拡大物性委員会
2022年3月19日
於：オンライン

J-PARC MLF
（物質・生命科学実験施設）

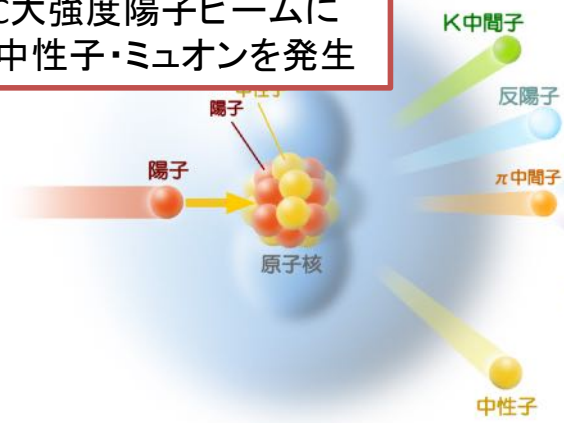
大友季哉（J-PARC MLF / KEK物構研）
柴山充弘（CROSS）

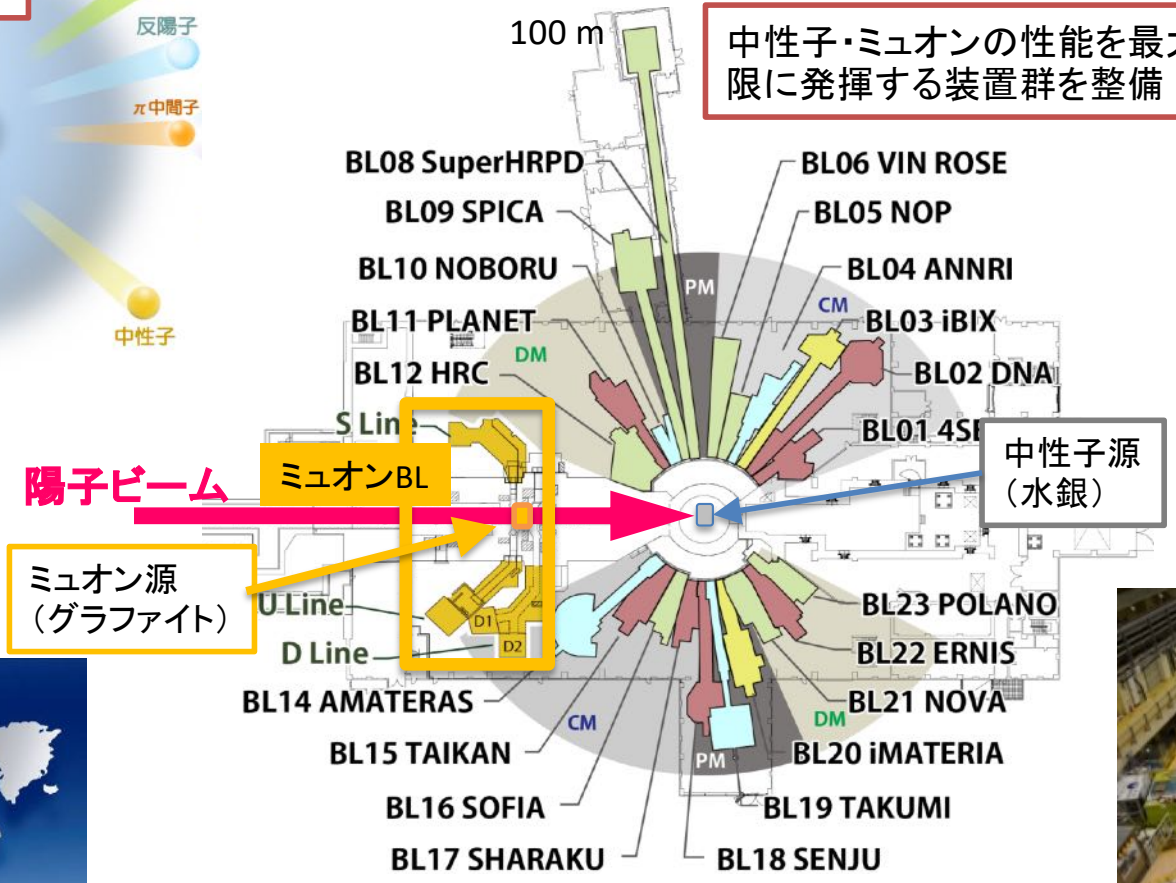
■ 主な内容

- 施設の運転状況、
- 成果ハイライト、
- 2022A採択状況、
- 要望対応（リモートアクセスに焦点）

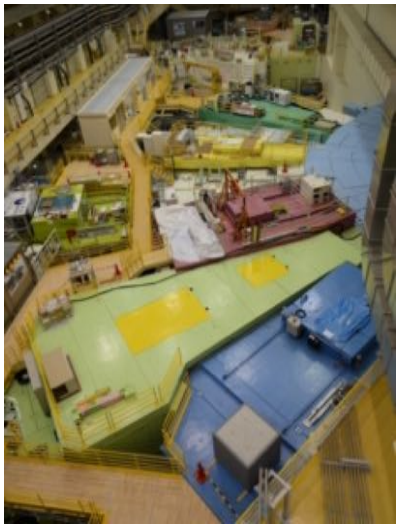
物質・生命科学実験施設（MLF）の概要

J-PARC大強度陽子ビームにより、中性子・ミュオンを発生

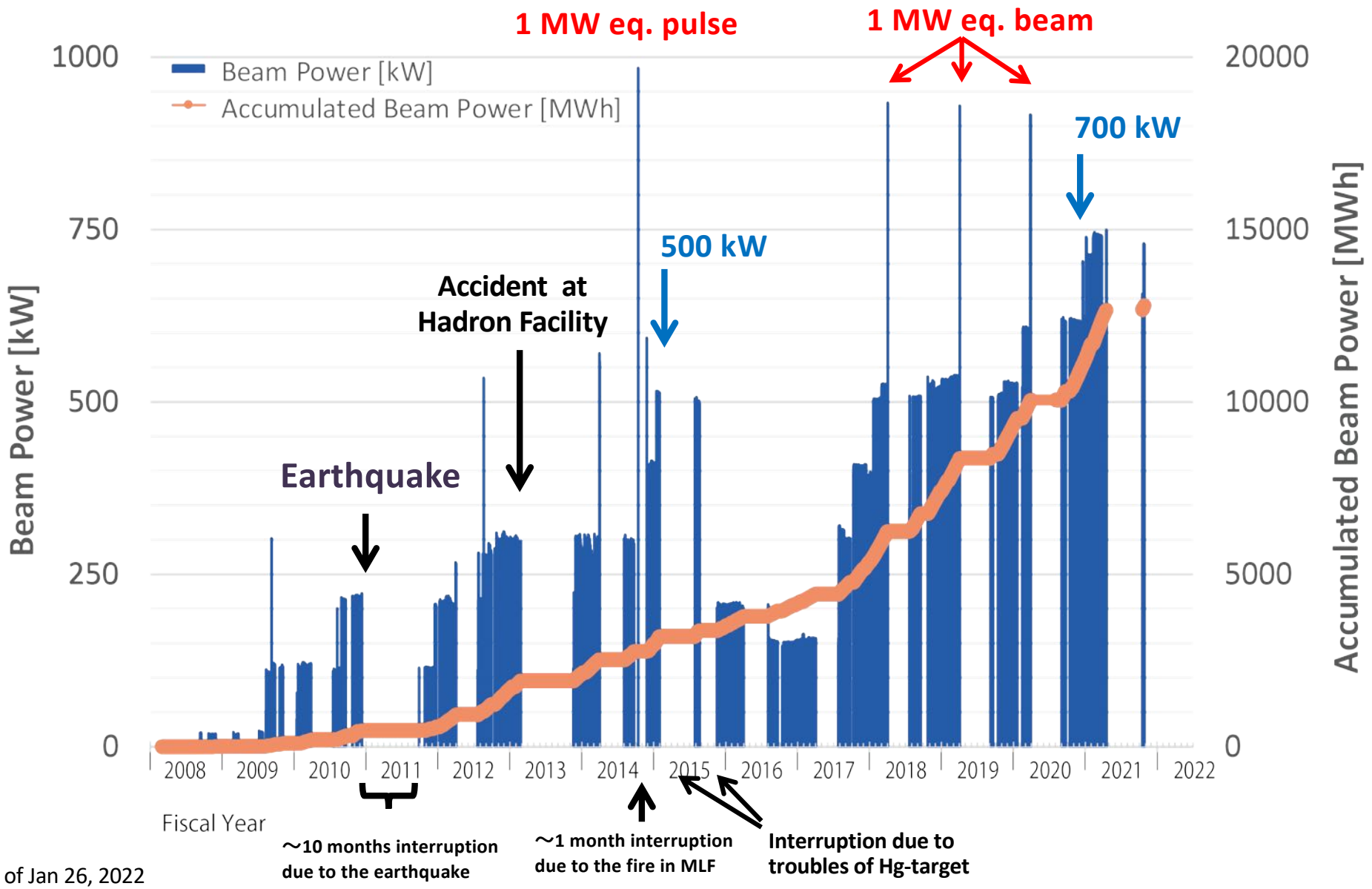




MLFは世界的な拠点施設



Beam Power History at MLF



as of Jan 26, 2022

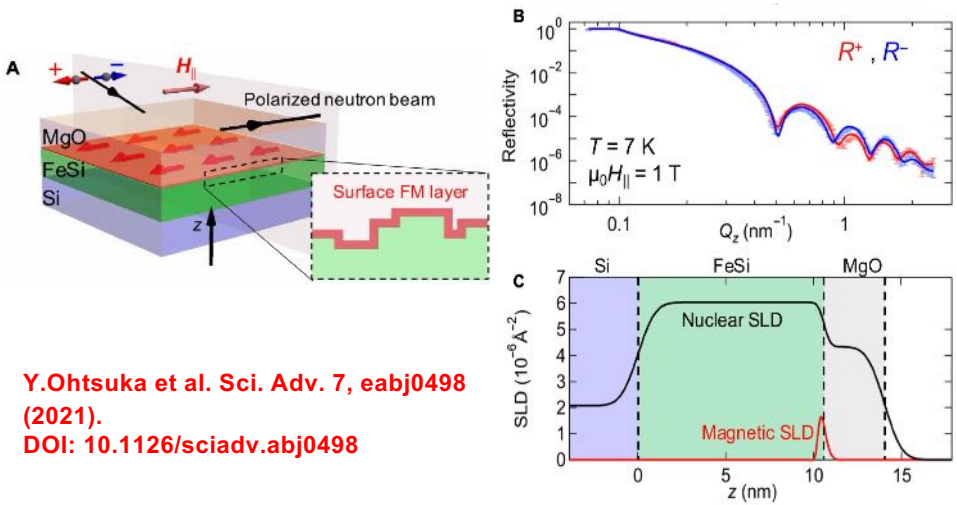
BL17 Emergence of spin-orbit coupled ferromagnetic surface state derived from Zak phase in a nonmagnetic insulator FeSi

