$\mathbf{p(e,e'p)\omega^0}$ Analysis Update
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1 Data analysis and cuts

In March, Tanja kindly replayed all of the Fpi-2 data for me using proton kinematics, her latest offsets, calorimeter and Cerenkov efficiency calculations, as well as Vladis' tracking code improvements, and Chuncheng's SOS optic corrections. The COIN ntuples were brought to Regina and 'skimmed' (i.e. loose HMS proton and SOS electron identification cuts applied) to reduce the size of the data files by a factor of ∼100 and produce a single COIN ntuple for each kinematic setting.

Each event is tagged with the run number it came from, as well as the product of the efficiencies

$$\begin{aligned}\eta =&(HMS.Fid.Eff) \times (SOS.Fid.Eff)\\ &\times (Comp.LT) \times (HMS.Elec.LT) \times (SOS.Elec.LT)\\ &\times (SOS.Cer) \times (SOS.Cal) \times (Coin.Trig.Eff)\\ &\times (Proton.Absorption).\end{aligned}$$

This product is typically $80-90\%$.

Since Tanja's pion absorption correction was determined from *ep* elastic analysis, with a factor of 1/2 applied, which comes from the ratio of proton and pion cross section ratio at our kinematics, the proton absorption correction is simply the pion absorption correction with the factor of 1/2 removed, i.e. a 3% correction becomes a 6% correction. As the proton analysis is not sensitive to the HMS Aerogel and Cerenkov inefficiencies, they are not included in the above calculation.

The effective charge for each run is then $q_{eff} = q\eta$, and these are summed to compute the effective charge for each kinematic setting. After the skimming, we obtain 20 $p(e,e'p)X$ coincidence data files, whose total size is about 350 MB.

In any subsequent analysis steps, the coincidence events are subjected to the requirements in Table 1. Events passing these conditions are then checked to see if they fall within a reals or accidentals proton identification box, as shown in Fig. 1. True reals are then obtained by subtracting the accidentals box events ($\times 1/3$) from the reals box events.

