

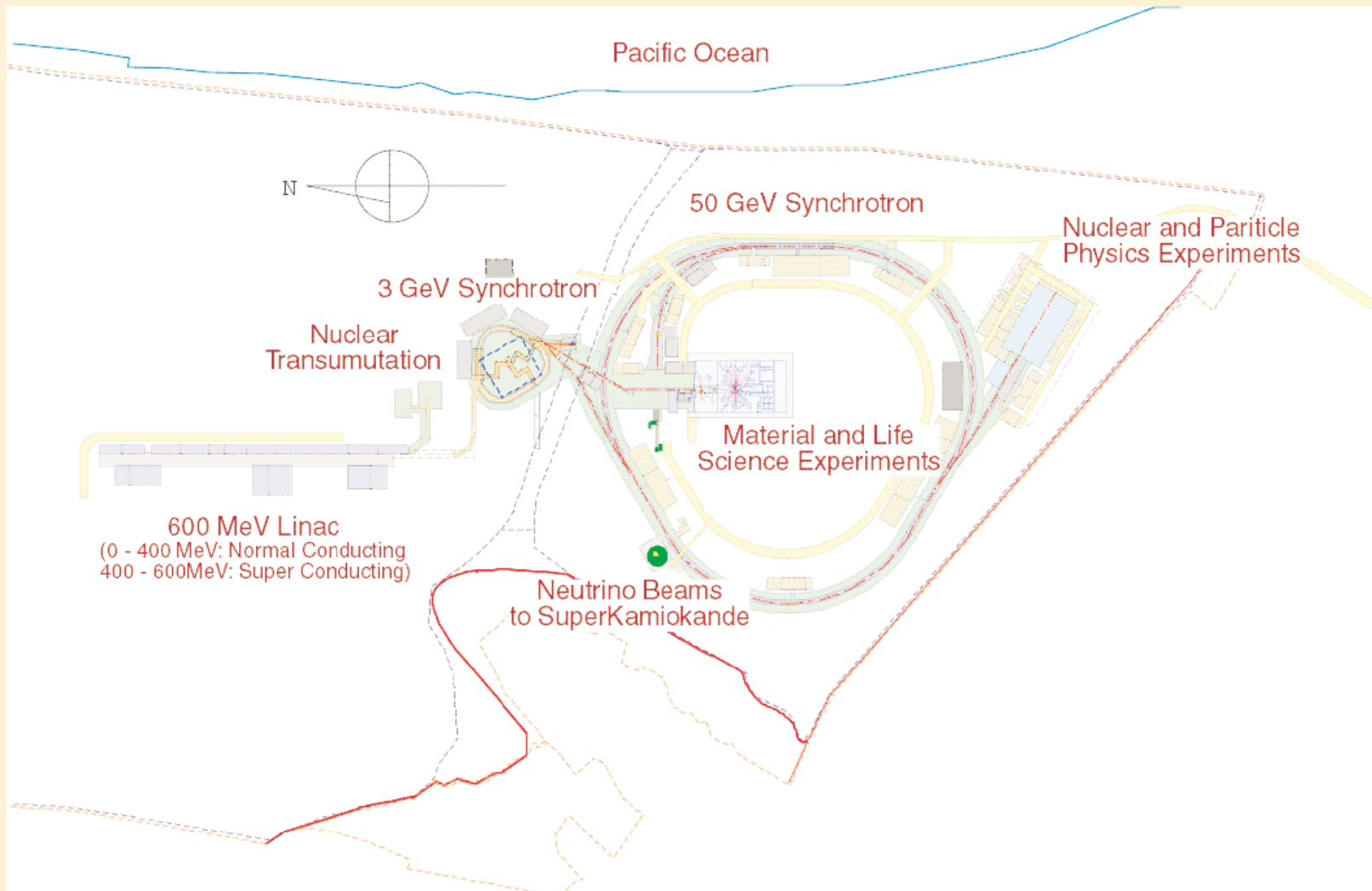
**Controls
at JAERI - KEK Joint Project
High Intensity Proton Accelerator Facility**

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for JKJ Controls Group

JAERI - KEK Joint Project (JKJ)

◆ At JAERI Site (50 km North from KEK)

