

Supported by



Overview of the NSTX Control System

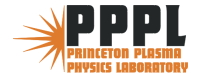
Paul Sichta

8th International Conference on Accelerator
and Large Experimental Physics Control Systems

Nov. 27 - 30, 2001
San Jose, California USA



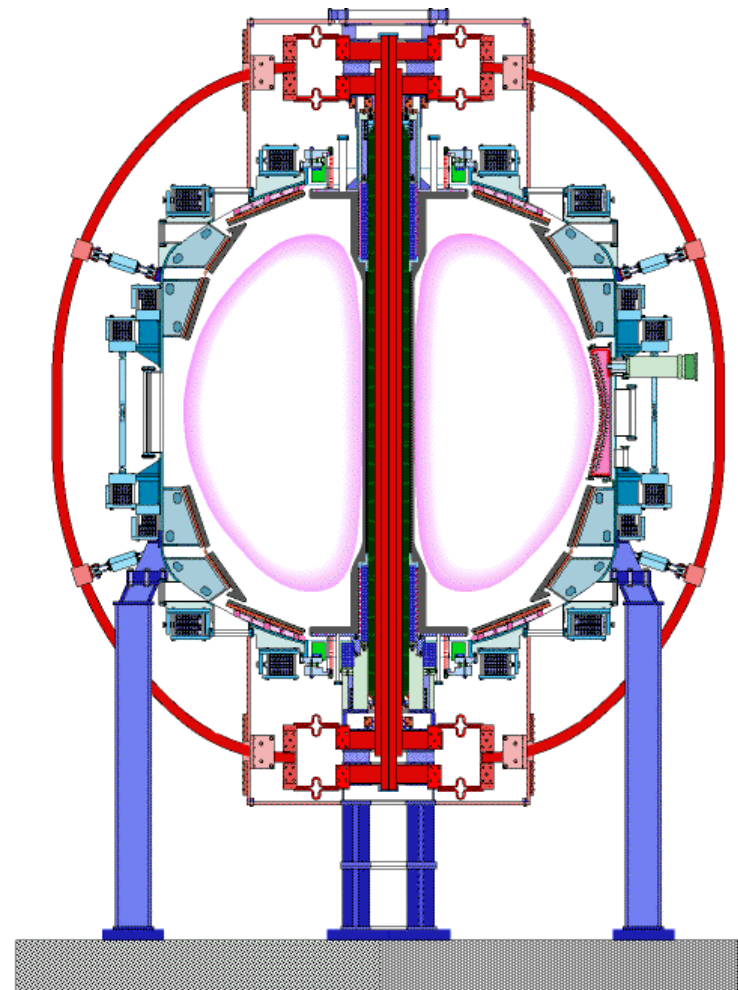
Los Alamos
NATIONAL LABORATORY



National Spherical Torus eXperiment



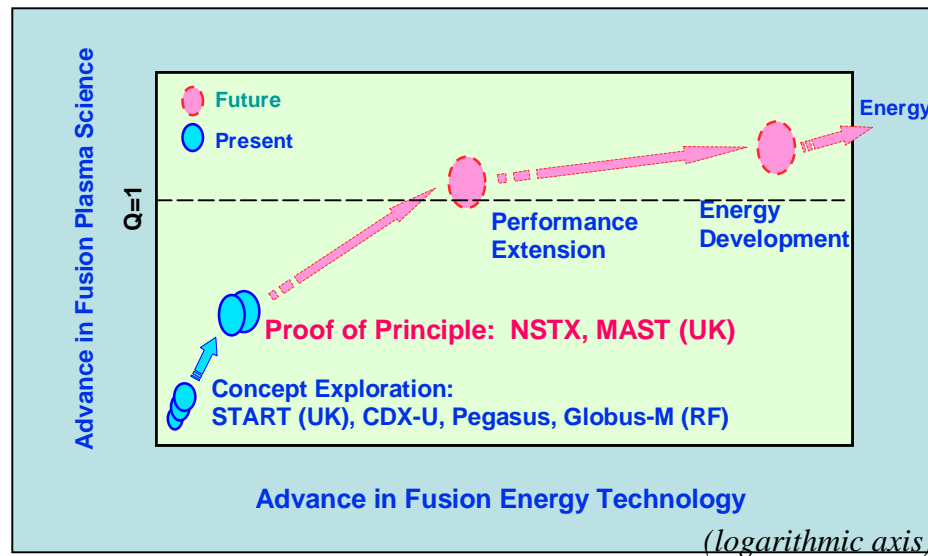
- Fusion Energy Research
- The NSTX Facility
- The Control System
- Timing & Synchronization
- Summary



