

NLC - The Next Linear Collider Project



# NLC Control System Requirements & Challenges

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for

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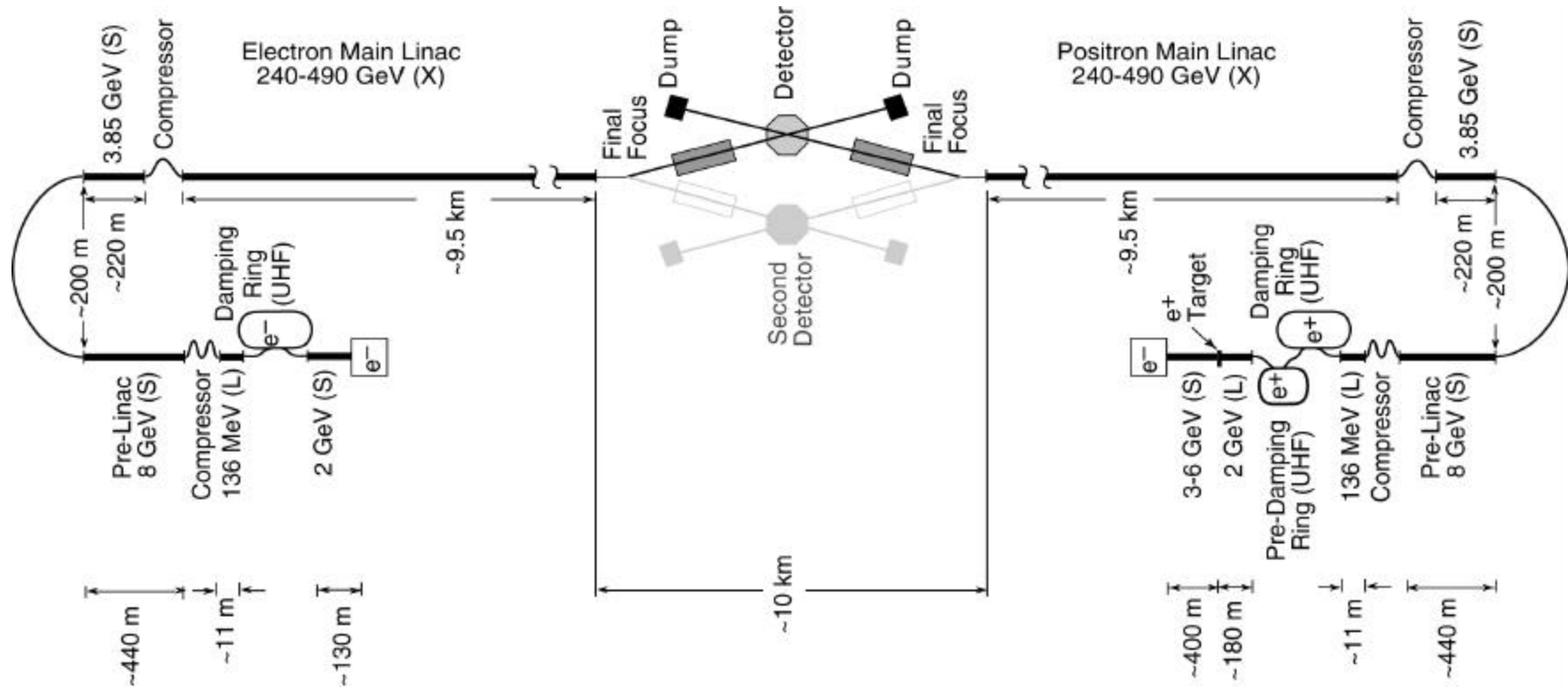


# Why an NLC/EPICS Workshop?

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- **We need help!**
  - Large facility - more than 30 kilometers of beam-lines
  - Complicated - multiple pulsed linacs
  - Will potentially be the **largest** EPICS site
  - Aggressive development schedule
- **Our goals:**
  - To introduce our issues of concern to the EPICS collaboration.
  - To invite and solicit ideas, comments and suggestions about our plans and approaches.
  - To lay the foundation for strong collaboration now and shared development in the near future.