Background : Topological insulators have attracted attention for the spintronic functionality. However, in existing materials, that state derives from the strong spin of heavy elements, and this has problems in terms of the rarity and toxicity of heavy elements.

Method **FeSi thin films were prepared on Si substrate. The magnetic structure was examined by polarized neutron reflectometry.**

Results **The PNR measurement revealed the existence of the magnetic layer with the thickness of 0.35 nm at the surface of the FeSi film. The ab initio calculation showed that these surface properties are closely related to the Zak phase of the bulk band topology.**

Significance **These results provide hints for developing another route to explore noble metal–free materials for spin-orbit coupling-based spin manipulation.**



Y.Ohtsuka et al. Sci. Adv. 7, eabj0498 (2021).
DOI: 10.1126/sciadv.abj0498

BL02 Dynamics of Water in a Catalyst Layer of a Fuel Cell by Quasielastic Neutron Scattering

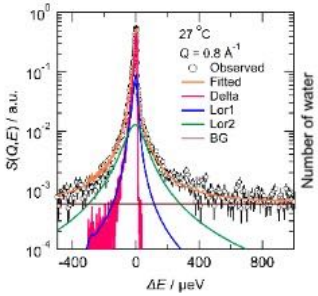
Background: : It is important to know how protons are supplied to a reactive field in a catalyst layer in order to improve PEFC. The performance of Power generation depends on dynamics of protons. However, water dynamics in a Nafion thin film covering Pt nano particles on a carbon support was still unknown.