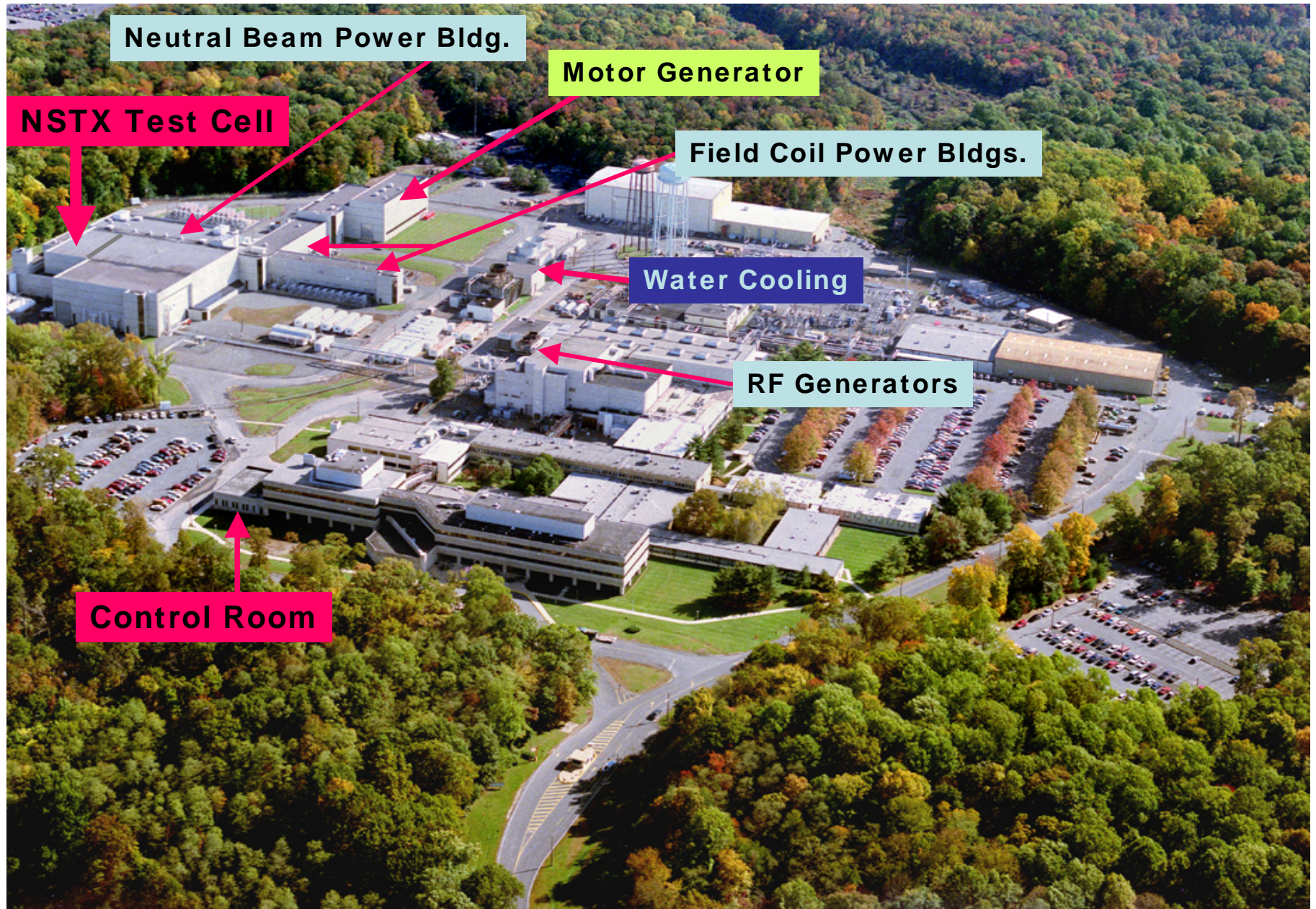
ST Development May Be An Attractive Element Of The World Program



