Beam Studies at JLAB

and the

Beam Transport Team

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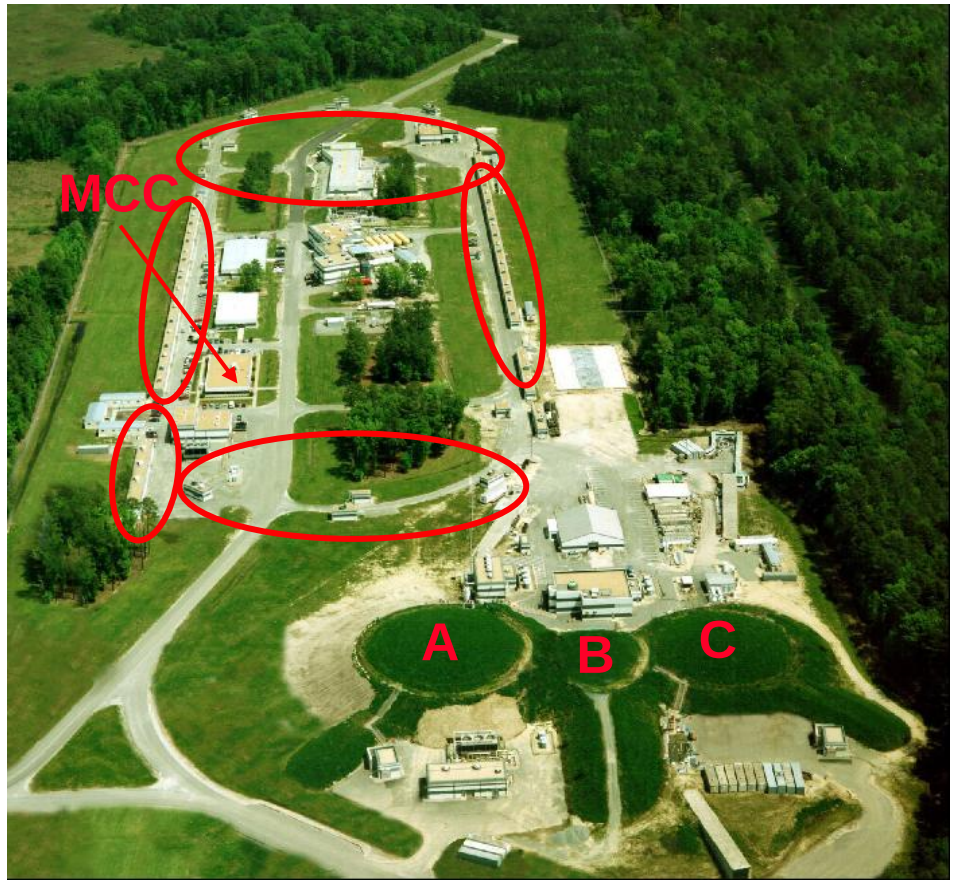
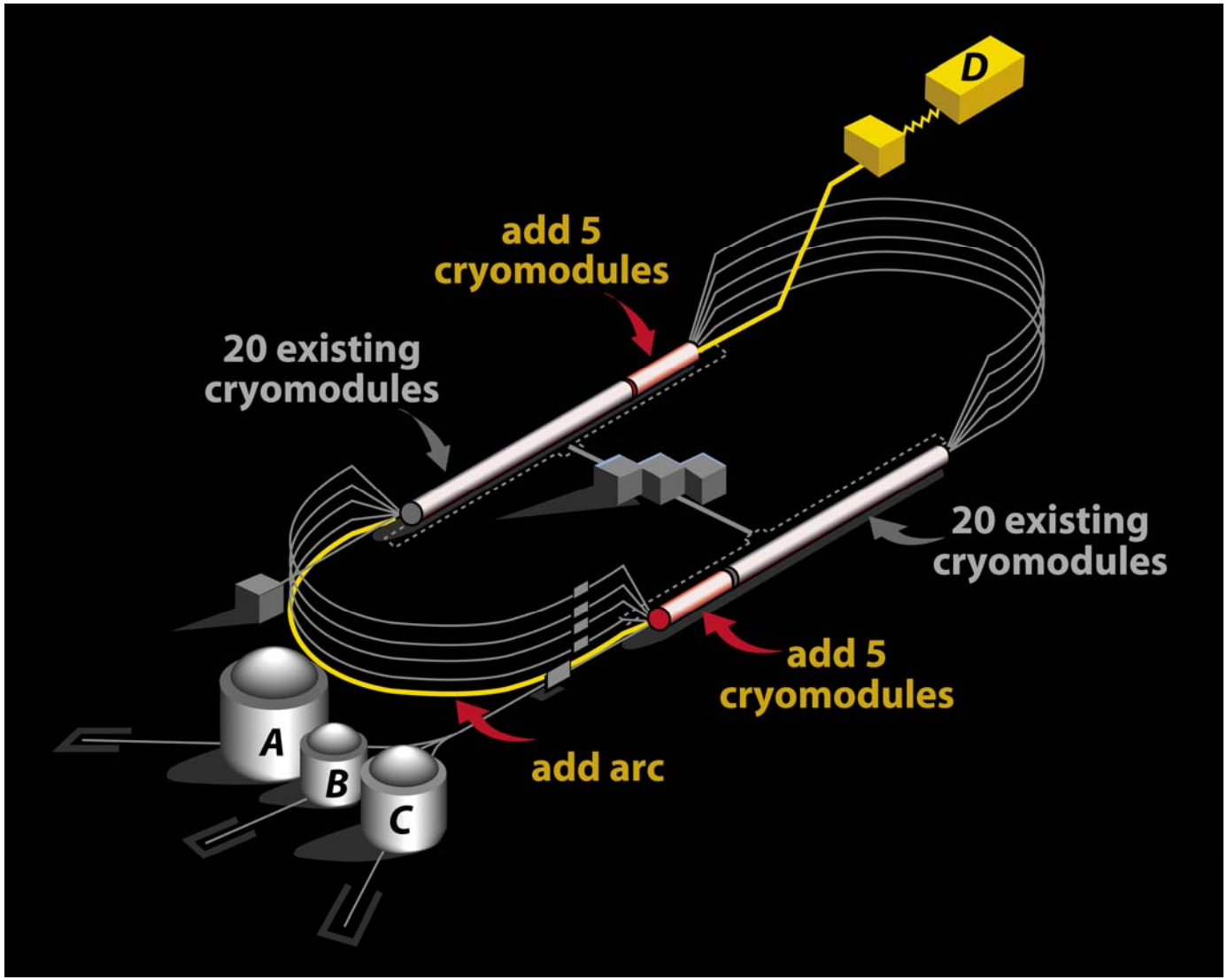
CEBAF Overview