Method **Water dynamics in a CL of PEFC was investigated by quasielastic neutron scattering (QENS)**

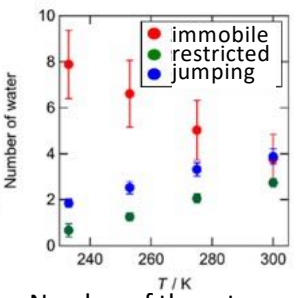
Results **Three types of water with different dynamics were found in the CL, which are immobile water, water with jump diffusion and water with free diffusion in a restricted area. It is clearly shown that, even at 233K, water with jump diffusion exists.**

Significance **The results give us direction to develop a CL optimized for proton conduction, which may devote grade-up of power generation of PEFC.**

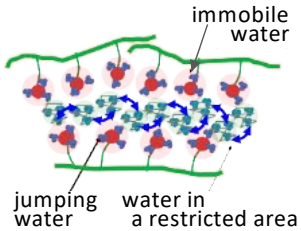
K. Ito et al., J. Phys. Chem. C 125, 21645 (2021).
https://doi.org/10.1021/acs.jpcc.1c06014



QENS profiles



Number of three types of water



Schematic model of water dynamics in CL

Future : By extending CLs of different materials or different fabrication process, relationship between proton conduction and water dynmicas in CL will be clarified.

H-line $\mu^{\pm}$

Slow（4 MeV）～fast（50 MeV）beam, for particle physics, atomic physics (“precision frontier”)

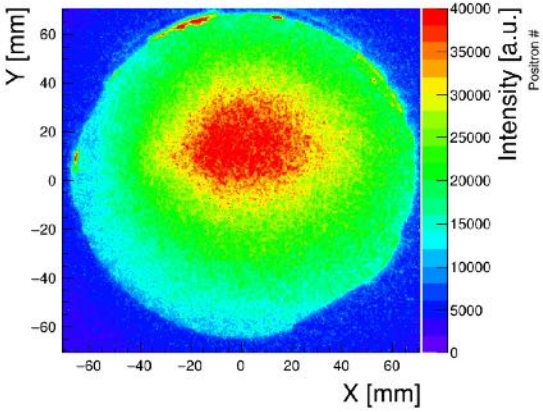
New muon H-line starts operation!

First beam on Jan. 15th, 2022!

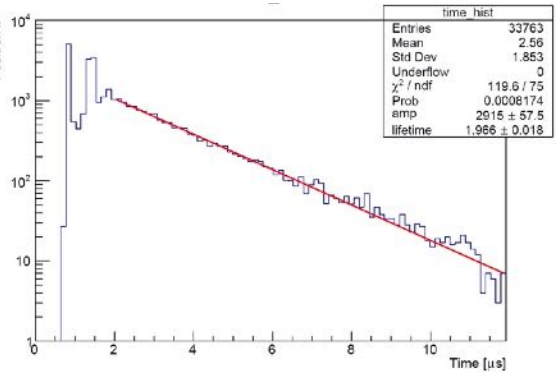
Beam commissioning is on-going with many members and groups

KEK, SOKENDAI, Osaka city university, Osaka university, Nagoya University, Niigata university, Ibaraki university, and Kyushu university

Muon beam profile
σ_x=44mm, σ_y=24mm



Time spectrum of muon decays



Muon intensity is roughly consistent with our expectation (>10^8 /s with1MW).

J-PARC MLF
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- Neutron experiment
- Muon experiment
- Accepted proposals
- Statistics
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- Pamphlets and reports

Proposal Application

mlf info

- Neutron · Muon Sources
- Instruments
  - List of Instruments
  - Maps of Experimental Halls
- Laboratory / User Facilities
- Software
- Operation

Become a User

- User Program Overview
  - How to Submit a Research Proposal
  - Before You Arrive
  - Upon Arrival
  - After Experiment
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liquid

