Overview of software developments at J-PARC

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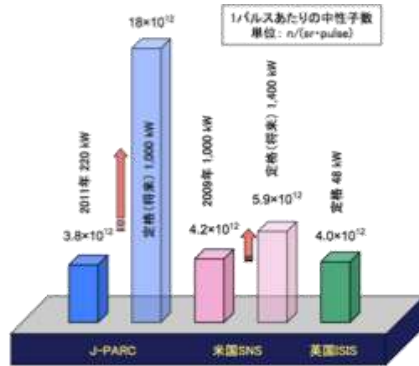on behalf of MLF computing group

Neutron facility of MLF

Brightest neutron beam (neutron/pulse)

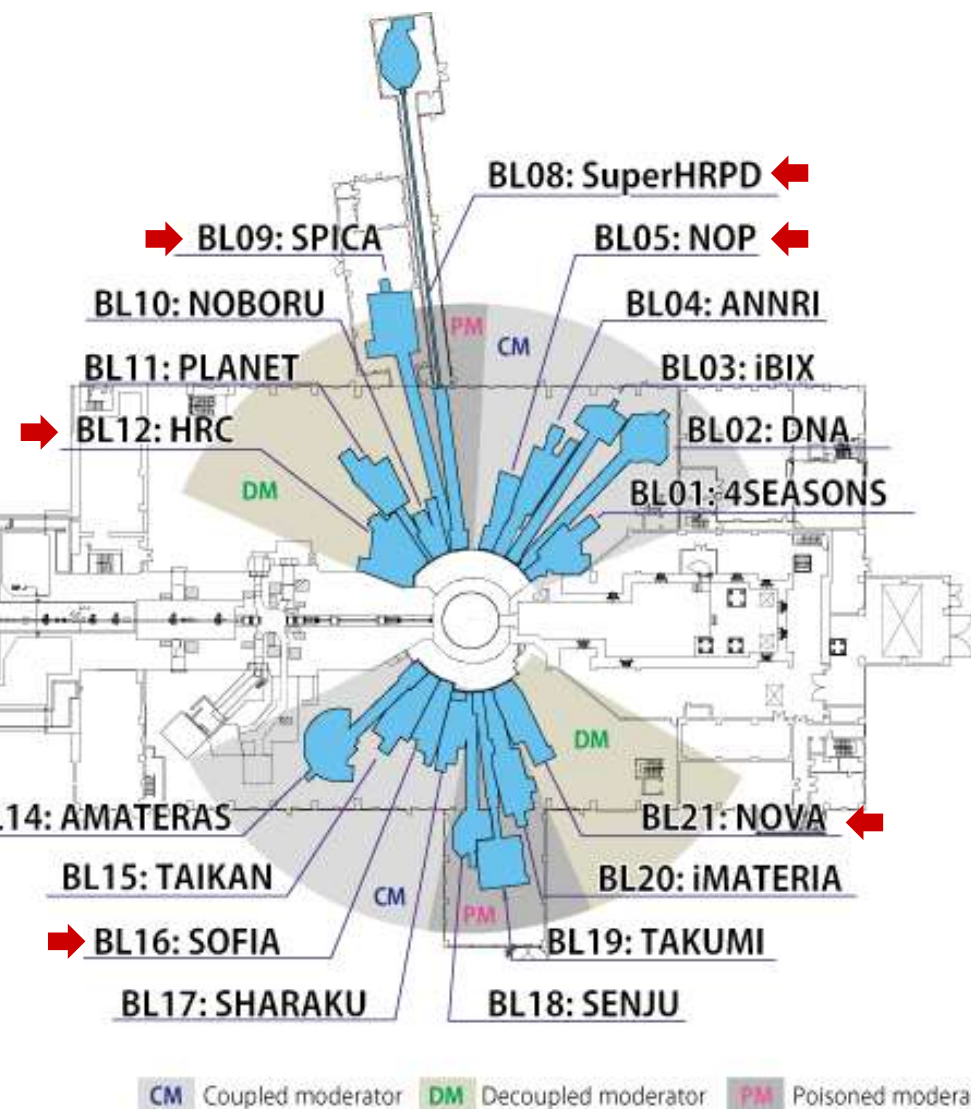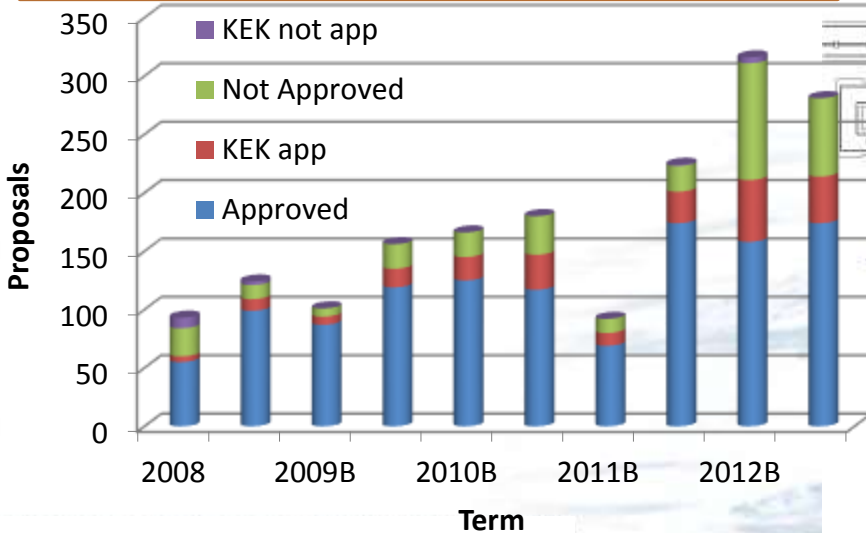## 18 instruments are opened for users

