Moller runs during RSS

1 Summary

The Wien angle at the injector was set to four angles. The Moller measurements for 71.2° are in Table 1. The Moller measurements for 81.2° are in Table 1. The Moller measurements for 60.2° are in Table 1. There was one measurement of 72.85 ± 1.3 for 45°, but no data was taken with this Wien angle. In Fig. 1, the Moller measurements as a function of run number are plotted. The value of the weighted average for each Wien angle is given in Table 1. In Fig. 2, the polarization values are histogrammed and a gaussian is fitted to the data. The plots are the left side of Fig. 2 have been fit with the mean was fixed to the weighted average, while for the plots on the right side all parameters were varied. One point to note is the the beam polarization has the wrong sign. At this beam energy and Wien angles the beam polarization in the Hall should have be about 180° out-of-phase with the beam at the injector. The helicity convention for picking "plus" beam helicity is the same between the Moller setup and the experiment. If one keeps the same sign measured by Moller and the same helicity convention then the asymmetry after correcting the raw asymmetry for the beam helicity will have the right sign since both the raw asymmetry and beam helicity have the wrong sign.

Wien angle	Valid Runs	Weighted average	Gaussian fit 2	Gaussian fit 3
71.2°	start-43422,43434-43611	65.55 ± 0.22	65.55 ± 2.6	66.30 ± 2.4
81.2°	43423-43432	60.66 ± 0.73		
60.2°	43702-end	70.74 ± 0.24	70.74 ± 1.7	70.91 ± 1.8

Table 1: Table of Average Beam Polarization for different run periods

2 Further analysis

In the preliminary analysis done above, basically all Møller runs were included. Some runs should be discarded out of hand because of various reasons: the Møller was still being tuned, the laser phase was deliberately changed, the LED flasher was on, and runs with many trips. Several runs from the Wein angle = 81.2° and 71.2° data sets can be excluded for these reasons. In the case of the 81.2° data set, only one run remains (Run 43428, $P_e = 57.82 \pm 1.56\%$). The run–to–run variation of the 71.2° data set is shown in Fig. 4, both before and after the bad runs are excluded.

There are other effects, like large leakage currents, unstable beam positions, etc., that may be desireable to include in the estimate of the beam polarization of the actual experiment (since they were likely there during the actual running) that affect the results of the Møller runs. However, it is useful to remove these runs to try and gain increased understanding of the systematics of the Møller itself.

First we remove runs with large Hall A leakage currents (as noted in the HCLOG). We also remove runs that are marked "beam motion at 3C12": this indicates that the beam energy may not have been stable and may have been varying in some (helicity–correlated?) manner. Also, runs that are marked to have an unstable position at the target are also removed. The effects of these cuts are shown in Fig. 5 and Fig. 6 for the 71° and 60° Wein angle data sets.

Finally, while tests during G0 suggest that Møller results are not very sensitive to the (absolute) beam position at the target, this may depend on the tune of Møller quadrupoles. As a final test, we remove all runs that have beam positions at the Møller target outside the nominal ±0.5 mm specification. This effects runs from the 60.2° Wein angle data set and the result of this cut is shown in Fig. 7.

3 Conclusion

By excluding runs with non–ideal beam and/or polarimeter conditions, the consistency of the RSS polarization measurements are improved. It should be noted that several runs with non–ideal conditions may still be included. For example, runs with large Hall A leakage currents were only excluded when this was noted in the HCLOG.

From the point of view of extracting the polarization (and the variation of the polarization) under the running conditions of the actual experiment, it is probably most appropriate to use the data set with the "obviously bad" runs excluded. Runs with large Hall A leakage currents and motion at 3C12 probably reflect actual running conditions. The exclusion of runs with bad beam positions at the Møller target seems to improve the consistency of the 60.2° Wein angle points, but not to a large degree.

