EPICS-based control of FFAG

Yasutoshi KURIYAMA (RRI, Kyoto Univ.)

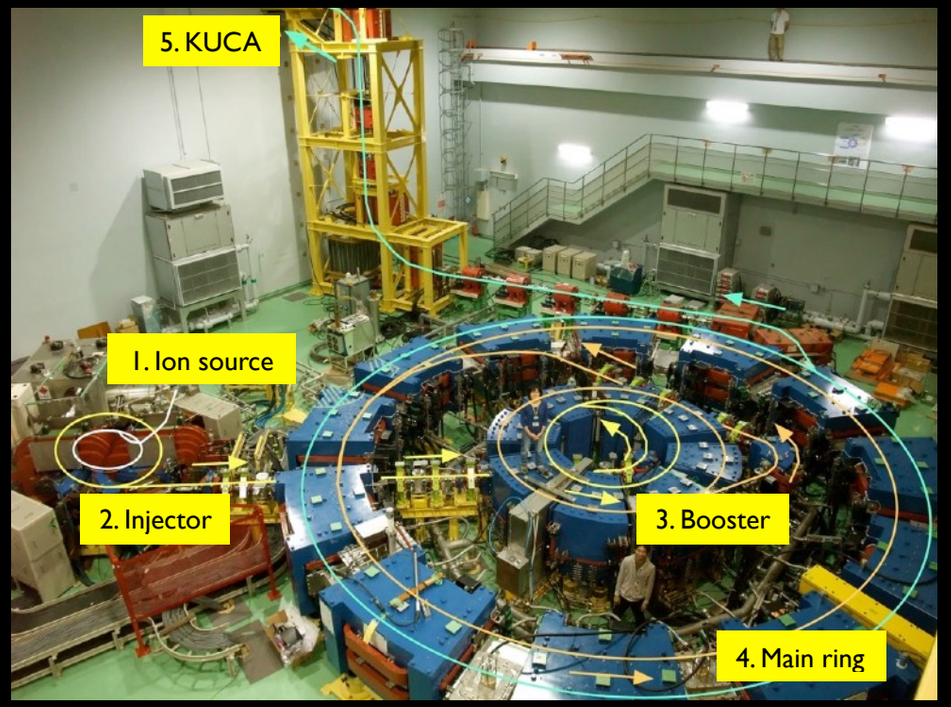
京都大学 原子炉実験所
Kyoto University Research Reactor Institute

Contents

- FFAG Construction History
- Control of FFAG Accelerator Complex
  - PLC + LabVIEW based Control
  - Timing System
- PLC + EPICS based Control
- Next Plan

FFAG Construction

FY2002	KART (ADS) Project started
FY2004	Building Construction was finished
FY2005	Construction of Accelerator complex started
FY2008	Authorized as a radiation generating device
FY2009	First ADS Experiment （100MeV - 2pA@Neutron Production target)
FY2011	Injector to the MR was changed to Linac
FY2012	Energy upgraded 100 MeV to 150 MeV Beam current upgraded to 10 nA with 20 Hz Rep. Irradiation experiment was started
FY2015	Beam cannot provide from October 2015 to now now because of RFQ Trouble