J-PARC 65×10^{12} (at 300 kW)
SNS 53×10^{12}
ISIS 49×10^{12}
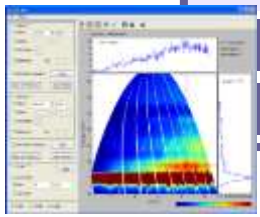

No. of proposals increasing

- KEK not app
- Not Approved
- KEK app
- Approved

Proposals

350
300
250
200
150
100
50
0

2008   2009B   2010B   2011B   2012B

Term

BL08: SuperHRPD
BL09: SPICA
BL05: NOP
BL10: NOBORU
BL04: ANNRI
BL11: PLANET
BL03: iBIX
BL12: HRC
BL02: DNA
BL01: 4SEASONS
BL14: AMATERAS
BL21: NOVA
BL15: TAIKAN
BL20: iMATERIA
BL16: SOFIA
BL19: TAKUMI
BL17: SHARAKU
BL18: SENJU

CM Coupled moderator   DM Decoupled moderator   PM Poisoned moderator

MLF software components

Home Laboratory

Visualization

Common Interface

2D 3D

>3D

Experimental control

Common Library

Device control

DAQ-Middleware

Device controllers

DAQ electronics

Remote Access

Software Framework "IROHA"

Python

Working Desktop

Integrated User Interface

DAQ script

Analysis script

XML/HTTP

PS-17

Analysis "Manyo-Lib

Common Library

Instruments specific Lib.

Powder Diff. Single Xtal
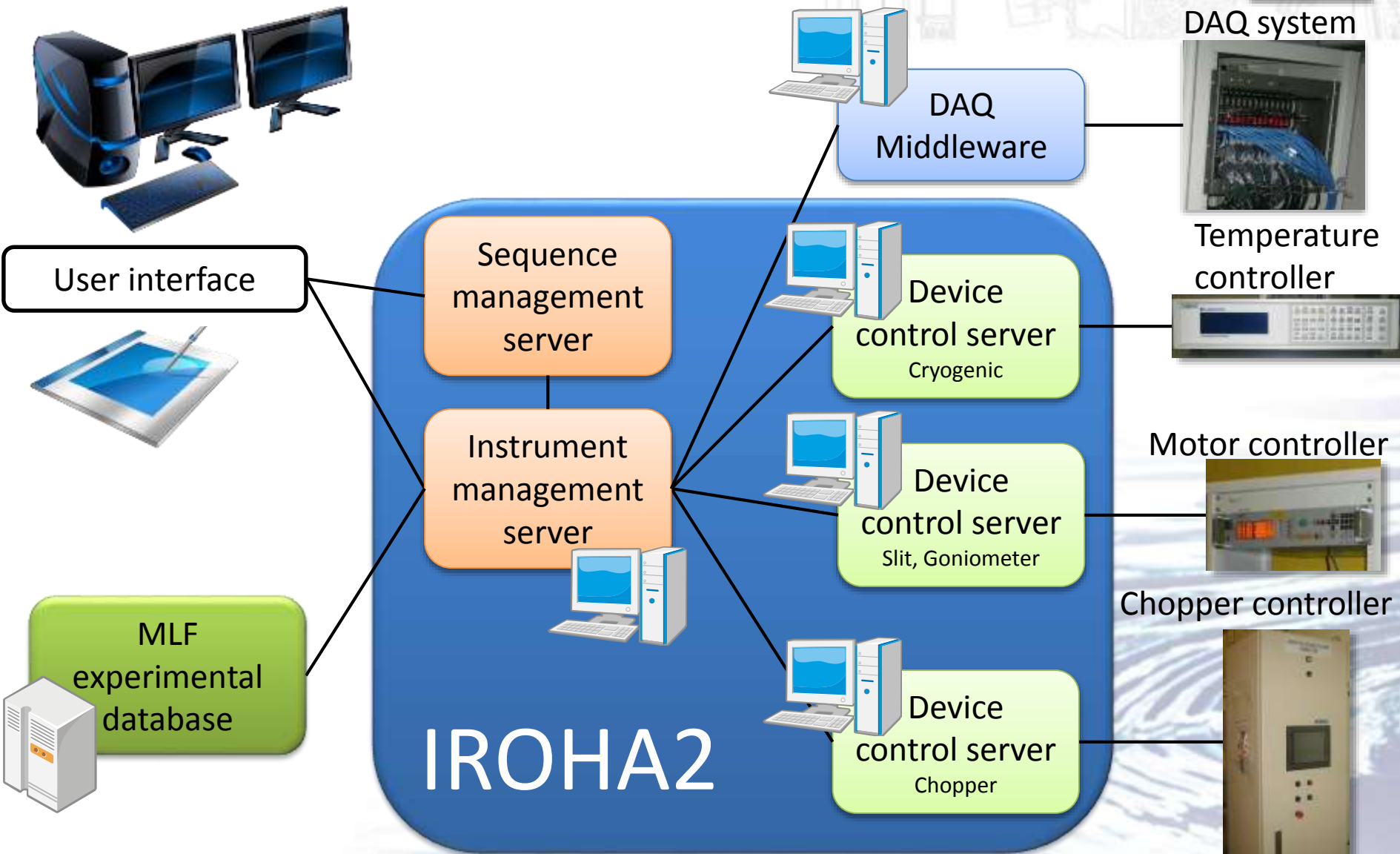
Chopper

Res. Stress etc.

