

# APPLICATION OF EPICS SOFTWARE IN LINEAR ACCELERATOR

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## • Abstract

The institute of modern physics (IMP) has two sets of linear accelerator facilities, they are CAFe (China ADS front-end demo linac) and LEAF (Low Energy Accelerator Facility).

In the process of commissioning and running linac equipment, The EPICS Archiver application and Alarm system are used. According to the refined control requirements of the facility sites, we have completed the software upgrade and deployment of the archiver and alarm systems.

- Over all structure of the software system

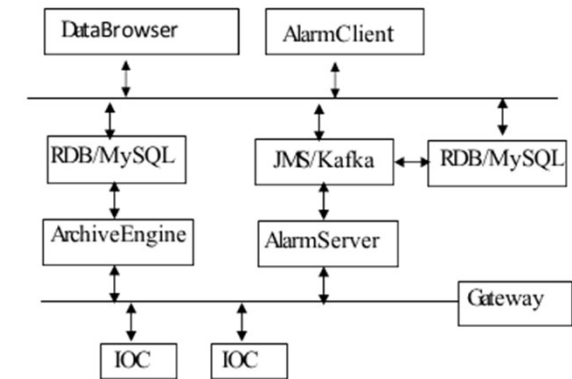


Figure 1: The structure diagram of application software

## • CAFe facility

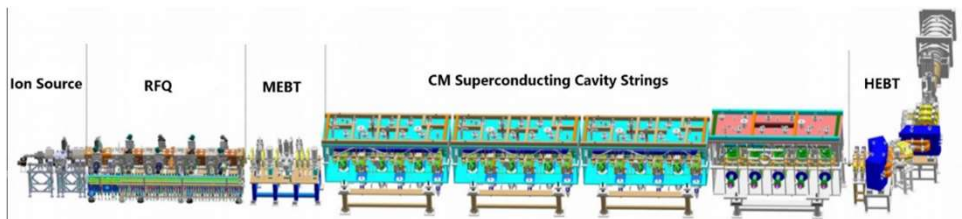


Figure 2: The layout of the CAFe facility

## • LEAF facility

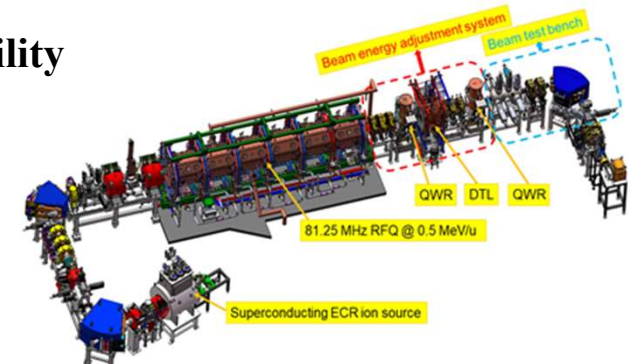


Figure 3: The layout of the LEAF facility

## FACILITY INTRODUCTION

The Main equipment of LEAF facility consists of ion source, LEBT (Low Energy Beam Transport), RFQ (Radio Frequency Quadrupole) and some experiment terminals. Compare with LEAF, CAFE equipment has more and adds MEBT (Medium Energy Beam Transport) and four sets of superconducting cavity strings at the back end of RFQ.

The CAFE facility can provide a high power beam with the beam intensity of several mA. At the same time, CAFE, as a new research device, needs to do some research on the operation mode of the machine.

LEAF can provide pulse (beam energy range of 0.1-20 MeV) and continuous beam with high beam intensity, high charge state and many kinds of ions. The core parts of the LEAF are superconducting high charge ECR ion source and RFQ accelerator. They are the most key equipment of the front-end injector for the next generation large heavy ion accelerator. Therefore, the development of the LEAF will build a good foundation for the development of the next generation high-power high current heavy ion accelerator.

## • ALARM SYSTEM

When the operating status of the field equipment changes, especially when a fault occurs, the Alarm system will issue alarm information to the accelerator commissioning, operation and maintenance personnel or equipment maintenance personnel through software user interface, voice, SMS(text messages) or other methods.

In the construction of the Alarm system of the CAFE facility, we adopt the Phoebus-based CSS software system for interface development and deployment. The Phoebus software architecture is simpler, and the development environment is easy to set up, all of which help greatly improve the user experience.

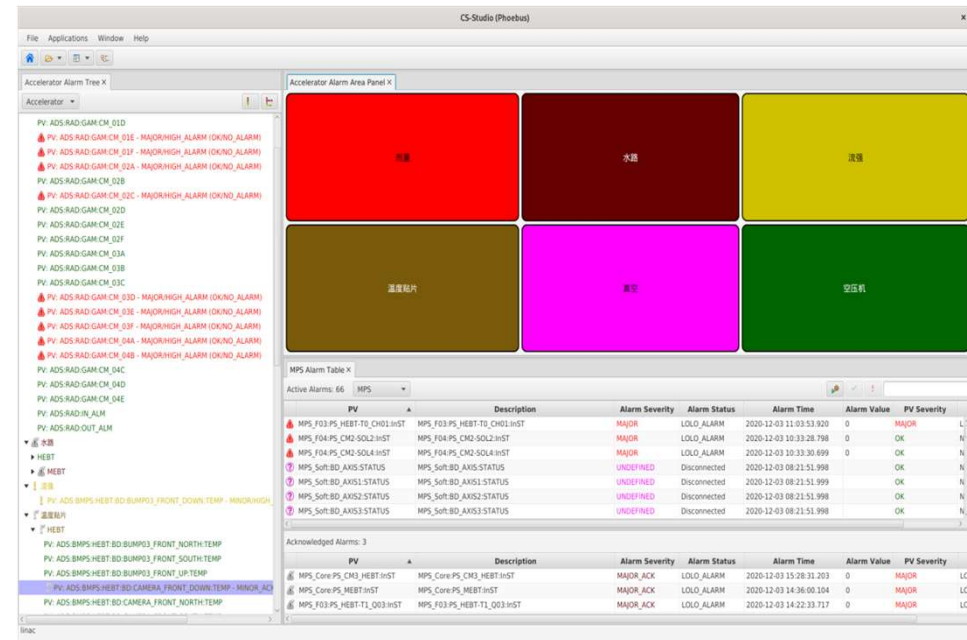


Figure 4: Operation interface of the Alarm system

The data source monitored by the Alarm system can come from the device IOC or the PV variables published by the soft IOC. For example, the Alarm system of CAFE can monitor the change of the PV values published by using the pccspy software package to realize the alarm of the soft protection logic value in the MPS system.

