Energy reach and polarization
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Abstract

In preparation for the FY20 run I used the Spin Doctor tool created by Yves Roblin, Joe Grames and Michele Joyce to explore various momentum combinations for Injector, North Linac and South Linac to provide full polarization to Hall A, B and C and energy > 11.5 GeV to Hall D. Following the MOLLER collaboration meeting I extended the energy range to that needed for that experiment. This was not an exhaustive search but it seems reasonable to document the results in this text document and the accompanying spreadsheet.

Results provided to Accelerator Division Managers

Inj_P	NL_P	SL_P	P^2_A1	P^2_B5	P^2_C5	P_D(MeV/c)	P^2_C1	angle w flipper	scenario
122	1052	1052	1	0.994	0.999	11634	0.895	50.02	
117	1042	1042	1	0.98	0.999	11521	0.936	58.28	unlikely, but
123	1048	1055	1	0.985	0.976	11626	0.895	51.25	
123	1055	1048	1	0.994	0.998	11633	0.891	48.39	dashed hope
118	1030	1057	1	1	0.993	11525	0.93	62.43	
105	1057	1030	1	0.999	0.98	11539	0.946	57.82	
123	1050	1030	1	0.977	1	11515	0.933	52.39	
124	1050	1030	1	0.992	0.998	11516	0.931	51.9	
121	1031	1031	1	0.97	0.991	**11405**	0.959	62.67	possible
122	1001	1021	1	**0.917**	**0.93**	**11181**	0.992	77.83	likely
120	1000	1000	1	**0.864**	**0.884**	**11070**	0.956	81.1	
95	1000	1010	1	**0.884**	**0.889**	**11095**		-87.42	
106	998	1008	1	**0.877**	**0.887**	**11084**		88.31	

bold: problematic ochre: suggested

P^2	polarization squared figure of merit
A1	first pass to A, parity experiment
B5, C5	fifth pass to B, C
P_D(MeV/c)	momentum to hall D

It appears that the SL is close to early-2019 performance but that the NL has degraded. The C100s are not performing as desired, except for NL25 (C100-6R).

The table which follows summarizes energies relevant to MOLLER. If Hall C needs polarized beam, running MOLLER at 1080/linac for most of the experiment and 1060/linac for the planned (g-2) reversal to reduce systematics, may be better than 1090/linac and 1070/linac. The Experiment Scheduling Committee will be challanged during the four years of MOLLER and the subsequent years of SoLID.

And for the distant future

Inj_real_P	NL_real_P	SL_real_P	P^2_A5	P^2_B5	P^2_C5	P_D(MeV/c)	P^2_D	angle w flipper
115	1056	1056	1	0.993	0.971	11670	0.962	-6.48
115	1060	1060	1	0.981	0.92	11713	0.819	-83.13
123	1060	1060	1	0.977	0.907	11720	0.78	66.91
115	1070	1070	1	0.921	0.703	11820	0.248	87.74
123	1069	1069	1	0.923	0.708	11817	0.263	76.91
123	1080	1080	1	0.816	0.393	11934	0.018	46.77
123	1090	1090	1	0.694	0.145	12041	0.459	34.83

