



EPICS Environment at J-PARC Neutrino Facility

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for J-PARC Neutrino Facility



J-PARC

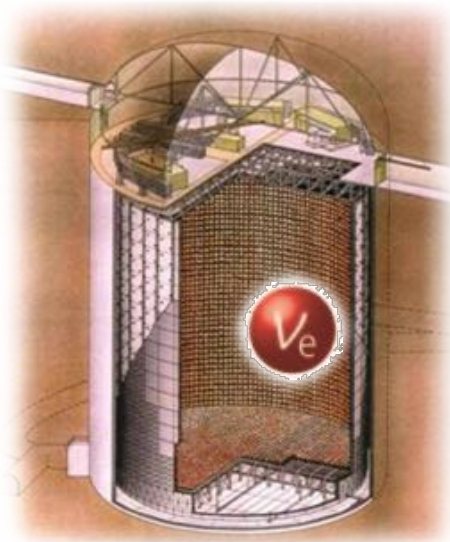
Japan Proton Accelerator Research Complex



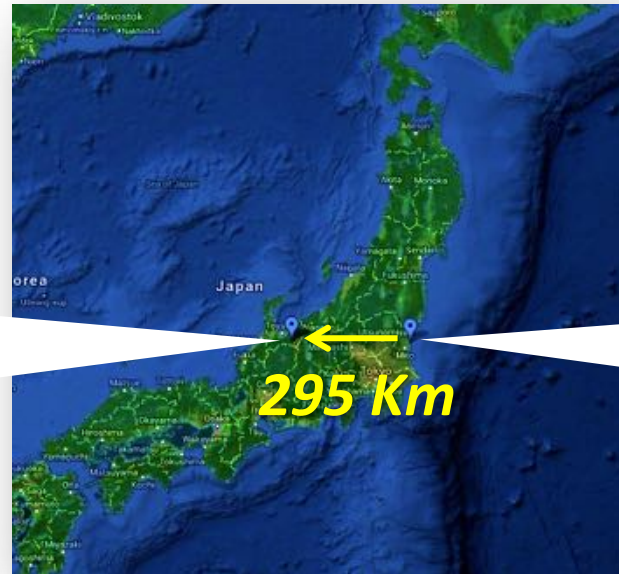
T2K (Tokai to Kamioka) Experiment



A long-baseline neutrino oscillation experiment at J-PARC



