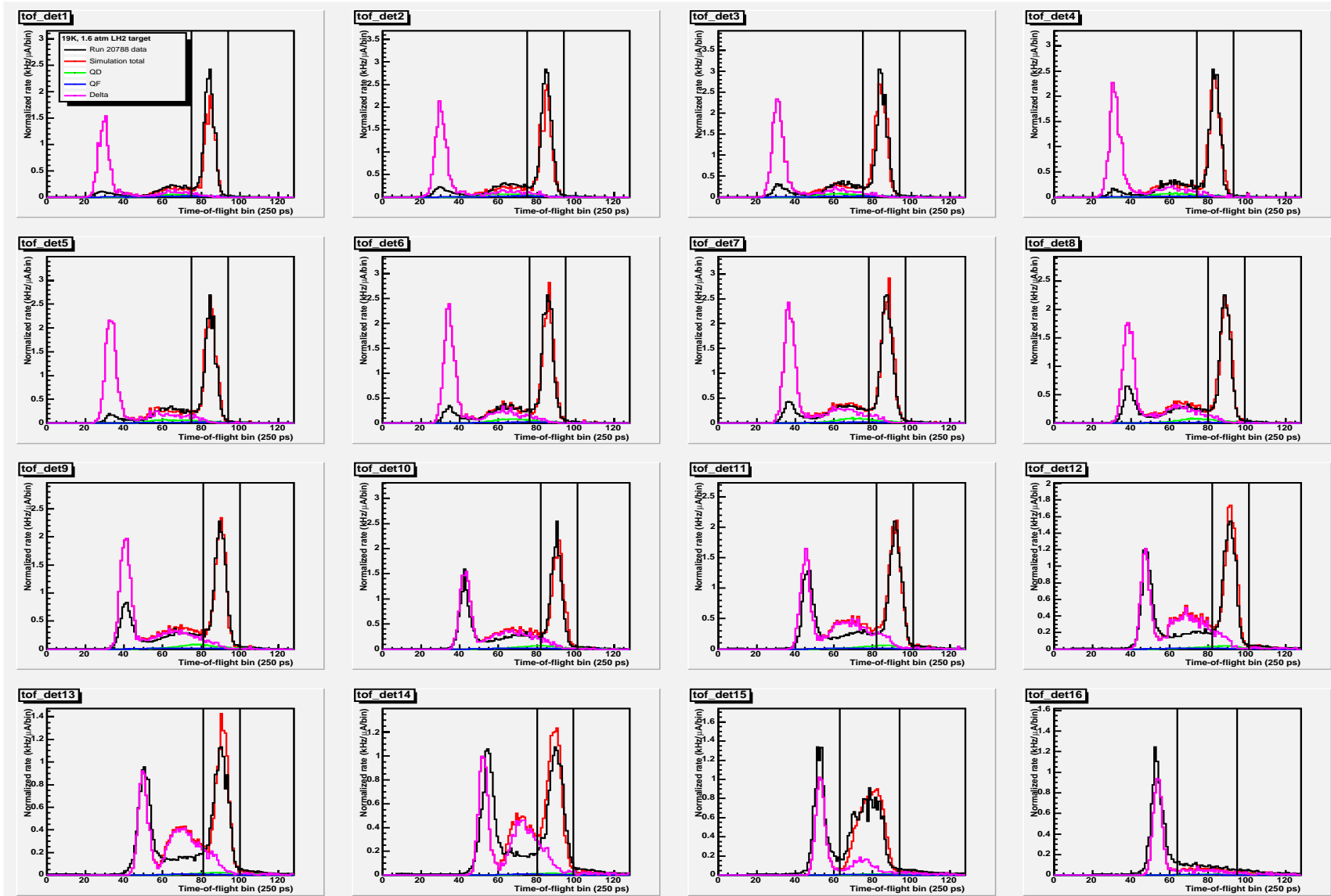
28K, 2.1 atm GH2 'empty' target

Data – Simulation tot – Al+He – GH2



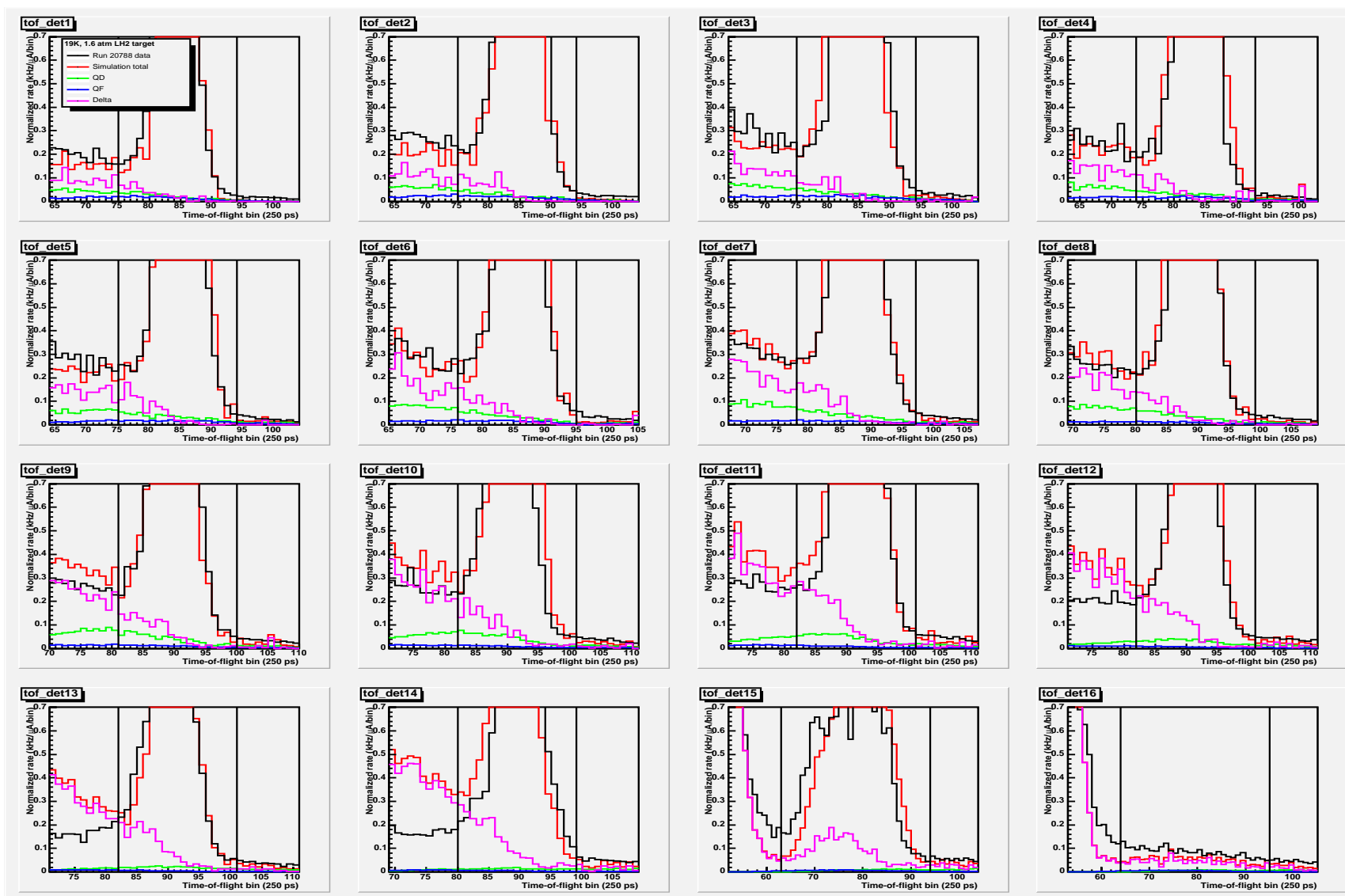