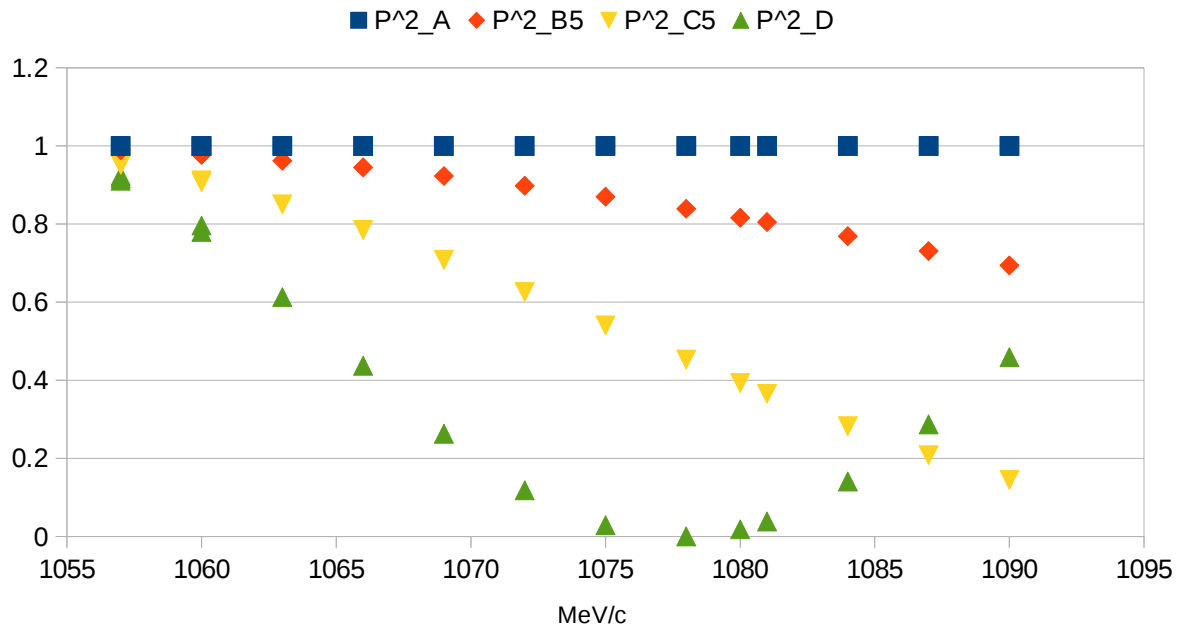

Figure 1. This shows polarization as a function of linac energy with injector fixed at 123 MeV. Hall A is assumed to have a fifth pass parity experiment requiring full longitudinal polarization, MOLLER or SoLID. There are Hall D LOIs requiring longitudinal polarization so its polarization is included above.

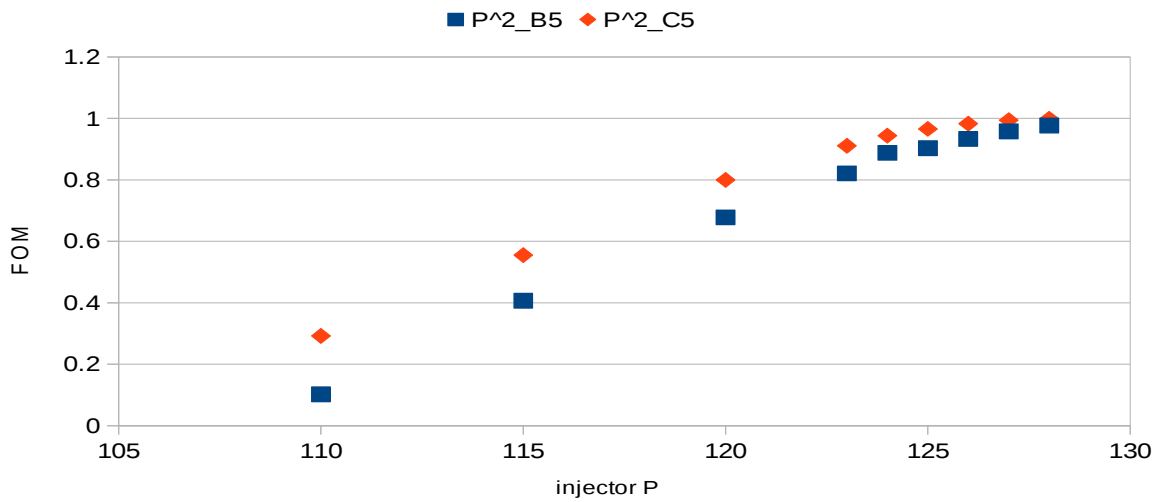

Figure 2. This shows polarization for B and C on fifth pass with A a parity experiment at first pass as a function of injector energy for linac energies of 1040/1040.