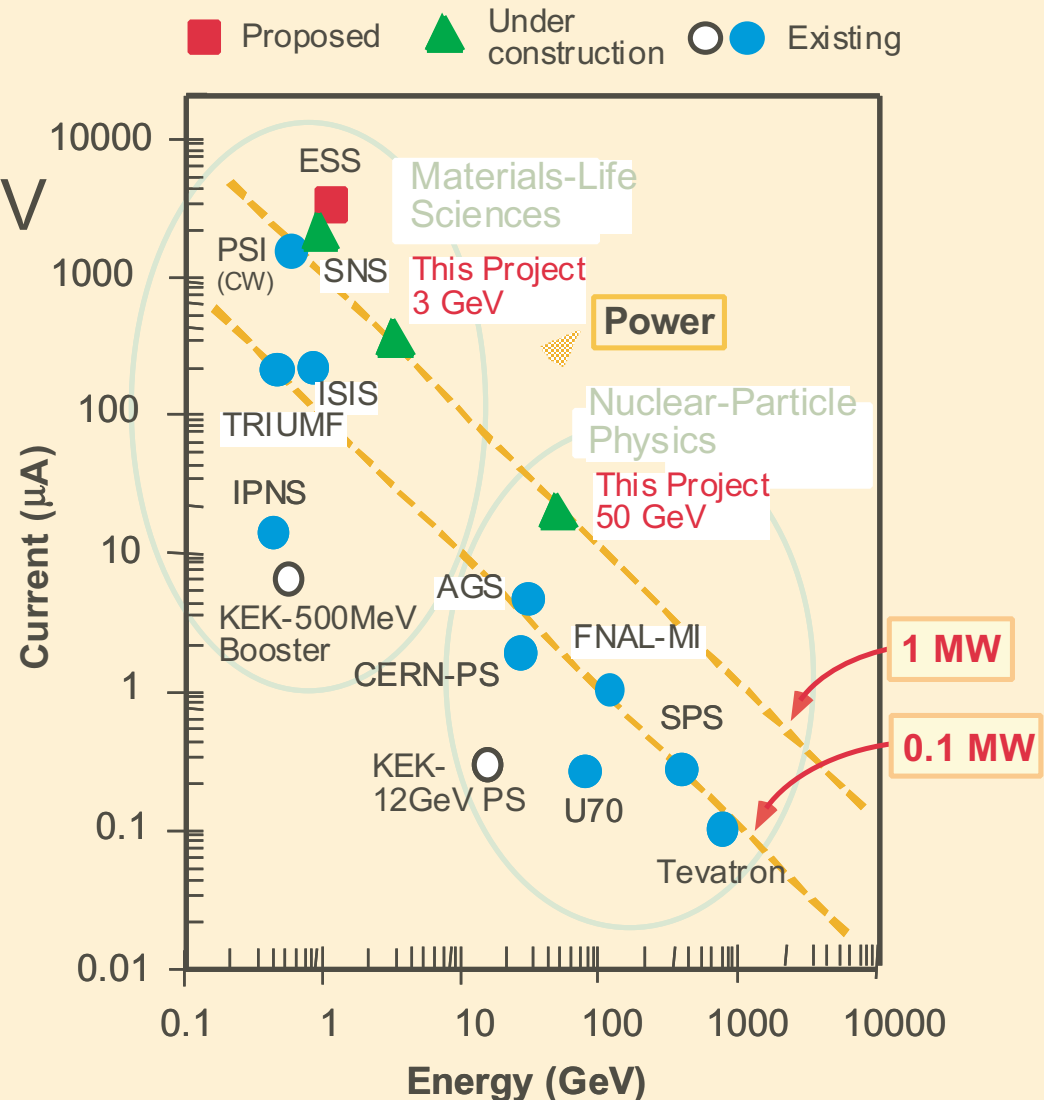


Proton Accelerators in the World

◆ New Project (JKJ)

