



EPICS Migration for the Fermilab Accelerators

PIP-II and Modernization

EPICS Collaboration Fall Meeting 2020

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Controls at Fermilab

Not historically an EPICS lab for the accelerators

EPICS in use for experiments slow-controls (Nova, ICARUS)

PIP-II

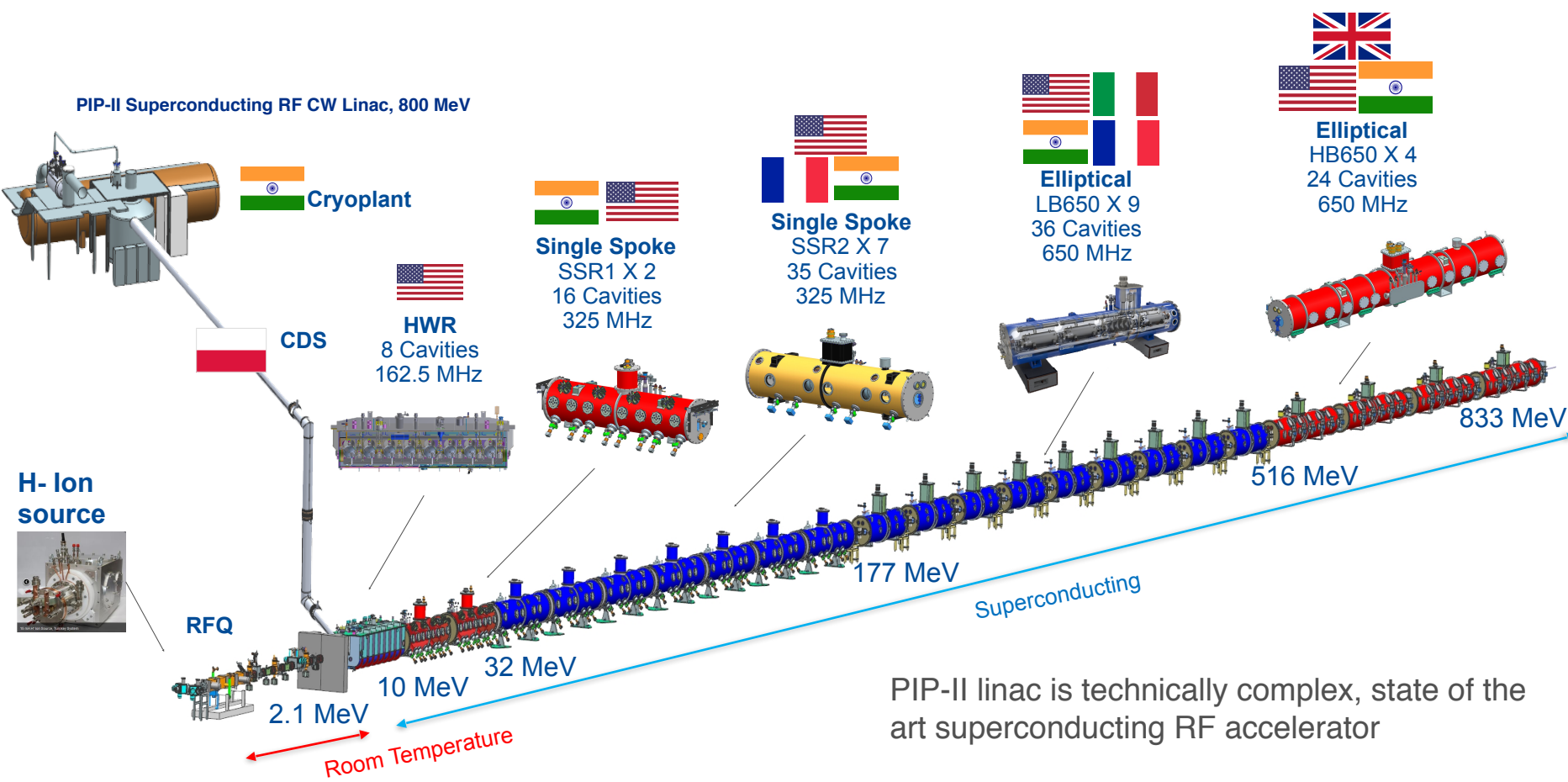
250 meter 800 MeV Superconducting RF Linac