Figure 1:

Run	Beam Pol	Error	Comment
43210	70.02	1.57	still tuning Møller
43211	68.79	1.28	tuning
43212	66.81	1.29	tuning
43213	66.97	1.38	tuning
43215	66.60	1.26	beam motion at 3C12
43216	68.90	1.43	motion at 3C12
43251	63.89	1.40	LED flasher on
43252	61.58	1.13	motion at 3C12
43253	62.75	1.08	motion at 3C12
43254	65.41	1.00	
43278	68.02	1.40	
43279	65.32	1.39	
43280	65.84	1.37	
43281	65.90	1.39	laser phase +3 deg
43282	61.93	1.39	laser phase -5 deg
43283	63.60	1.38	
43317	67.64	1.27	motion at 3C12
43318	65.56	1.40	motion at 3C12
43319	65.84	1.27	motion at 3C12
43401	61.61	1.25	large Hall A leakage
43402	60.19	1.32	large Hall A leakage
43403	64.40	1.15	
43433	67.99	1.29	
43459	64.80	1.20	
43473	67.65	1.19	
43474	66.40	1.22	
43524	67.60	1.30	motion at target
43525	65.82	1.50	motion at target
43526	68.31	1.30	motion at target
43545	65.77	1.34	motion at target
43546	66.26	1.34	motion at target
43567	65.86	1.31	
43568	63.72	1.23	motion at target
43577	67.75	1.17	large Hall A leakage
43590	64.04	3.97	
43592	61.69	1.56	

Table 2: Table of Beam Polarizations for Wien Angle = 71.2°

Run	Beam Pol	Error	Comment
43707	71.76	1.30	beam motion at 3C12
43708	70.23	1.30	motion at 3C12
43731	72.60	1.30	motion at 3C12
43744	68.80	1.30	position at target not stable
43745	67.90	1.40	position at target not nominal
43756	72.85	1.32	position at target not nominal
43771	70.65	1.34	position at target not nominal
43772	73.74	1.35	position at target not nominal
43794	71.28	1.30	
43795	73.93	1.36	
43818	69.85	1.29	position at target not nominal
43819	71.09	1.30	position at target not nominal
43857	70.95	1.42	
43858	70.57	1.32	
43884	70.22	1.38	position at target not nominal
43885	70.51	1.39	position at target not nominal
43908	71.46	1.45	
43909	69.08	1.42	
43932	71.13	1.35	large charge asymmetry (1700 ppm)
43933	68.53	1.34	
43953	70.09	1.33	
43954	69.36	1.33	
43955	72.54	1.24	
43956	69.52	1.24	
43979	71.57	1.36	
43980	73.40	1.36	
44007	69.46	1.34	
44008	70.60	1.35	
44023	66.75	1.33	position at target not nominal
44024	69.63	1.33	position at target not nominal
44025	72.86	1.33	

Table 3: Table of Beam Polarizations for Wien Angle = 60.2°

Run	Beam Pol	Error	Comment
43428	57.84	1.56	
43426	60.25	1.57	laser phase +4 deg
43427	60.78	1.33	laser phase -4 deg
43424	63.12	1.40	beam trips

Table 4: Table of Beam Polarizations for Wien Angle = 81.2°

Figure 2:

Figure 3:

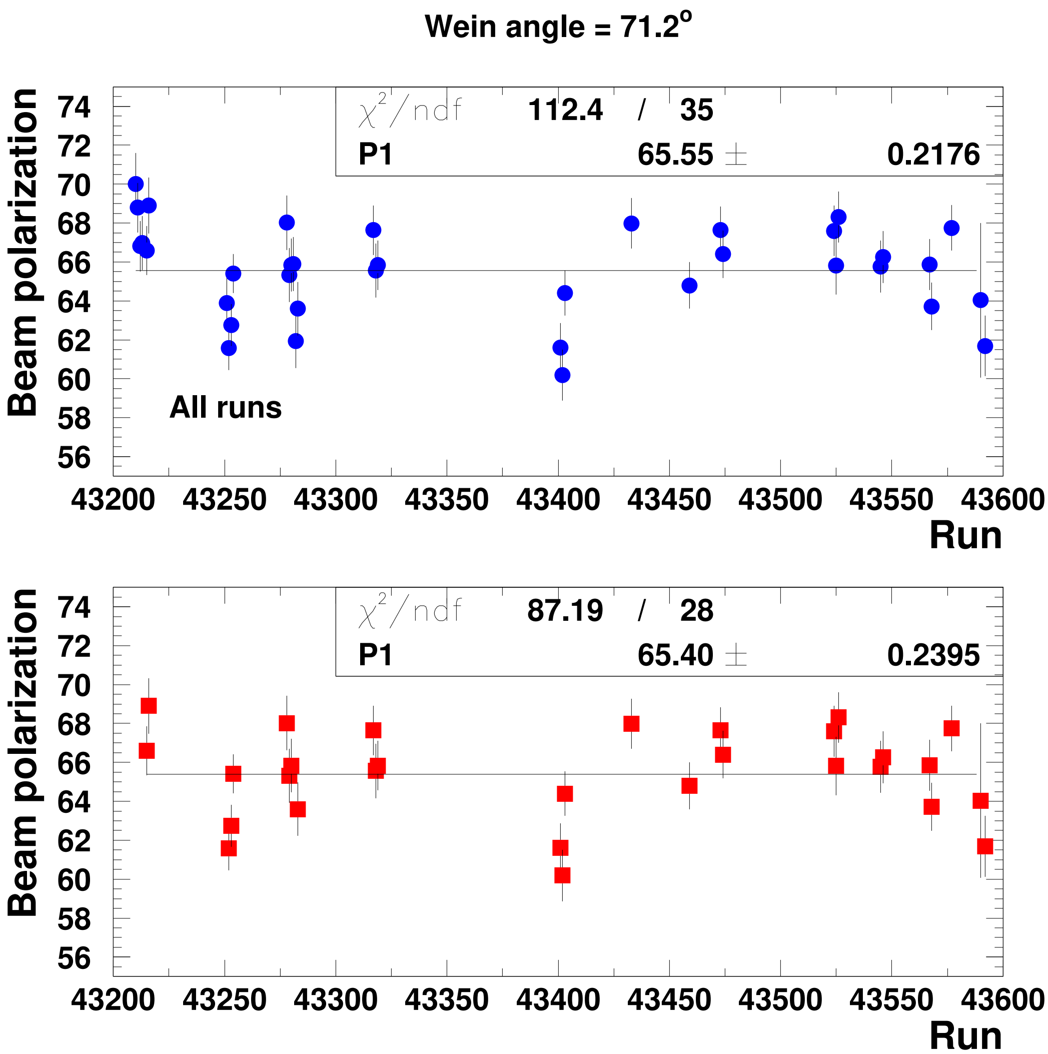

Figure 4: Run–to–run variation of Møller polarization measurements for runs with the Wein angle set to 71.2°. The top plot includes all runs and the bottom plot excludes obviously bad runs. Each plot is fit to a constant, and the χ^2/ν (≈ 3) is effectively unchanged by throwing out the bad runs.