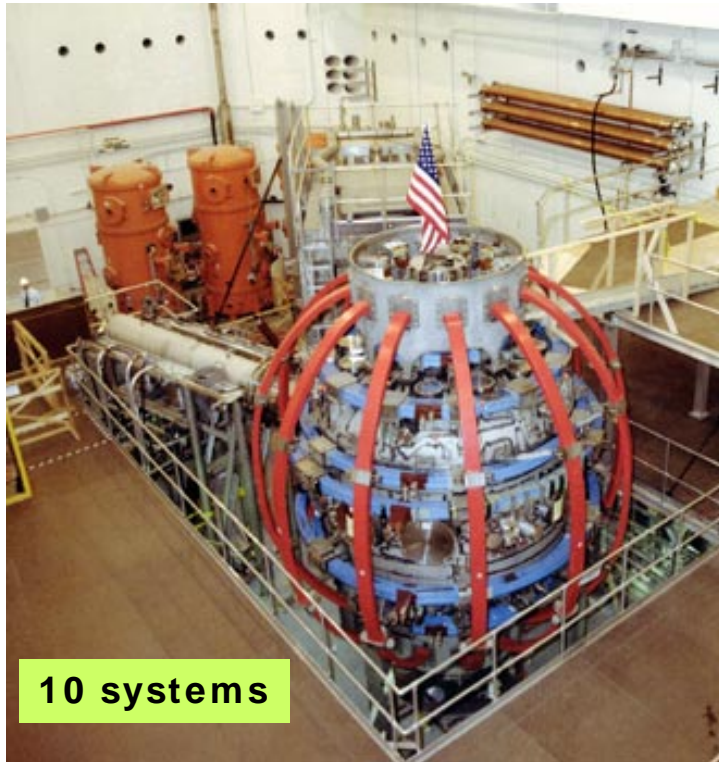
Magnetic Fusion Energy



Princeton Plasma Physics Laboratory



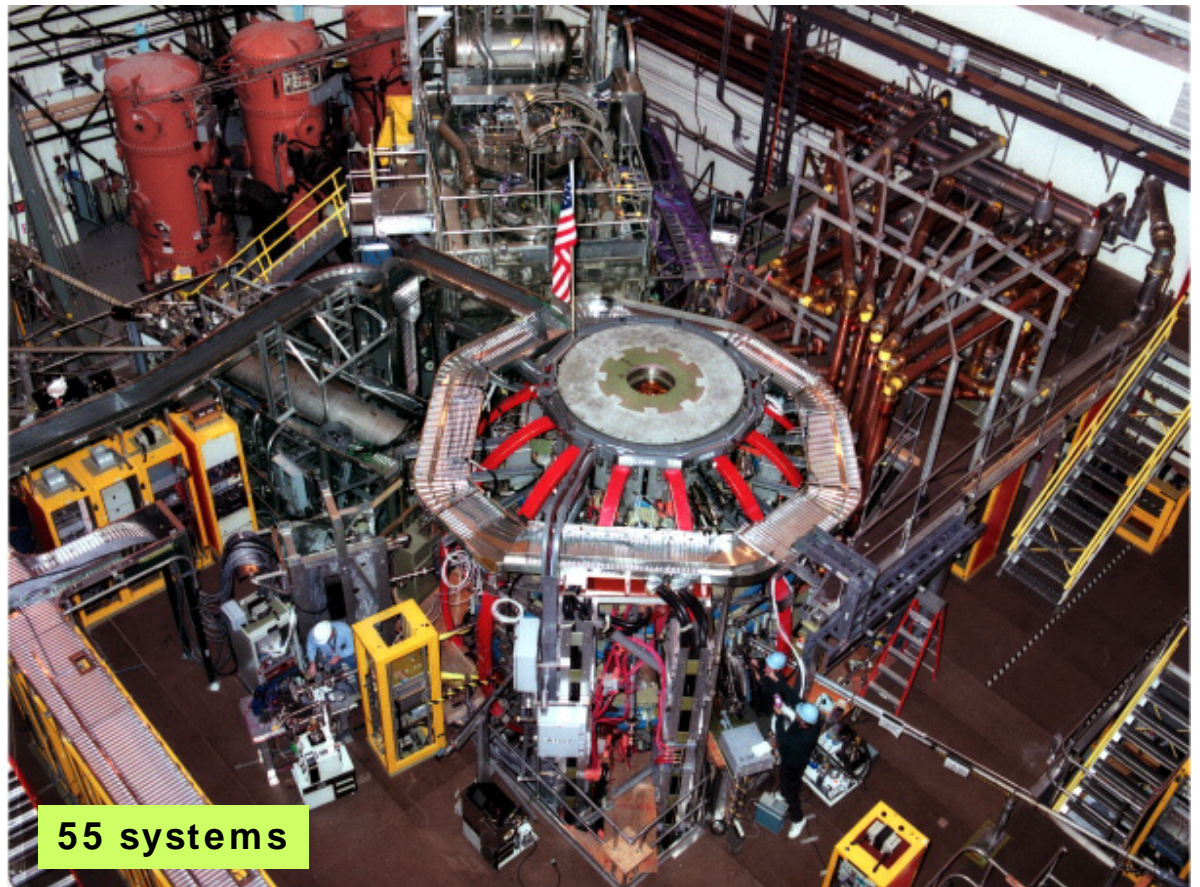
Operational and Experimental Capabilities have Progressed Rapidly since *First Plasma* in 1999