19K, 1.6 atm LH2 target

Data – Simulation tot – QD – QF – Delta



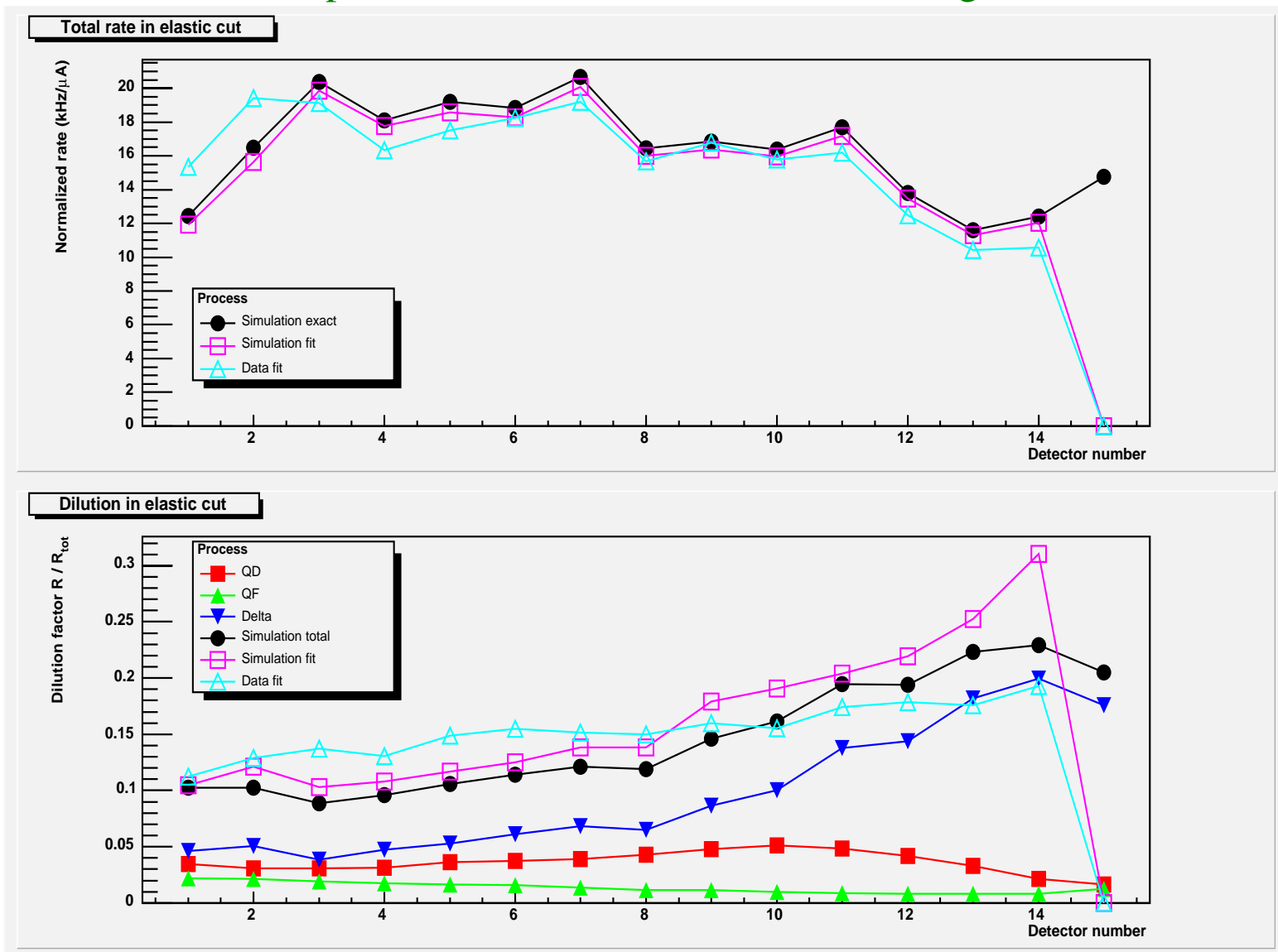
