12 GeV CEBAF





Model Development

- Not just an interesting exercise:
- Must be able to explain observed machine behavior and predict new behavior
- Part of this involves designing "ad-hoc" solutions to optics problems as we encounter them (i.e extraction redesign)
- Also, focused on achieving certain beam parameters for the needs of the users (PQB team)







- Revisiting Extraction
- Magnet Field Quality
- Synchrotron radiation effects on upper pass steering
- Linac Focusing
- Longitudinal phase space tracking
- Spin tracking
- Hall A raster pattern
- Hall A 5T moller target
- Future Plans



Revisiting Extraction

- Initial commissioning of separators showed they lacked the power to fully extract the beam
- Revisited the optics to use the E01,E02 and E03 quadrupoles to compensate for the lesser RF kick.
- Successfully tested and utilized to run the beam. The observed position was as predicted.





Revisiting Extraction(cont)

For the 12GeV project, developed an analytical model to calculate the extraction parameters,

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Quadrupoles and dipoles Field quality



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Dipoles were converted From C to H style



	MBE1m(16)	MBR2m	MBE1m	MBB2m	MBA3m	MXP4m
	ARC1	ARC2	ARC3	ARC4, 5, 6	ARC7,8,9	ARCA
$K_2L \ (m^{-2})$	0.35	0.22	0.24	0.12	0.11	0.07
$K_{3}L(m^{-3})$	2.22	3.51	8.31	4.21	2.20	2.26
$K_4L \ (m^{-4})$	543	1390	327	166	215	148
$\frac{\underline{B'}L}{BL} (m^{-1})$	0.022	0.020	0.036	0.018	0.015	0.010



Magnet field quality (cont)

- We have the measured quadrupole terms for the dipoles in the model. Beam based measurements confirmed they are correct.
- It is possible to analyze the data for the sextupole term. Currently in progress.
- Comparison with TOSCA calculations (from J. Benesch) in progress.





Linac Focusing

- Effect of gradient distribution in linac
 - Tool developped by D. Turner to load in grad.
 Distribution in ELEGANT.
 - Effects are small unless one is at low gain per linac
- Effect of cavity Focusing in linac
 - Just affects the first two quadrupoles in LINAC.
 Not adjusting them produces a beta beat of a few percents at most.
- Effect of gradient calibration in linac

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Because of "fudging process", its has a negligeable effect even with 5% uncertainty.



Effect of synchrotron radiation on upper pass steering





Longitudinal Optics

- Parity Experiments require tight beam quality.
- Longitudinal match of the machine now a concern.
- Optimized with LiTrack for fast turnaround
- Final tracking in ELEGANT confirms the results.
- Initial results suggest installing sextupoles in injector chicane and running off crest in linacs if we keep the non-zero M56 arcs.







Tracked to MQK1H04 wired backwards. After reversing the polarity we get the expected pattern:









Zero M56 in upper arcs



No tails in both cases, just longer bunch if we run with the chicane off.





Spin Tracking

- Currently Collaborating with F. Meot (Brookaven) to perform 3D spin tracking through the machine
- Preliminary estimates of dilution (with ELEGANT) show that one will have to readjust Wien filters and that the optimal setups for multiple hall deliveries will be slightly different.
- Putting together a model to do that.





New Moller Target

- Hall A is installing a 5 Tesla solenoid.
- Manufacturer provided field $B(r, \theta, z)$
- Tracked 3D field in ELEGANT

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Sample distributions. The real field map is more fine grained.



Spot at DUMP

 Adjusting MCZ1H04V and MBD1H04H centers beam on dump. MCZ1H04V was added specifically for this purpose.



Plans

- Short term
 - Eliminate step Optim -> ELEGANT
 - Convert optics to zero M56 in upper arcs
 - Revert Extraction to nominal
- Medium term
 - Develop strategy for longitudinal matching aimed at minimizing Halo in Halls.
 - Study chromatic effects (sextupoles?)
 - Analyze magnet measurements for sextupole component, formulate new measurements, include in model



