

POSITRON BEAMS AT Ce+BAF

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Abstract: We present a scheme for the generation of a high polarization positron beam with continuous wave (CW) bunch structure for the Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Laboratory (JLab). The positrons are created in a high average power conversion target and collected by a CW capture linac and DC solenoid.

The Low Energy Recirculator Facility (formerly FEL) is repurposed to build and test a 123 MeV polarized e⁺ injector

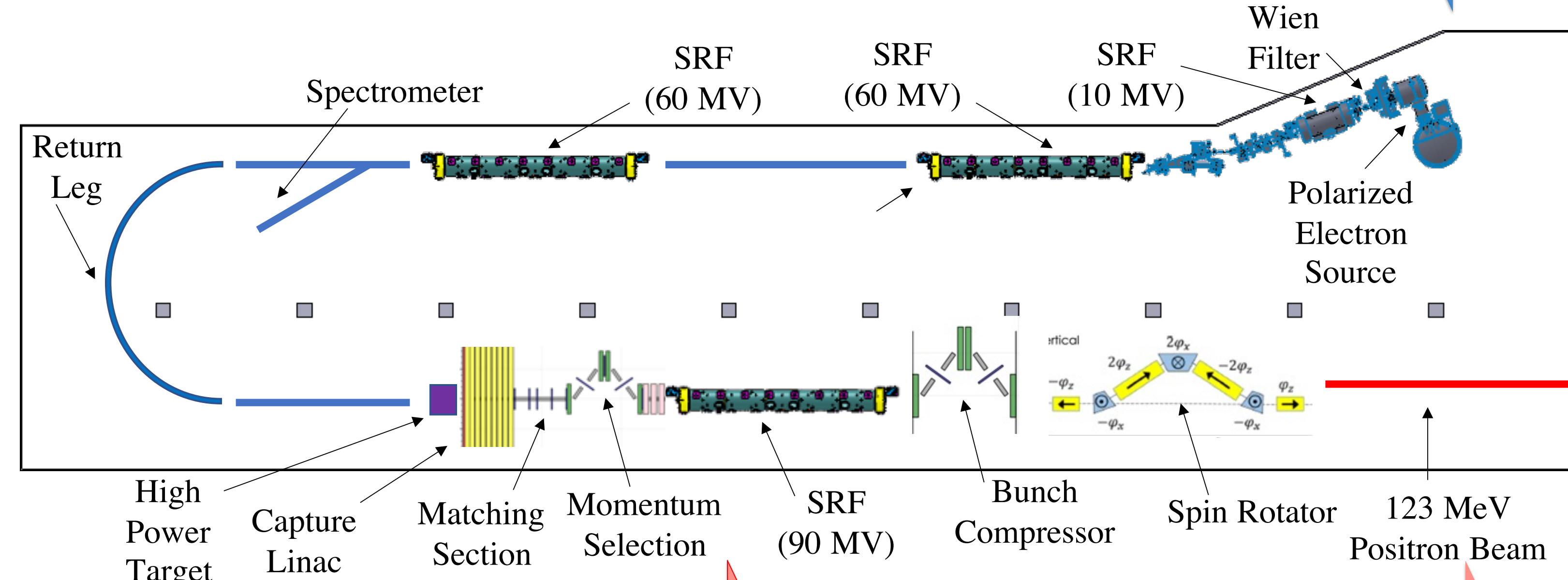


3 Superconducting RF cavities accelerate milliAmp e⁻ beam >100 MeV

2 Low energy beam line with compresses 60 psec bunches to ~few psec for acceleration

1 >300 kV dc-high voltage GaAs photogun generates milliAmp e⁻ beam with polarization ~90%

Please visit WEPA035 "Polarized electron injector for positron capability at CEBAF 12 GeV"

