

# Application of Neutron Detection Systems to Compact Neutron Sources

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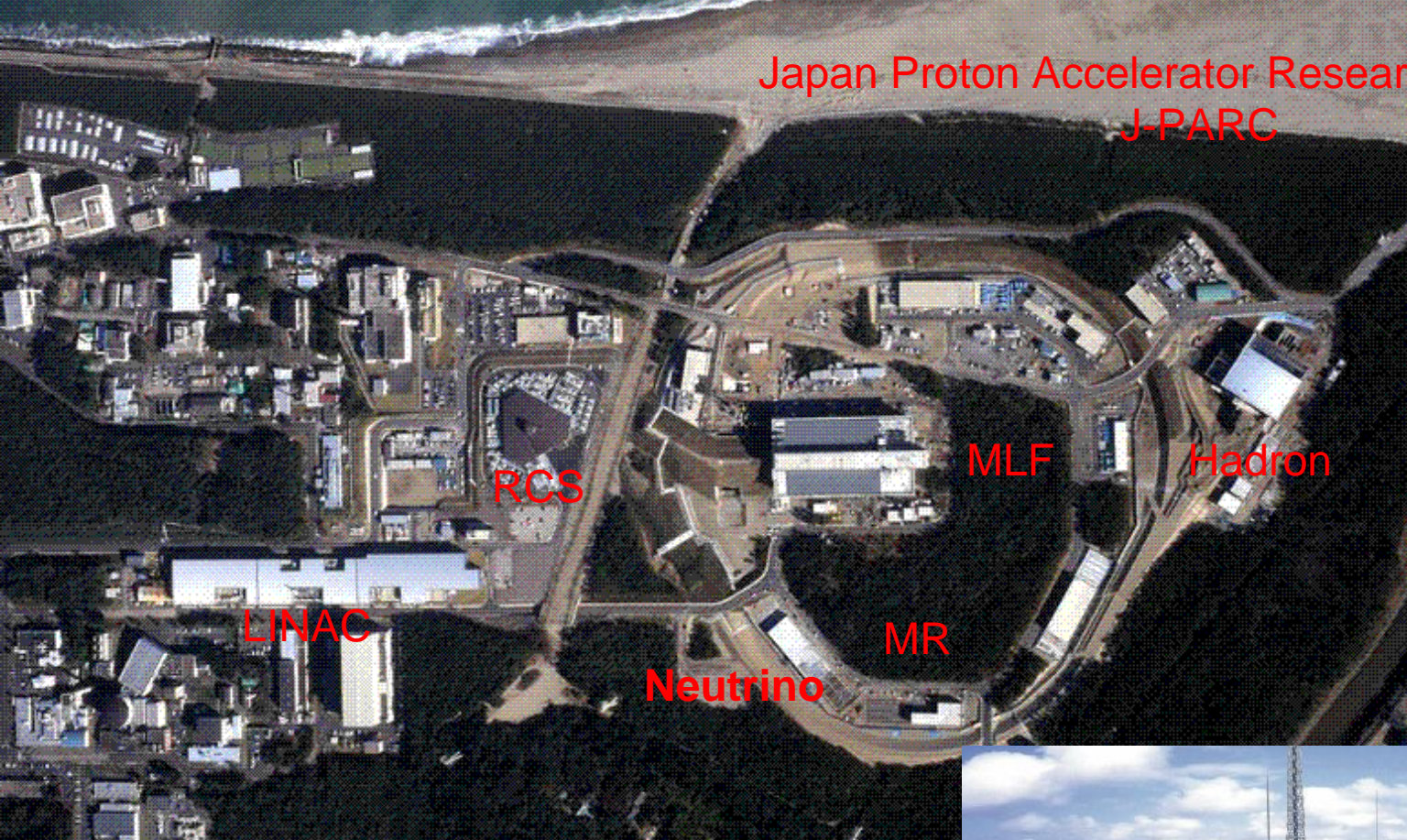
# Collaboration of MLF-DAQ

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- Ibaraki University: T. Hosoya

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Japan Proton Accelerator Research Complex  
J-PARC