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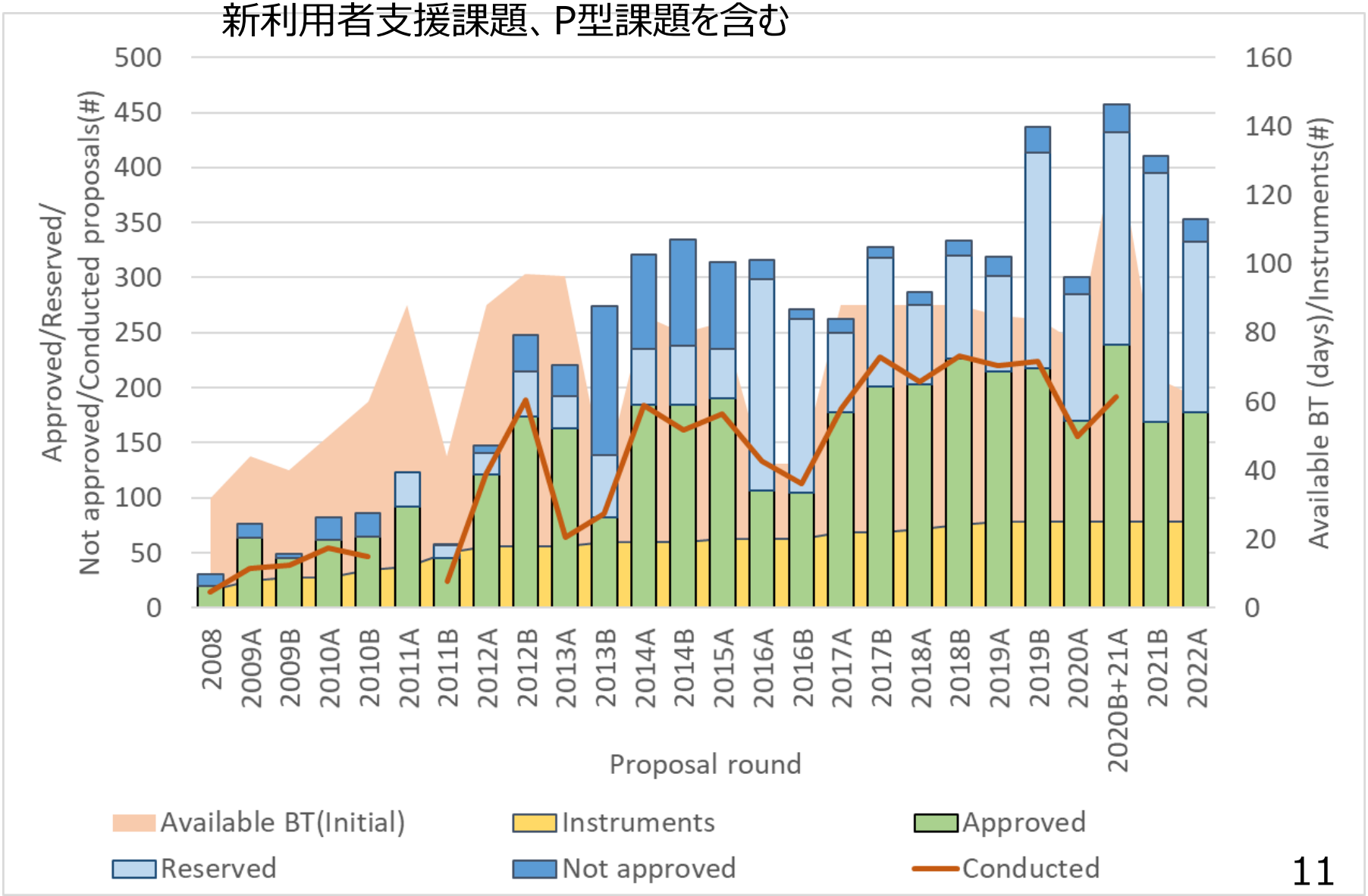
Journal

2021

- Experimental analysis on dynamics of **liquid** molecules adjacent to particles in nanofluids
  Shunsuke Hashimoto, Kenji Nakajima, Tatsuya Kikuchi, Kazuya Kamazawa, Kaoru Shibata, Takeshi Yamada
  Journal of Molecular Liquids **342** 117580 (2021). Neutron BL02 BL14 Science
  DOI: 10.1016/j.molliq.2021.117580
  Proposal No. *2017A0081, 2018A0075*
- Overscreening Induced by Ionic Adsorption at the Ionic **Liquid**/Electrode Interface Detected Using Neutron Reflectometry with a Rational Material Design
  N. Nishi, J. Uchiyashiki, T. Oda, M. Hino, and N. L. Yamada
  Bull. Chem. Soc. Jpn. (2021). Neutron BL16 Science
  Proposal No. *2013B0104, 2014A0172, 2015A0054*