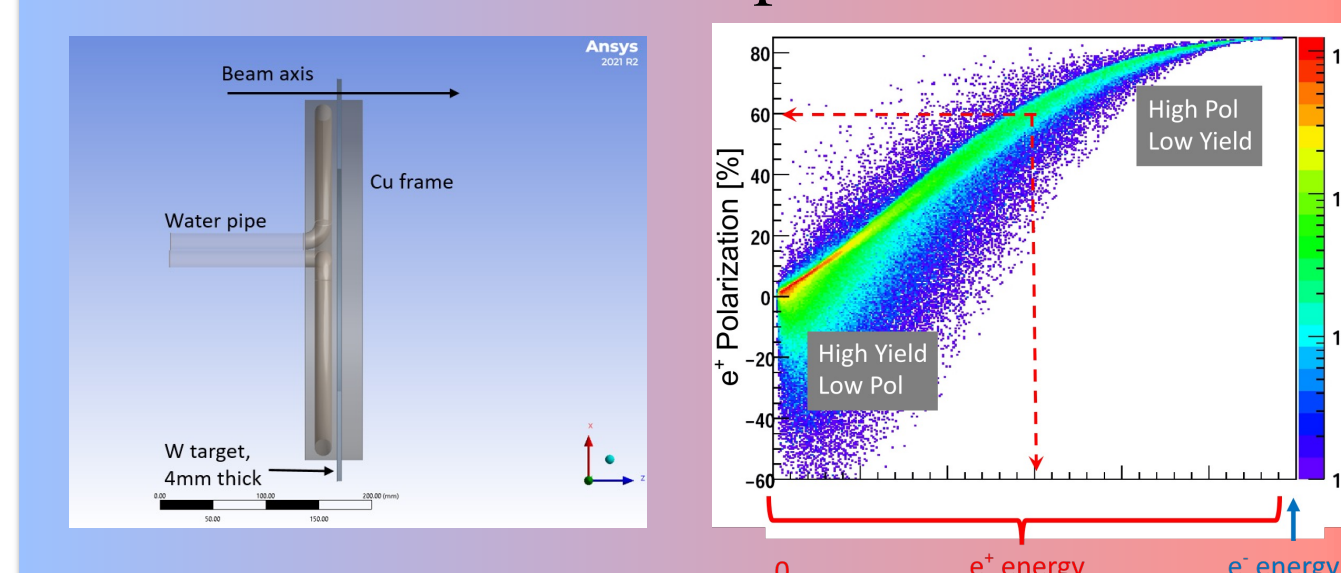


High power electron beam is transported through 180° to the positron target area

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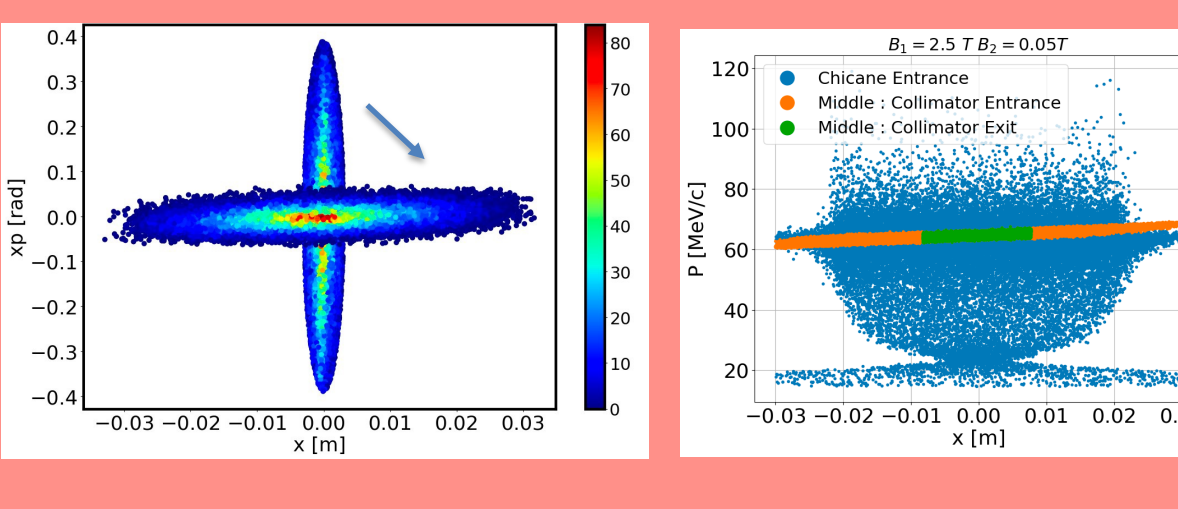
Please visit WEPM120 "Conceptual design of a high-power target for positron production at CEBAF"