10 systems

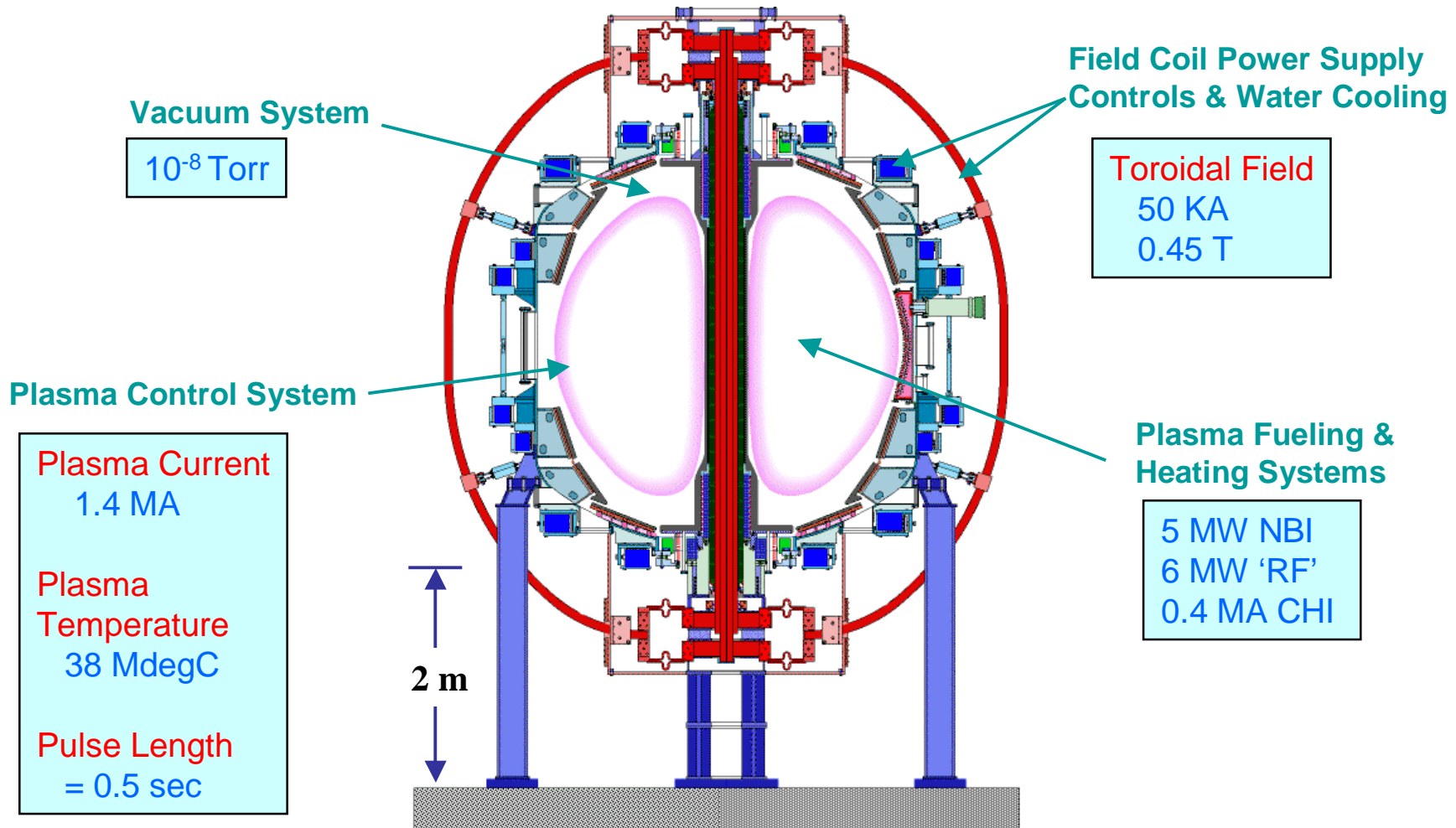
1999

2001



55 systems

Achieved NSTX Machine Parameters



Topology of the NSTX Computing System

Engineering

Physics

MDSplus
Database

Unix & VMS
Analysis

PC apps & X-Windows

X-Windows & local Apps

Secure
Network

NSTX
FW

PPPL
Network

Solaris
EPICS

VMS
MDSplus

VME
EPICS IOC

VME
Plasma Control

CAMAC

RS-232

FPDP

PLC

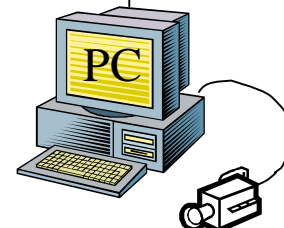
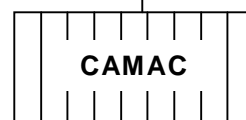
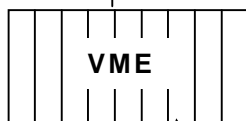
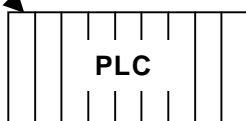
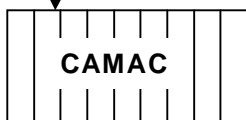
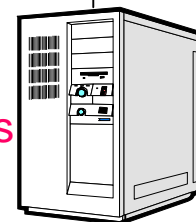
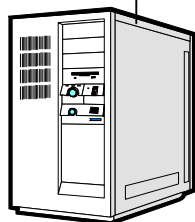
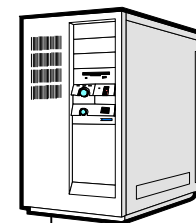
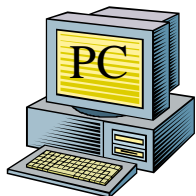
VME