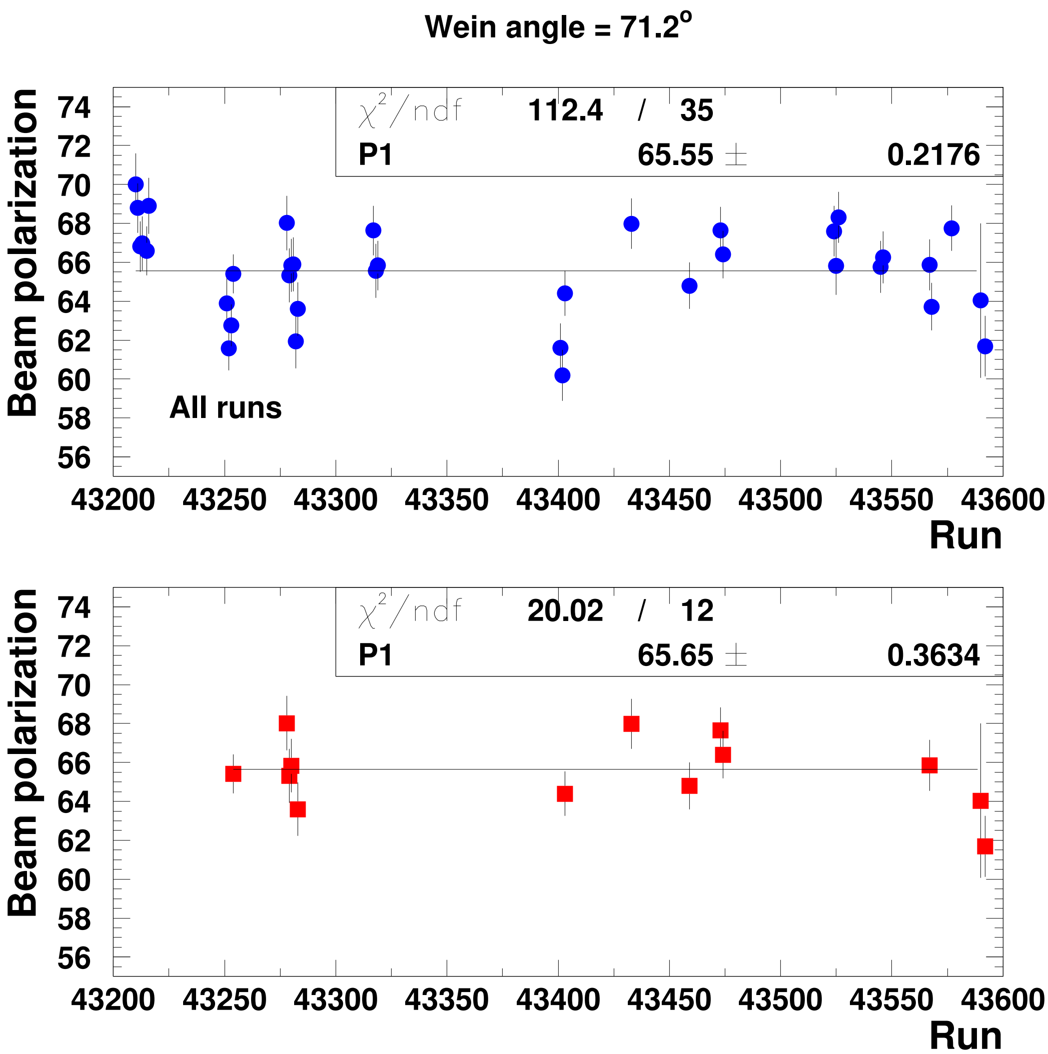

Figure 5: Run–to–run variation of Møller polarization measurements for runs with the Wein angle set to 71.2°. The top plot includes all runs and the bottom plot excludes obviously bad runs and runs in which the beam position varied significantly at IPM3C12. Each plot is fit to a constant, and the χ^2/ν improves from 3.2 to 1.67 with the motion at 3C12 cut.