- DATA ARCHIVER SYSTEM**

As the scale of data in the archive database becomes larger and larger, the speed of reading and retrieving the data stored in the MySQL database becomes slower and slower. At the same time, the BEAUTY-based archive system does not provide a friendly interfaces of information query and management. Therefore, we upgraded the archive system of these two facilities (LEAF and CAFE) with Archiver Appliance.

### Archive Engine

**Summary**

<b>Version</b>	3.3.0.20140627
<b>Description</b>	Demo
<b>HTTP Server</b>	localhost.localdomain:4812
<b>State</b>	RUNNING
<b>Start Time</b>	2018/12/12 10:54:36.803026825
<b>Uptime</b>	23.07 h
<b>Workspace</b>	/home/newroot/archiverEngine400/workspace/
<b>Groups</b>	10
<b>Channels</b>	1196
<b>Disconnected</b>	730
<b>Batch Size</b>	500 samples
<b>Write Period</b>	30 sec
<b>Write State</b>	OK
<b>Last Written</b>	2018/12/13 09:58:39.829461492
<b>Write Count</b>	7132 samples
<b>Write Duration</b>	1.2 sec
<b>Idle Time</b>	19.6 %
<b>Memory</b>	81.0 MB of 228.0 MB used (35.5 %)

### LEAF Archiver Appliance

Low Energy Accelerator Facility

Home Reports Metrics Storage Appliances Integration Help

This is the archiver appliance management console for the LEAF archiver. Please contact YuTing Liu for any questions regarding these archiver appliances. For support, please contact Masahiko Shantar at 650 xxx xxx or Bob Hill at 650 xxx xxx.

To check the status of or to archive some PVs, please type in some PV names here.

RFQ:LLRF\*

[Check Status] [Archive] [Archive (specify sampling period)] [Logout] [Pause] [Resume]

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PV Name	Status	Appliance	Connected?	Monitored?	Sampling period	Last event	Details	Quick chart
RFQ.LLRF.AChannel_Gain	Being archived	appliance0	true	true	1.0	11/14/2019 09:23:19 +08:00		
RFQ.LLRF.AChannel_PhaseSta	Being archived	appliance0	true	true	1.0	11/14/2019 09:23:19 +08:00		
RFQ.LLRF.BChannel_Gain	Being archived	appliance0	true	true	1.0	11/14/2019 09:23:19 +08:00		
RFQ.LLRF.BChannel_PhaseSta	Being archived	appliance0	true	true	1.0	11/14/2019 09:23:19 +08:00		
RFQ.LLRF.Cavity_Amp	Being archived	appliance0	true	true	1.0	11/14/2019 09:23:19 +08:00		
RFQ.LLRF.Cavity_Phase	Being archived	appliance0	true	true	1.0	11/14/2019 09:23:19 +08:00		
RFQ.LLRF.Frequency	Being archived	appliance0	true	true	1.0	11/14/2019 09:23:19 +08:00		
RFQ.LLRF.Intelock1	Being archived	appliance0	true	true	1.0	11/14/2019 09:23:19 +08:00		
RFQ.LLRF.Intelock2	Being archived	appliance0	true	true	1.0	11/14/2019 09:23:19 +08:00		
RFQ.LLRF.Intelock3	Being archived	appliance0	true	true	1.0	11/14/2019 09:23:19 +08:00		
RFQ.LLRF.Intelock4	Being archived	appliance0	true	true	1.0	11/14/2019 09:23:19 +08:00		
RFQ.LLRF.Openloop_AmpDns	Being archived	appliance0	true	true	1.0	11/14/2019 09:23:19 +08:00		
RFQ.LLRF.Pl_Amp	Being archived	appliance0	true	true	1.0	11/14/2019 09:23:19 +08:00		

**Figure 4 : The operation interface of Archiver Appliance.**

The data archiving system based on the Archiver Appliance solves the problems of low data index efficiency and inconvenient background management in the past. At the same time, the upper human-computer interaction interface is designed by using CSS software system based on Phoebus, which provides convenience for physical personnel to access experimental data and fault diagnosis and analysis.

## CONCLUSION

After the upgrade and redeployment of the above application software, the usability of the data service in the control systems of the two facilities is improved, and better user-friendly interfaces are provided for data query and operations. The upgraded software systems run more stable, and the user interfaces are more friendly, which improves the maintainability of the accelerator device for long-term operation.

### ***1. Alarm System***

Compared with the alarm system of ActiveMQ message mechanism, the accelerator alarm system based on Kafka streaming data platform can effectively improve the data throughput of the system and the real-time performance of alarm information release.

### ***2. Archiver System***

The archive system software of Channel Archiver was released earlier, and its client software is relatively rich. The new Archiver Appliance software uses a multi-level storage method, which can retrieve 1 Hz double-precision data for one day within 0.5 seconds. It also provides a Web front-end management interface, which has more advantages in system information management and fast data retrieval.