京都大学 原子炉実験所
Kyoto University Research Reactor Institute

Accelerator Group

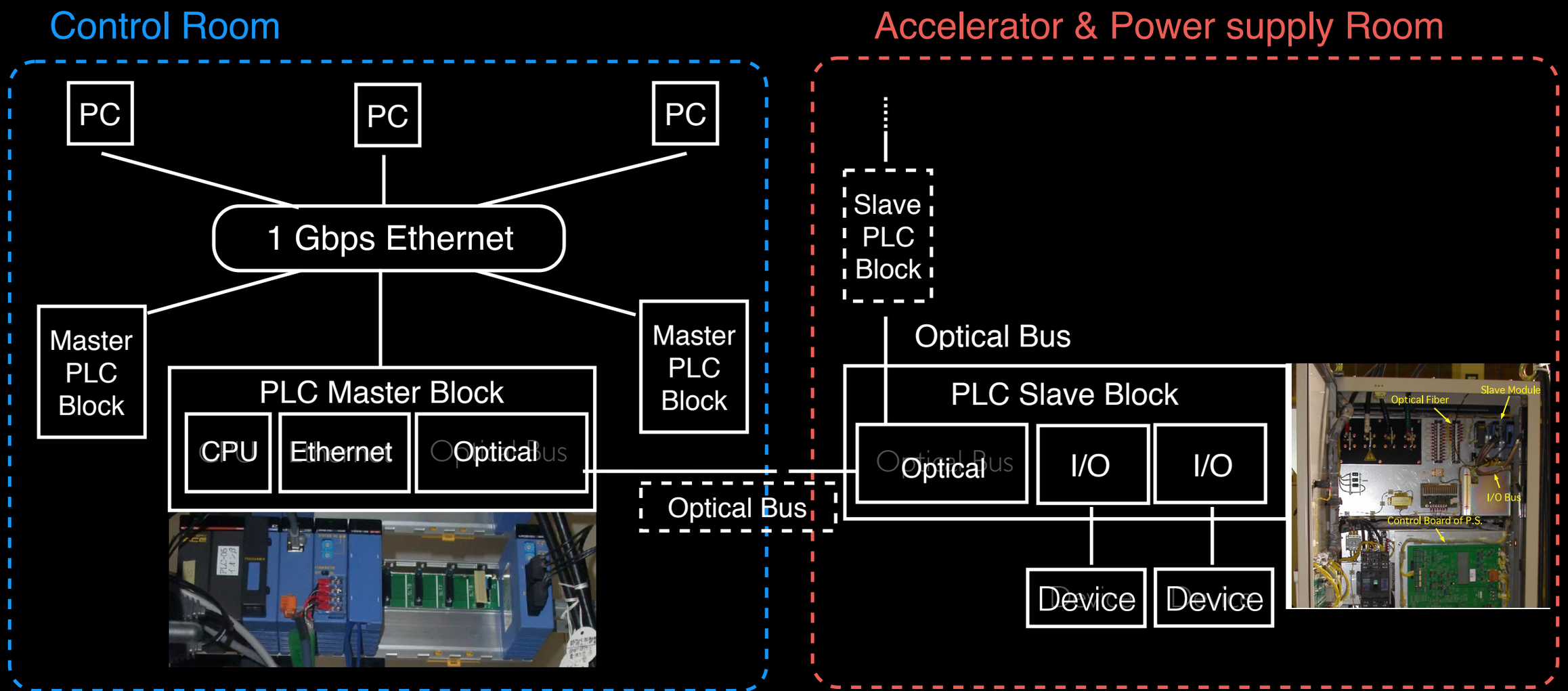
- The number of research staff is five …

  No one is control system expert!!

学 原子炉実験所
ty Research Reactor Institute

Control system

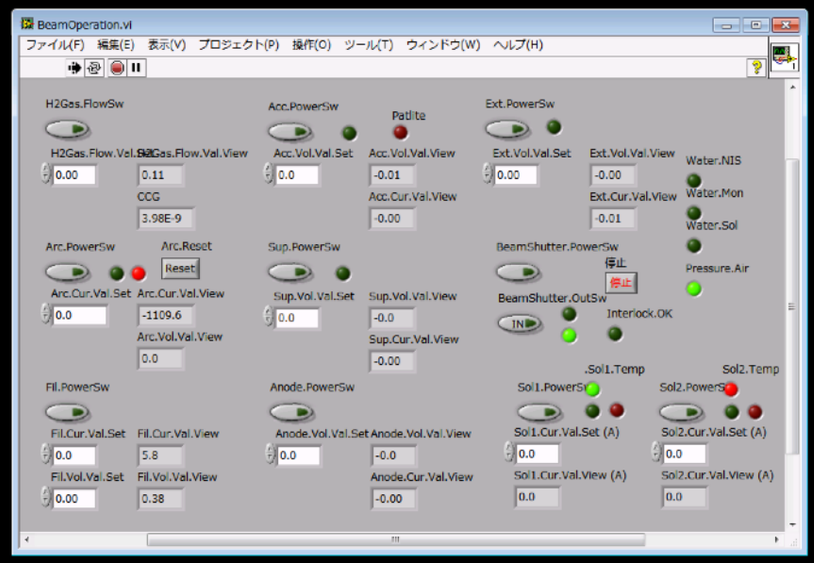
Network PLC based Control System



NIMA “Control system for the FFAG complex at KURRI”, M.Tanigaki, et al.