120 kW e⁻ beam irradiates a water cooled spinning tungsten target, generating large 6D volume of polarized e⁺



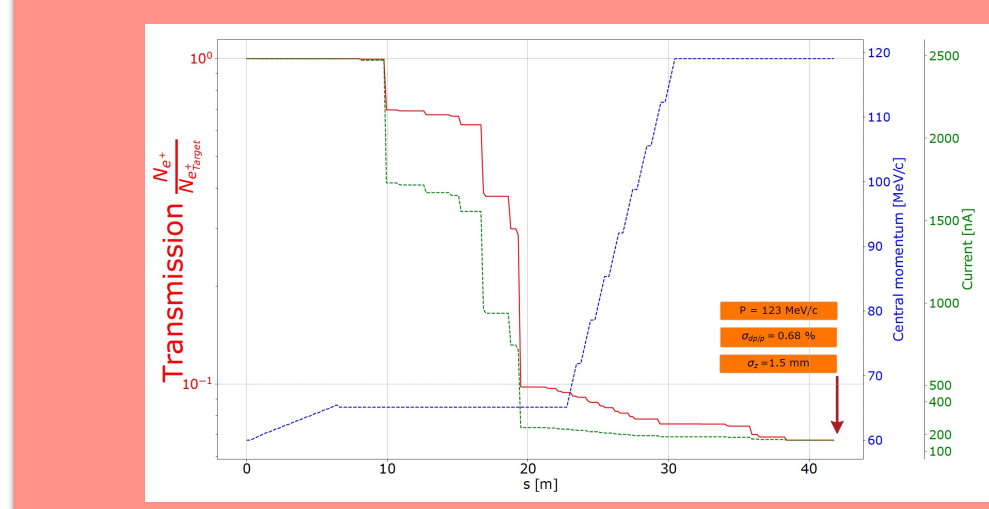
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High field >1 T dc-solenoid rotates e⁺ phase space into CW capture linac, then $\delta p/p$ defined in momentum collimating chicane



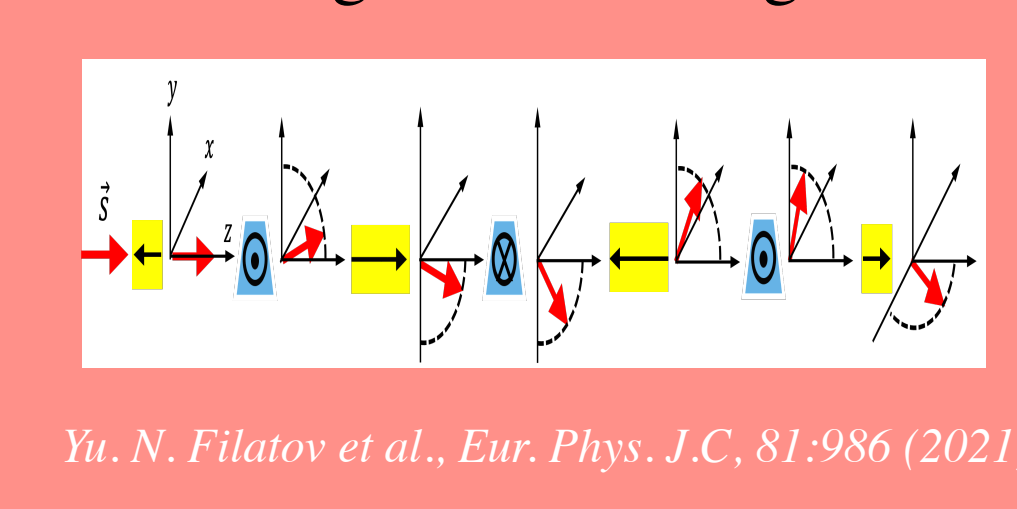
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e⁺ of 30-60 MeV are accelerated off-crest in a 90 MV SRF cavities to 123 MeV and bunched in a chicane



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Interleaved dipoled and solenoids rotate the e⁺ precess spin in horizontal plane, leaving orbit unchanged