Storage

API Library
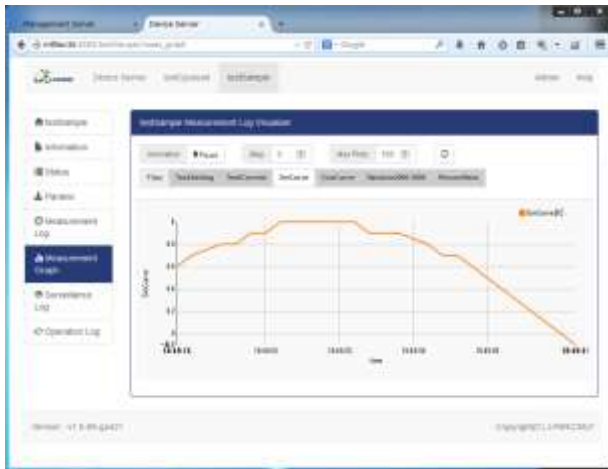
Raw data

NeXus File

XML File

Network Storage
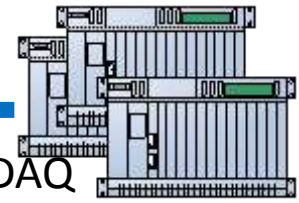
Data base

Common Interface

Device monitoring

DAQ log

Analysis log

Simulation

Common Interface

Simulator

ab initio

User Interface : IROHA2

PS-08

DAQ system

DAQ Middleware

Temperature controller

User interface

Sequence management server

Device control server
Cryogenic

Instrument management server

Motor controller

Device control server
Slit, Goniometer

Chopper controller

MLF experimental database

IROHA2

Device control server
Chopper

Web user interface of IROHA2
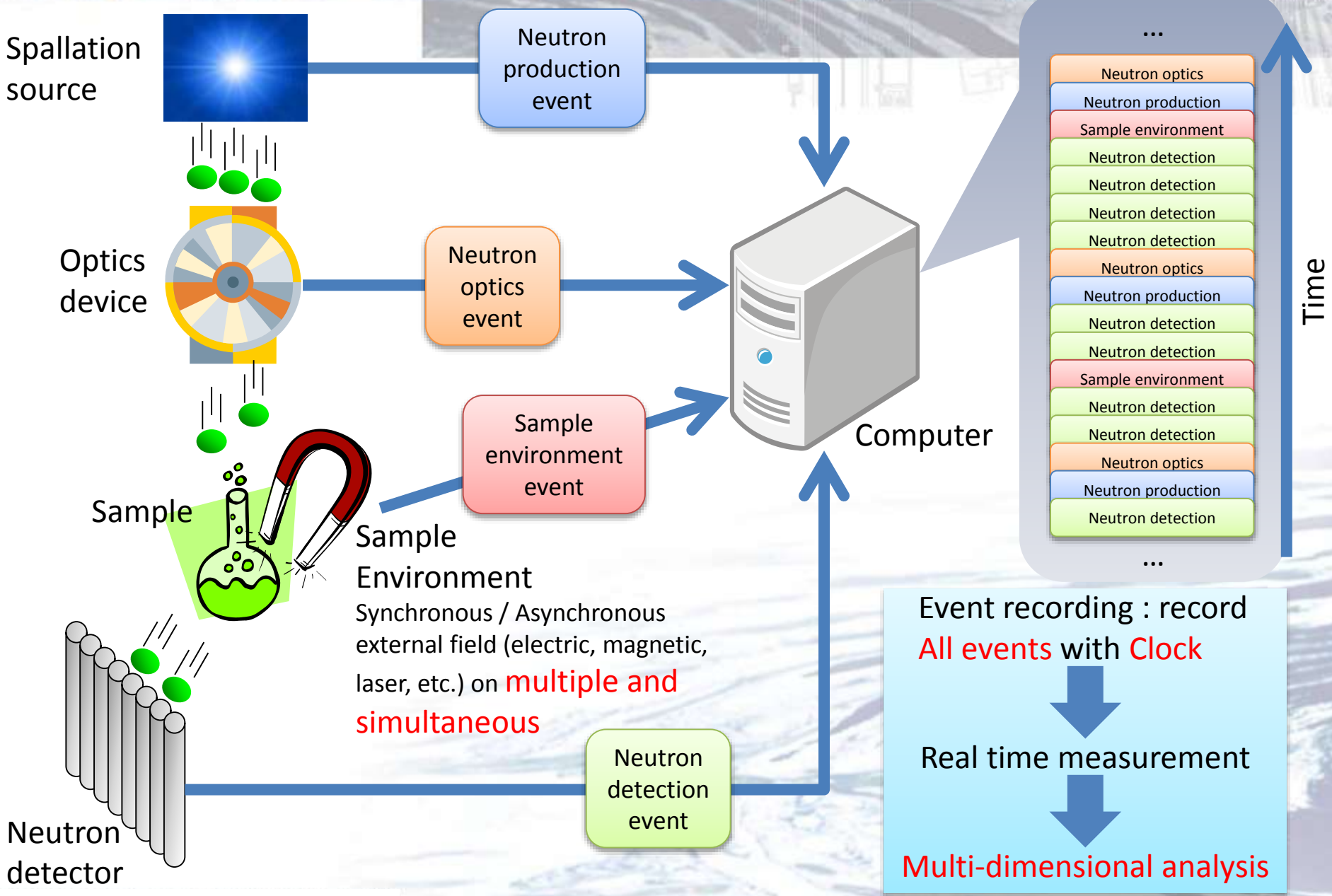
Device control server