LabVIEW based Control

- Development of OPIs
  had been started with
  LabVIEW + Windows XP
- Easy to start for the beginner
- Suitable for small group
  - There is no expert in the
    accelerator group



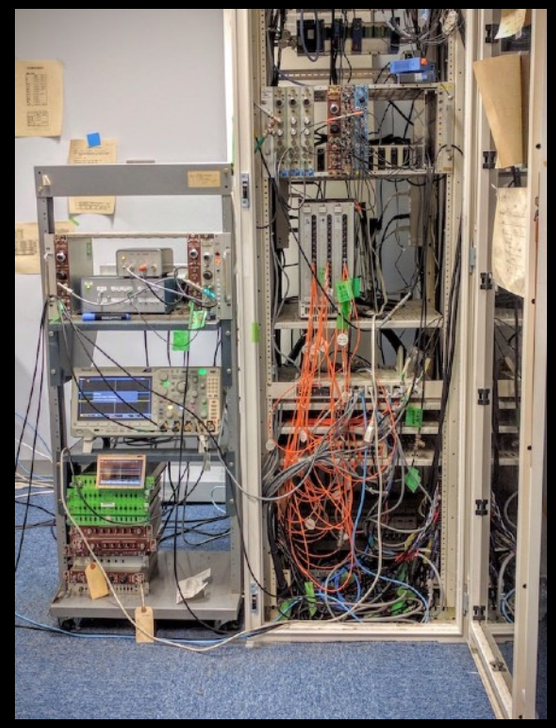
京都大学 原子炉実験所
Kyoto University Research Reactor Institute

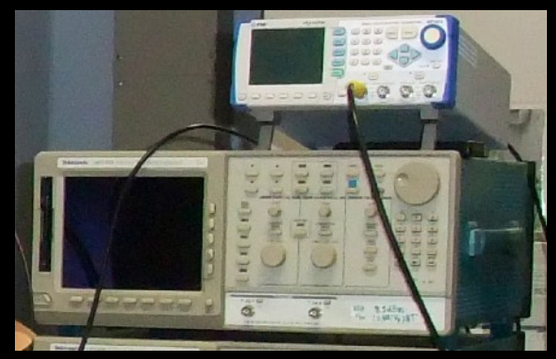
Timing Control

- Variable Repetition (1 to 120 Hz)
- Control objects
  - Trigger for @ NIS
    - Trigger for Beam Chopper @ LEBT
      - Trigger for RF @ LINAC (RFQ,DTL1,DTL2)
- LLRF for Cavity @ MR
- Trigger for two Extraction Kicker @ MR
- Trigger for Extraction Septum @ MR

Timing Control

- Trigger :
  - NF (waveform generator) + NIM module
- LLRF :
  - Tektronix AWG series





LabVIEW to EPICS

- In 2009, thanks to KEK/J-PARC Control Group (especially Yamamoto-san & Kamikubota-san) control system for the new beam line from MR to the reactor had been constructed with EPICS
- Motivation :
  - Reduce the cost of License fee (Windows, LabVIEW)
  - Avoid Windows Security Issue (I don't WannaCry)
  - Get Stability