CAMAC

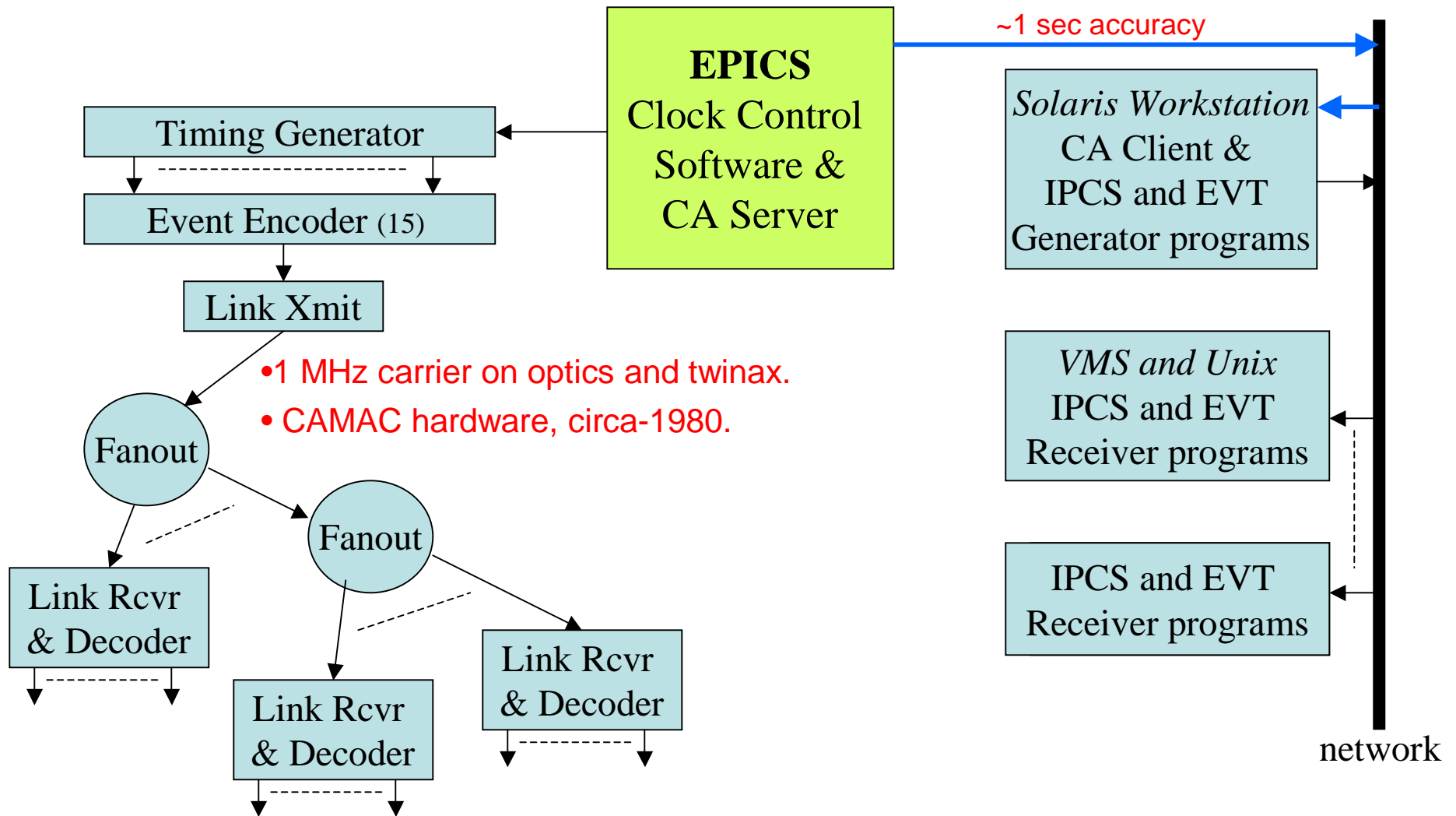
CAMAC

Instrumentation & Controllers

NSTX Spectroscopy Data



Topology of the Timing & Synchronization System



Common Computing Components and Collaborative-Software are used at NSTX



Computing Hardware

- Solaris/SPARC Workstations
- VMS/Alpha Server
- PC, MAC, and X-terminals

Networks

- 10/100 Mbps Switched
- Engineering systems behind firewall

Input/Output Technologies

- CAMAC – a maintainability problem.
- VME, CompactPCI
- PLC
- PC – applications growing.

Application Software

- X-Windows
- IDL

- **EPICS**
- **MDSplus**
- **PCS**
- **IPCS**
- **CCL**

Collaborative
Software

EPICS provides integrated Control and Display services for Engineering Subsystems



- 10 of the 13 Engineering subsystems use EPICS.
- 1500 direct I/O points. Access to 2700 additional points via (6) PLCs.
- 7000 EPICS records on (3) VME **Input Output Controllers**.
- 135 EPICS displays, at 20 x-terminals.
- **EPICS Applications:** **medm, gdct**, alh, StripTool, ss_arch, chan_arch, SNL.
- 'C' programs written to interface EPICS with other NSTX software (IPCS/MDSplus/gnuPlot) and to **support *pulsed* operations**.

The “Model Data System” (MDSplus) is used for Storage of all Physics and Engineering NSTX Data