- 5-pass 6 GeV CW Electron Accelerator
- Three user facilities (A, B, C)
- 6.6 km Beam Transport System
- Photocathode source with 80% polarization
- Two 1497 MHz 600 MeV Superconducting Linacs
- Two Recirculation Arcs
- Dynamic Physics Program Requiring Frequent Energy & Pass Changes



Schematic and 12 GeV Upgrade



B-Team Charter

The Beam Transport Team is charged with ensuring that the CEBAF accelerator efficiently and consistently meets the near-term and long-term beam specifications of the nuclear physics program while advancing the scientific and engineering disciplines of the team members.

B-Team Composition

- 10 Accelerator Physicists
- 3 Computer Scientists
- 1 Engineering Manager
- 3 Injector Scientists
- 2-5 MCC Operations Staff
- 2 Operability Managers
- 1 Nuclear Physics Liaison

B-Team Deliverables

- Define the accelerator's baseline beam quality specifications for use by the Nuclear Physics Experiment Scheduling Committee and prospective Users.
- Ensure that the accelerator is capable of meeting the beam quality specifications of future scheduled experiments.
- Conduct detailed analysis of recent machine performance and specify appropriate changes in the following areas in order to optimize future machine performance:
  - High-level applications
  - Machine diagnostics
  - Engineering initiatives in support of configuration changes
  - Beam setup and troubleshooting procedures
- Support the development of the accelerator model through the implementation and analysis of beam-based measurements with the express goal of minimizing the required tuning of the accelerator and improving the scalability of the machine.
- Provide on-call support for Beam Transport issues and partner with MCC staff to ensure that lessons learned are properly incorporated into the procedural base

Logistics

- Weekly 1-hour meetings to discuss near-term machine performance and plan for upcoming Beam Studies
- 12 hours of Beam Studies per week of Operations
- Web-based test plan system for developing, approving and tracking Beam Studies
- Small working groups are often spun-off to handle specific issues
- Beam Transport on Call acts as direct support to Control Room Operations during commissioning efforts and for general troubleshooting

Quadrupole and Dipole Model Development

- Beam-based determination of scale of field map errors for families of dipoles and quadrupoles throughout machine
- Restore dispersion and beta tuning quadrupoles to design settings
- Improve scalability of machine
- Presently able to scale machine energy by ~15% without having to retune

Minimizing Cross-plain coupling

- Parity experiments require small residual errors in helicity correlated position and charge asymmetries
- Major source of errors due to cross-plain coupling in low energy injector
- Careful tuning of skew quadrupoles provides exceptional results with helicity-correlated position differences reduced to a few nanometers

High Level Applications Development

- Automated Beta Matching Tools
- Automated RF Cresting Algorithms
- Betatron Phase trombones to provide optimal phase advance at Physics targets
- Model Development Tools
- Database Development

Operational Efficiency

- Beam Transport team members serve as on-call experts for day-to-day operations
- B-Team analyzes machine performance
- Provides new/revised procedures
- Provides training to Ops and Engineering staff

Configuration Control

- Beam Transport Team acts as Configuration Control Agent for machine lattice
- Sanctions changes to machine lattice and partners with Engineering Group to develop beamline modifications
- Ensures that new beamlines meet requirements through the development of Commissioning Plans

Low Energy Running

- 350 MeV multi-user Operations planned for next Summer
- B-team developing Operational plans for transporting beam through machine with second linac RF system OFF
- Beam will be directed through 5-th pass beamline by scaling West Arc dipole systems down

Conclusion

- Near real-time development of beam studies to improve machine performance and solve operational problems
- Long-term focus for upcoming physics experiments and in support of the 12 GeV upgrade
- 12 hours of dedicated time doing Beam Studies for each week of Nuclear Physics Operation
- Strong presence in configuration control management