Instrument management server

◆ Platform-independent user interface
→Browser-based, Responsive web design

◆ Operation, monitoring, logging of devices and measurement

◆ Trend graph of device status

Event Recording method

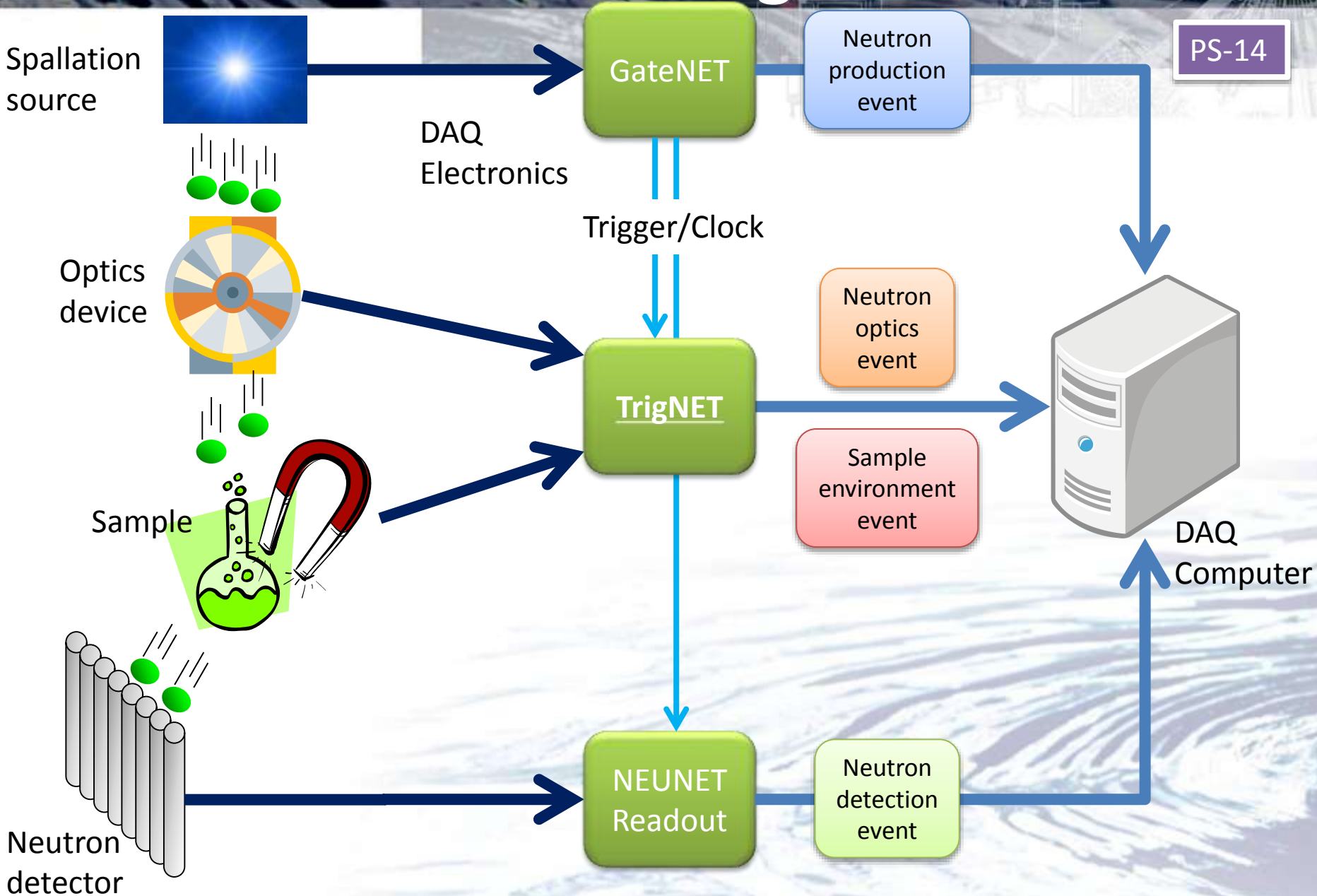Spallation source

Optics device

Sample

Sample Environment
Synchronous / Asynchronous external field (electric, magnetic, laser, etc.) on multiple and simultaneous

Neutron detector

Neutron production event

Neutron optics event

Sample environment event

Neutron detection event

Computer

Time

...
Neutron optics
Neutron production
Sample environment
Neutron detection
Neutron detection
Neutron detection
Neutron detection
Neutron optics
Neutron production
Neutron detection
Neutron detection
Sample environment
Neutron detection
Neutron detection
Neutron optics
Neutron production
Neutron detection
...