# Next Linear Collider





# Some System Parameters

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- Center of Mass Energy 500-1000GeV
- Repetition Rate 120Hz
- Bunch Charge  $10^{10}$
- Bunches/RF Pulse 95
- Unloaded Gradient 77MV/m
- Linac Length 10Km
- Total Length 30Km
- # of Klystrons 3168-6624
- # of BPMs 12000
- Total AC Power 100-200MW



# DOE Life-Cycle Milestones

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- Decision of Mission Need Present  
Lehman Review in progress
- CDR Project 99-Spring 2002
  - Conceptual Report
  - R&D effort
- Project Baseline Approval Spring 2002  
Pre-construction Engineering and Design
- Construction Start Fall 2003
- Operational Approval Fall 2010



# General Requirements for the Global Controls System

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- Support an accelerator facility spread over a large geographic area.
- Acquire, process and distribute massive amount of data.
- Support pulsed multi-bunch accelerator operation.
- Provide a rich set of applications for commissioning and operation.
- Provide an extensive feedback facility.
- Seamlessly accommodate various data acquisition systems.



# Control System Model

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- Distributed hardware & software control system  
⇒ Use EPICS
- Use of commercially available “open” communications Networks
- Support for industry standard I/O buses
- A suite of SLC style user applications
- An extensive feedback facility
- Enterprise-wide consolidated database



# Technical Challenges & Schedule Risks

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- “Scaling EPICS” is more than just scaling Channel Access & database. We also need to “scale” the features, tools, and the applications.
- System Extensibility: EPICS (Mark Crane)
  - Managing > 1000 IOCs and millions of PVs
- Large Volume, and/or High Rate Beam and RF Data Management (Tera Bytes/day)
- Integrating a High Resolution Timing System with EPICS (120 Hz pulsed operation)



# Challenges & Risk Factors

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- 120 Hz. Operation, continued
  - Timing stability /jitter  $<10$  psec (in hardware)
  - Data acquisition, processing and distribution
  - Developing applications requiring synchronized data across the whole accelerator.
- Database and Channel Access upgrades
  - Multi-priority clients
  - Command completion
  - Synchronized Setting of Devices Across IOCs
- Tools and utilities - upgrade & add new ones
  - Archiving, correlation tools, multi-knobs, etc.
  - Button macros, etc.



# Challenges & Risk Factors

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- Next generation OPI
- One of our Biggest Challenges is to Satisfy Customers Used to SLC Type Applications (not native to EPICS)
- Create a suitable infrastructure for efficient development of millions-of-lines-of-code applications
  - Server/middleware architecture
  - process-to-process communication: Software bus
- An enterprise-wide database
  - to consolidate all relevant machine data and parameters
  - To serve as the central piece for any application development
- Schedule risks



# Control Software Effort Roll Up

1	PROJECT					Person-Year
13	<b>GLOBAL CONTROL SYSTEM</b>					
136	<b>GLOBAL CONTROL SYSTEM SOFTWARE</b>					
1361	<b>Control Software</b>					<b>474</b>
13611	Systems Architecture					30
13612	Software Infrastructure					104
13613	Low-Level Applications					137
13614	Tools and Utilities					25
13615	High-Level Applications					23
13616	Feedback Systems					24
13617	Protection Systems					48
13618	Systems Integration					20
13619	Automation					4
1361A	Detector Interface					3
1361B	Supervision					56



# The Need for Collaborative Development

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- Given the project scale & complexity, SLAC cannot develop this alone:
  - We are relative newcomers to EPICS and need much more expertise to implement it at the required scales.
- The aggressive project timeline requires a ramp-up of control experts also beyond a single lab's capability.
- May use an SNS-model of multi-lab development.
- Along with SNS, NLC is expected to be the drive behind the next major upgrades to EPICS.
- Close collaboration with the EPICS community is essential to NLC.



# Collaborative Development Continued

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- We need to expand the traditional collaboration boundaries to include additional areas:
  - System architecture design
  - Networks planning
  - System design reviews
  - Proposal of new ideas as well as conceptual designs
  - Actual implementation of NLC software at other labs.
- Develop infrastructure for distributed controls effort
  - Detailed requirements and technical specifications
  - Subsystem and applications Interface definitions
  - Remote project management & communication tools

# Conclusion

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- Need Help in All Phases of the Project, from the Conceptual Steps to Implementation.
- Users' Experience with EPICS Extremely Valuable to Us.
- The Goal Would be to Use NLC Resources to Enhance EPICS Rather than to Fork.