Materials and Life Science Experimental Facility  
MLF



# MLF/J-PARC DAQ System

## Future of J-PARC Neutron Source

- High Intensity (1MW), Pulsed Neutron (25Hz) Source

## DAQ System concept

- (1) New Experiments with neutron detection event recording  
(e.g. observation of transition phenomenon)  
⇒ Histogram to Event-mode data-taking  
(still photo to motion picture)  
⇒ Mass data production -> high speed data transfer
- (2) Accurate and Precise Experiments on TOF measurements  
(e.g. World highest resolution spectrometer)  
large spectrometer and wide detection area  
⇒ distributed and scalable DAQ system

## J-PARCの中性子回折実験装置が世界最高の分解能を達成

J-PARCセンター

大学共同利用機関法人高エネルギー加速器研究機構(機構長 鈴木厚人 以下「高エネ機構」と)と独立行政法人日本原子力研究開発機構(理事長 岡崎俊雄 以下「原子力機構」)の共同運営組織であるJ-PARCセンター(センター長 永宮正治)は、大強度陽子加速器施設J-PARC<sup>※1</sup>の今年12月の一部施設利用開始を目指して調整運転を進めています。

このうち、物質・生命科学実験施設(MLF)の「超高分解能粉末中性子回折装置SuperHRPD<sup>※2</sup>」が、機器調整過程の平成20年6月末、世界最高の分解能<sup>※3</sup>を達成したことを、データ検証の結果、確認いたしました。

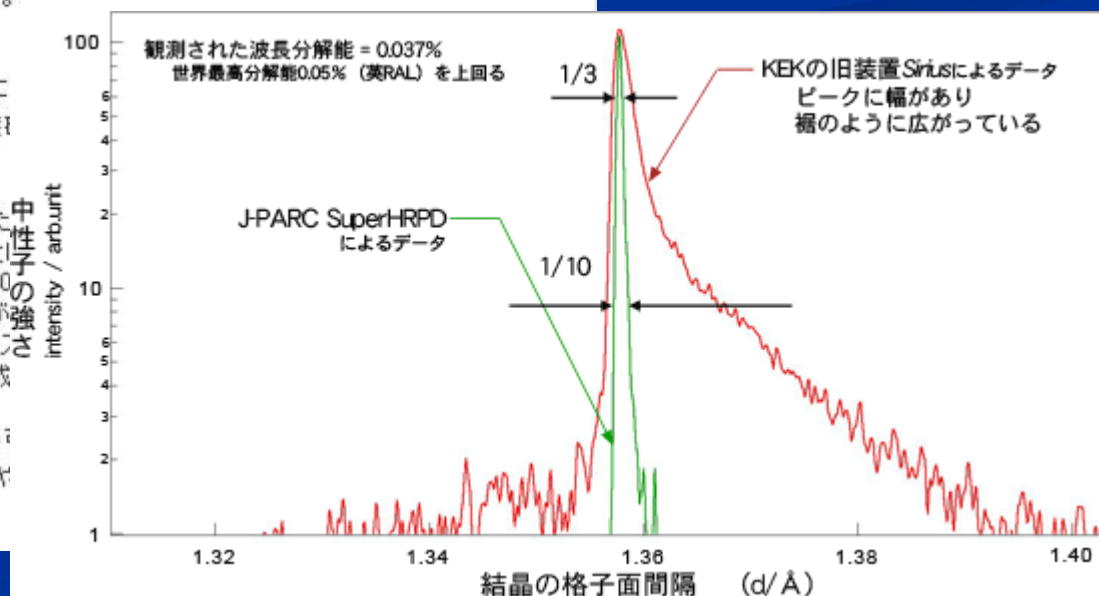
今年12月に中性子利用実験を開始するJ-PARCは、SuperHRPDを初めとする高性能実験装置が幅広いユーザーに利用され、最先端研究の進展に大きく貢献することが期待されています。

### ●概要

J-PARCは、光速近くまで加速した高エネルギー陽子をターゲットに<sup>※4</sup>を利用して多様な実験を行う研究施設であり、このうちMLFは核実験施設です。