Event recording : record
All events with Clock

Real time measurement

Multi-dimensional analysis
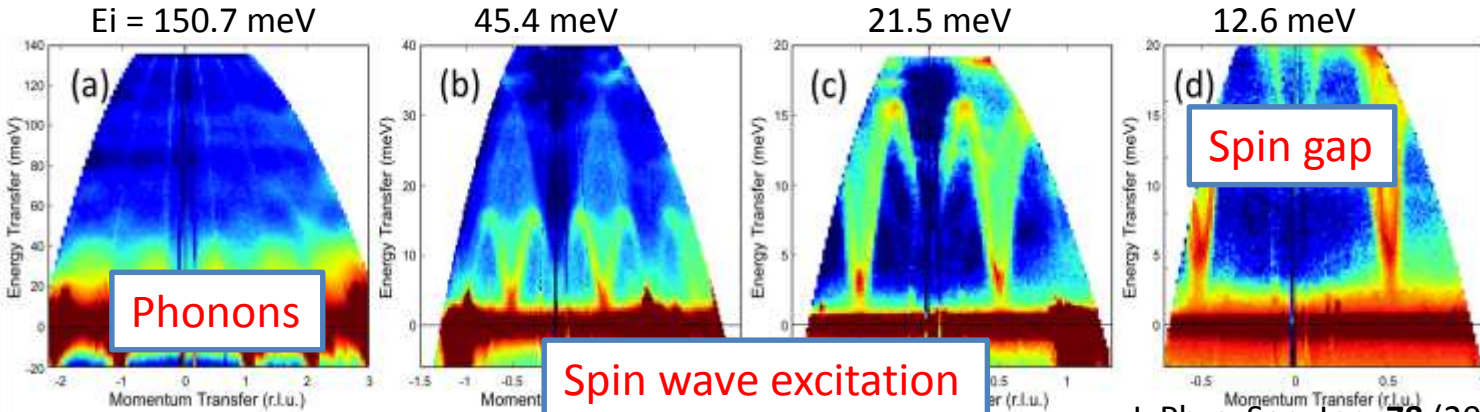
Event Recording method

Multi-Ei methods @ Neutron Inelastic Scattering

Several scan area in momentum(Q)-energy(ω) space from one measurement
Different physics phenomea in a sample can be obtained at a same time

Ei = 150.7 meV   45.4 meV   21.5 meV   12.6 meV
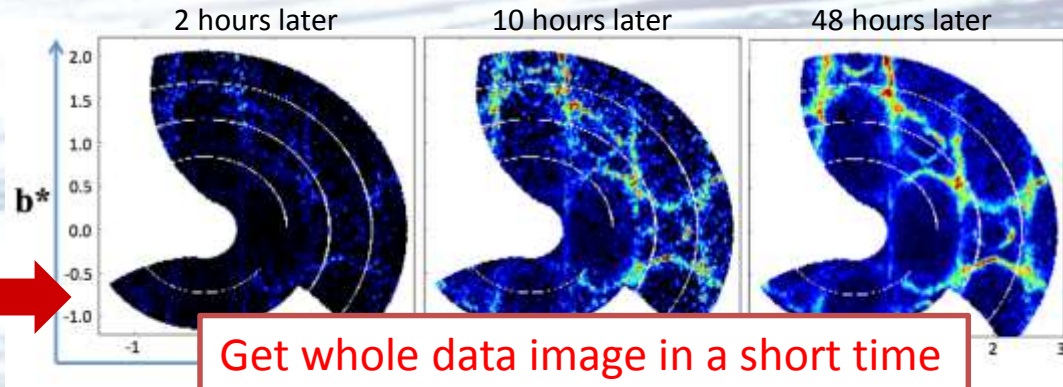
Spin gap

Phonons

Spin wave excitation

J. Phys. Soc. Jpn. **78** (2009) 093002

New method for measurents of multi-dimensional data

Previous Method   To cover wider scan area in Q-ω space, this requires several tens of Step-by-Step measurements with different sample orientation and merge them.
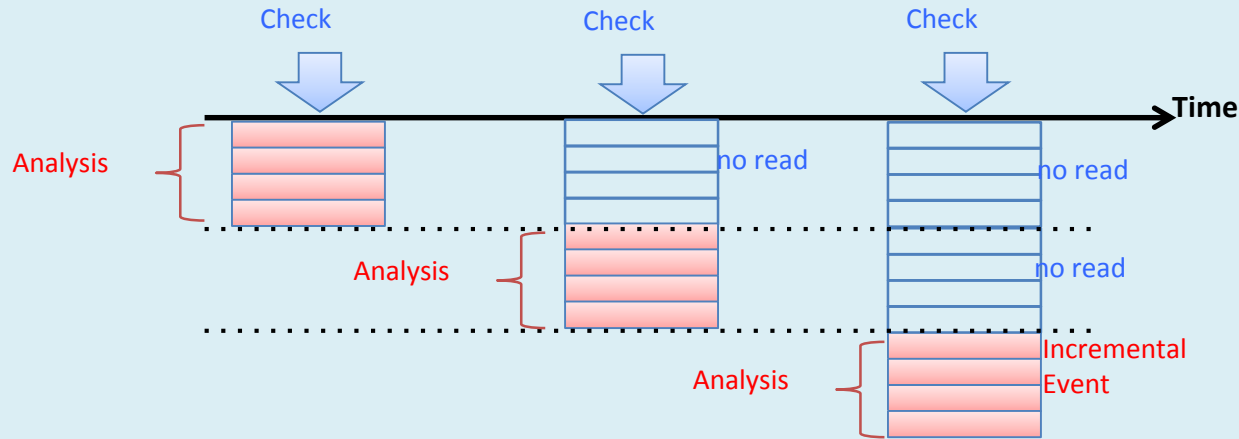