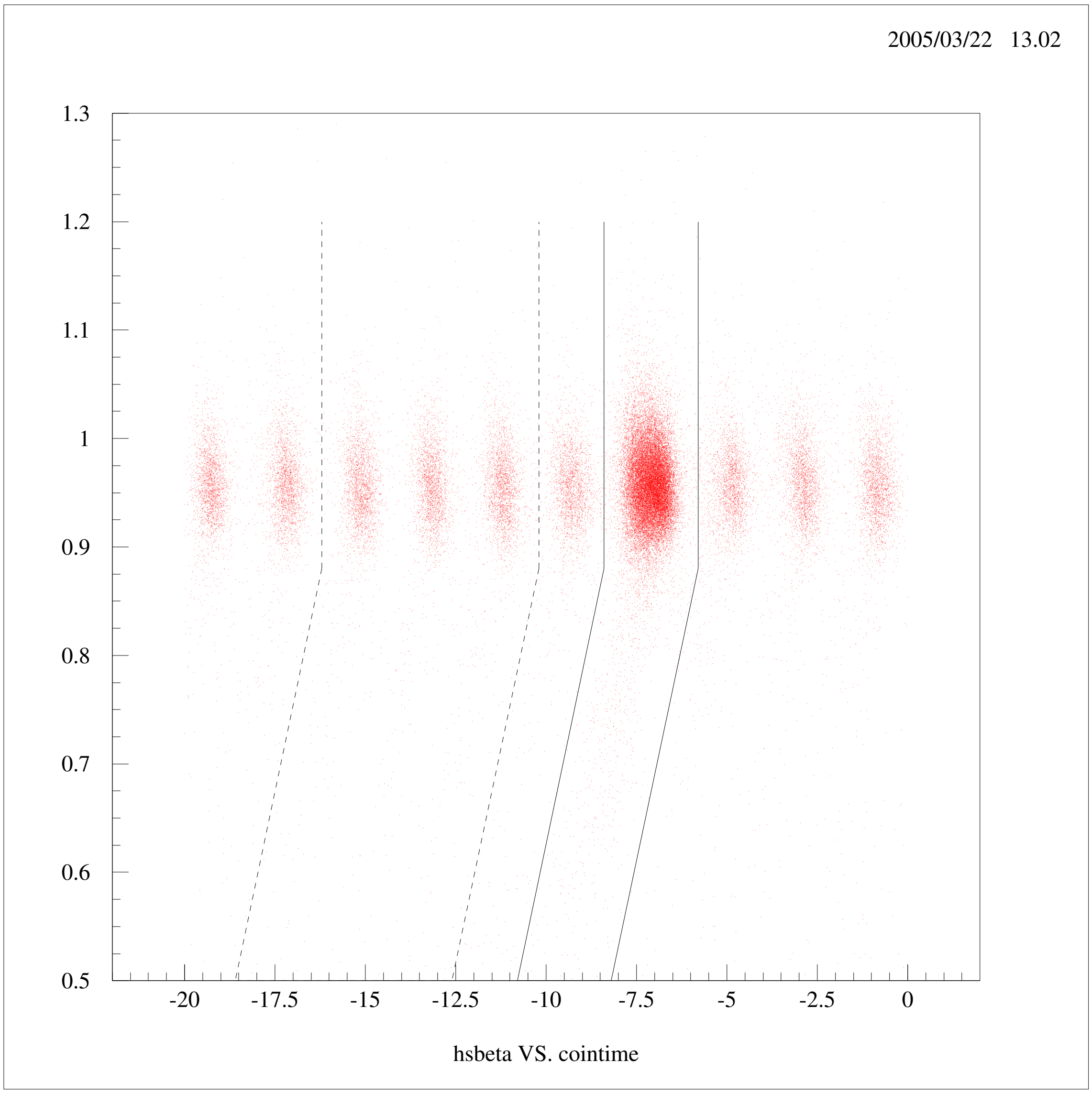

Figure 1: Reals and accidentals proton boxes shown for skimmed data from runs 47725-47735. Because of the excellent job that Tanja has done on the timing corrections, these boxes can be applied without modification to all $Q^2 = 1.60$ data. The $Q^2 = 2.45$ boxes are similar, except they are shifted to more positive cointime by 0.25 ns, and are 0.1 ns wider.

	HMS Aerogel	$\leq$ 2.5 p.e.
	HMS Cerenkov	$\leq$ 2.0 p.e.
	SOS Calorimeter	$\geq$ 0.7 p.e.
	SOS Cerekov	$\geq$ 0.5 p.e.
	HMS $\|\delta\|$	$\leq$ 8.0%
	HMS $\|x'_{tar}\|$	$\leq$ 90 mrad
	HMS $\|y'_{tar}\|$	$\leq$ 55 mrad
	SOS $\|\delta\|$	$\leq$ 15.0%
	SOS $\|x'_{tar}\|$	$\leq$ 40 mrad
	SOS $\|y'_{tar}\|$	$\leq$ 80 mrad
-20 cm $\leq$	SOS x_{fp}	$\leq$ 22 cm

Table 1: PID and fiducial cuts (below line) applied to the coincidence data. These fiducial cuts are also applied to the simulated MC data.

2 Subtraction of background underneath ω^0 peak

To subtract the events remaining underneath the ω^0 peak, I have modified a fitting program supplied by Pawel Ambrosewicz. Simulated events from ω^0, ρ^0 and phasespace MC's are first subject to the same fiducial cuts as the real data (the cuts below the line in Table 1) and then binned. A simultaneous fit of the MCs to the data is performed to determine the contribution of each of the three MC processes to the experimental data. The fit is a simultaneous optimization of the five kinematic variables: Missing Mass, $-t$, Q^2, W, using the log likelihood routines of the CERN library. Sample fits are shown in Figs. 2,3.

To my surprise, I find that the background underneath the ω^0 peak is almost exclusively due to ρ^0 production. At much lower Q^2 and W, Pawel Ambrosewicz had found that his background was best fit by the phasespace production MC. A sample 'false fit', where the phasespace mechanism is used instead of the ρ^0 mechanism is shown in Fig 4. The fit is clearly much worse, particularly in the $-t$ dependence.

