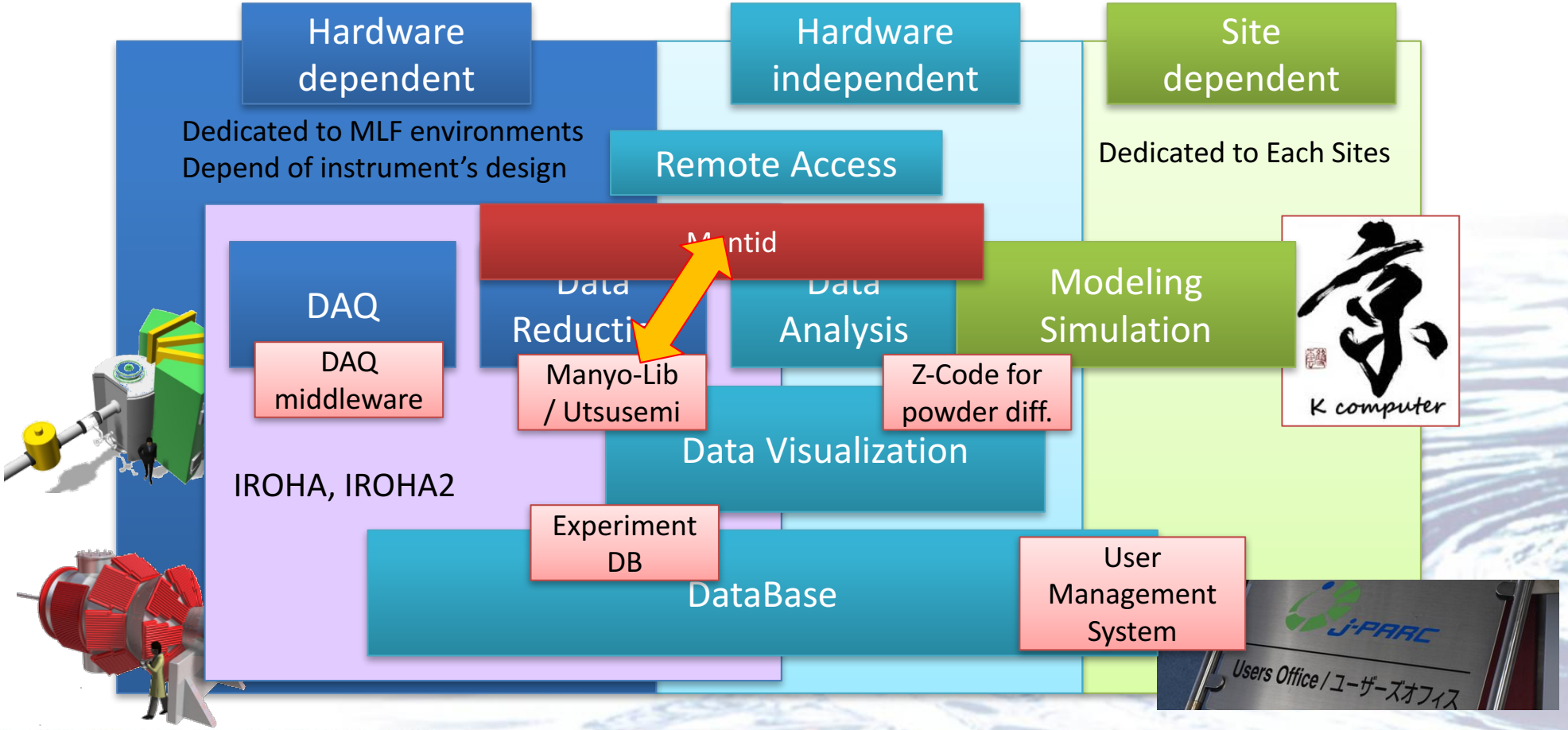
Data reduction : Softwares and Hardware (Neutron Monitors incl. Proton monitor)