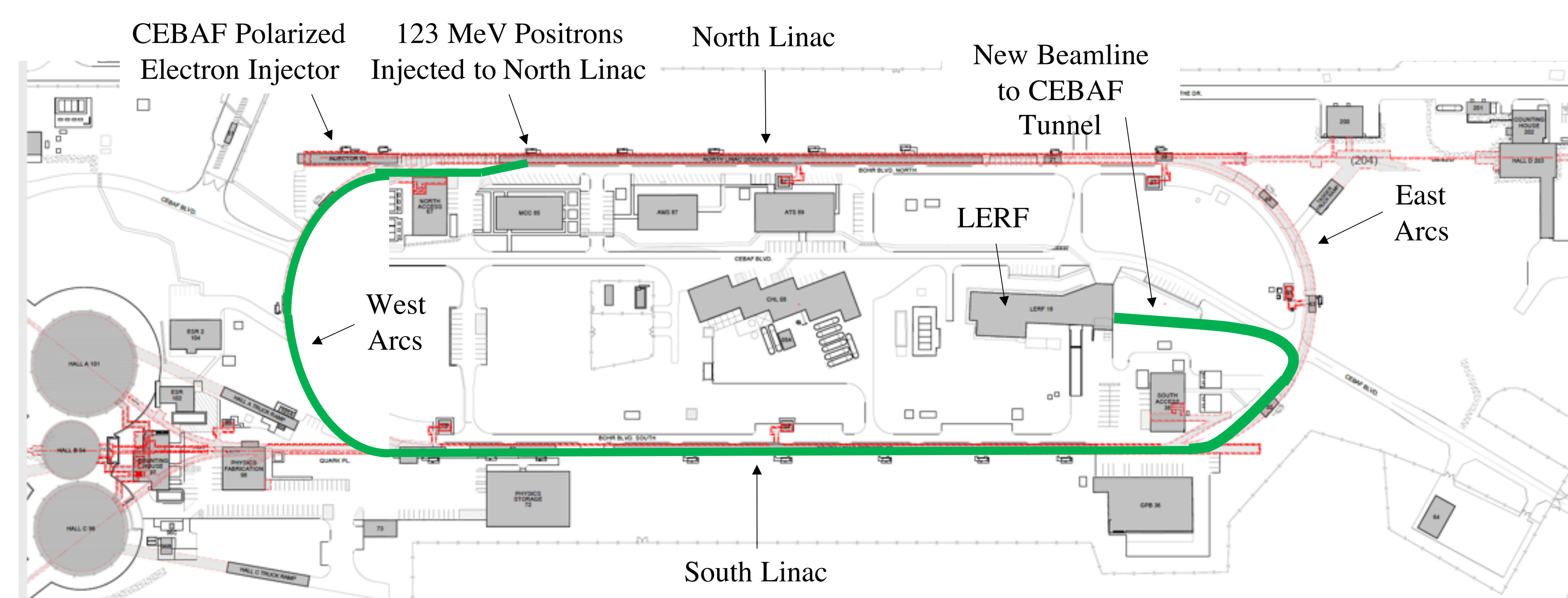


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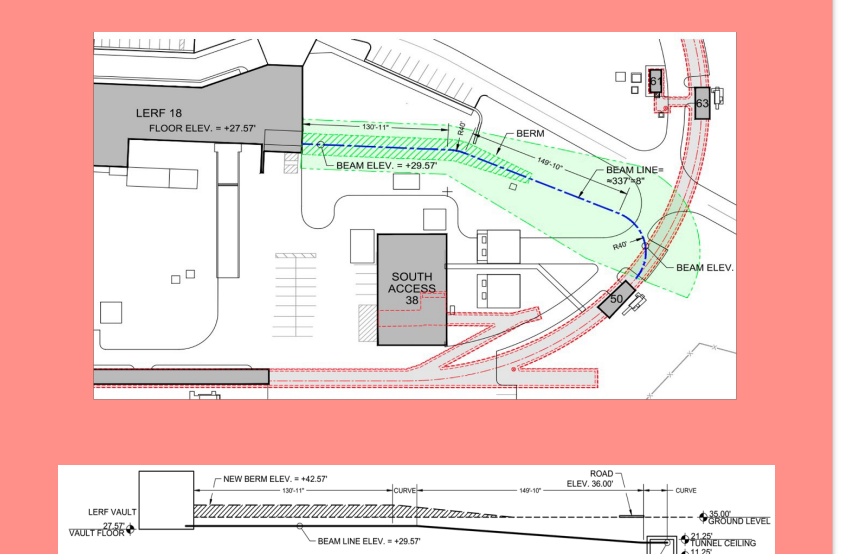
Yu. N. Filatov et al., Eur. Phys. J.C, 81:986 (2021)