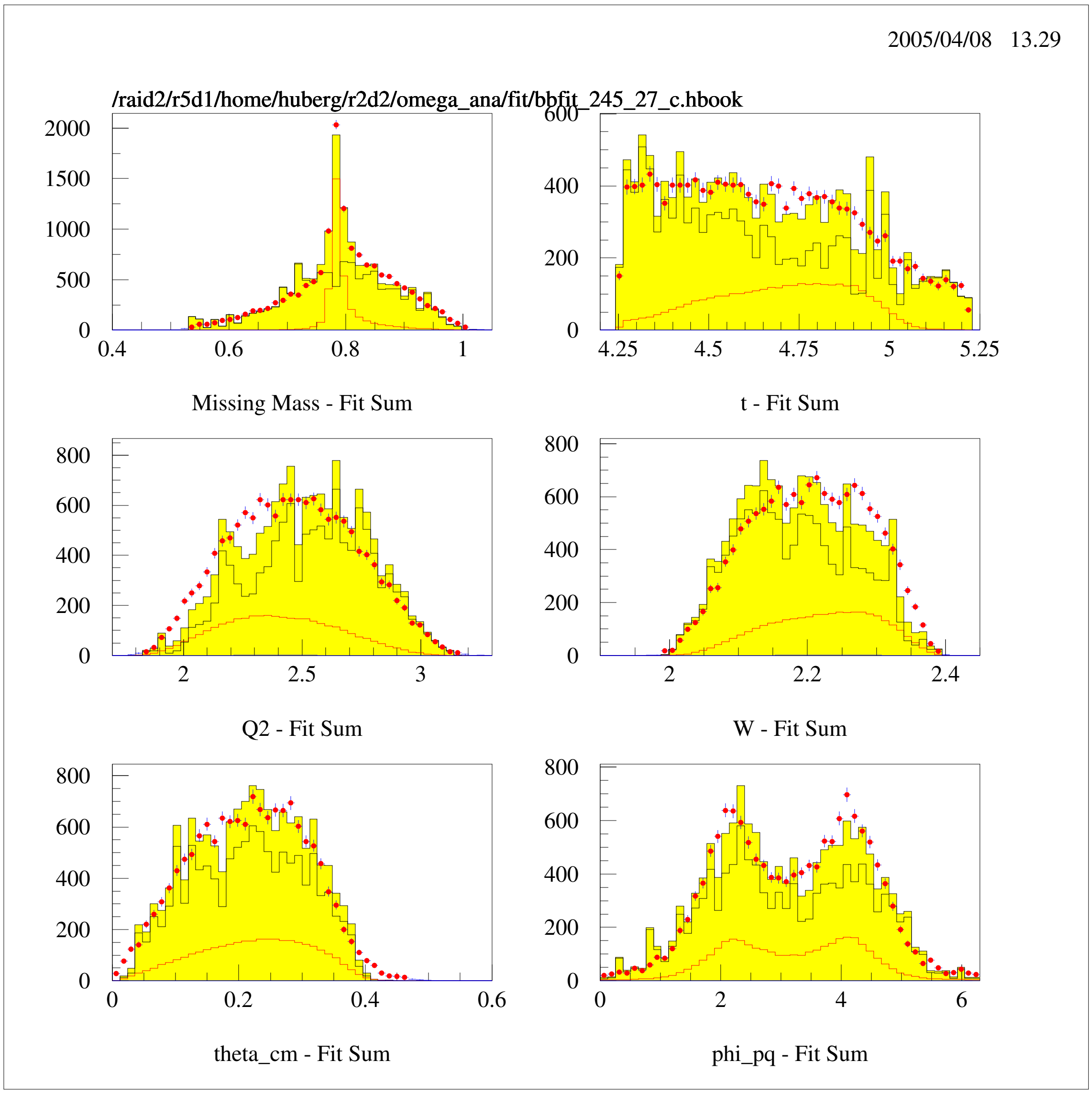

Figure 2: Fit results for the $Q^2 = 2.45$, $\epsilon = 0.27$, Central HMS kinematic setting. The red dots are the data after accidentals have been subtracted. The red line is the fit ω^0 contribution, the black line is the fit ρ^0 contribution, and the blue line (barely visible) is the fit phasespace contribution. The filled yellow region indicates the sum of the three MC's to the data. In this case, ω^0's make up 23% of the data, with the remainder being ρ^0's.