一般利用課題（短期、1年）申請数・採択数の推移

新利用者支援課題、P型課題を含む



2022A審査結果まとめ（MLF全体）

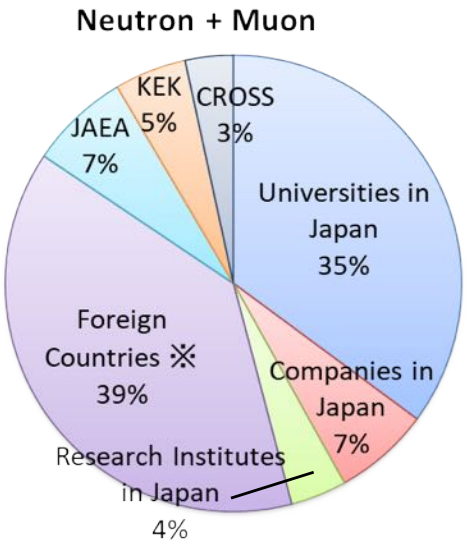
一般利用課題（短期、1年）（中性子、ミュオンBL）

申請：353 件（中性子：303 件、ミュオン：50 件）

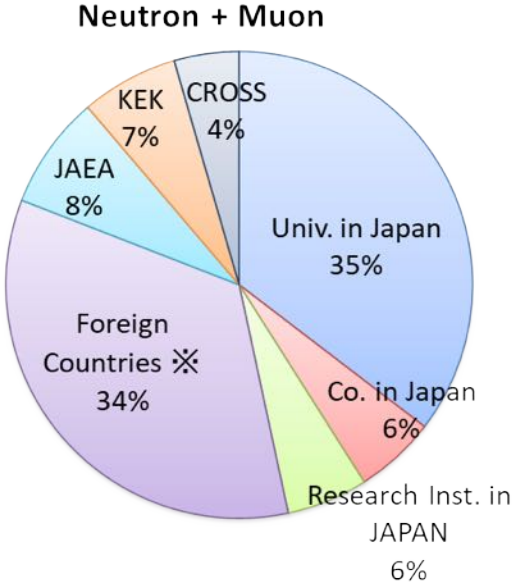
採択：178 件（中性子：152 件、ミュオン：26 件）

採択率：50 %

申請割合（所属機関別）



採択割合（所属機関別）



※Including Universities, Research Institutes

要望へのMLFとしての対応について

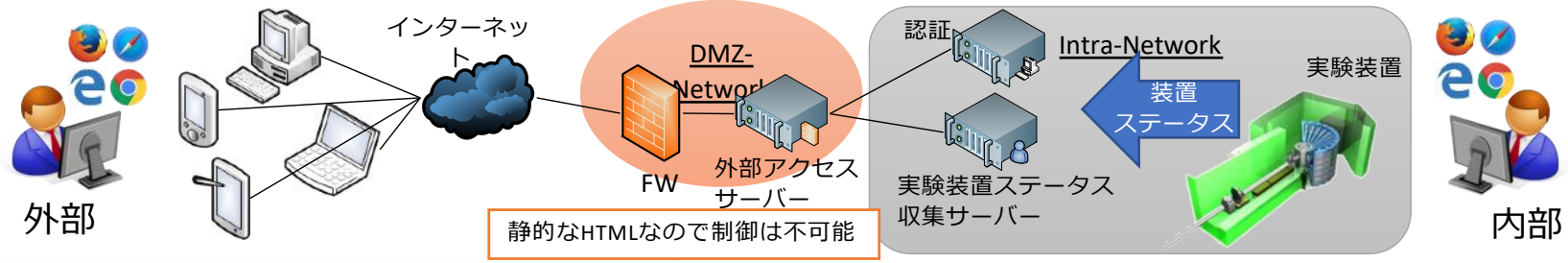
MLF 大友 2022/3/7

- 要望1：課題申請手続きのスケジュールと公平性
- 要望2：ネットワークアクセス
- 要望3：ユーザー控室、休憩室、軽食コーナー
- 要望4：試料環境
- 要望5：ソフトウエア

昨年度の回答についてはMLF利用懇のホームページに掲載

現時点で可能な装置監視

- インターネット経由で、中性子装置の一部のステータスを確認することが可能
  - 実験ホール内で制御していた画面がそのままインターネットから見える
  - 以前はスタッフのみだったが、ユーザー（管理はスタッフ）も利用可能となっている