19K, 1.6 atm LH2 target - zoom

Data – Simulation tot – QD – QF – Delta

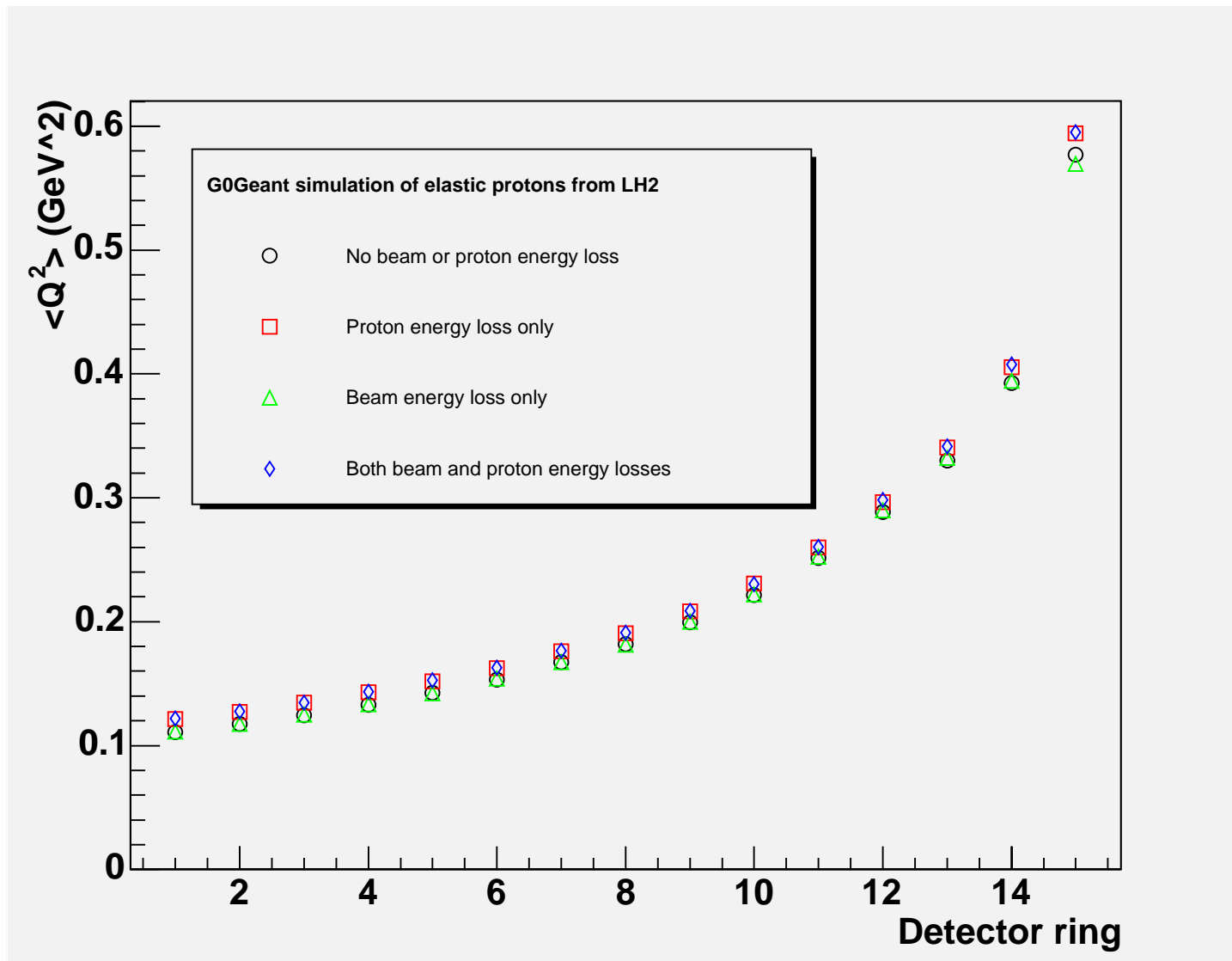


19K, 1.6 atm LH2 target - dilution

Elastic peak fit with Gaussian + linear background



Q^2 simulation



Proton rescattering in LH2 target

Simple estimate:

$$P_{lab} \sim 500 \text{ MeV}/c$$

$$\sqrt{s} \sim 2 \text{ GeV}$$

$$\sigma \sim 20 \text{ mb (PDG elastic } pp)$$

$$\rho \sim 0.0708 \text{ gcm}^{-3}$$

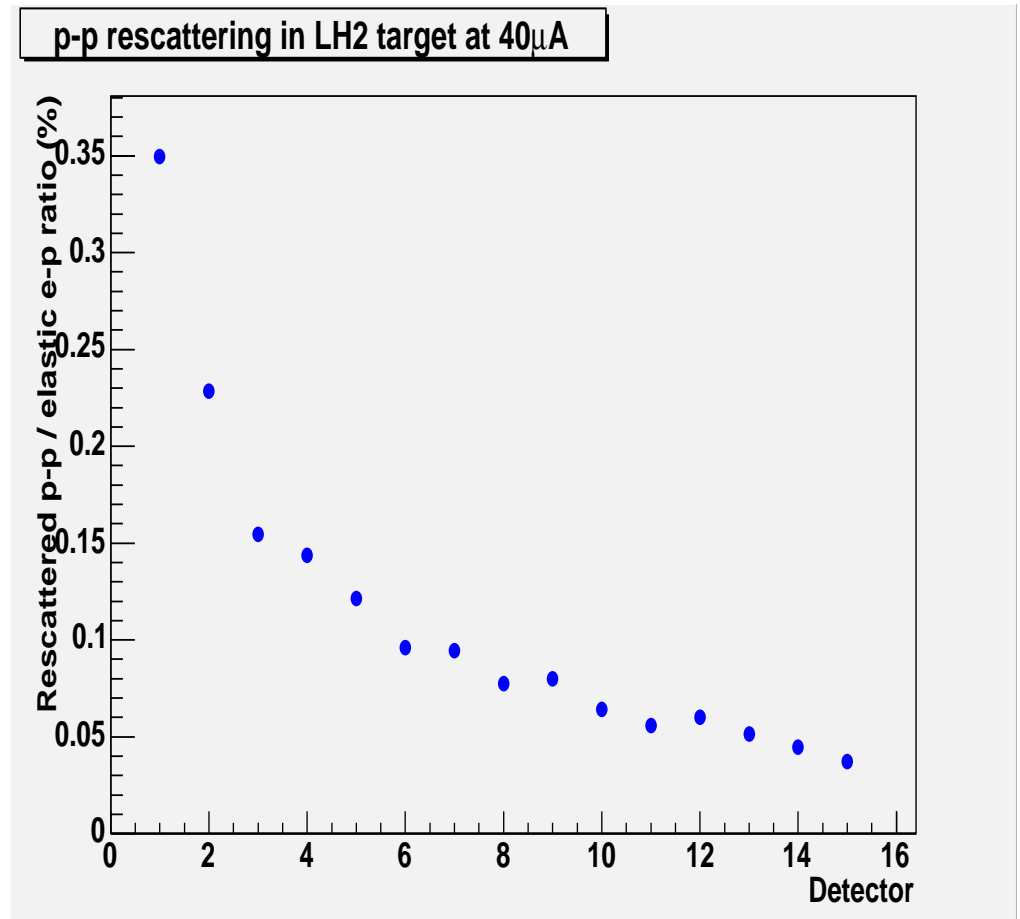
$$L \sim 3.5 \text{ cm}$$

$$\text{rescattering probability } p = \sigma \rho L N_A \sim 3 \times 10^{-3}$$

$$\frac{L}{X_0} = 0.012 \text{ r.l.}$$

$$\theta_{0,Coulomb} = \frac{13.6 \text{ MeV}}{\beta pc} z \sqrt{\frac{L}{X_0}} (1 + 0.038 \ln(\frac{L}{X_0})) \sim 10^{-2} \text{ rad}$$