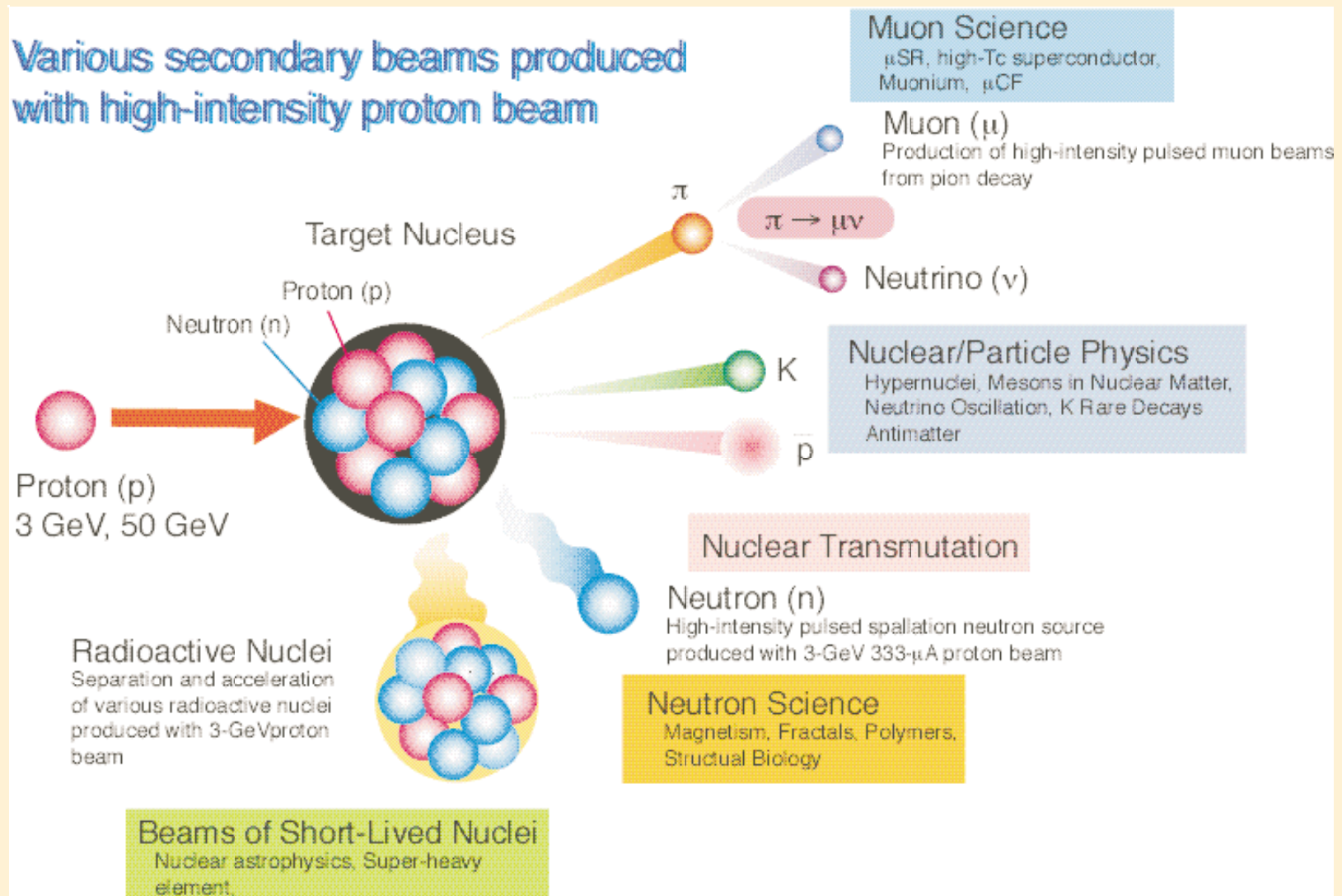
1 MW at 3 GeV

0.75 MW at 50 GeV



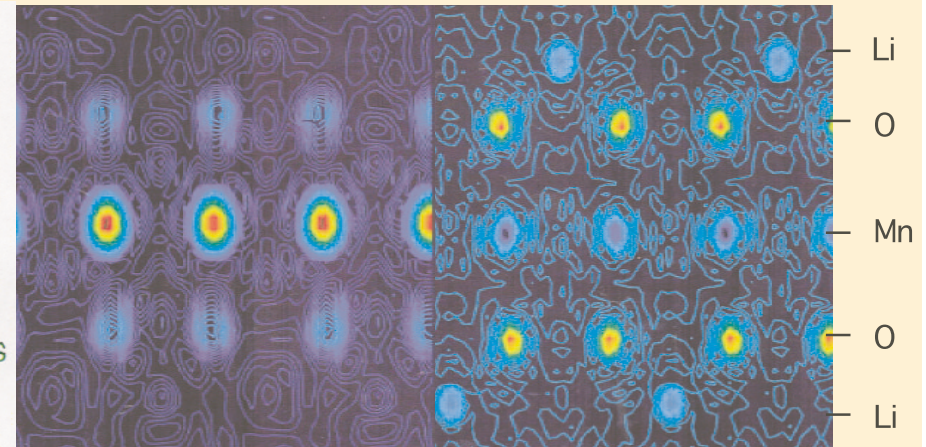
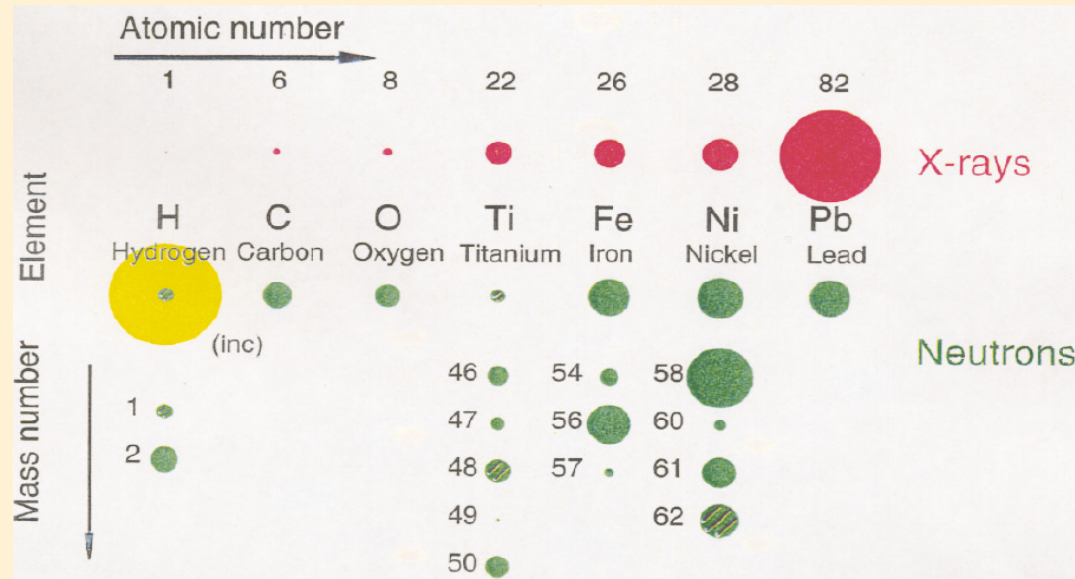
Purpose of the Project

◆ Various Probes to Study Materials, Nucleus and Particles + Transmutation



Example of Study

◆ Neutron Science



T. Kamiyama, et al

X-rays interact with electrons.

- ◆ X-rays see high-Z atoms.

Neutrons interact with nuclei.

- ◆ Neutrons see low-Z atoms.

Material for Li-battery seen by
X rays (left) and
Neutrons (right)

Control System for JAERI-KEK Joint Project

◆ Members

JAERI : 1 + 3?, KEK : 1 + 3 (+ 3?)

Hope for Formation of EPICS Group at KEK
(Control Groups at KEK:

EPICS: KEKB, PF-AR, Non-EPICS: Linac, PF, PS, ATF)

◆ Chose EPICS After Studied Control Systems at KEK

Recent Success of KEKB

Feasibility to Share Software Resources with Others

◆ Contact Persons from Equipment Groups

Machine-design, Linac-rf, Linac-Acc, SC-linac,
Ring-rf, Magnet, Vacuum, Injection-extraction,
Beam-instrumentation

