

JLAB ACCELERATOR DIVISION
FULL ENERGY INJECTOR UPGRADE
 Scientific/Technical Project Charter

Project Name (and Number)	Full Energy Injector Upgrade (PC 2010-01)
Project Abstract	<p>Providing improved parity quality beam for the 12GeV CEBAF to meet Nuclear Physics experiment requirements. The entire project scope includes:</p> <ul style="list-style-type: none"> • To install a higher voltage source and a second Wien filter (<i>installation and commissioning in progress</i>). • Design and build an improved cryomodule with accelerating capability of up to 10 MeV with elimination of x/y coupling and more adiabatic damping. • Increase the injector final energy from 45 MeV to 123.5 MeV to achieve the 12 GeV injector energy requirements.
Project Sponsor	Andrew Hutton
Funding Sources	Nuclear Physics Accelerator Ops and AIP
Project Management Team	Reza Kazimi, Arne Freyberger, Geoff Krafft
Lead Organization	SRF Institute, Electron Gun Group, CASA
Supporting Organizations	Accelerator Operations and Experimental Nuclear Physics are the primary stakeholders with improved beam quality and ease of accelerator operation. Engineering and FEL will be called upon for their expertise to provide design and planning guidance.
Scientific/Technical Background	<p>The current injector system was designed for lower final beam energy. The upgrade from 45 to 123.5 MeV is necessary to match the injector energy to the 12 GeV CEBAF. This is achieved by replacing one of the two injector region C25 cryomodules with a refurbished unit capable of reaching 100 MeV. This added to existing C25 cryomodule will attain the final 12 GeV design energy of 123.5 MeV</p> <p>The electron gun voltage increase will produce a more relativistic beam from the start. This will lower the space charge effect for high current beams resulting in better beam quality with lower transverse and longitudinal emittances.</p> <p>The redesigned capture and Cryo-unit will reduce the x/y coupling, achieve better adiabatic damping across the Cryo-unit, and produce a beam up to 10 MeV as opposed to present 5 MeV. The redesign may include changing the cavity sizes to better match the beam velocity, establishing new distances between the elements, and finding different phase and gradient for the cavities.</p>
Project Scope	<p>Within the project scope:</p> <ul style="list-style-type: none"> • Install a higher voltage source and a second Wien filter (installation and commissioning in progress). • Redesign the ¼ cryomodule for adiabatic acceleration. • Eliminate x/y coupling in ¼ cryomodule. • Find optimum operational gun high voltage, by considering the bunching process, capabilities of the chopper system, and final beam parameters. • Replace a C25 cryomodule with a higher gradient cryomodule. <p>Outside the project scope:</p> <ul style="list-style-type: none"> • Other considerations such as calculating the change to the helicity properties of the beam or designing higher energy Wien filters and so on will be outside the scope of this work. • Upgrades to diagnostics hardware and software.

Objectives	Match injector energy to 12GeV CEBAF, and improve beam quality to meet Nuclear Physics experimental demands for clean parity quality beams.
Deliverables Do we need to state a 10 MeV requirement for cryounit?	<ul style="list-style-type: none"> • Provide robust full-energy injector for 12 GeV era with digital LLRF and RF power for up to 200μA. • Installation and commissioning of higher voltage source and a second Wien filter • New quarter cryounit to eliminate transverse coupling for improved parity quality beam. • Replace C25 cryomodule with a higher gradient cryomodule (R100). • Optimum operational gun voltage specified. • Measure and document realized beam quality improvements in first year of post-installation operation.
Constraints	<p>Competition for engineering and simulation expertise, demands on the SRF Cryomodule production staff, and the 12 GeV Project installation schedule are potential constraints outside the immediate control of the project managers. Achieving the goals of the Full Energy Injector projects before the first 12 GeV operational experiments will rely on the schedule and priorities of the Lab.</p> <p>The replacement of the existing C25 cryomodule with the R100 cryomodule must take place during the May 2012 to April 2013 Scheduled Accelerator Down.</p> <p>The warm RF cavities, controls, and RF power supplies devices, including choppers, pre-buncher, and buncher, will be reused. The capture section may be redesigned as internal to the cryounit; if not, the capture will remain unchanged.</p> <p>New components:</p> <ul style="list-style-type: none"> • The cryounit will be redesigned and remanufactured. • All cold RF controls will convert to digital.
Assumptions	Use of R100 cryomodule; engineering support for design and construction of cavities and 10MeV quarter cryomodule; integration of cryomodule in SRF production schedule. Engineering and Operations support available for installation and commissioning phase.
Special JLab Commitments	None identified.
Budget	\$5 million (not including overhead or escalation for inflation)
Schedule	FY09-FY10 200kV gun and Two-Wien filter (Parity improvements phase) FY10-FY12 R100 cryomodule (Rebuild CM phase) FY10-FY12 New quarter cryounit section (Intermediate Energy Phase)
Controls/Reporting	Combined use of JLab internal annual work planning system and budget reporting should provide adequate oversight of financial progress. Internal review by Project Sponsor and Other Participants will be used to monitor project progress.