Toshiya OTOMO

Components of MLF software

- Hardware dependent software have been developed by MLF



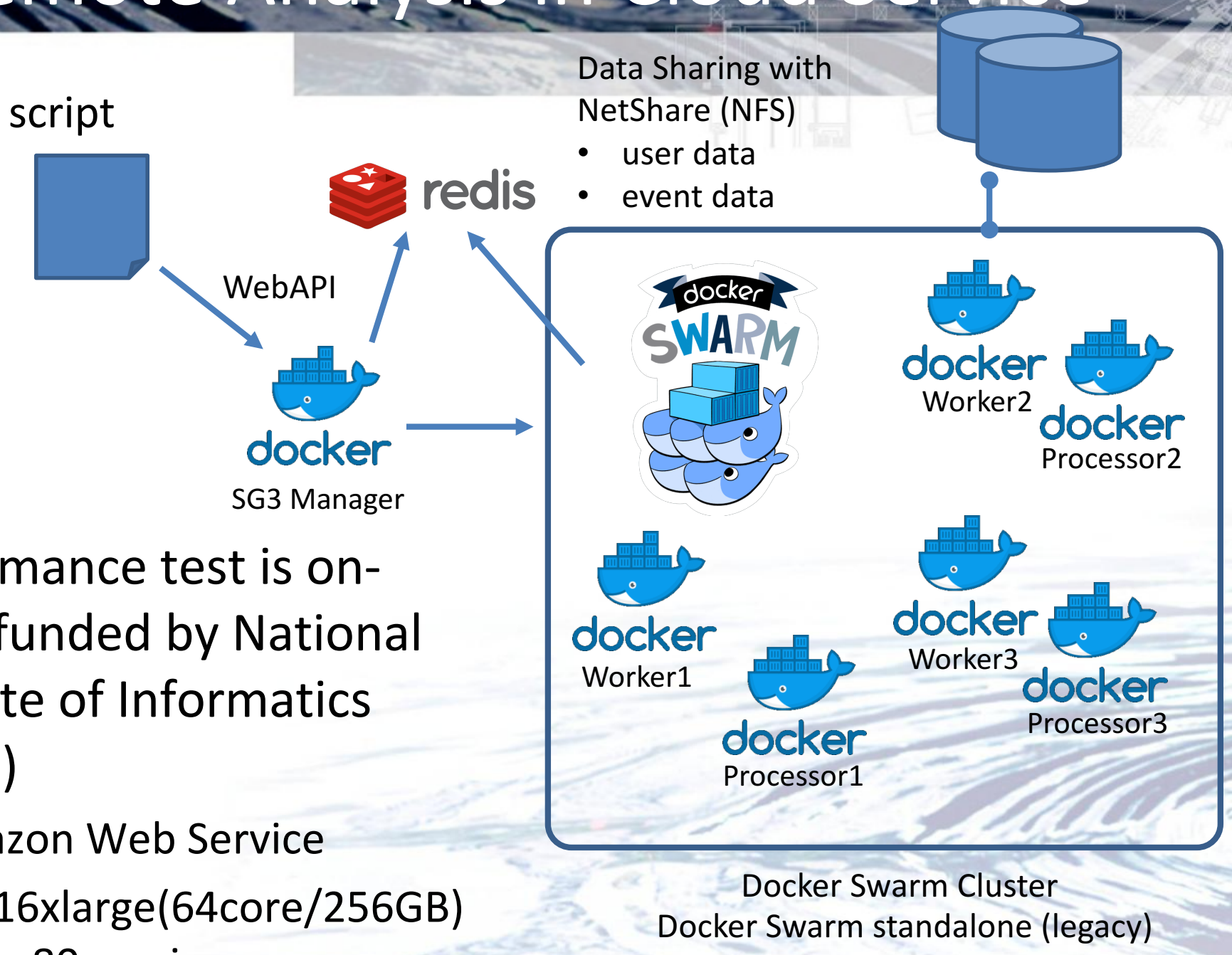
Software Status for the data analysis of MLF Beam Lines