2 hours later   10 hours later   48 hours later

revealed data partially with scans
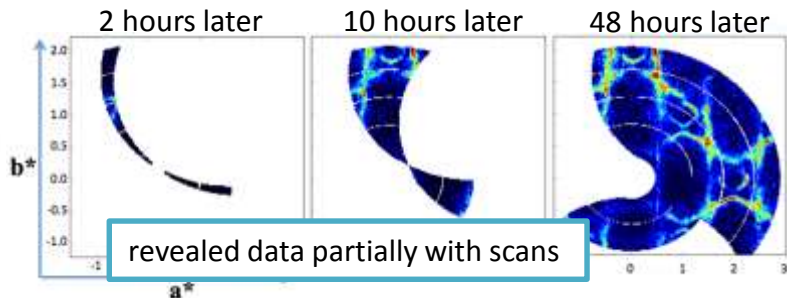
Using event data of sample orientation changing continuously

2 hours later   10 hours later   48 hours later

Get whole data image in a short time
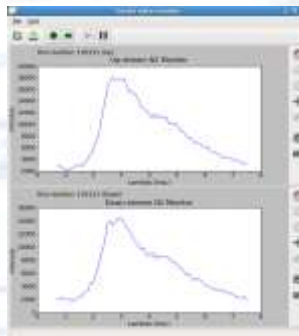
Incremental analysis of events
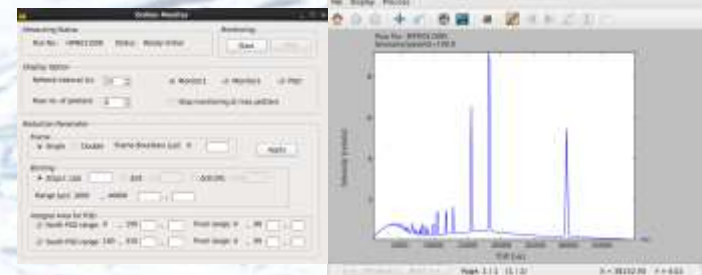

__Advantage__

1. Enable to change analysis parameters during monitoring.
2. Using Manyo Library :
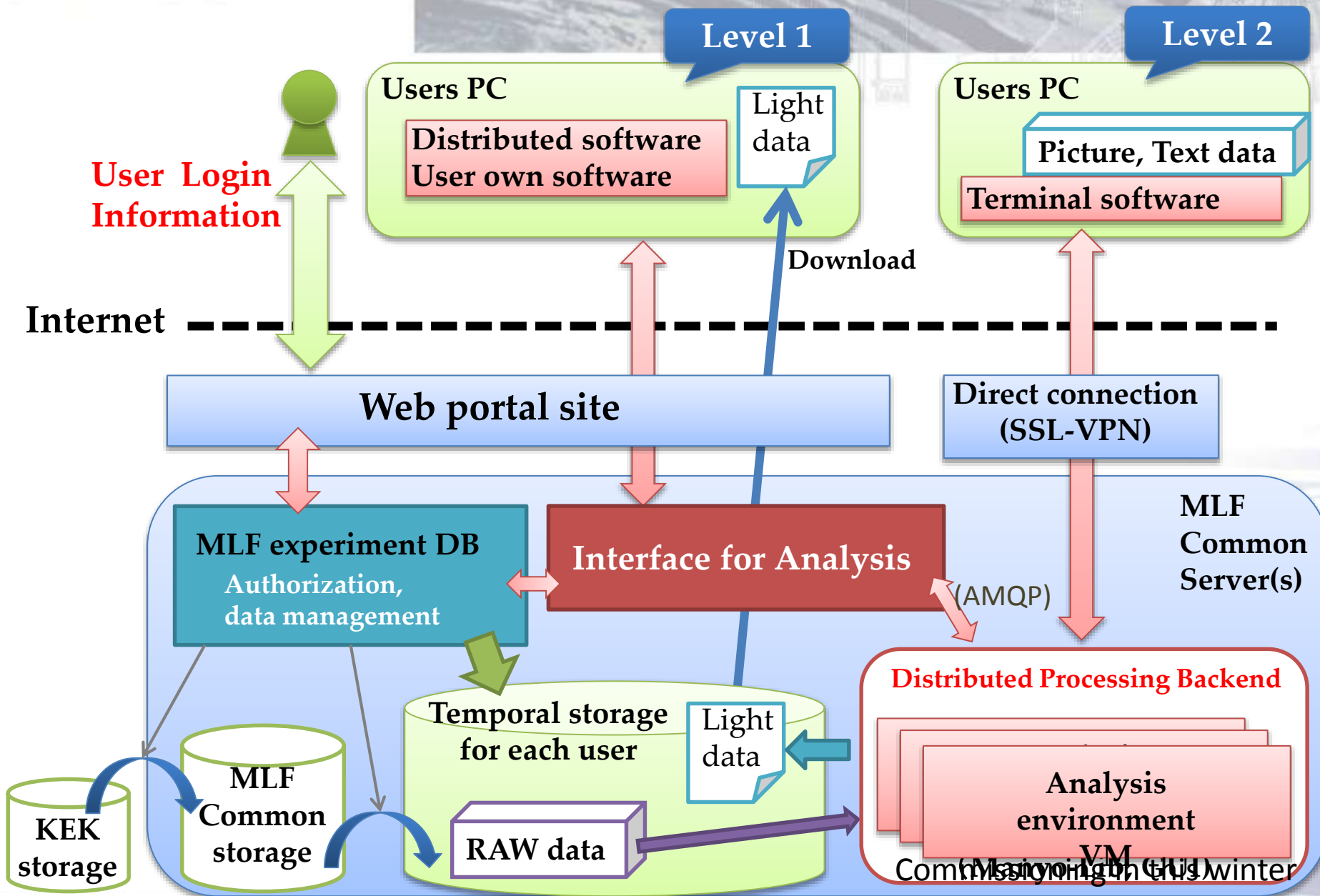   enable to do same analysis as off-line