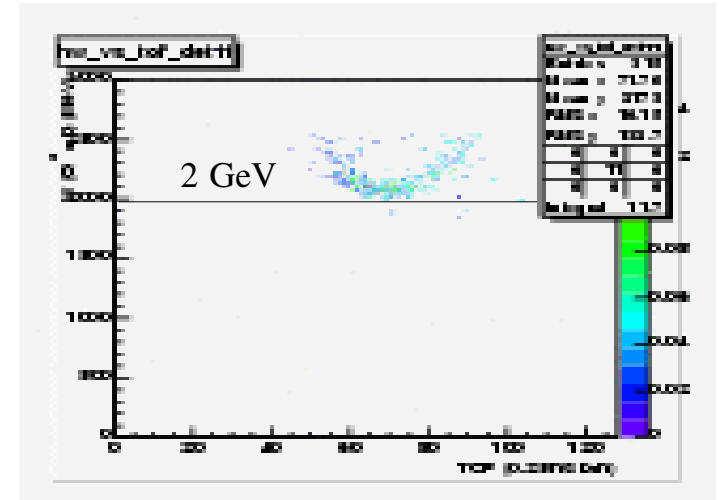
G0-Geant + pp model gives small rate (J. Liu, elog #83389, 4/2004):



Outstanding Issues

- MAID model is not valid at high $W > 2$ GeV, ie. in the higher detectors.
- Quasideuteron model certainly not 100% accurate.
- No model for deuterons (?) seen in high TOF bins.
- Simulated detector 16 rate is always too low – acceptance?
- Internal r.c. need to be implemented for final Q^2 .
- False asymmetries from polarized proton rescattering.

W vs. TOF from LH2 for det 11, $Q^2 = 0$



W distr. from LH2, MAID electroproduction - J. Liu

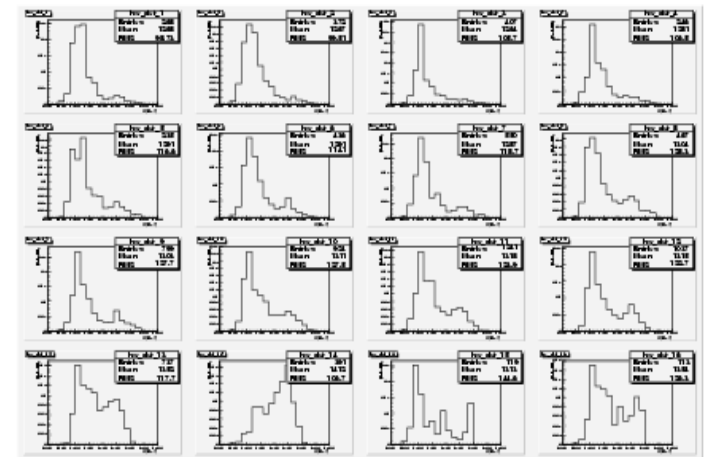


Figure 4: The distribution of the invariant mass W (weighted by the rate) of the inelastic yields due to π^0 electro-production

Conclusion

- Simulation suggests the background under elastic peak is dominated by the quasideuteron effect and pion electro/photo-production, a large part of which is above the $\Delta(1232)$ resonance.
- Simulated rates and dilution factors in the lower 8 detectors compare reasonably well with data.
- Rates in the higher detectors are overpredicted, probably because of the $W < 2$ GeV limitation in MAID and extrapolation into an unknown region. Orsay model to the rescue? GRAAL?
- Detector 16 rate is consistently underpredicted. Reason not yet understood.
- Proton rescattering rate in the LH2 target appears to be small, but not necessarily negligible; contribution to false asymmetry still an open question.

Acceptance (5000 A)