BL		Analysis
BL01, BL14	inela. chopper	Utsusemi, Mslice, HORACE
BL02	inela.	QuensFit, DAVE
BL03	Bio. single Xtal	STARGazer, Free software for modeling
BL08, BL09	powder	Z-code
BL11	High press	Z-code, NovaSq, GSAS, etc.
BL12	inela. chopper	Mslice, BL software
BL15	SANS	Igor macro, Igor (users depend)
BL16	reflectometer	Igor-based free software
BL17	reflectometer	Igor-based software, free fitting software
BL18	single Xtal	STARGazer
BL19	residual stress	Z-code, GSAS, Igor, CMWP, MAUD
BL20	powder	Z-code
BL21	total scattering	NovaSq, Z-code, GSAS, FullProf, RMC++, PDFgui
BL22	imaging	nisct（CT calc.）+VCAD(RIKEN）, ImageJ(OSS), RITS(Hokkaido Univ.）

MLF-soft

External soft (depend on users)

Remote Analysis in Cloud Service



- Performance test is on-going funded by National Institute of Informatics (Japan)
  - Amazon Web Service
  - m4.16xlarge(64core/256GB) x10 – 80 sessions

For Effective Experiments

- Visualization on the fly
  - Live Data Monitoring
    - Introduced Publish/Subscribe system
- Effective parametric study
  - Machine learning to decide measurement time at each sample condition

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- Incident Neutron Monitoring
  - direct beam monitoring
  - precise normalization

neutron monitoring

- Precise incident neutron monitoring is essential for high-flux experiments
- Neutron monitors at MLF
  - N_2 gas monitor
    - 50 kHz
    - Efficiency: 10^{-6}～10^{-7}
  - GEM monitor
    - 1 MHz
    - Efficiency: ～10^{-3}
    - spatial resolution: ~ 1mm
  - Proton number & T0 event

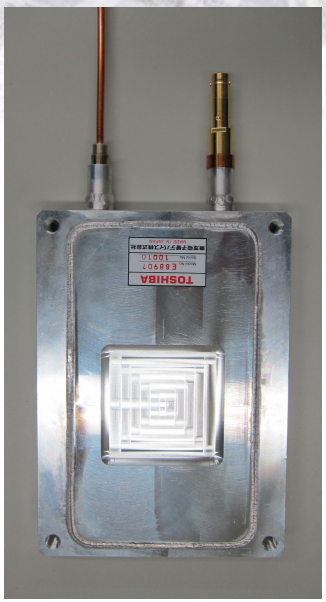
N_2 gas monitor

S. Takata

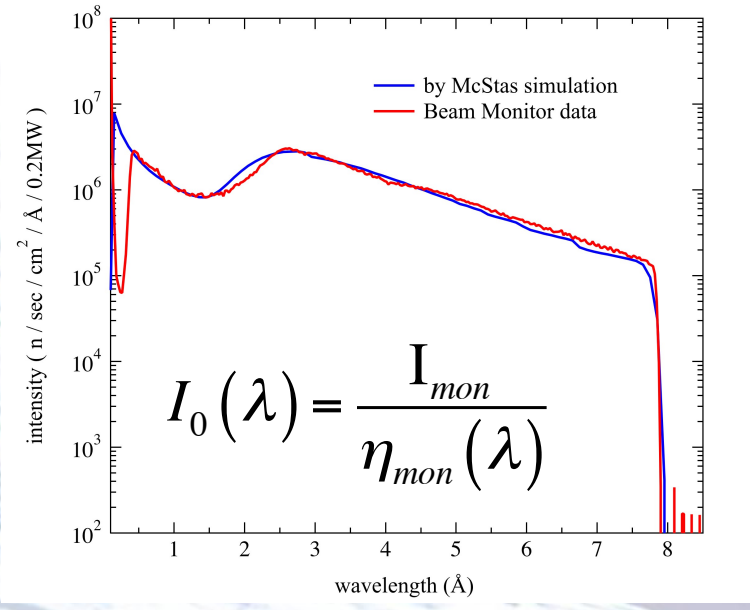
- Small cross-section of N enables low efficiency with realistic gas pressure ~ 10^{-5}
  - $\sigma_a(^3He)/\sigma_a(^{14}N)=2792$