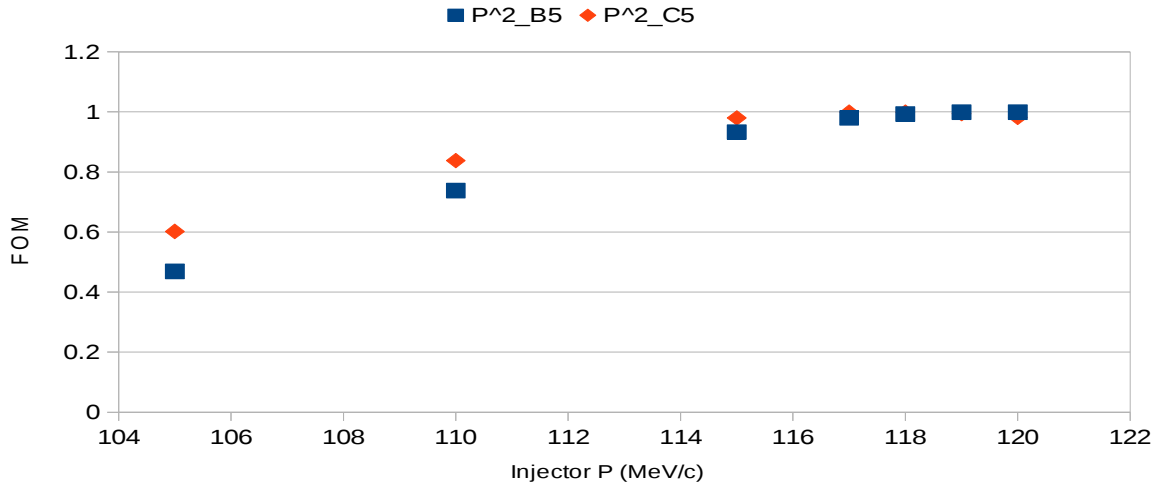

Figure 3. This shows polarization for B and C on fifth pass with A a parity experiment at first pass as a function of injector energy for linac energies of 1042/1042. Comparing to figure 2, one sees that it is very important to improve the accuracy with which we set the injector and linac energies to a few parts in ten thousand.

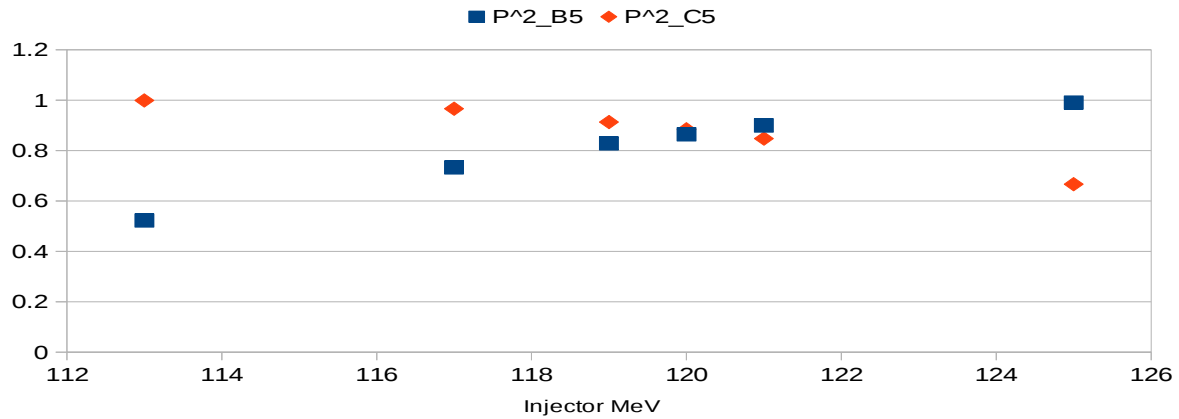

Figure 4. Given the present NL difficulties I explored the range about the last line in the table on page one. This makes clear why I chose 120/1000/1000. I will explore the effects of modest increases in SL energy gain.