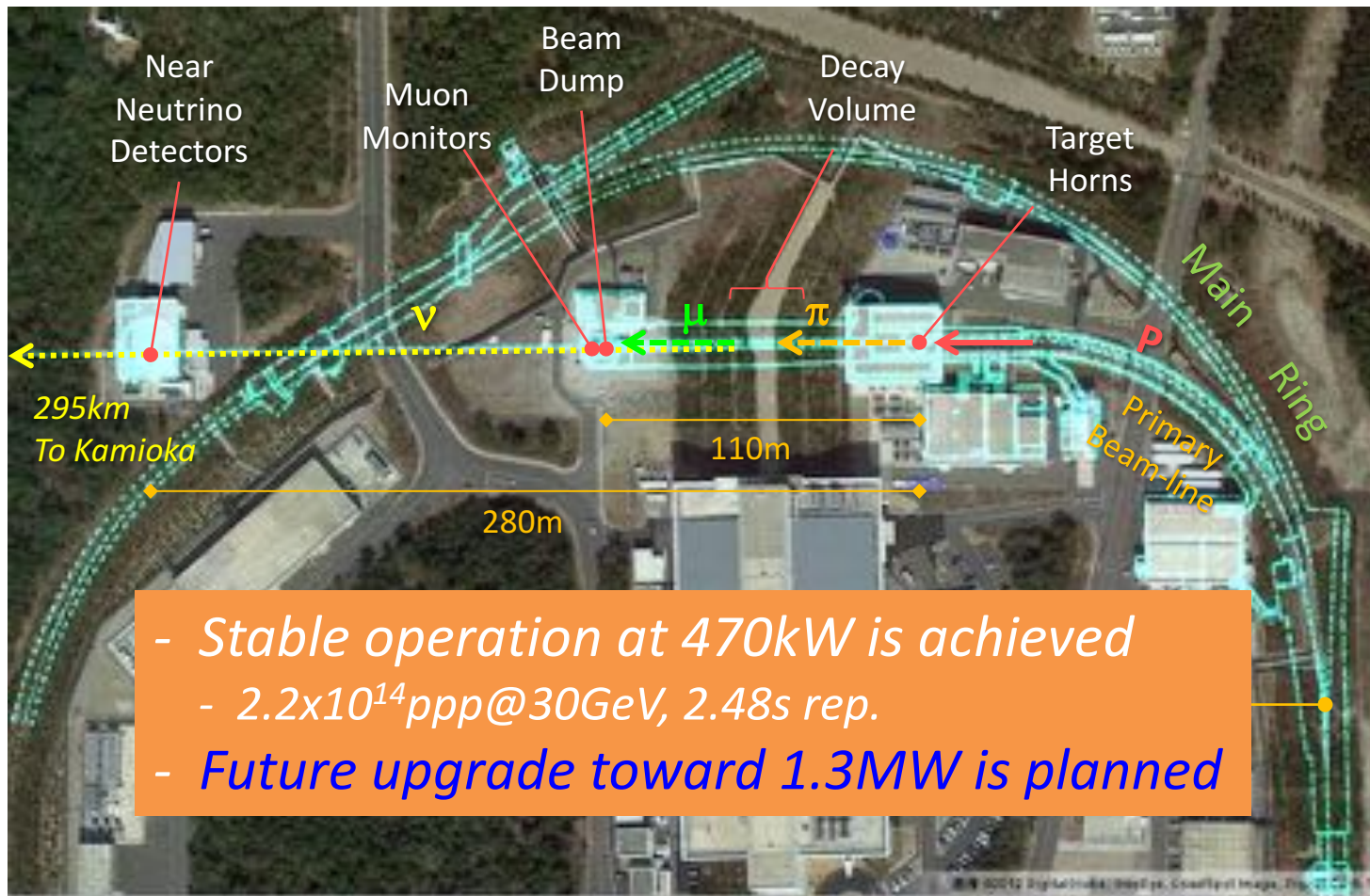
SK@Kamioka

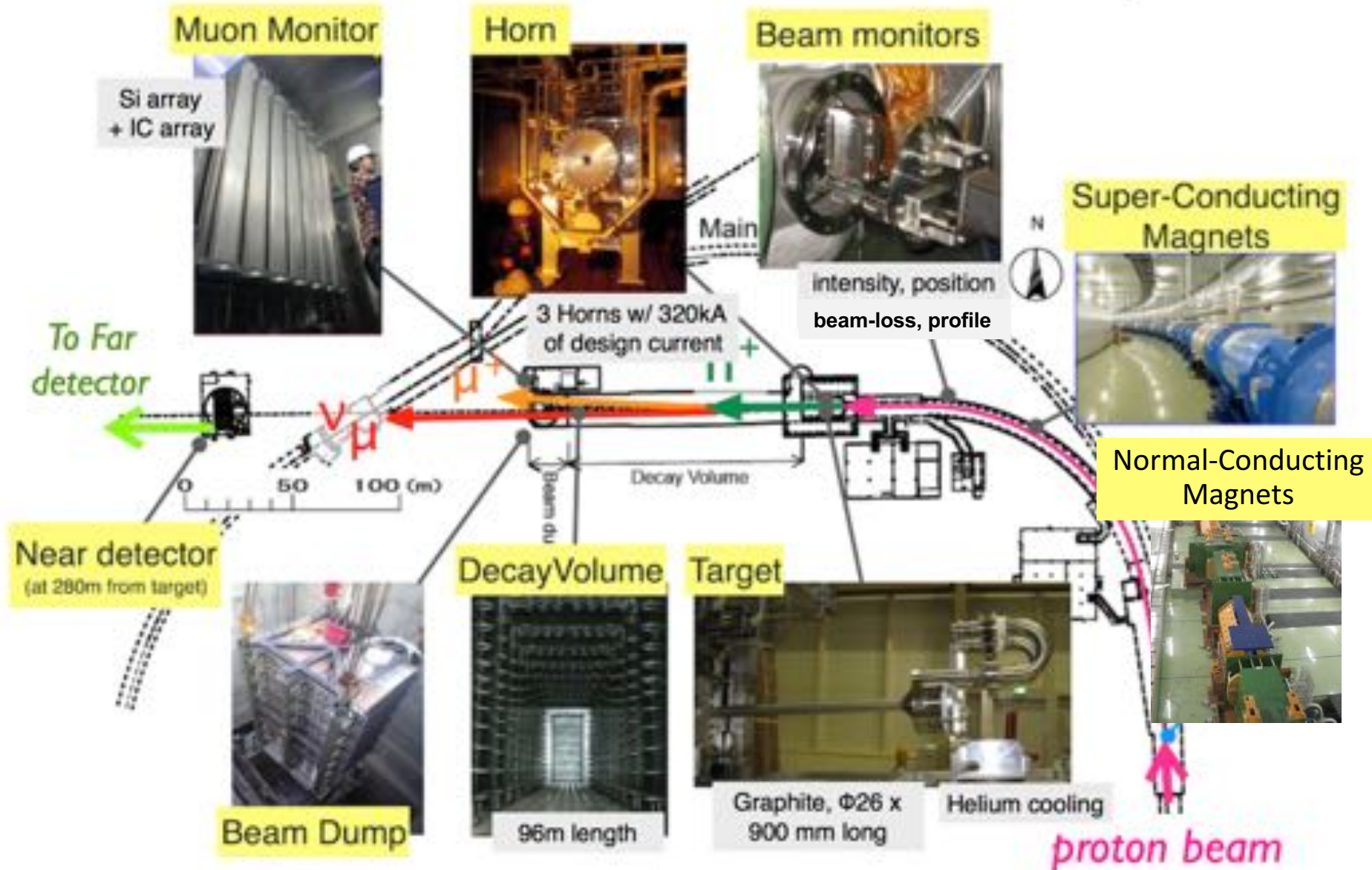


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- T2K has been taking physics data from Jan. 2010.
- In July 2013, muon ν to electron ν transformation has been established.
- Now T2K is searching for CP symmetry violation in neutrino