$^{14}N + n \rightarrow p + {}^{14}C + 627keV$
$\sigma_a(^{14}N)=1.91barn$
proton energy = 585 keV
carbon energy = 42 keV

$^{3}He + n \rightarrow p + {}^{3}T + 764keV$
$\sigma_a(^{3}He)=5333.barn$
proton energy = 574 keV
tritium energy = 191 keV



- BL02, BL15, (BL17), BL18
- Sensitive to radiation of the window
  - $n + {}^{27}Al \rightarrow {}^{28}Al \rightarrow {}^{28}Si + \gamma + \beta^- + \nu$
  - discrimination becomes difficult
  - selection of window material is the key (testing on going)



Gas Electron Multiplier（GEM）

H. Ohshita

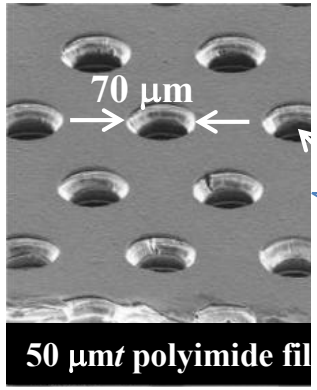
F. Sauli, Nucl. Instr. and Meth. A **386** (1997) 531.

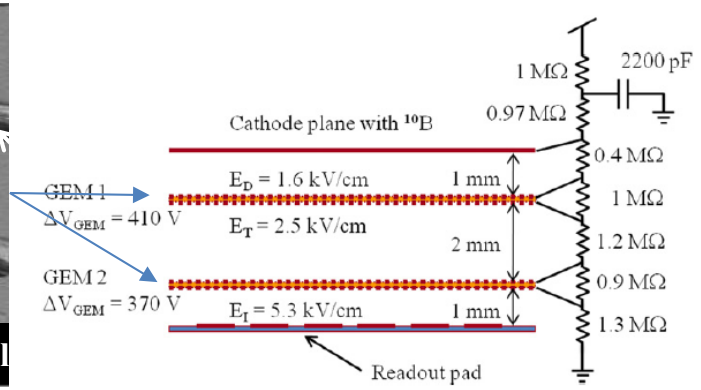
$^{10}B + n \rightarrow {}^{7}Li + \alpha + 2.79\ MeV\ (6\%)$

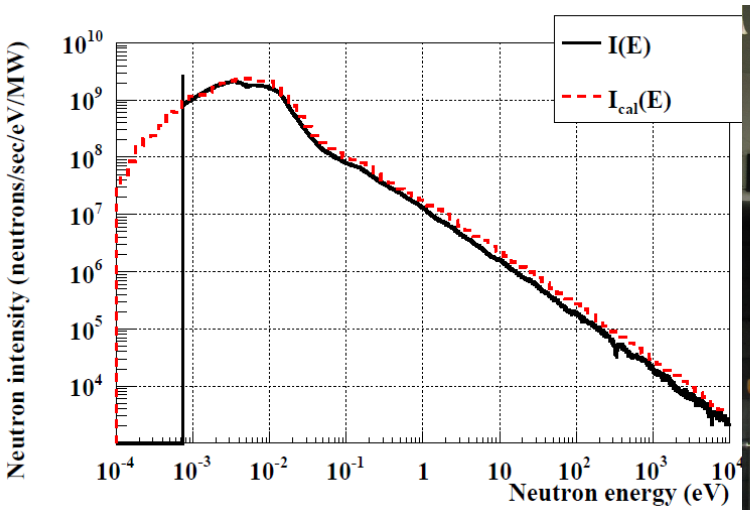
$^{10}B + n \rightarrow {}^{7}Li^{*} + \alpha + 2.31\ MeV\ (94\%)$