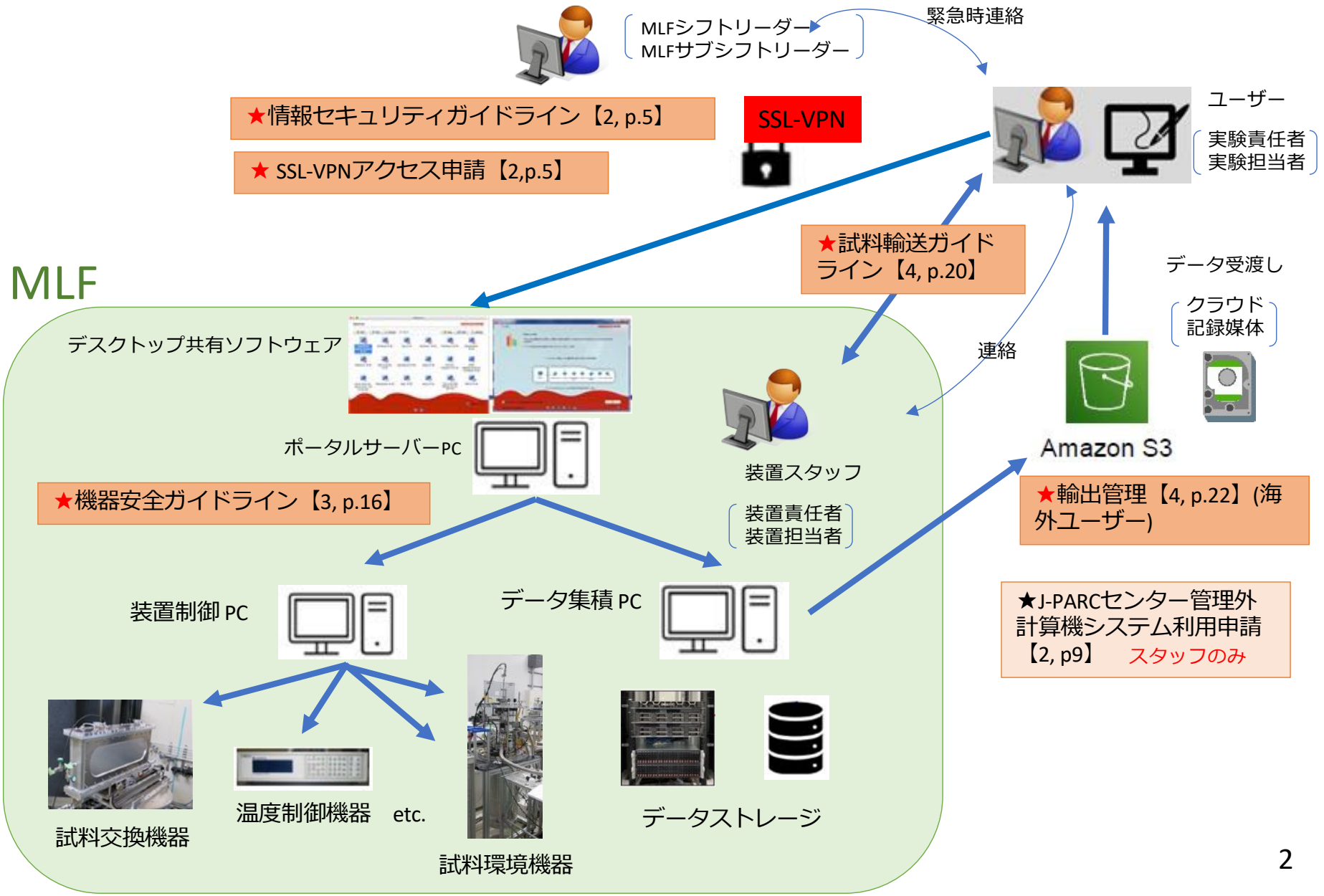
データ集積ソフトウェア（DAQミドルウェア）のWeb制御画面
対応BL：
BL03, BL08, BL09, BL11, BL19, BL21

統合制御サーバー

装置制御ソフトウェア（IROHA2）のWebインターフェース
対応BL：
BL01, BL02, BL14, BL15, BL18, BL22

シーケンスサーバー

MLF遠隔実験のガイドライン【まとめ図】



遠隔実験についての検討事項

- 国際諮問委員会からのアドバイス
  - 代行実験（ユーザー来訪無し）は施設スタッフの負担が大きく、持続的ではない
    - 遠隔実験整備によりスタッフの負担を減らす（実験の省力化・効率化も実現）することを検討
  - すべての実験を遠隔化することは困難
  - 代行実験を定常としてしまうと、中性子・ミュオン実験を支える人材が育たない
    - MLFとしてはユーザー来訪が原則

MLFの遠隔利用で目指すところ

MLFの遠隔利用による利用形態の拡大