Neutrino Facility at J-PARC





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NU: Neutrino Facility

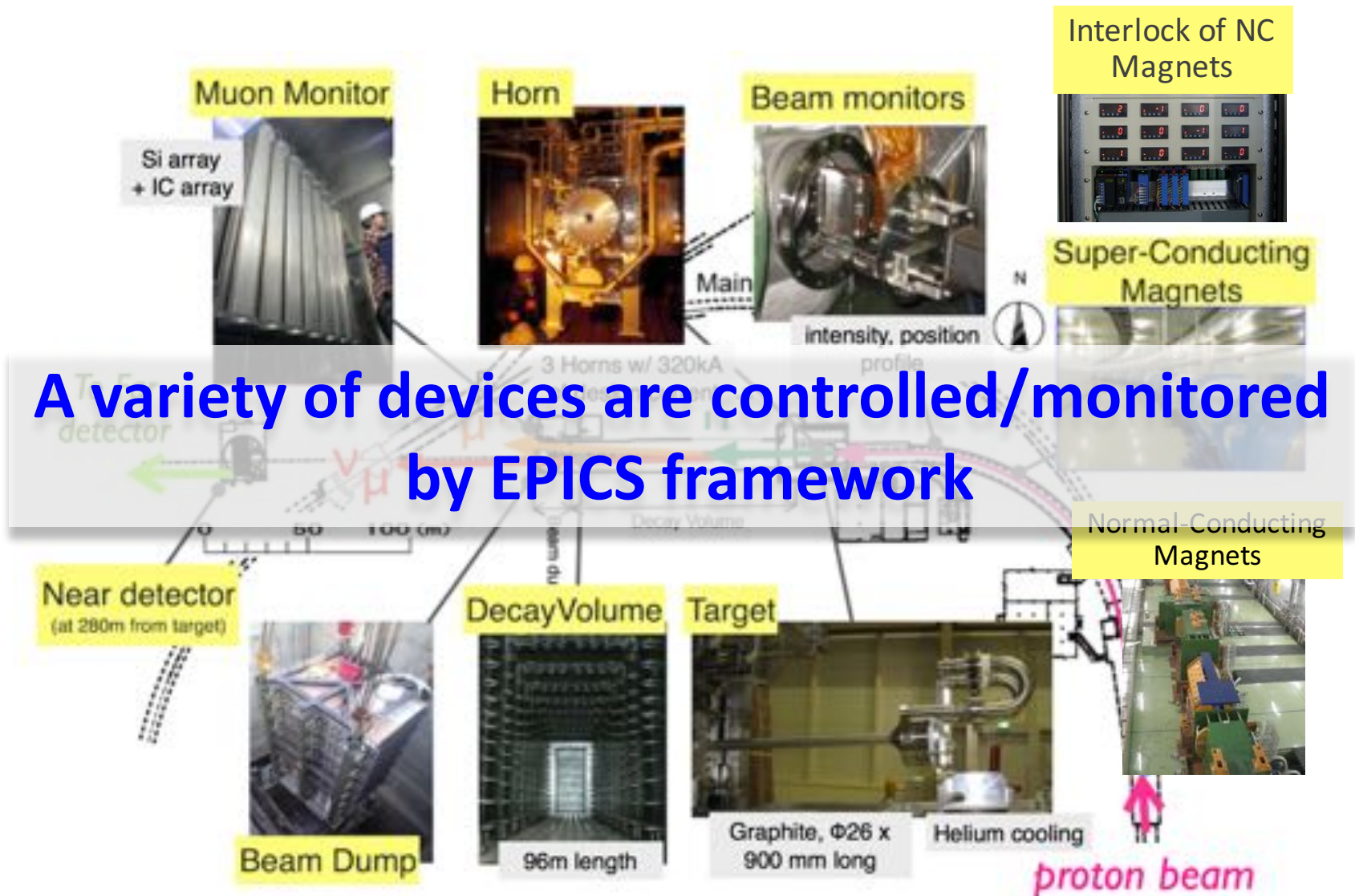
INTRODUCTION OF BEAMLINE CONTROL AT NEUTRINO FACILITY

Requirements for the Beamline Operation at NU

- One mistaken shot can potentially do ***serious damage*** to the beamline equipment.
- *Information sharing about beam status between the accelerators and Neutrino facility is essential for safety operation*

➡ ***We utilize EPICS for beamline control/monitoring***

Features of Beamline Control at NU