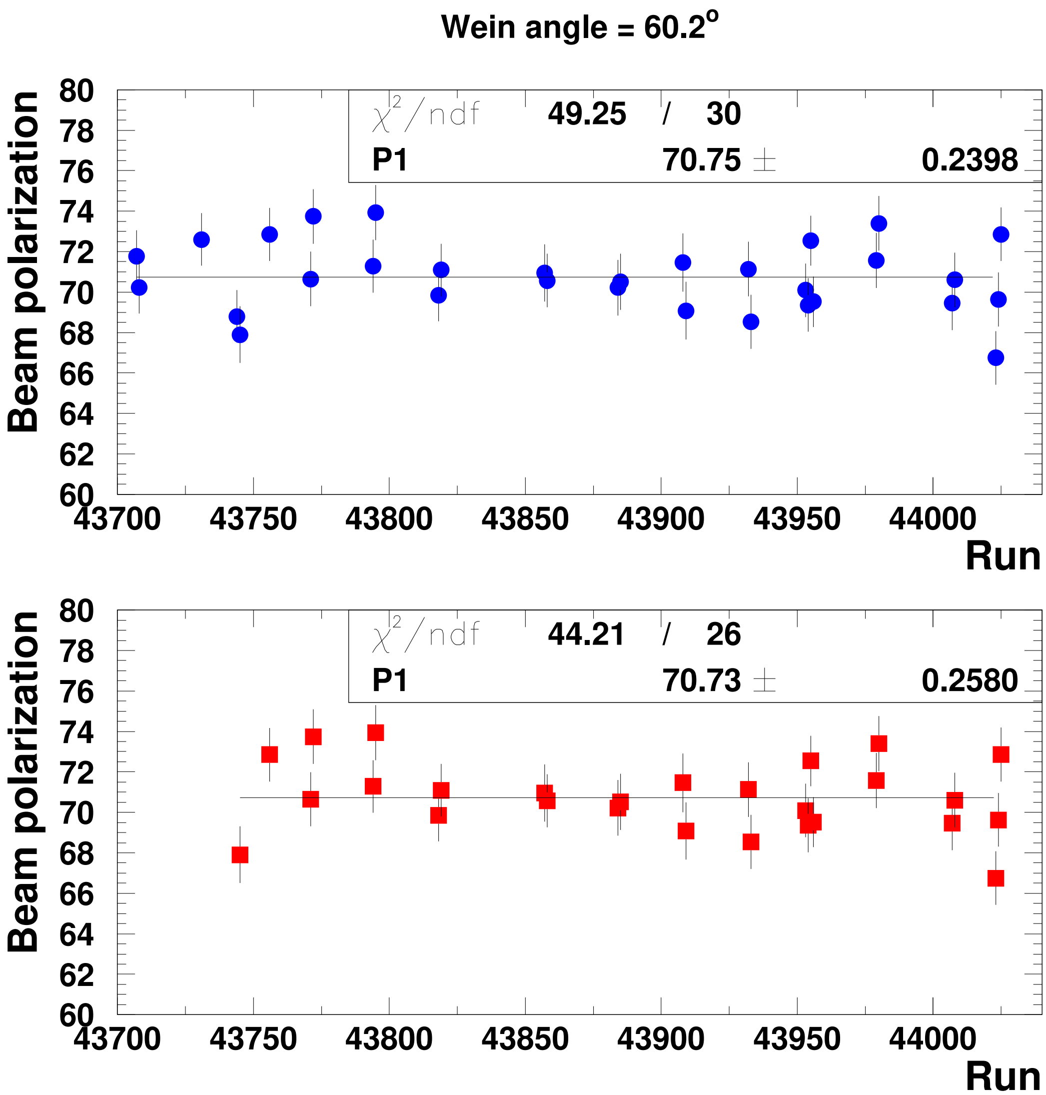

Figure 6: Run–to–run variation of Møller polarization measurements for runs with the Wein angle set to 60.2°. The top plot includes all runs and the bottom plot excludes runs in which the beam position varied significantly at IPM3C12. Each plot is fit to a constant, and the χ^2/ν remains about the same (≈ 1.7) with the motion at 3C12 cut.

