Overview: The purpose and impact of SubMIT

Basic Computing Services in the Physics Department

David Walter

22th May 2025

Annual review

The purpose of SubMIT

Time to do an analysis on your laptop are over

- Upcoming experiments will produce multi-exabyte-scale datasets
- Theoretical physics becomes increasingly computational
- Fast time to insight essential for efficient physics data analysis

Call for interactive, user-friendly, scalable Analysis Facility

- Provide basic computing services for everyone in the MIT physics department
- Enable easy access for newcomers to start their physics analysis
- Support advanced customization for experienced users
- Ensure sufficient and efficient computing resources through fair sharing

Such that users can focus on research

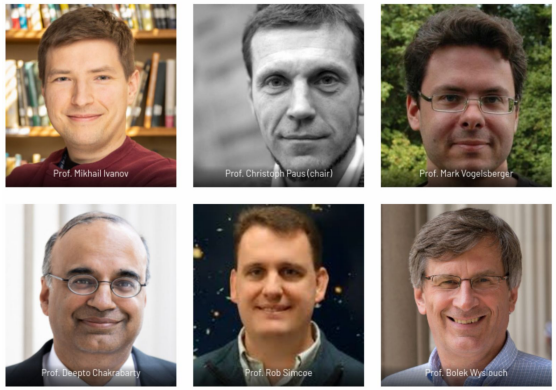
Organization

[Full description]

Steering committee

- Oversight
- Funding

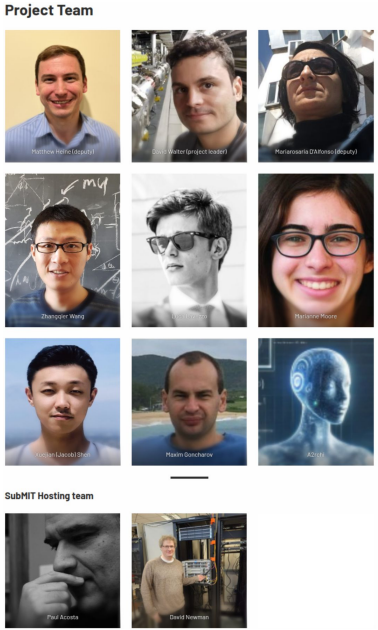
Meeting monthly with project team leader & deputies



Project team

- Implementation
- Operation
- Maintenance
- Support

Meeting weekly



Users group

- Information flow
- Feedback
- Requests

Meeting monthly in open user group meetings

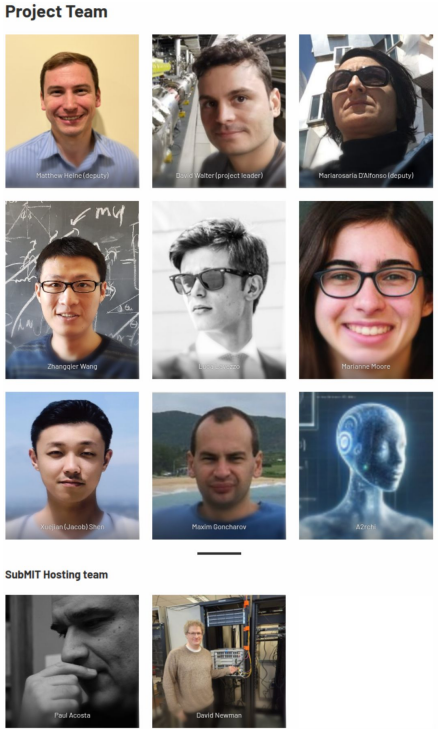
How we aim to achieve it: project team

Project team's responsibilities

- System configuration, upgrades, security
- Central software installation and management
- Integration with external resources and services
- User support

User support is a key feature of the system

- Beyond basic troubleshooting
- Help users make optimal use of the available resources
- Expert advice on designing/improving workflows
- Customize and evolve system configuration to accommodate user needs as appropriate

