LERF to South Linac Transport Line for PPB Brainstorming

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Introduction

The basic idea:

- Place a polarized positron source in the LERF vault.
- Transport the positrons to CEBAF via a transport line connecting LERF to the South Linac stub.
- Accelerate positrons with CEBAF (CPBAF?) for science.

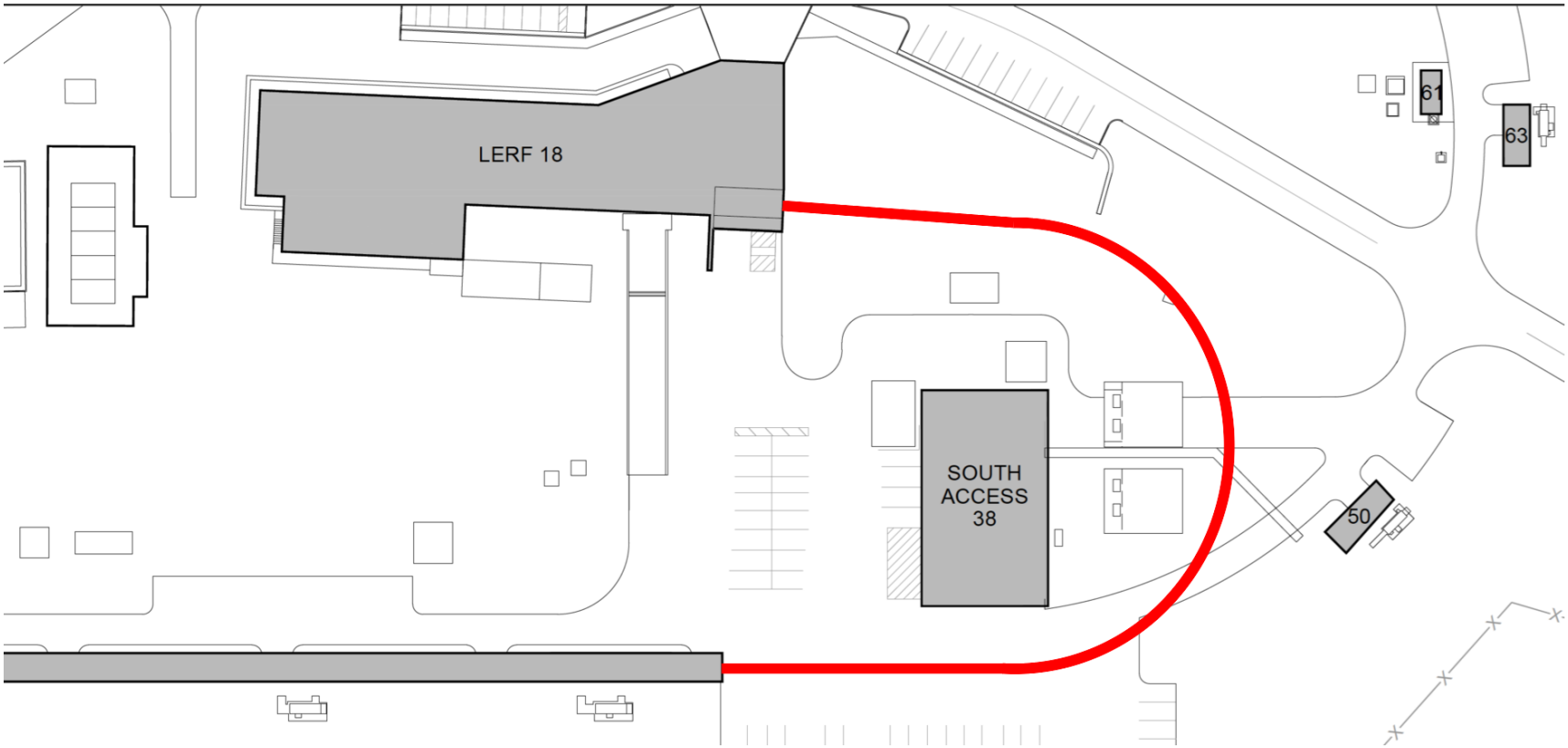
Here we're talking about the transport line, and we're simply jotting down ideas at this point.

Concept

The idea is to come straight(ish) out of the east end of the LERF where the 2G dump is presently located, go through a 180° arc, then straight into the South Linac stub:

Artist's Rendition, Credit: Joe Grames

Concept



Coordinates

S&A uses different coordinate systems for CEBAF and LERF. To link the two machines, we need to be in the same coordinate system for both.
To transform from LERF to CEBAF coordinates (from Kelly Tremblay):

- x shift: -13.836309m
- y shift: 0.009387m
- z shift: 61.976552m
- x rotation: -0.00217°
- y rotation: 2.54975°
- z rotation: 0.011267°

These are good to $\pm$3mm.

Dimensions

In CEBAF coordinates, all in meters:

- Start at the center of MGX2F06 ($X = 4.40774$, $Y = 105.00437$, $Z = 100.40717$)
- End at the center of MQB2L01 ($X = -80.6$, $Y = 100$, $Z = 156.304$)

Resulting dimensions:

- Straight beamline from LERF to arc $L \approx 8.9$m (scaled from FML map).
- Transport arc bend radius $\rho \approx 38.07$m.
- Straight from arc to SL $L \approx 12.2$m.
- ~ 5m elevation change from LERF to SL.

Of course, these dimensions are all rough and subject to change due to civil engineering concerns, optics layout, etc.

Optics Concerns

- Matching section in each straightaway to match from positron source to the transport arc, and exit of arc to SL (betatron match and dispersion suppression).
- Initially, $M_{56} = 0$ in the arc, but would like to have the option to set $M_{56} \neq 0$ for bunch compression if needed. Measure using the SL M_{56} cavity.
- 5m elevation change results in vertical dispersion. Lay out a DBA in the vertical ramp.
- Horizontal dispersion from the arc to be addressed as well.
- Large horizontal dispersion at the center of the arc to provide resolution for energy measurement, energy lock, etc.
- SR losses: at 123MeV and $\rho \approx 38.07$m, SR losses are negligible ($\sim 10^{-7}$MeV). Might be difficult to see light on an SLM, though.
- Pathlength: Use BPM offsets like we use in Arc 10, or use a dogleg?

Magnets

If we're limited to 123MeV, we can likely use the same MBL dipoles and MQD quads we use in the Injector Chicane. No need to design new magnets.
These magnets are powered by the usual trim power supplies which are already bipolar. Switching from electrons to positrons is trivial.