

Energy Options for CY2022 Revisited

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Background

In March 2021 I submitted TN-21-013 outlining energy options for CY22 assuming that Hall B polarization would stay constant and that Hall A, as the hall changing passes, would get variable polarization. Information on the energy impact of the 300 K cycle of the NL and four zones in the SL was not available. First pass polarized beam to A was not planned at that time. The solution proposed was Inj/NL/SL at 105/1050/1050 MeV. It is now unlikely that CEBAF can support those linac energies at acceptable RF fault rates given rates during January 2022, C75-1 performance and the CMTF commissioning gradients of C50-R1. The MBD correctors needed in 1S/1R to deal with the low injector energy will not be on hand by 1 May for installation. Information is therefore presented about alternatives in which polarization is simultaneously optimized for Halls A and B aka “sharing the pain”.

Results

In the TN-21-013 setup, Hall B would have P^2 1 all run and Hall A would have P^2 0.771/0.480/0.814 on passes 2/3/4 respectively. The MBD correctors mentioned above are needed because the 105 MeV injector energy is 13.5 MeV lower than that assumed in designing the angles of the beams in 1S/1R. The plan was to set the common dipoles up for the nominal injector energy (118.5 MeV) and buck the field of the first common dipole with a MBD corrector mounted on the first pass beam pipe immediately after that dipole. This would allow all beams to follow nominal paths. As a result of the Continuing Resolution budget, Accelerator Division did not allocate funds to buy the MBD correctors. The scenarios below have the normal injector to NL energy ratio so MBD installation is not necessary and setup will be easier.

Table 1 Polarization figures of merit for eight other scenarios

Inj MeV	NL MeV	SL MeV	P^2 A1 B5	P^2 A2 B5	P^2 A3 B5	P^2 A4 B5	P^2 sum	Hall C MeV	Hall D MeV
112.8	1000	1000	0.866	0.996	0.981	0.932	3.78	10076	11064
114	1010	1010	0.871	0.935	0.848	0.527	3.18	10175	11174
115.1	1020	1020	0.874	0.807	0.652	0.956	3.29	10275	11283
115.7	1025	1025	0.830	0.947	0.831	0.996	3.60	10325	11337
116.2	1030	1030	0.876	0.631	0.992	0.891	3.39	10374	11392
116.8	1035	1035	0.826	0.999	0.674	0.670	3.17	10424	11446
117.4	1040	1040	0.881	0.562	0.812	0.600	2.86	10474	11501
117.9	1045	1045	0.824	0.974	0.995	0.839	3.63	10524	11555
118.5	1050	1050	0.883	0.748	0.697	0.981	3.31	10573	11610

As of 1520 on January 18, the RF Dashboard shows the NL at 989 MeV for four true arc faults per hour and the SL at 979 MeV for the same. C100 faults total about one per hour. Let me assume that 2L18 must be removed and replaced with C50R at 51 MeV, comparable to its CMTF value. SL sum 1030 MeV. C100R may be ready in time to replace 2L23 (75 MeV) for a possible gain of 20 MeV, SL sum

1050 MeV. NL10 (14 MeV) will be replaced by C75-2 (≥ 65 MeV) for a net gain of 51 MeV and sum 1040 MeV. Until C100R is in the tunnel it would be imprudent to plan for more than 1030/linac.

If 2L18 can be restored with a 30 K cryocycle it should produce 26 MeV, taking the SL from 979 to 1005. C100R would take it to 1025 MeV. Recovery of some of the 18 SL cavities with hardware issues might take this to 1050 MeV. Two or three day RF recovery periods would be required at least every three months during the June 2022 - March 2023 run period to maintain the SL value. The NL would be in excellent shape, with 989 (now) + 51 (NL10) + 25 (NL15 C50) = 1065 MeV.

During the week ending 0700 January 18, 2022, there were 925 RF faults and 843 other faults. It seems imprudent to set linac energy to provide nine true arc RF faults per hour per the two paragraphs above given that there were 0.7 C100 faults/hour and five non-RF faults per hour during the last week.

Conclusion

It is suggested that NPES consider linac energies no higher than 1030 MeV in lieu of the present plan for the physics run June 2022 - March 2023. Wien filter adjustment will be required each time Hall A changes pass, about one shift, plus Moller polarization measurement.

Appendix: perhaps a clearer layout of the two paragraphs of options

Uncertainties: 2L18 recovery, C100R swap for 2L23 as may not be completed in time. Tony Reilly writes me that the C100R will be available for tunnel installation in time, barring unforeseen events, but SRF may not have time to test it in the CMTF.

SL

If 2L18 recovered and 2L23 (95 MeV assumed) swap: 1025 MeV plus repairs

If 2L18 not recovered so C50R installed and 2L23 not 95 MeV: 1030+ plus repair

If 2L18 not recovered so C50R installed and 2L23 at 95 MeV: 1050 plus repairs

NL

If 2L18 not recovered, only C75-2 replacing 1L10 to 1040 MeV

If 2L18 recovered, C75-2 into 1L10 and C50R into 1L15 to 1065 MeV