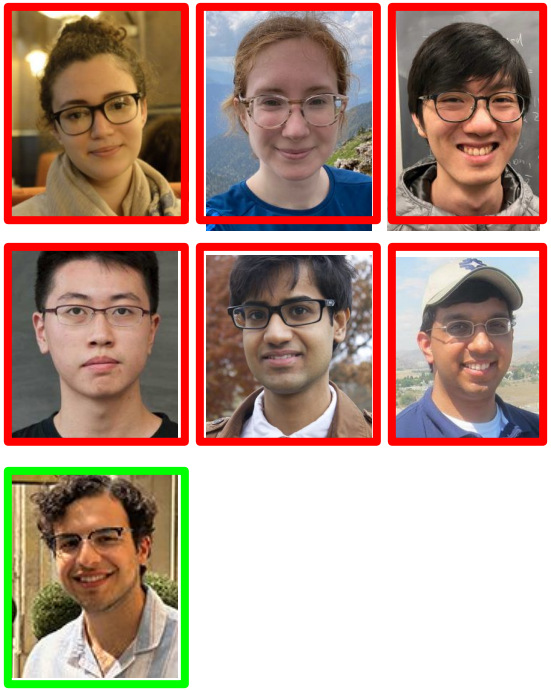


New users group representatives

Current user group representatives

- Amer Ahmad Al-Hiyasat, ABCP, Biophysics
- Hans Moritz Günther, MKI,
- Jordan Lang, LNS, relativistic heavy ion (CMS)
- Jose Miguel Munez Arias, LNS/IAIFI nucelar
- Josu Aurrekoetxea, CTP cosmology
- Luke Kim, CMT

June 2024



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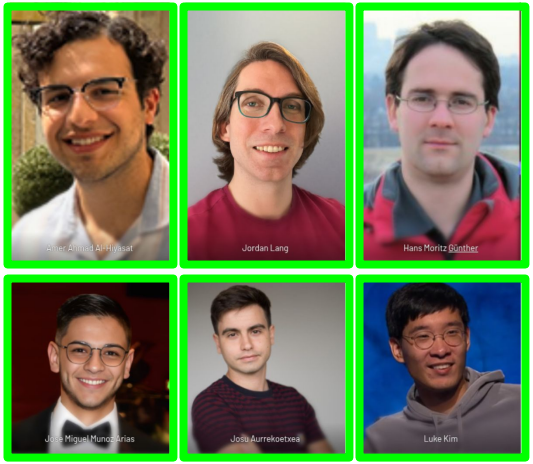
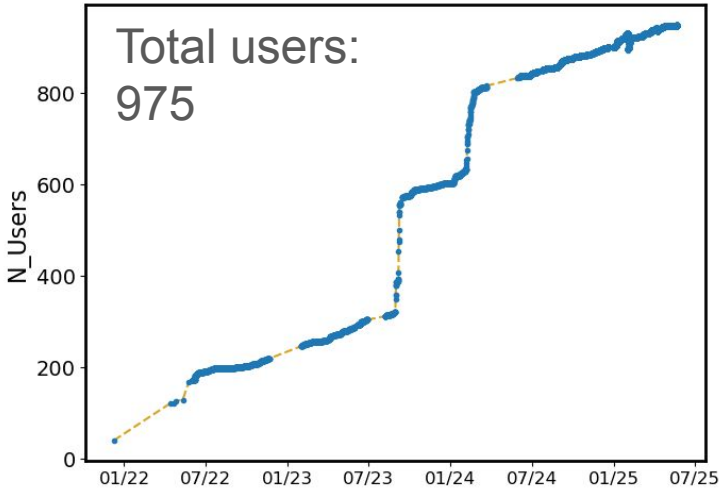
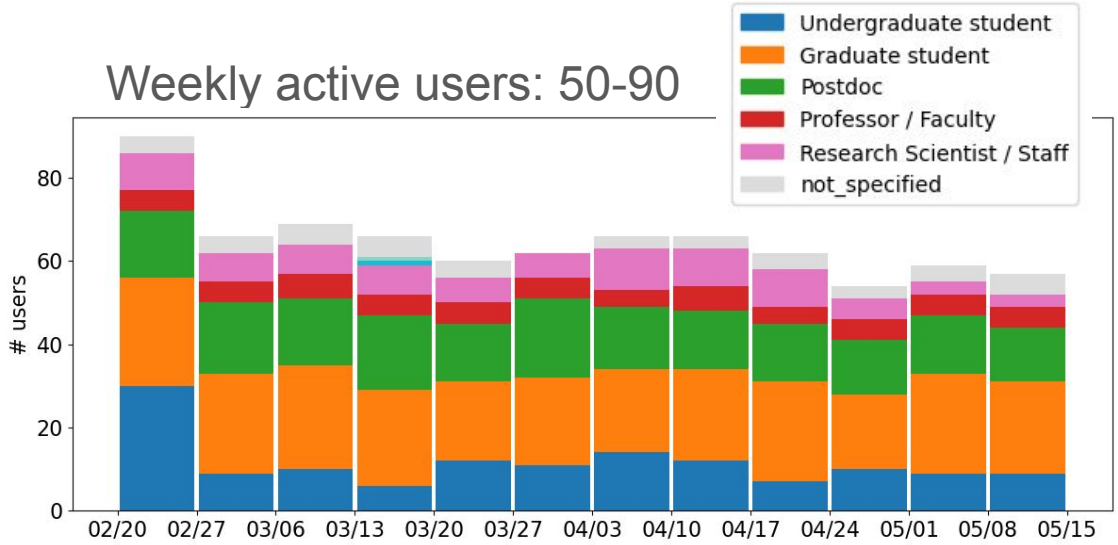