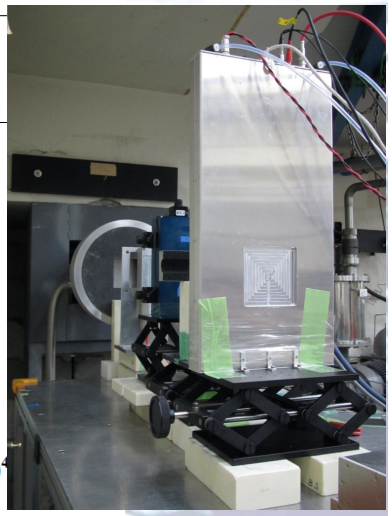
$^{7}Li^{*} \rightarrow {}^{7}Li + 0.48\ MeV\ (\text{prompt}\ \gamma)$

- Efficiency can control by the thickness of B and no. of GEM sheet ~ 10^{-3}
  - 3x 10^{-3} at 0.02 μm ^{10}B
  - max efficiency limited
- systematic error ~ 0.1%
  - H. Ohshita, et al. NIM A **672** (2012) 75-81





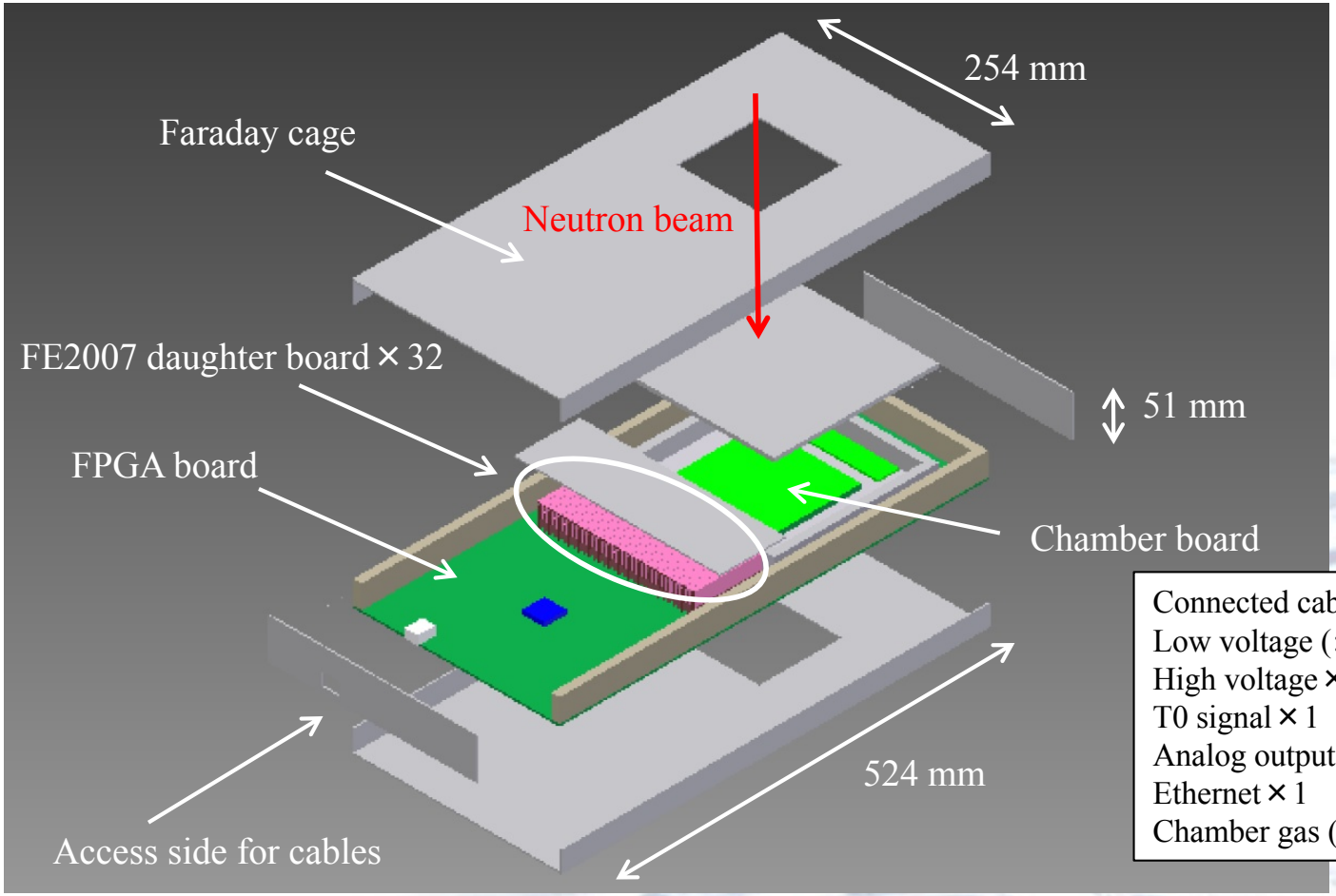




- incident mon. :BL21
- trans mission mon. : BL09, BL21 BL22

nGEM system

nGEM is a built-in system having a gas chamber and an electronics.
All signal lines from the readout pad are wired inside the printed circuit board.
FE2007 daughter board is able to exchange.
We can stack some 100 mm × 100 mm GEMs in the chamber stand
(The height of the chamber: ~20 mm, Gas flow system only).