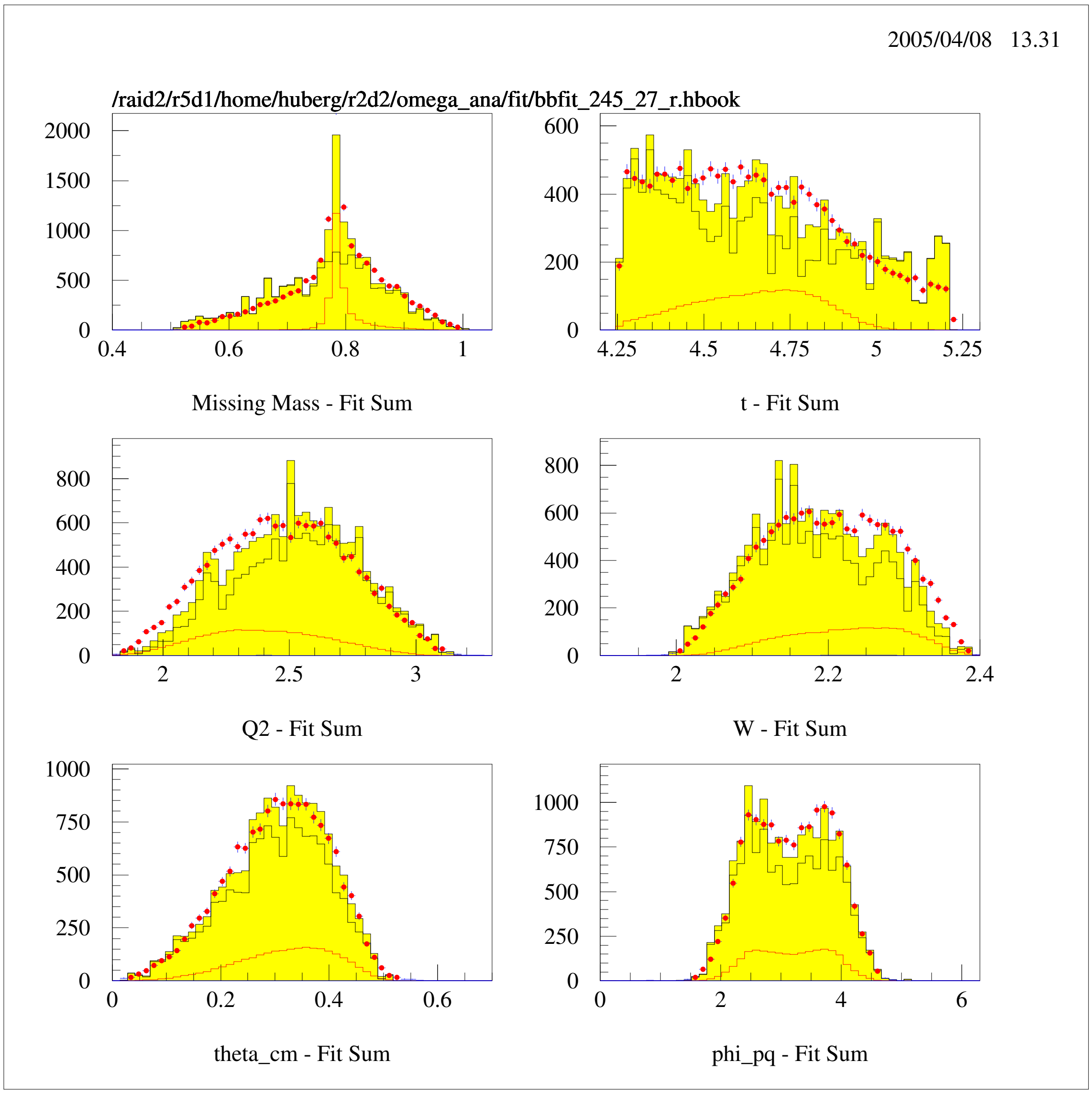

Figure 3: Fit results for the $Q^2 = 2.45$, $\epsilon = 0.27$, Right HMS kinematic setting. Here, ω^0's make up 17% of the data.