__Applications__

Monitoring of the beam
current detector
(BL17, BL15)

Monitoring Data for all detectors(BL11)

Remote access for analysis

Level 1

Level 2

User Login Information

Users PC

Distributed software
User own software

Light data

Users PC

Picture, Text data

Terminal software

Download

Internet ──────────────

Web portal site

Direct connection (SSL-VPN)

MLF Common Server(s)

MLF experiment DB
Authorization, data management

Interface for Analysis

(AMQP)

Distributed Processing Backend

Temporal storage for each user

Light data

Analysis environment VM

KEK storage

MLF Common storage

RAW data

Commissioning in this winter

Experimental database

■DB Link

User Application

User Support System

Web application interface for user.
User, Research Proposal, Sample, etc.

Users Office

BIZ-DB

Business data management. User, Proposal, Sample

Sample-DB

Safety review
Stock management

Account-DB
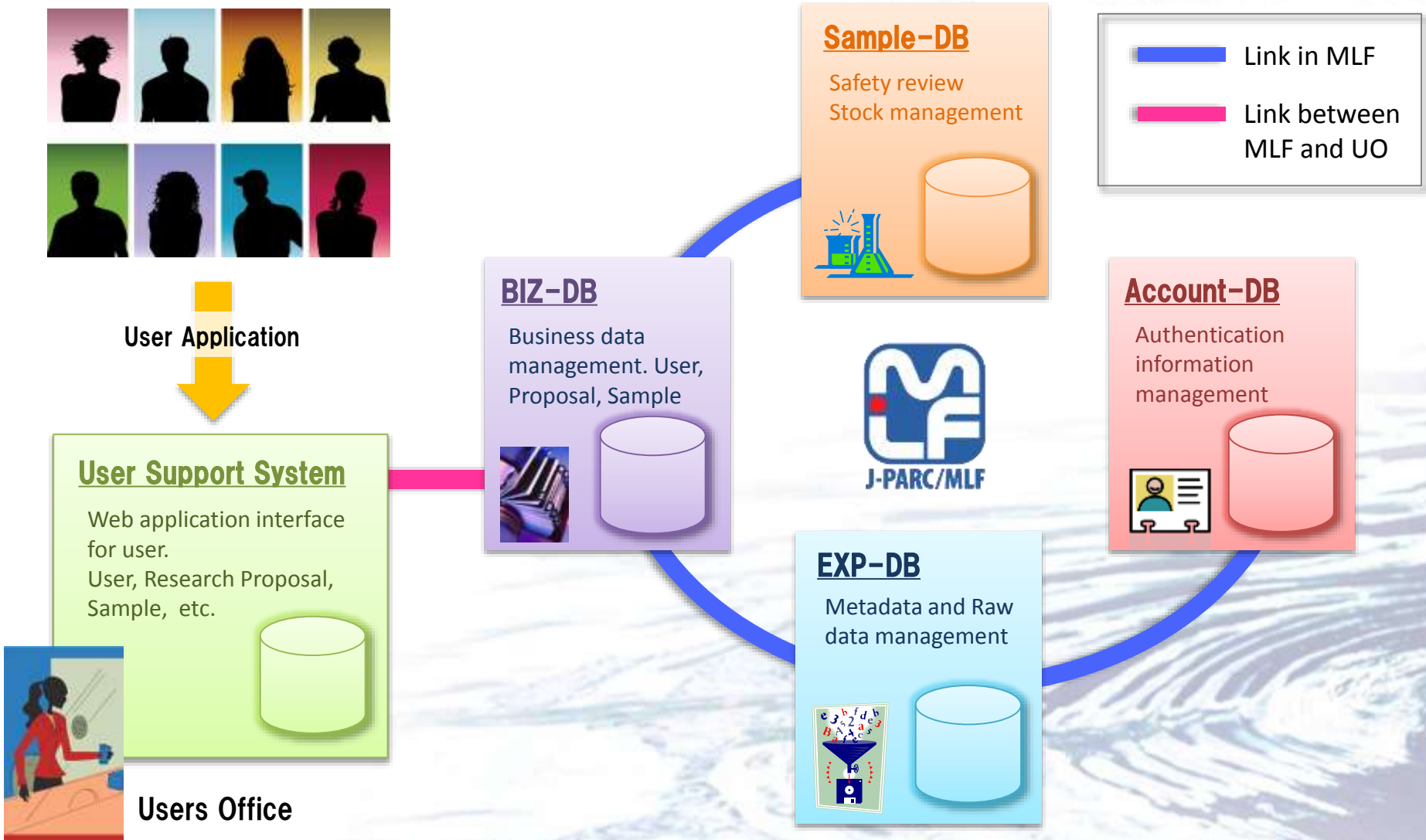
Authentication information management

EXP-DB

Metadata and Raw data management

J-PARC/MLF

	Link in MLF
	Link between MLF and UO

Experimental database

■UI

PS-03

- Web-based interface
- Browsing metadata catalogue and searching experimental data
- Downloading raw data and log files

Positions of MLF software

◆ Hardware dependent software have been developed by MLF for future developments of hardware

Hardware dependent

Dedicated to MLF environments
Depend of instrument's design

Hardware independent

Site dependent

Dedicated to Each Sites

Remote Access

Mantid

DAQ

Data Reduction

Data Analysis

Modeling Simulation

DAQ middleware

Manyo-Lib

Z-Code for powder diff.