Feed into existing Booster and rest of accelerator chain and beam lines

Enable intense high-energy neutrino beam for LBNF/DUNE

International Collaboration





PIP-II linac is technically complex, state of the art superconducting RF accelerator

PIP-II is the world's highest energy CW proton linac, and the first U.S. accelerator project to be built with major international contributions



PIP-II Controls

All New Linear Accelerator

BPMs, BLMs, Motion Ctrl, Images, Vacuum, MPS,...

New Cryo Plant

New Accelerator Clock Timing System

Integration Into Existing Accelerators

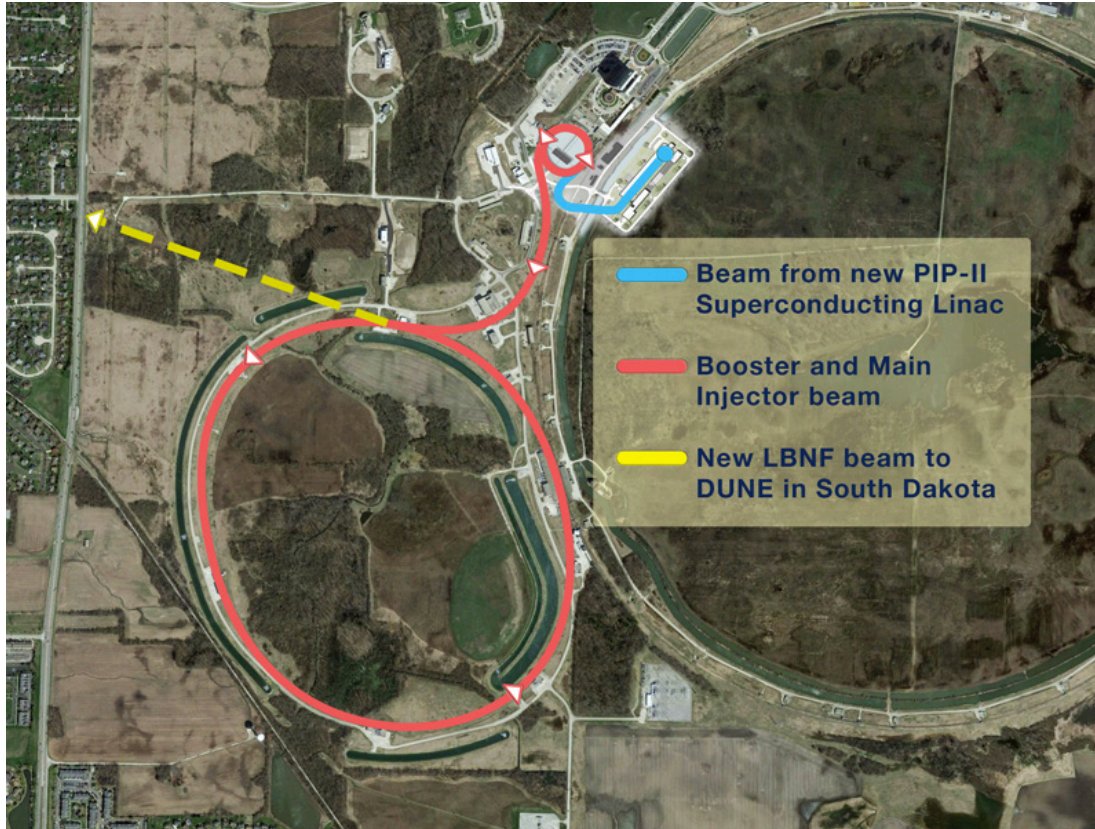
EPICS Selected for Control System

EPICS Is a Toolkit

Different Implementation Choices