APPLICATION EXAMPLES OF EPICS AT NEUTRINO FACILITY

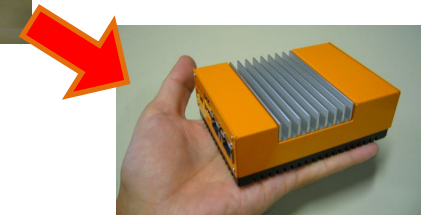
EPICS IOC Environment at NU

We adopted micro servers “Saba-taro” for EPICS IOC in place of commodity PCs. It had been initially R&D’d and used successfully at MR.

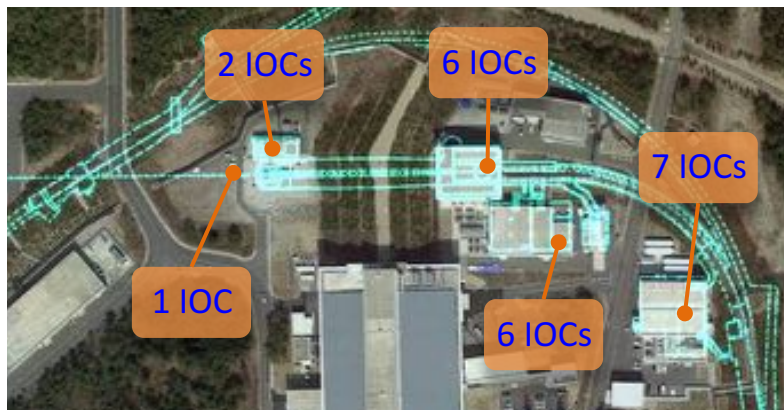
| | |
|----------------|---------------------------------------|
| OS | Scientific Linux 6.8, x86_64 |
| EPICS version | 3.14.12 |
| # of IOCs | 22 |
| Total # of CHs | ~13000 |
| IOC platform | Micro server (Celeron J1900, Mem:8GB) |