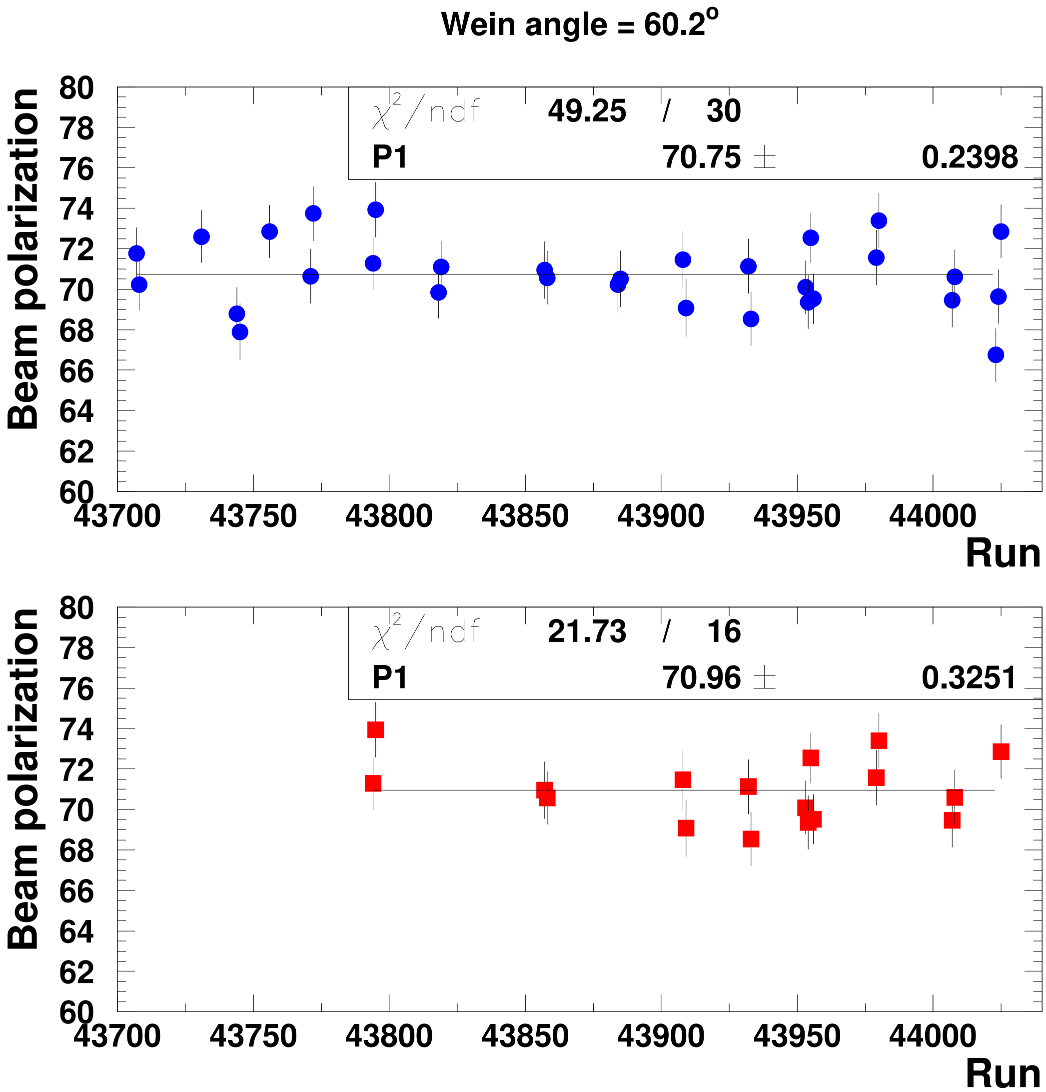

Figure 7: Run–to–run variation of Møller polarization measurements for runs with the Wein angle set to 60.2°. The top plot includes all runs and the bottom plot excludes runs in which the beam position near the Møller target (at IPM3C16 and IPM3C17) was beyond the "nominal" range of ± 0.5 mm. Each plot is fit to a constant, and the χ^2/ν improves from 1.6 to 1.36 with this cut.