SuperHRPDはMLFの中性子利用ビームライン、BL-08に設置されたルース状の中性子を照射し、通過する中性子線の強さを解析することができます。今回SuperHRPDが達成した世界最高の分解能となる0.037%が、同種装置の分解能0.05%を上回る値で、SuperHRPDが達成しました。今回の成果は、高エネ機構と原子力機構における高性能マルチフェロイック物質<sup>※5</sup>の構造科学研究への貢献が期待されています。

本成果により、物質の原子レベルでの構造をより詳細に知ることが期待されています。



Press release  
July 17, 2008

BL08 :  
powder diffractometer  
shows high performance

# MLF Spectrometers



SuperHRPD  
(KEK) ★



NOBORU  
(JAEA)

- ★  $^3\text{He}$ -PSD: 6
- ◎ Scintillator: 2
- Others: 4



NNRI  
(Tokyo Tech. U.,  
JAEA, Hokkaido U.)

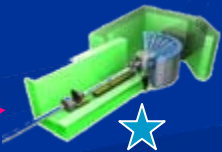


iBIX (Ibaraki  
Pref.) ◎

NOP  
(KEK)



HRC  
(KEK) ★



4SEASONS  
(JAEA, KEK, Tohoku U.) ★



AMATERAS (JAEA) ★

2nd Experimental Hall



NOVA  
(NEDO, KEK) ★



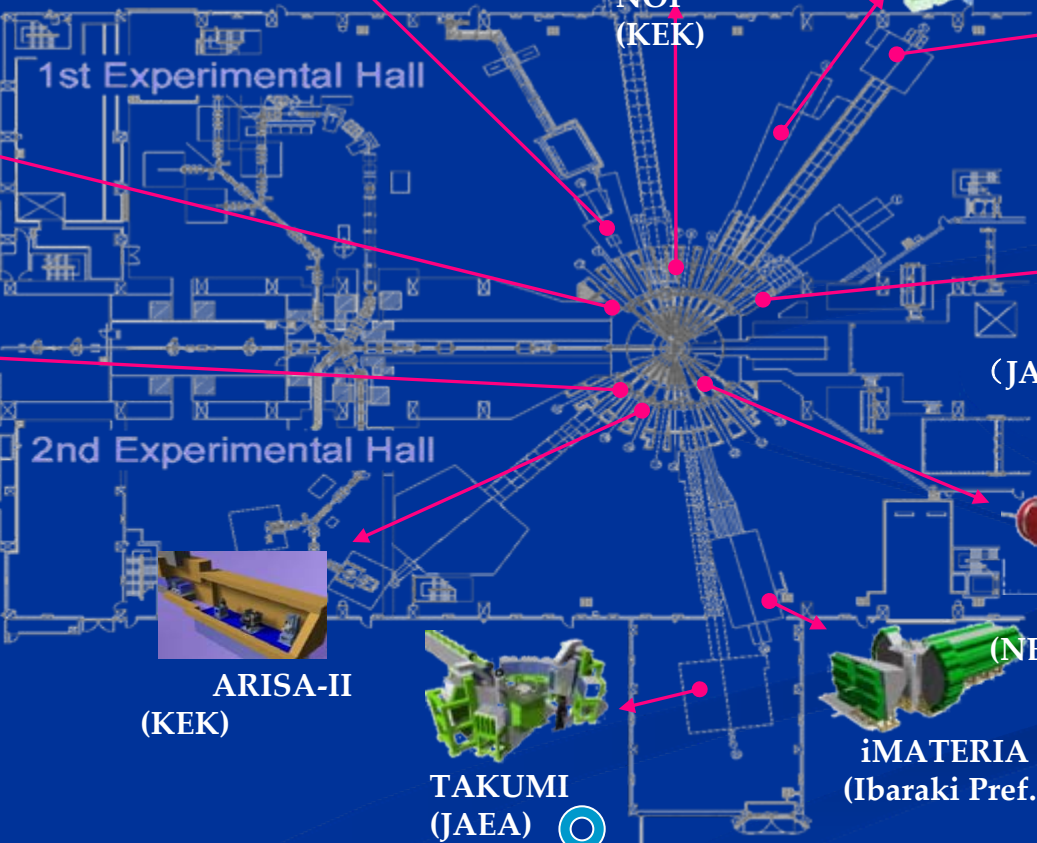
ARISA-II  
(KEK)