Old IOCs



A micro server IOC



IOCs at Target Station

Slow Control Framework at NU

- Slow control/monitor is based on PLC + EPICS
 - Yokogawa FA-M3 PLC + netDev (device/driver support)
 - Common scheme with J-PARC MR
- Application examples at NU
 - Magnet Power supply control system
 - Interlock system for NC magnet PSs

Magnet Power Supply Control

Various type of magnet power supplies are controlled by PLC/EPICS



21 NC Power supplies



2 HORN Power supplies



A SC Power supply

| | # of Magnets | # of PSs (PLCs) | # of IOCs |
|--------------|--------------|-----------------|-----------|
| HORN | 3 | 2 (2) | 1 |
| SC | 28 | 1 (1) | 1 |
| SC collector | 6 | 6 (1) | 1 |
| NC | 21 | 21 (21) | 2 |

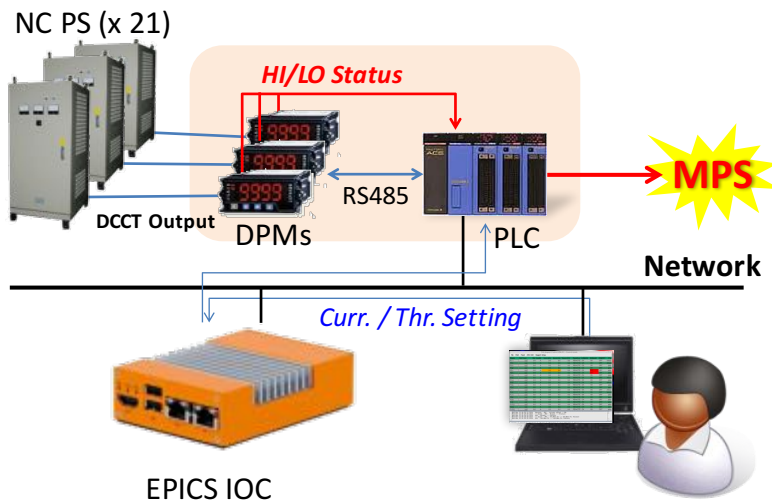
Magnets and its power supplies controlled by PLC/EPICS



A NC Power supply and PLC

Interlock System for NC Magnet Power Supplies

An interlock system for current change of NC PSs by panel meters (comparator)
The panel meters are controlled by PLC+EPICS



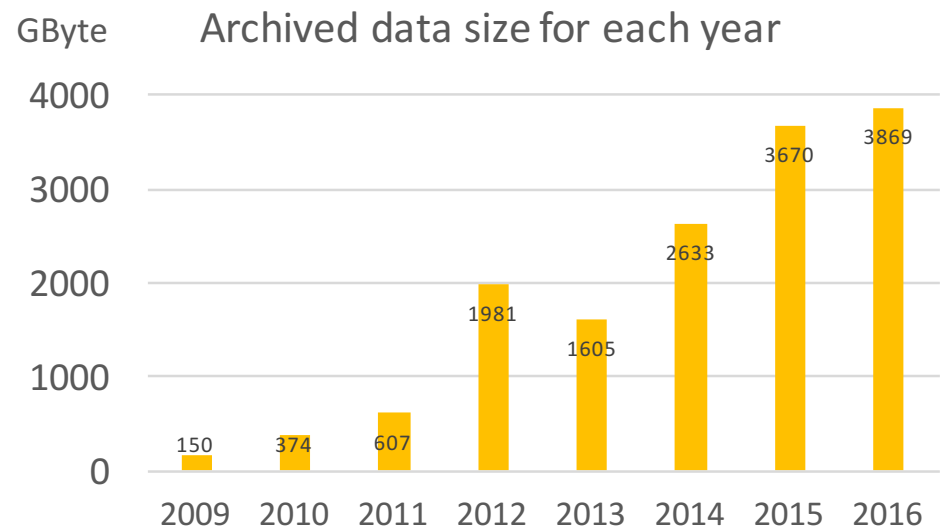
PLC and digital panel-meters for Interlock of NC magnet PS

We have developed the interlock system in 2012. From 2012 to 2013, we caught **3 failures** by this system. In 2014 we replaced all the PSs for NC magnets. After the replacement, we caught **no failures** so far.