EPICS Control System

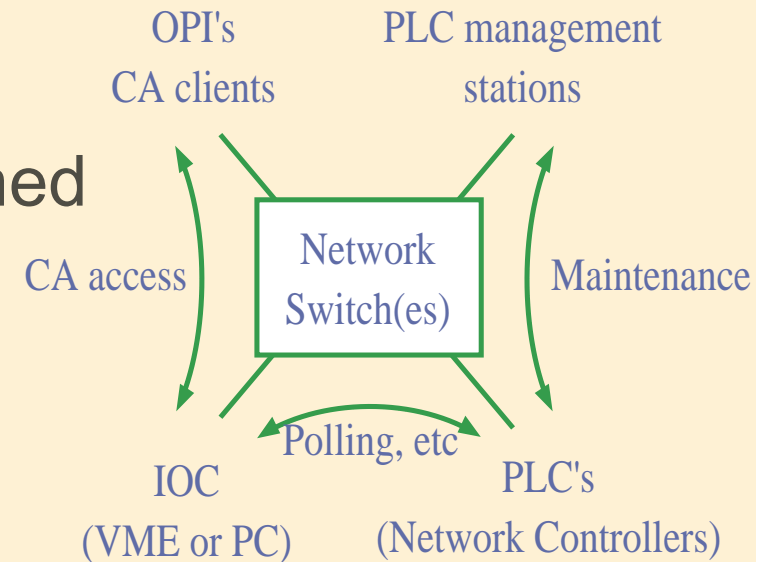
- ◆ Development
 - HP-UX : VxWorks development, CA-Client
 - VME: Force PCore750, Motrola MVME...
 - FreeBSD: PC Terminals
- ◆ Chose Ethernet/IP Network Controller (as well as VME) instead of Using Special Field Networks
 - Success at KEK e^+/e^- Linac with Network Controller
 - ~ 250 Controllers
 - Only TCP/IP Software and Infrastructure
- ◆ Ask Equipment Groups to Design Sub-systems Instead of All Made by Control Group
 - They may Sub-contract Part by part
 - Sub-systems Behave Detachable Sub-systems

Network Connected Controllers

- ◆ Simplify Software, Management, Troubleshooting
Efficient in Speed, Cost, Manageability
Do not Consume Human Resource much
- ◆ Standard Network Device Technology
Standard Software
Flexible in Designing the Network
Easily Understood (the Same Technology at Offices)
- ◆ Normally UDP/IP for Simplicity and Error Handling
TCP/IP as well (cf. out-of-band TCP packets)

Network Based Controller (NC) under EPICS (1)

- ◆ 5 Components
- ◆ NC (such as PLC) : Mostly Designed by Experts, Carrys Local Logics
- ◆ EPICS IOC : Carrys Logics between Several Devices
- ◆ EPICS OPI : Normal OPI
Do not See Existence of NCs
- ◆ Management Station : Software Downloading and Monitoring
- ◆ Network : Switch Technology
Physical and Logical Views are Different



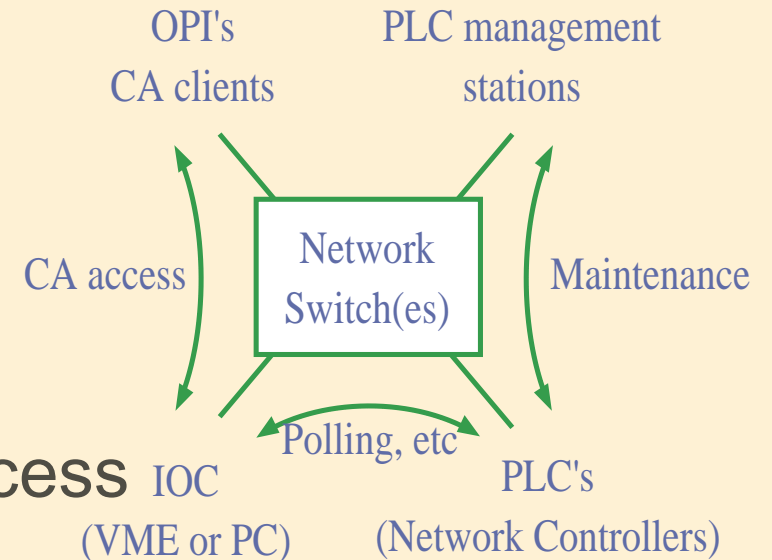
Network Based Controller (NC) under EPICS (2)

◆ 3 Ways of Communication

◆ NC — IOC : In its Own Protocol
Polling (+ Urgent)

◆ IOC — OPI : Through Channel Access
Normal EPICS

◆ NC — Management Station :
During Maintenance Time (+ Monitoring During Operation)