- *MDSplus* stores 100 MB raw and analyzed data for each NSTX ‘shot’. 5000 waveforms, 25,000 parameters.
- *MDSplus* provides a set of tools for performing setup, data acquisition, and post-processing analyses for *pulsed experiments*.
- Access to all NSTX data with unified methods enables a broad range of scientific research.
 - *MDSplus* clients run on VMS/Unix/Windows.
 - API’s for FORTRAN, C, Java, IDL, and LabView.
- *MDSplus* is becoming the de facto standard in fusion science research.
 - * Alcator C-Mod
 - * LDX
 - * TCV
 - * **NSTX**
 - * ZaP
 - * Pulse Test Facility
 - * RFX
 - * DIII-D
 - * H-1

There are new Web-browser Tools for Working with MDSplus Data

NSTX Web Tools - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Search Home History

Address <http://nstx.pppl.gov/nstx/Software/WebTools/index.html> Go Links

NSTX software

Overview Programming Diagnostics Details
FAQ Web Tools UNIX & VMS

Web-based tools for NSTX

FINDING SIGNALS IN LABEL LIST List of NSTX MDSplus [signals and their labels](#), for searching with Browser 'Find'

FINDING SIGNALS IN TREE [treesearch](#), search for text, node or TDI

LOGBOOK READ ACCESS [Logbook](#) standard and custom queries, autoupdates, find shots by date, entries by user, etc.