IROHA

Data Visualization

Experiment DB

DataBase

User Management System
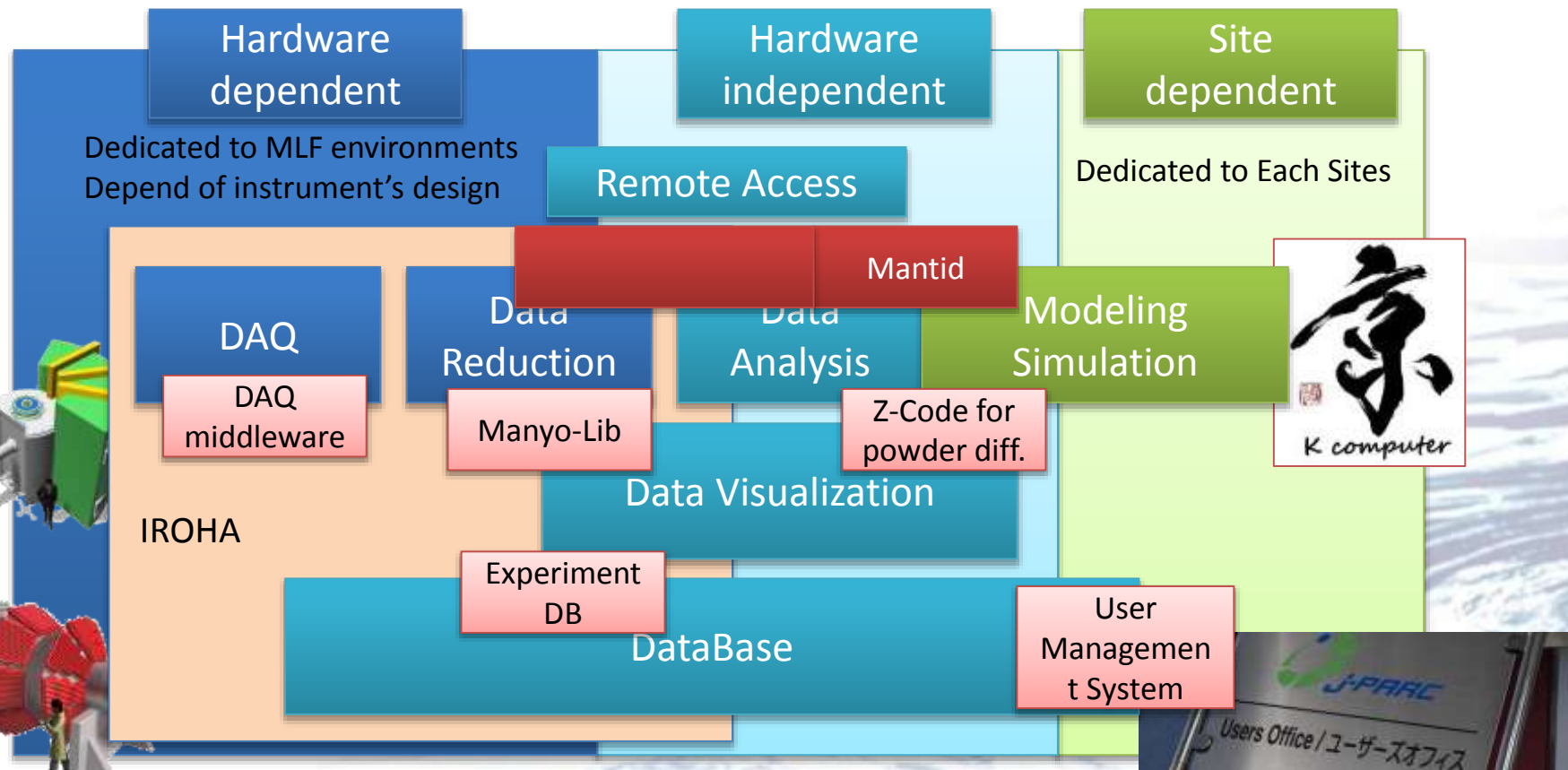
Infrastructure of Computing Environment

Requested Fund (not approved):
0.3 BYen for construction
0.05 BYen for running

The Environment for:
- Flexible Handling of Variety of information
- Advanced analysis

Data

50 ~ 100 MB/sec
(at 1MW from MLF)

Analysis & Visualization

- Reduction to scattering function
- Analysis of atomic structure, phonon & spin correlation

Analysis & Visualization

300 cores & 2.4 TB RAM

Data storage

1 PB / year

Broad band network

1 ~ 10 Gbps

Remote access

hundreds of users

Simulation

- Scattering function
- Calculation of atomic structure, phonon & spin correlation

Data management

- Authorization mechanism
- Disclosure of data after the period

Lessons

- ◆ MLF focused on developments of "hardware dependent" components

    - It was difficult to collaborate with other facilities
        - We had almost no ability to collaborate
    - The components were essential for MLF even-though the man-power shortage

- ◆ Now, core members, who have the ability to collaborate with outside researchers, exists at MLF (~ 8 people from J-PARC center & CROSS   = Yellow T-shirts men)

    - Event-recording DAQ & Analysis

- ◆ Issues:

    - We have started to re-build data reduction library with beam line scientists
    - Use of existing software and collaboration for software developments are essential for "data interpretation".