The LERF provides a CW polarized e⁺ beam with parameters approaching goals for CEBAF injection

Ce+BAF Parameter	Status	Goal
p_0 [MeV/c]	60	60
σ_{p_0/p_0} [%]	0.68	± 1
σ_x [ps]	3	≤ 4
Normalized ϵ_n [mm mrad]	140	≤ 40
p_f [MeV/c]	123	123
I_{e^+} ($P > 60\%$) [nA]	170	> 50



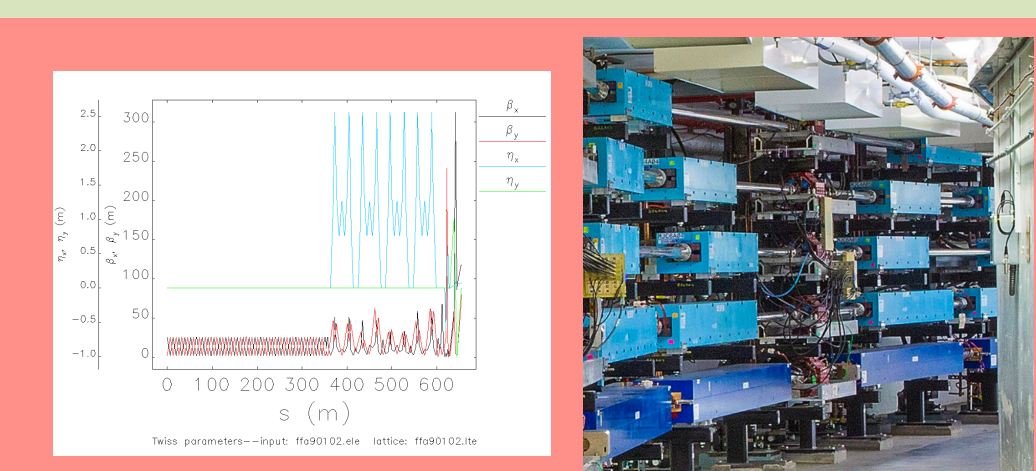
Once the e⁺ source is ready, civil construction connects the LERF by a new tunnel to CEBAF. The transport line will maintain the e⁺ polarization in plane.



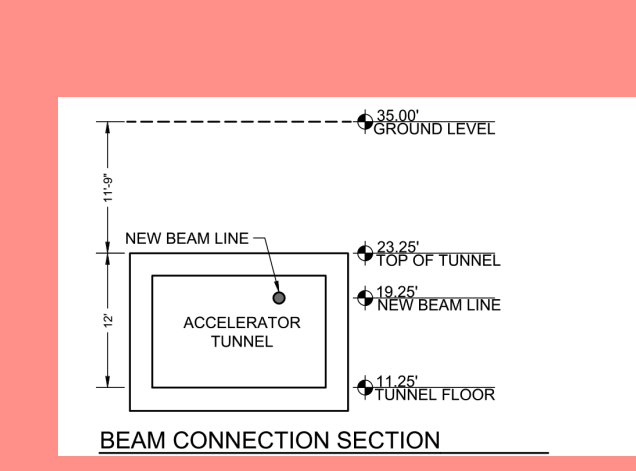
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Initial goal is >50 nA with polarization ~60% and higher currents >1 μ A when polarization is not needed.

11 e⁺ are injected to the North Linac and accelerated to 12 GeV, with magnet polarities reversed.



10 The 123 MeV e⁺ beam is transported in a new beam line along the ceiling of the South Linac tunnel



Please visit MOPM081 "Degraded beamline design at the CEBAF injector for machine acceptance studies"

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