CHECKING DATA LIMITS [mdsShotSearch](#) searches a range of shot numbers for signal data within user-specified limits

PLOTTING NSTX DATA [mdsplots](#), plot NSTX signals (with overlays) individually or from Scope files.

LISTING DATA VALUES [mdslist](#), data values in spreadsheet-compatible format

LISTING DATA VALUES [jTraverser](#), Traverse MDSplus trees and plot nodes (BETA VERSION)

XP/XMP SHOT INDEX

CY2000 Physics XPs

CY2001 Physics XPs

CY2000 Machine XMPs

CY2001 Machine XMPs

SHOT LIST BY DATE

CY2001

CY2000

CY1999

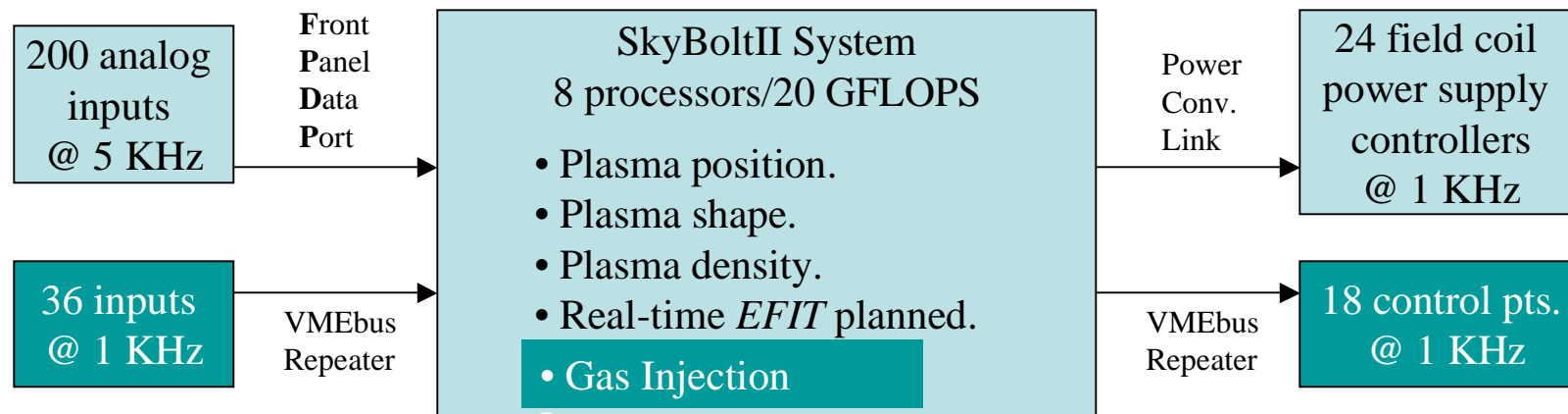
- View control room "VGDS" plots
- Java scope
- Web shot clock