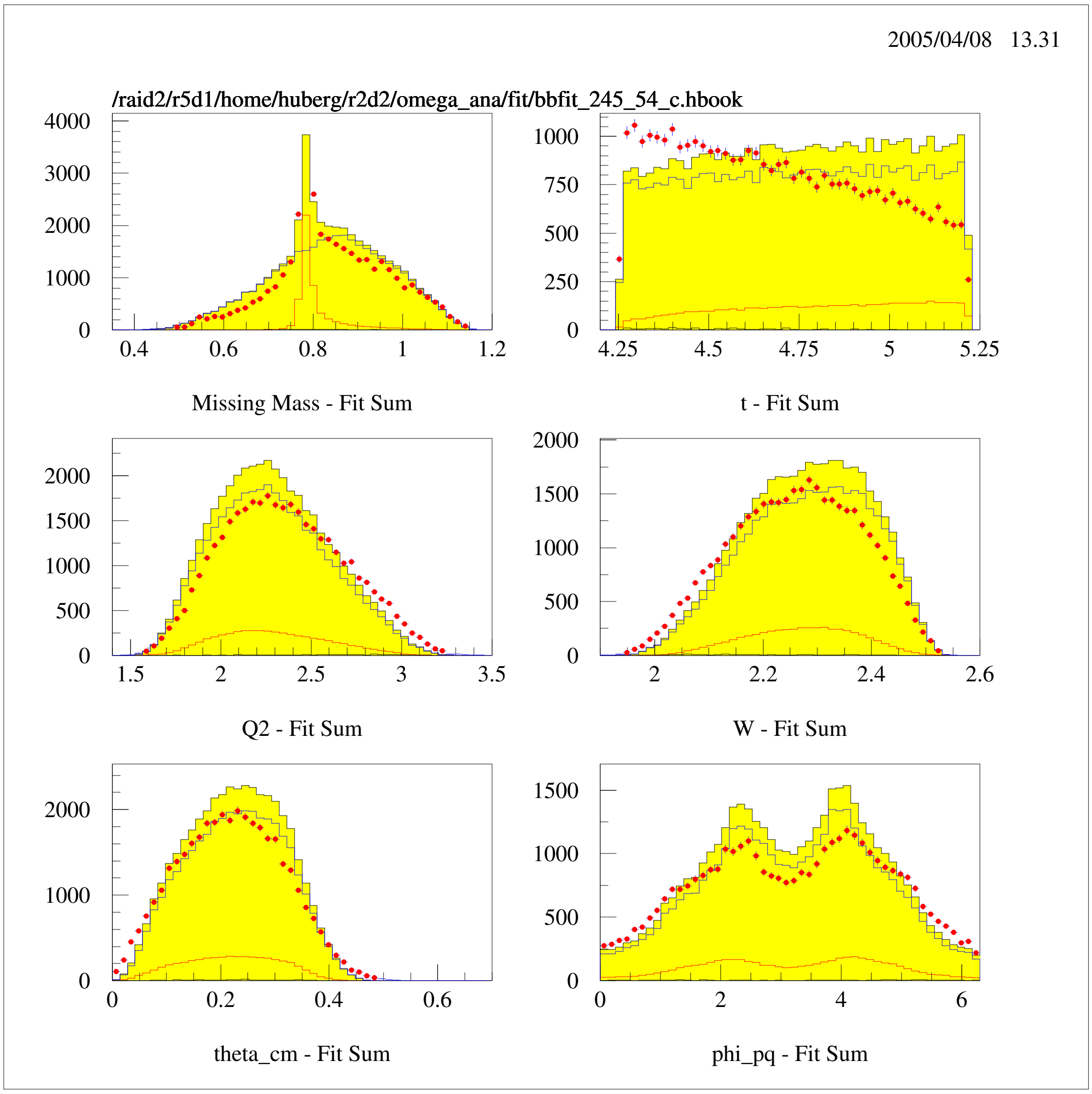

Figure 4: 'False Fit' to the $Q^2 = 2.45$, $\epsilon = 0.54$, Central HMS kinematic setting data, where the phasespace contribution is assumed to be the dominant source of background. As before, the blue curve is the phasespace contribution, the red curve the ω^0 contribution, and the black curve the ρ^0 contribution. The fit is clearly inferior to those in Figs. 2, 3.

3 What next?

Given that the SIMC models are largely untested, I am pleasantly surprised by the quality of these initial fits to the data. I clearly need to run much more statistics for the ρ^0 MC, and this is currently in progress.

The ω^0 simulation is based on my fit to the t-dependence of Laget's Regge model predictions at $Q^2 = 2.35$, $W = 2.47$ and my best guess for the Q^2 and W-dependence of his model. The ρ^0 simulations assume a diffractive production mechanism, and assume a Breit-Wigner shape, with a Soding-model skewing correction. The full report on these generators is posted as FpiLog 541.

After we discuss these results, I am looking for your suggestions on:

1. Things I should check to verify the MC description of the data.
2. Suggestions on iterations to the models that I should consider to improve further their description of the data.
3. Suggestions on how best to incorporate the subtraction of the ρ^0 background in the L, T, LT, TT separation.
4. Suggestions on how best to combine the three HMS settings at each ϵ setting.
5. Any other issues I may have forgotten.