TAKUMI  
(JAEA) ◎



iMATERIA  
(Ibaraki Pref.) ★



# New $^3\text{He}$ -PSD System

Changing Items from old system

- Data-taking : Histogram to Event-mode  
(recording neutron by neutron)
- Data processing : on board circuit to software based
- Data transfer : Fast and wide-band

Technique : from the Detector Technology Project (DTP) of KEK

- Network-based high-speed data transfer: SiTCP
- Software based data processing: DAQ-Middleware

Developing NeuNET

- KENS old PSD electronics + SiTCP  $\Rightarrow$  NeuNET electronics
- NeuNET electronics + DAQ-Middleware  $\Rightarrow$  NeuNET system

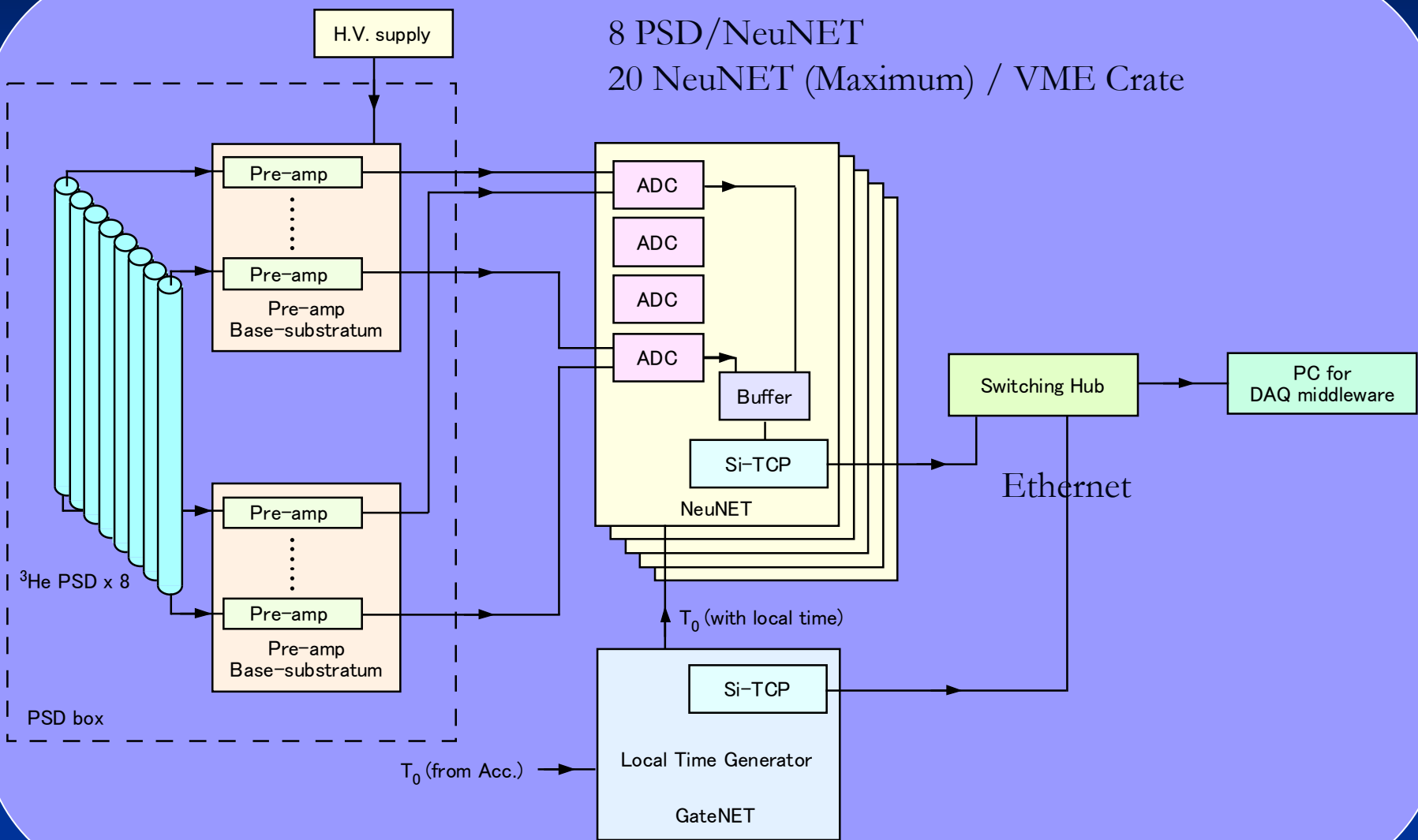


# NeuNET

## Future

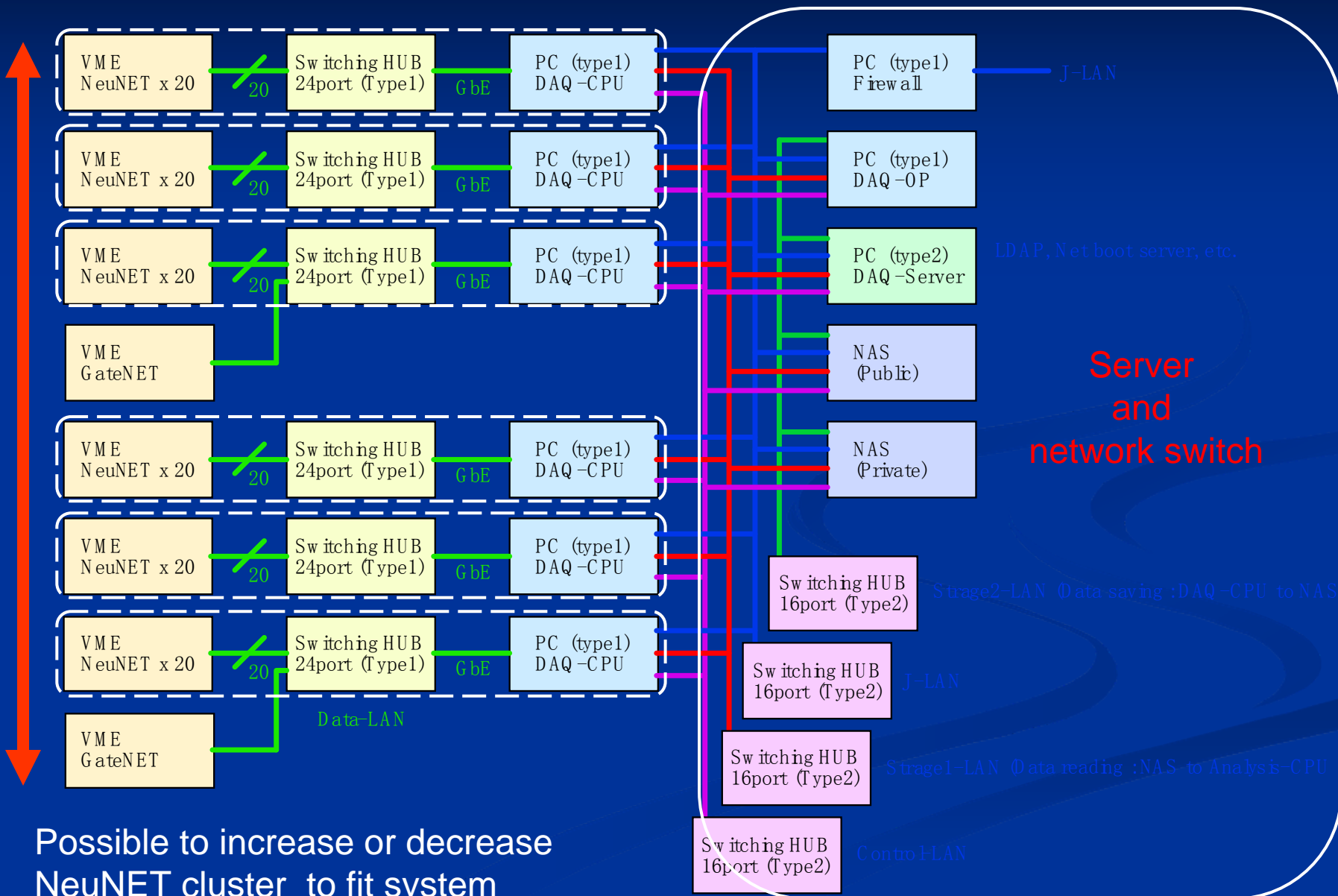
- Recording neutron detection as an event  
PSD No, detection position and time
- Data transfer via network  
easily expand data band width
- Simultaneous process in 8 PSD at one board
- Flexible configuration for any  $^3\text{He}$ -PSD
  - Over 100 board in one spectrometer at MLF with  
DAQ-Middleware
  - Small configuration for portable experiments
- Products are commercially available (Toshiba-ETD, etc.)