Connected cables and tubes are:
Low voltage (±5 V) × 1
High voltage × 1
T0 signal × 1
Analog output × 1
Ethernet × 1
Chamber gas (input and output) × 2

Proton & T0 event

Proton No. Server

M. Ooi

T0 event in event data

Proton current transformer (CT)

DB records time, shot no., no. of protons at 25Hz

no. of protons

Proton No. Server (DB)
PostgreSQL, WEB server

Data request (start time & end time)

Fire Wall

ACC. control LAN

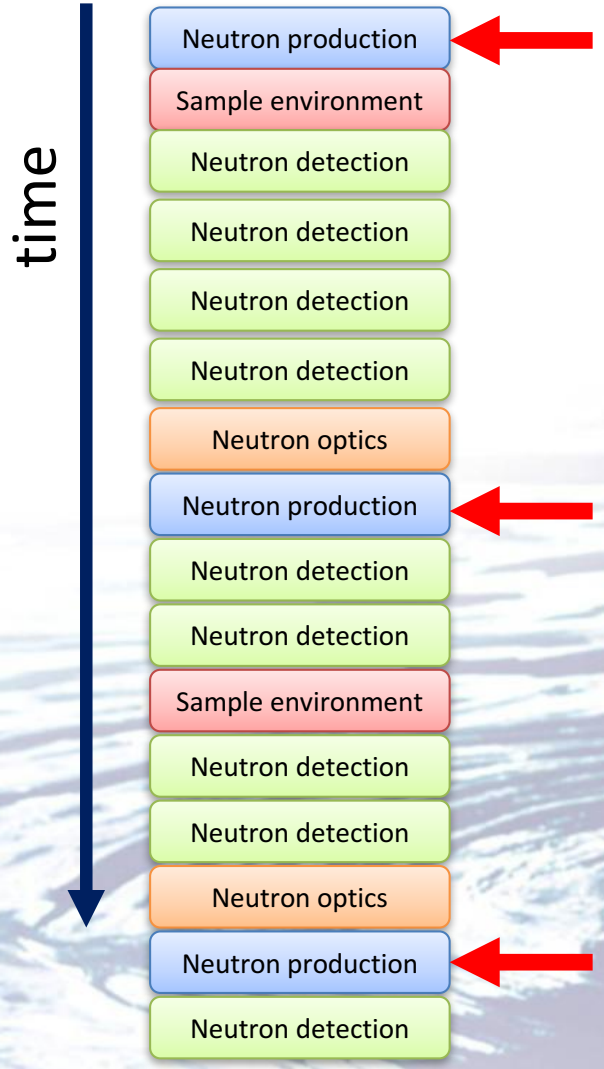
Proxy server

J-LAN

No. of protons

Neutron BLs

- all BLs



summary

- possible items in data reduction
  - ALL
  - neutron beam monitor
  - Introduction of information science
    - Machine learning
  - Cloud
  - Combination with ab-initio / MD / …