LabVIEW to EPICS

LabVIEW based

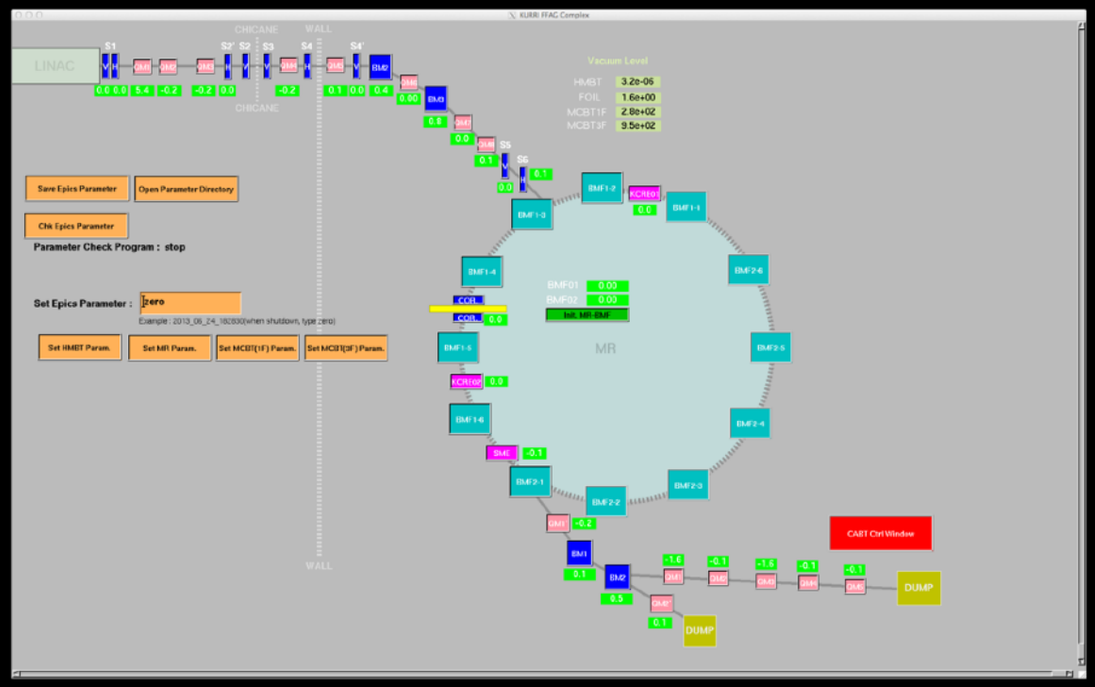
- PLC w/ Ladder
- IOC(?) : PLC only
- Device ⇔ Single operator

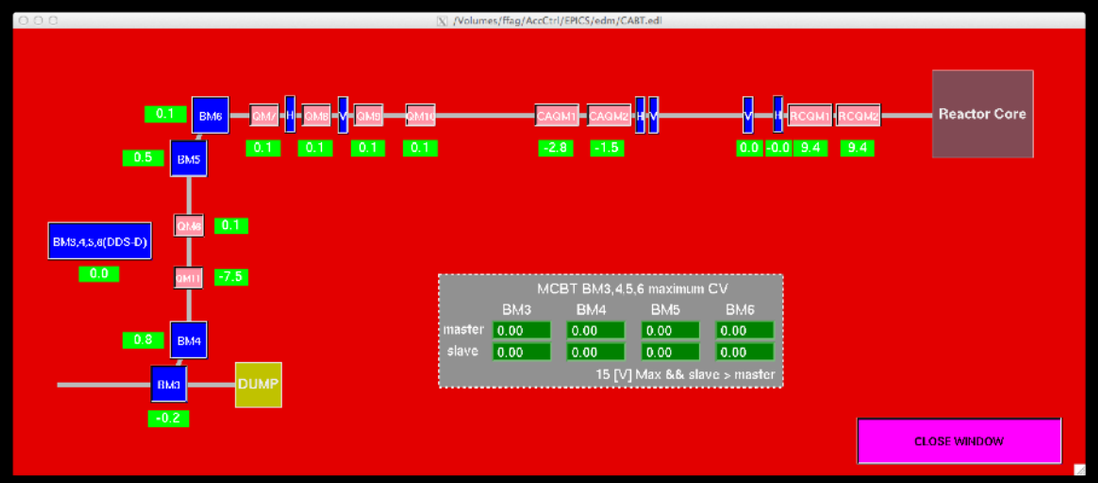
EPICS based

- PLC w/o Ladder
- IOC : PLC + PC (NetDeV)
- Device ⇔ Multi operator

EPICS based Control

- Development of OPIs using EDM/MEDM
- Communicate with PLC : netDev developed by Odagiri (KEK)