# NeuNET Cluster

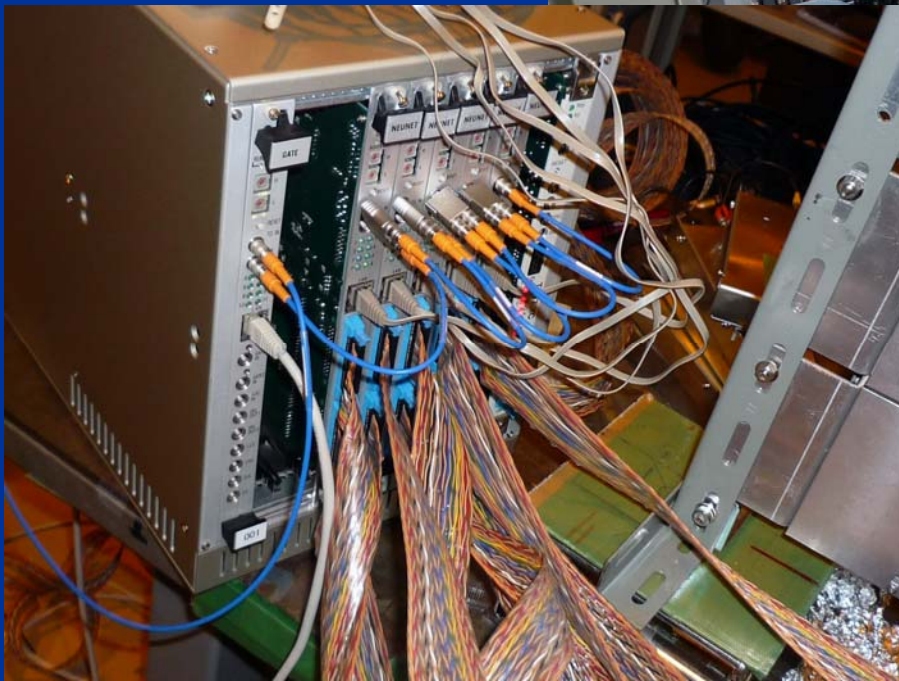


# Typical NeuNET system Diagram with DAQ-Middleware (BL09/MLF)

BL09 DAQ System Block Diagram



MLF BL21 System  
98 NeuNET board  
with DAQ-MW



Compact system  
5 NeuNET board

# Software

Systems are working on software (already main parts of the system)

Key software:

- Data-taking: "DAQ-Middleware" (from the DTP of KEK)
- Common library: "Manyo-Lib" (original)
- User desktop: "Working desktop" (original)
  - integrate of all experimental environment
  - improvement of usability

Most software are shared in MLF (as much as possible)

Avoid a double investment of cost and human resource

Developments are still going on

# for Compact Neutron Source Experiments

DAQ system must be  
simple and easy for use and maintenance  
reduce of cost and man-power

Recommendation:

Small scale of large system (shrink but same)

Sharing of operation know-how

Usability of system (not be puzzled)

NeuNET system is one of candidate !!

# Summary

- MLF/J-PARC experiments,
  - Developed new DAQ-system
    - Event-mode data-taking
    - Distributed and scalable DAQ system
  - NeuNET is standard for  $^3\text{He}$ -PSD system
  - Shared software are also commonly used
- NeuNET system will be applied for ANY scale of experiments covered a few PSD to over 1000 PSD in one system

Special Thanks to

the Detector Technology Project of KEK