Programmable Logic Controller; PLC

- ◆ Modern PLC's are Powerful and Flexible
 - Good Candidate for Remote I/O Controllers
- ◆ Not too Fast on the Network (2~10 millisecond Response)
 - but Fast Enough for Most Purposes
- ◆ Pre-processing of Control Variables
 - Scientific Functions, Floating Point Calculations
- ◆ Chose Yokogawa's FA-M3 (Factory ACE)
 - Maintenance Capability over Ethernet/TCPIP
 - (Not from other Venders in Japan)

Programmable Logic Controller; PLC

- ◆ At the Joint Project,
Vacuum, Magnet, Ion Source and Microwave Equipment
- ◆ Out-sourcing of Accelerator Equipment Easier
Isolated with Network
Ladder Program Development out of Control System

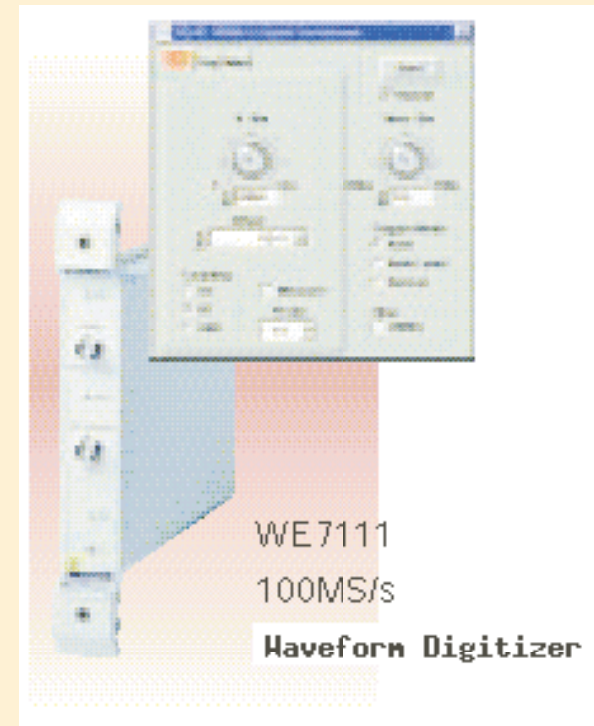


Measurement Station

- ◆ Waveform Observation
 - GPIB connected Oscilloscopes or VXI
- ◆ At the Joint Project,
 - Beam Pulse of Several Hundred Nanosecond
 - Cost Performance
 - Noises from Modulators
- ◆ Chose Yokogawa's WE7000 for Now
 - 100ks/s, 100Ms/s, 1Gs/s
- ◆ Network Specification Disclosed (Originally Windows only)
 - Evaluated IP Communication Software on Unix
- ◆ Mitsubishi Electric Co. Working on Device Support

Measurement Station

- ◆ Chose Yokogawa's WE7000
- ◆ Network Specification Disclosed (Originally Windows only)
Evaluated IP Communication Software on Unix