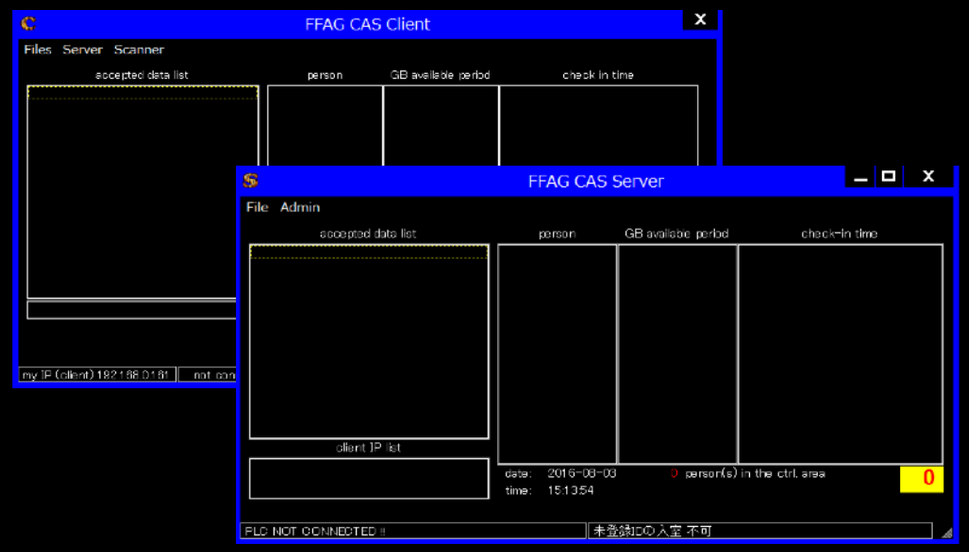




京都大学 原子炉実験所
Kyoto University Research Reactor Institute

Access Control to the Accelerator Room

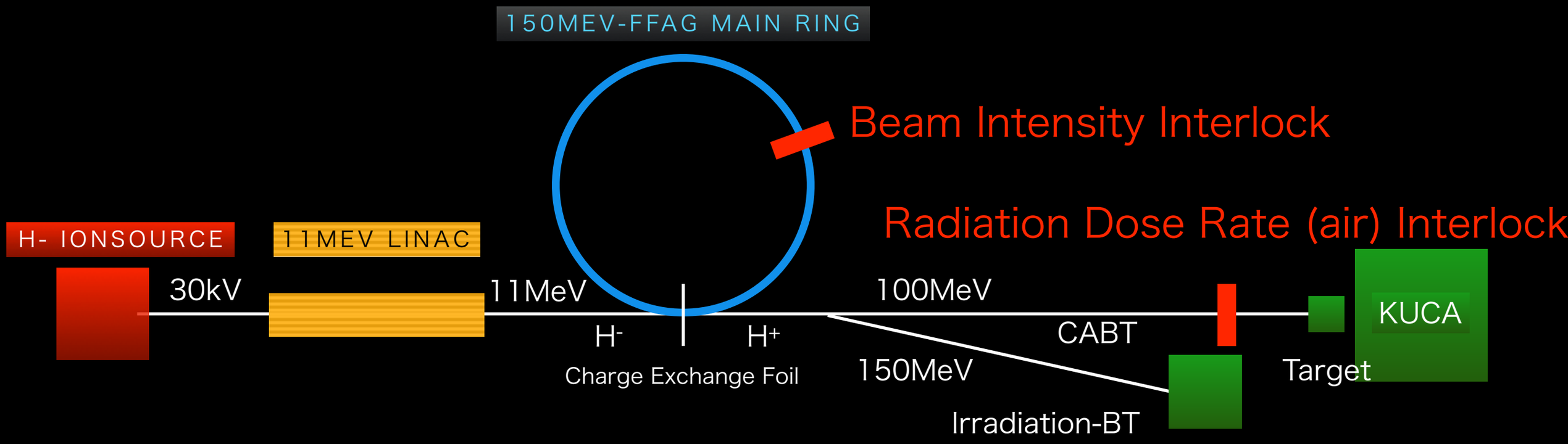
- In 2016, Update to Raspberry Pi from Windows + VB6 based system
  - **Used for Beam Interlock**
- Raspberry pi + PLC (with Ladder)
  - QR code reader : usb-cam
  - Software : ZBar + Python