We're trying to select the best subsystems/apps/clients that fit our needs

PIP-II Feeds Into Existing Accelerator Chain



Accelerator Controls Modernization

Fermilab recently awarded DOE CD-0 for Controls Modernization

Expected to be about a 7 year project

Focus on replacing obsolete hardware and software

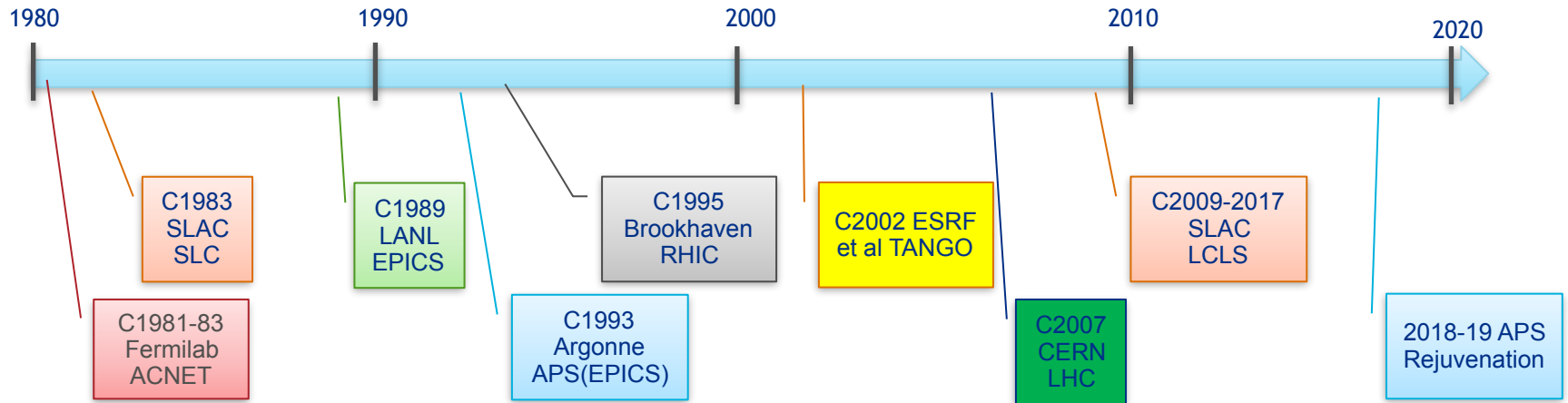
Opportunities for upgrades abound

Not in the budget to replace *everything*

Accelerator Controls Modernization

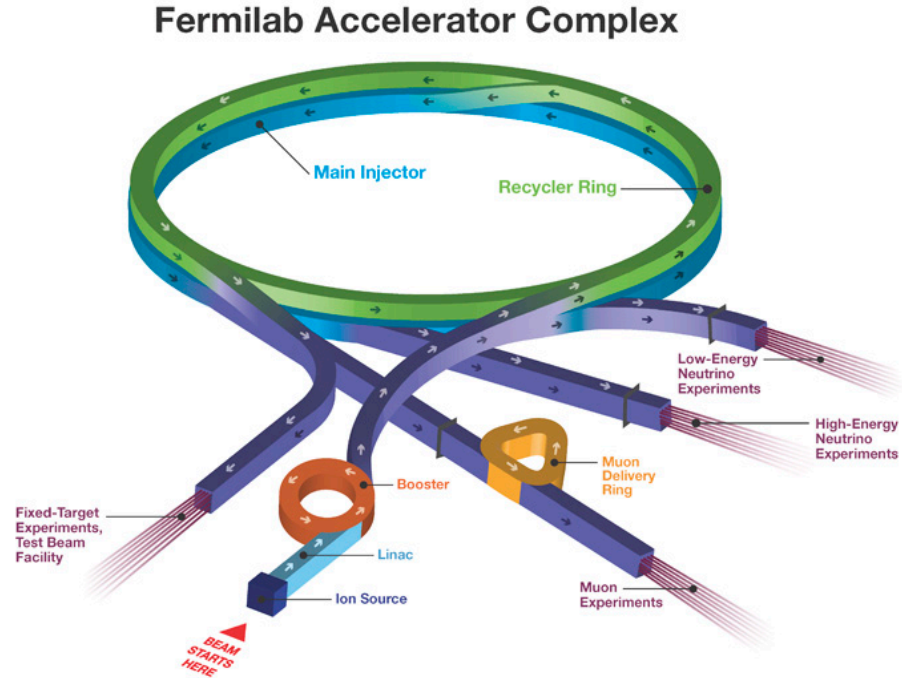
- Replace obsolete hardware and software, reducing some serious failure risks
- Allow us to take advantage of modern hardware and software technologies
- Position ourselves to exploit future emerging technologies.
- Attract talented engineers