Channel Archiver

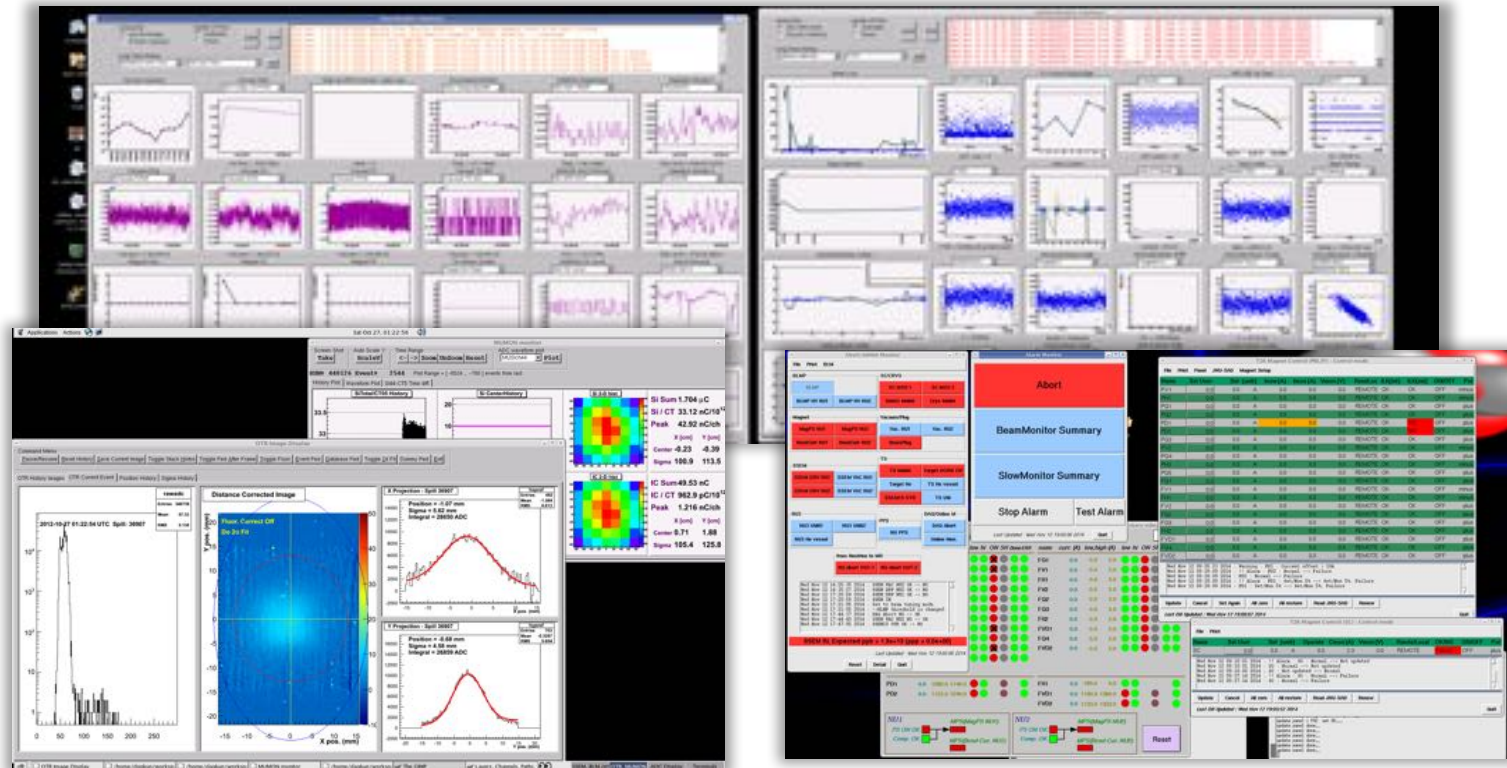
- We use Channel Archiver and Archive Viewer
- Archived data size is increasing year by year
- Watching and examining next-generation archiver
 - *Any suggestion? Archiver Appliance?*

| | |
|--------------|------------------------------|
| OS | Scientific Linux 6.4, x86_64 |
| EPICS ver. | 3.14.11 |
| # of Servers | 2 (DELL PE T620, T630) |
| # of engines | 27 |