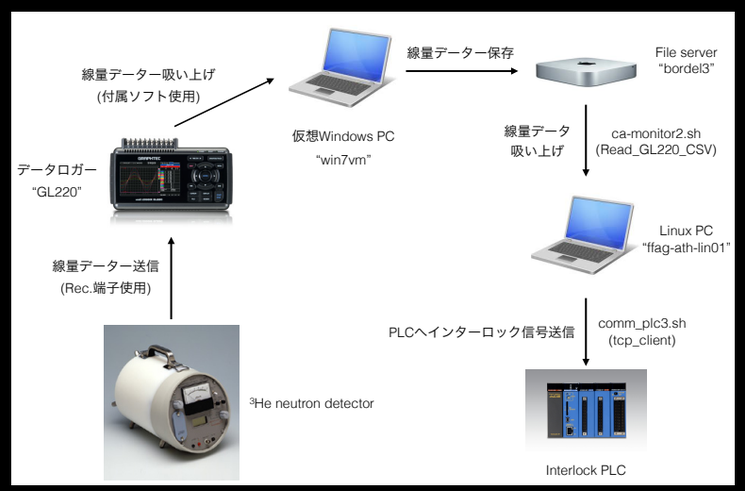


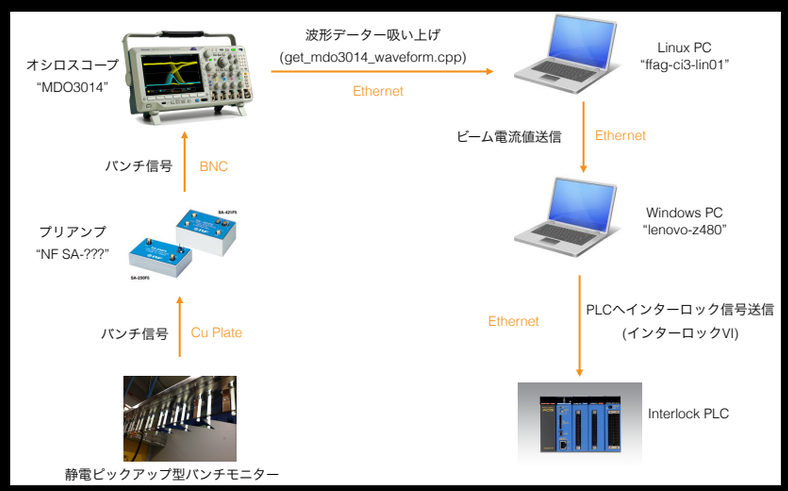
Developed by Yuya HORITA

京都大学 原子炉実験所
Kyoto University Research Reactor Institute

Beam Interlock







Comunicate
w/ intelock-PLC
(EPICS IOC)

京都大学 原子炉実験所
Kyoto University Research Reactor Institute

Next Task

- Integration of GPIB control program to EPICS
  - GPIB Control used for
    - Old Power Supply (too much old but too expensive to replace)
    - Stepping Motor Control
      - Tektronix AWG430 (LLRF@MR)
- Build parameter archiving system (CSS Archiver?)
  - Shell script is used for saving parameter value
- Integration of beam monitors to EPICS
  - Beam monitors are operating independently of control system