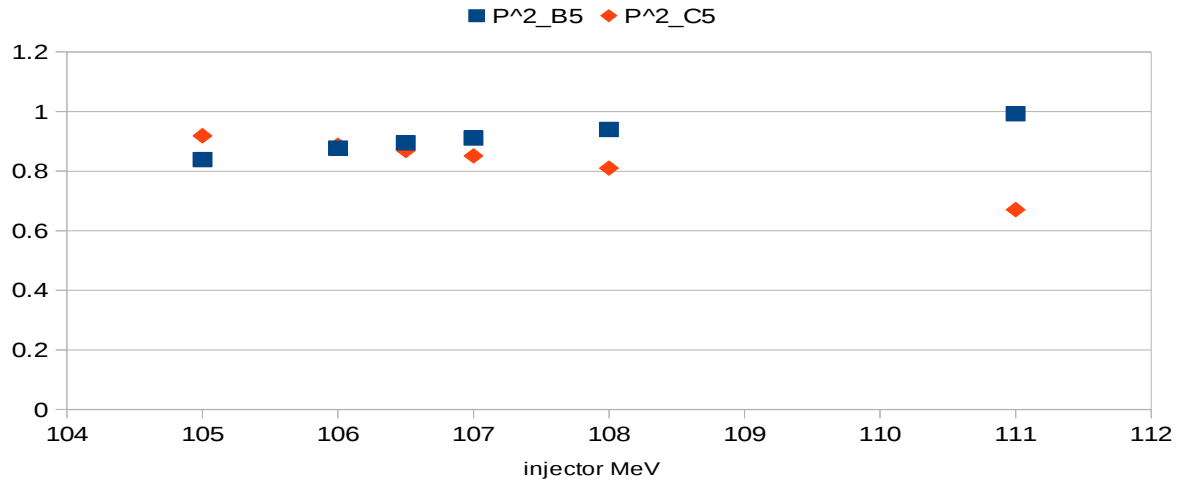

Figure 5. Since SL is good for 1048 MeV, I ran cases around NL 998 SL 1008 with varying injector energy. No improvement over Fig. 4

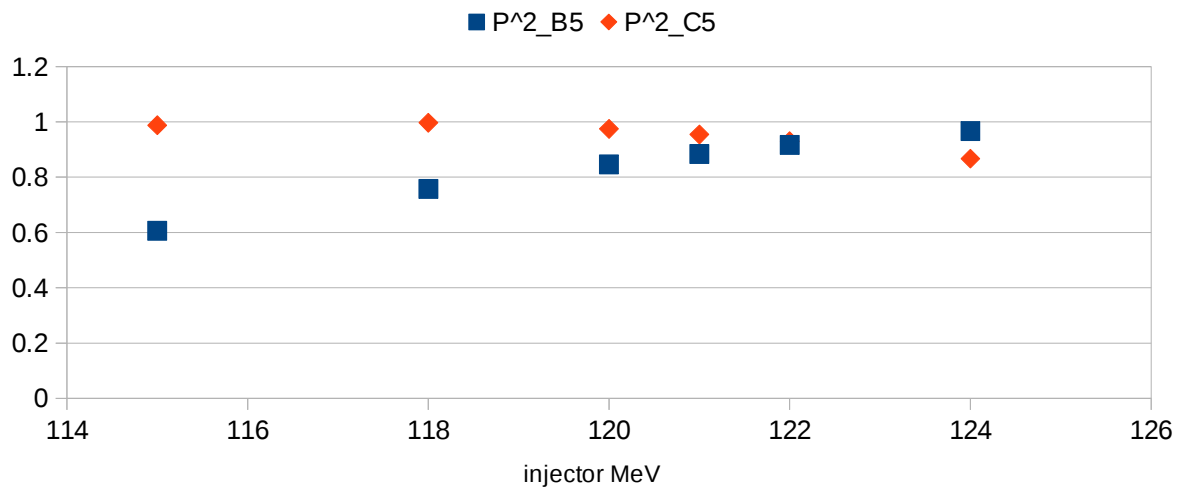

Figure 6. Here I increased asymmetry to NL 1001 SL 1021 and ran cases with varying injector energies. 122/1001/1021 is better than the best cases in figures 4 and 5 and should be doable given shunt capacityif NL RF cooperates. Hall B P^2 0.917, Hall C P^2 0.930. Hall D energy low, 11181 MeV. Hall C at first pass P^2 0.992. Hall C at second pass P^2 0.997.

Conclusions

Providing full longitudinal polarization to parity experiments in Hall A will severely constrain the polarization available to Halls C and D from mid-decade onward. Hall B will be impacted less but there will still be reduced physics productivity.