Internet

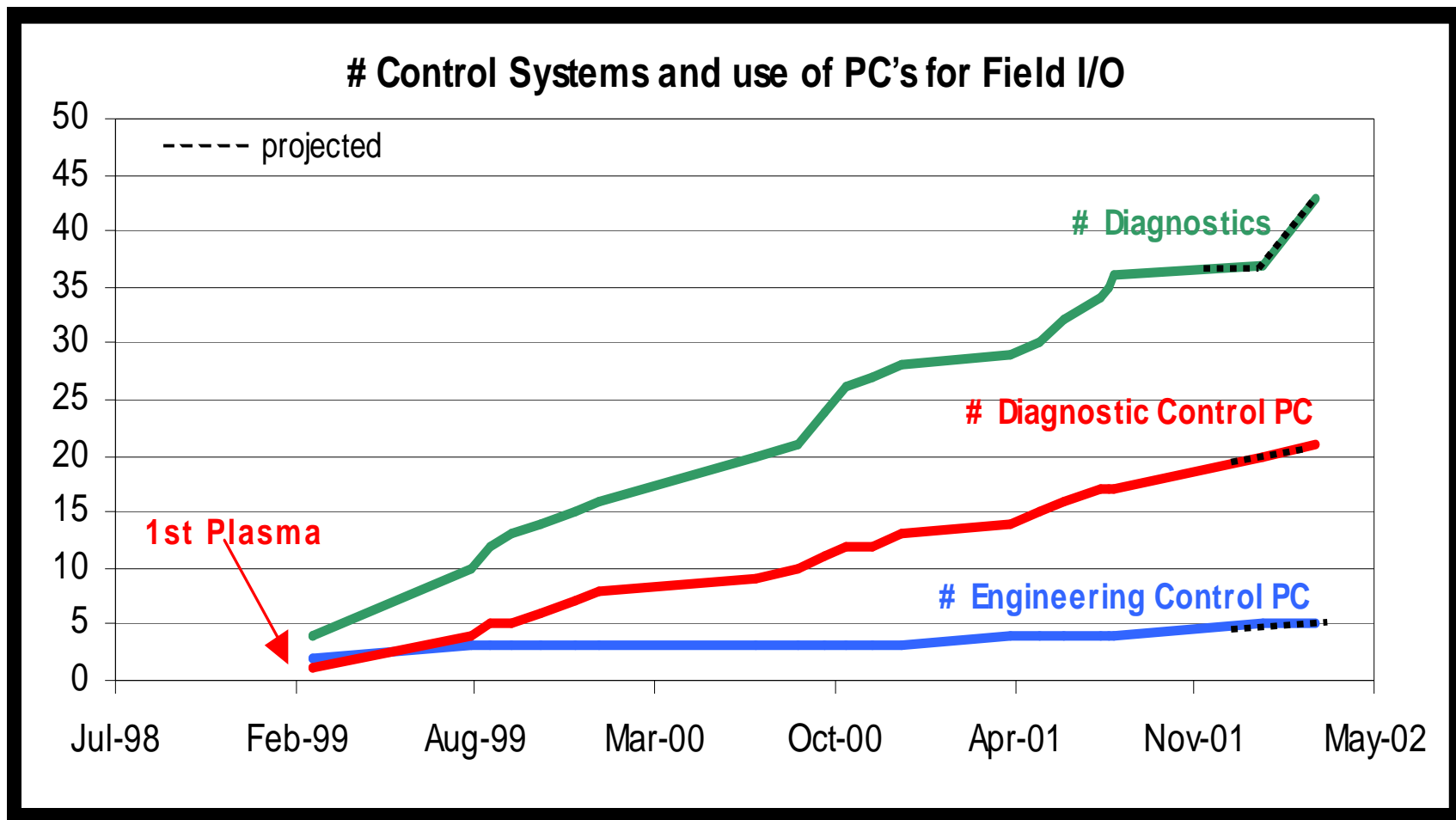
The Plasma Control System is a high-performance real-time control system



- VME-based Control System.
- The **Plasma Control System** software was developed by *General Atomics*, and is used on their DIII-D fusion experiment.
- May control auxiliary heating systems in the future.



PC's are the "Field I/O" platform of choice for many of NSTX's collaborator's Diagnostic Control Systems



Conclusion:
The Control Systems are Effectively Supporting NSTX



- NSTX is fostering world-class 'ST' physics research, with an ever-growing list of collaborating institutions.
- The NSTX machine has demonstrated **high reliability** (>90 % shot-success rate).
- Engineering and Physics computing have 'very rarely' caused a missed shot or schedule delay.
- Successfully used collaboration-supported software.
- Small **engineering staff** supports core computing (~10).

The Engineering Department is continuously striving to improve the effectiveness and maintainability of the NSTX Control System



- Address the CAMAC obsolescence problem.
- Enhance use of web technologies.
- EPICS Development:
 - Focus on hardware architectures and operating systems that have a large installed base, or promising future:
 - * Well-known 'features'. * Breadth and Longevity of support. * Cost effective.
- Clock System Enhancements:
 - FPGA on Industry-Pack to permit **clock receiver** in a PC or VME system.
 - Explore the **S**pallatial_**N**eutron_**S**ource (10 MHz) timing system.