Plug-in Network Controller

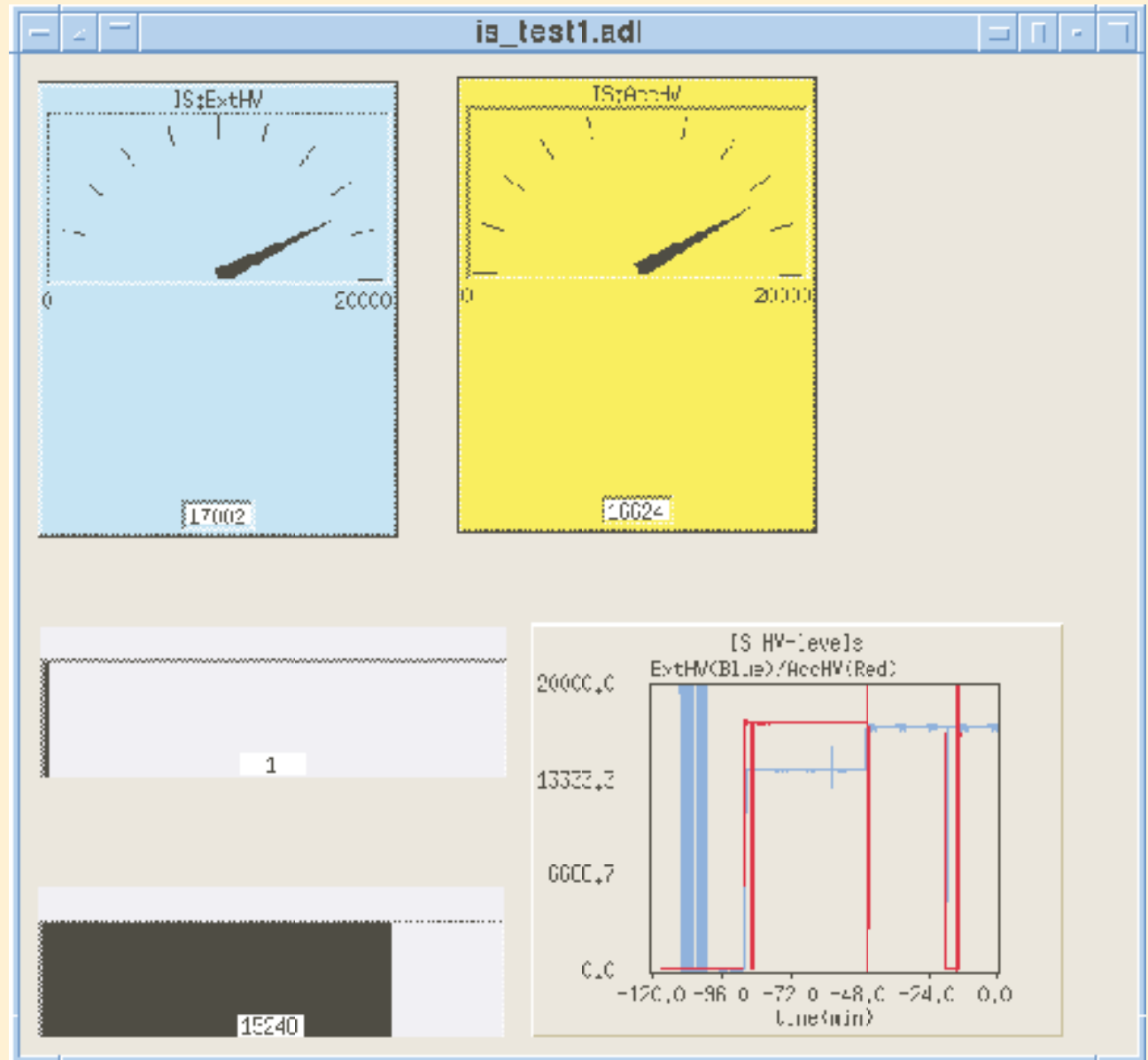
- ◆ On Designing Relatively Large Power Supply for Drift-tube Linac (DTL) and Separated DTL
- ◆ Ethernet Board with about 50 (User Visible) Registers Added to Intelligent Internal Controller Including Diagnostic Information
- ◆ Being Built with Power Supplies
- ◆ Although Extended, Software is Almost Compatible with PLCs

Software for PLC

- ◆ PLC Access Routine at e⁻Linac was Generalized
Base on General Network Library
- ◆ No On-demand (Interrupt) Protocol Currently
Host IP Address Have to be Hard-coded
- ◆ Block of PLC Memory as Shared Memory
Between IOC and PLC
- ◆ Naming Scheme for OUT/INP
(Hostname:VarAddress)

Simple Usage of PLC for Ion Source

- ◆ MEDM Panel with Current Value and Strip-charts for High Voltages of Ion Source



Software for WE7000

- ◆ Software was Evaluated and Investigated on Unix

- ◆ Port Software on to VxWorks IOC

Replacing POSIX Thread with VxWorks Task

- ◆ Waveform Record is Being Evaluated

- ◆ Mitsubishi Electric Co. Working on Device Support

We Thought This is a Good Candidate for Out-source

Relational Database Test

- ◆ All Linac Cabling between Gallery and Tunnel
First Made from Excel-like Tables
Put into PostgreSQL
- ◆ User Interface by Web Browser
CGI Search/Extract ...
- ◆ PostgreSQL is Fast for Most Purposes
Oracle is Tested as Well

Naming Convention

- ◆ Project Name
Group Names, etc.
- ◆ EPICS Record Names
Based on SNS (Old) Design
KEKB Has Group Name
- ◆ Equipment Groups Began Designing Names
- ◆ Some Discussion
Colon Usage (Windows)
Relational Database Mapping