Accelerator Controls – Timeline of Accelerator Controls



Fermilab Accelerator Control System

- One common control system used for all the core accelerators
- Support operator consoles used in control rooms and offices throughout lab.
- Accelerators provide beams for Fermilab experiments: Nova, MiniBoone, ICARUS, SBND, g-2, mu2e, Test Beam Facility,...



Accelerator Controls Modernization Focus

Replacement of CAMAC Fieldbus hardware

275 crates, 200 Multiplexing ADCs, many custom cards

Replacement of 68040-based data acquisition systems

Get rid of PSOS Operating System

Modernize user interface

Move off of X-windows

Adapt to more modern screens

Opportunities for upgrades abound (e.g. VXI-based LLRF)

Not in the budget to replace *everything*

Accelerator Controls Modernization

Leaning towards EPICS as the #1 alternative for modernization
(CD-1 funding requires that we consider alternatives)

Software for Control System Includes:

- Data Acquisition Framework and Device-Specific Software,
- Console and Application Software Framework and Applications
- Central Services Replacements (Alarms, Archiving, Save/Restore,...)

Accelerator Controls Modernization Focus

Why EPICS?

- Proven solution at many labs

- Easier opportunity for collaboration

- Has many existing solutions (clients, drivers) that will fit our needs

- PIP-II Integration

EPICS — What Is There to Like?

Large existing variety of device drivers (OPC/UA, ...)

Archiving Clients/applications

Kafka-based Alarm Applications

User Interface Choices

Phoebus/CSS

Community of Knowledge to Draw Upon.

Accelerator Controls Modernization EPICS and PIP-II

EPICS and Current System (ACNET) will have to co-exist for some time

Bridging tools already in use

- These are good for protocol translation

- Harder problems come with data management (archives, etc.)

Larger issues with integration and management of databases

- ACNET relies on one central database of devices

- EPICS IOCs are more decentralized but there are tools like Channel Finder

We're building infrastructure for both

Migrating to EPICS Is a Management Problem/Opportunity

- We're confident in the technical capabilities of EPICS
- Specifications for Collaborators
 - We can't just say "Make it EPICS" and expect it will inter-operate
- Database Integrations
- Choice of Central Applications (Alarms, Modern, supportable technologies)
- Authentication Issues and Policies
- Settings logging consistency
- Common precision timing system
- Sustainable Control System for future experiments.

Migrating to EPICS Is a Management Opportunity — People!

- Collaborators!
- New Hires (there's a lot of work!)
 - (But Covid-19 — remote interview, remote on-boarding:-(.)
- Training
- Modernization can attract talented engineers
- Deal with staff turnover
- Position ourselves to exploit future emerging technologies.

EPICS for PIP-II and Modernization

- Despite Heinz' presentation Monday, I'm pretty sure it's going to take us longer than 45 minutes.