GUI, Panels

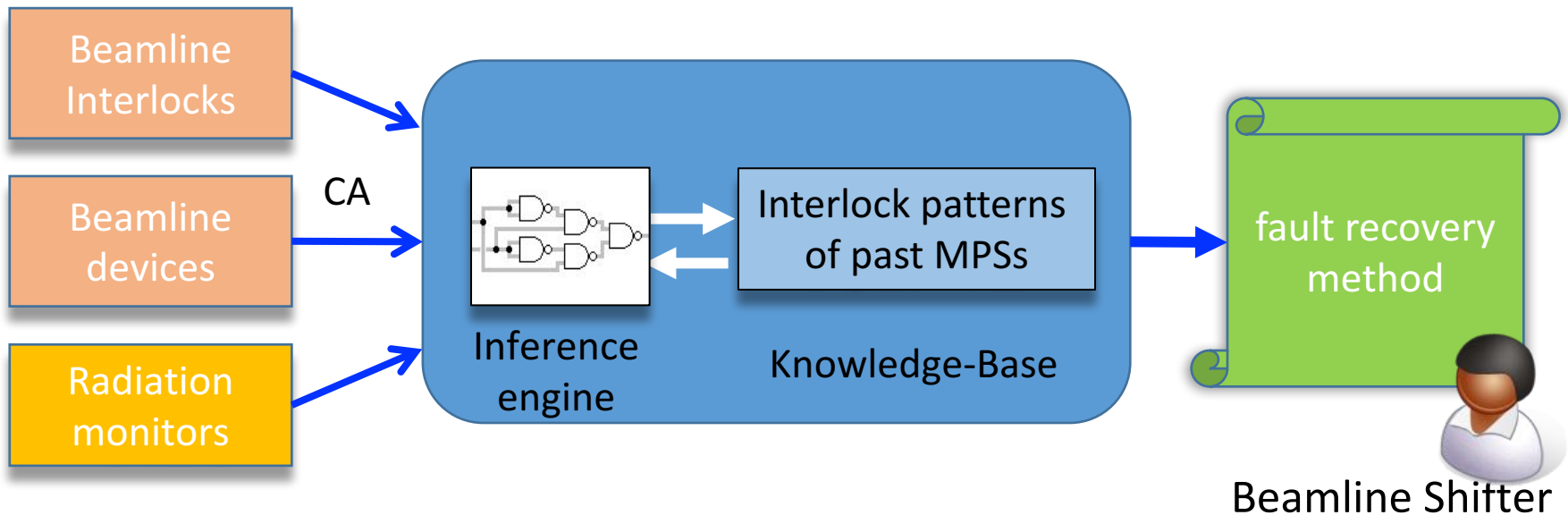
- Online monitoring display for beamline shift
 - we use root, EDM and CaPython for GUI
 - *Any suggestion? CSS?*



DEVELOPMENT OF THE BEAMLINE EXPERT SYSTEM

Development of the beamline expert system

EPICS Records



- The system acquires EPICS records of beamline status every 1 sec.
 - usual case: Watches the beamline status to detect a signs of anomalies in equipment
 - Interlock case: Shows details of interlock and recovery method for beamline shifter

Development of the beamline expert system (Contd.)

EPICS Records

- Current status

- We investigated the past interlock pattern and important interlock pattern was picked up.
- We developed a CA client for the data input part.
- Now we are evaluating a inference part using the past interlock pattern.

Beamline Shifter

Summary

- EPICS environment at J-PARC neutrino facility was introduced. EPICS framework is essential for high intensity beam operation at neutrino facility.
- In neutrino facility a typical configuration for the control system is combination of PLC and EPICS. As actual examples, the magnet PS control and interlock systems were introduced.
- We are developing a beamline expert system for the safety and stable beam operation.

***We are grateful for EPICS community,
especially MR control group of J-PARC***

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