User base

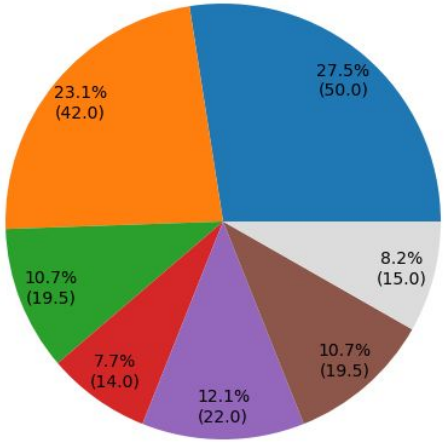
- Across all career stages





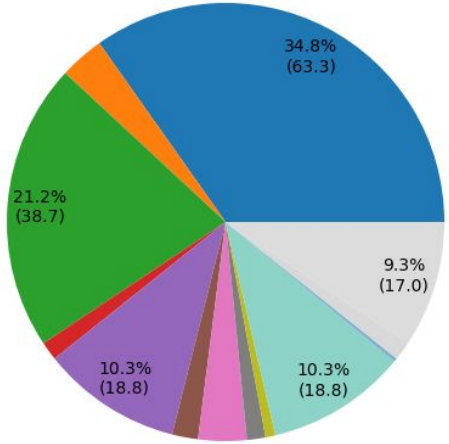
User base

- Across all departments and centers



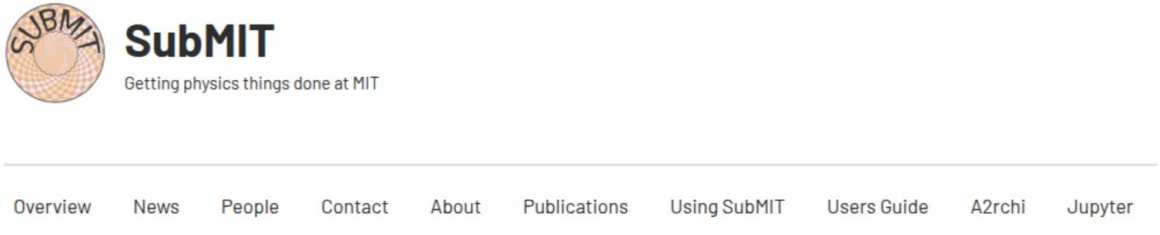
other (mainly undergrad)
Experimental Nuclear & Particle Physics
External to the physics department
Atomic, Biophysics, Condensed Matter, & Plasma Physics
Astrophysics
Theoretical Nuclear & Particle Physics
not_specified (early members that didn't fill out poll)

other (mainly undergrad)
NSF AI Institute for Artificial Intelligence and Fundamental Interactions (IAIFI)
Laboratory for Nuclear Science (LNS)
Research Laboratory of Electronics (RLE)
Kavli Institute for Astrophysics & Space Research (MKI)
Physics of Living Systems
Condensed Matter Theory Group (CMT)
Bates Research and Engineering Center
Laser Interferometer Gravitational Wave Observatory (LIGO)
Center for Theoretical Physics (CTP)
Materials Research Laboratory (MRL)
Plasma Science & Fusion Center (PSFC)
not_specified (early members that didn't fill out poll)



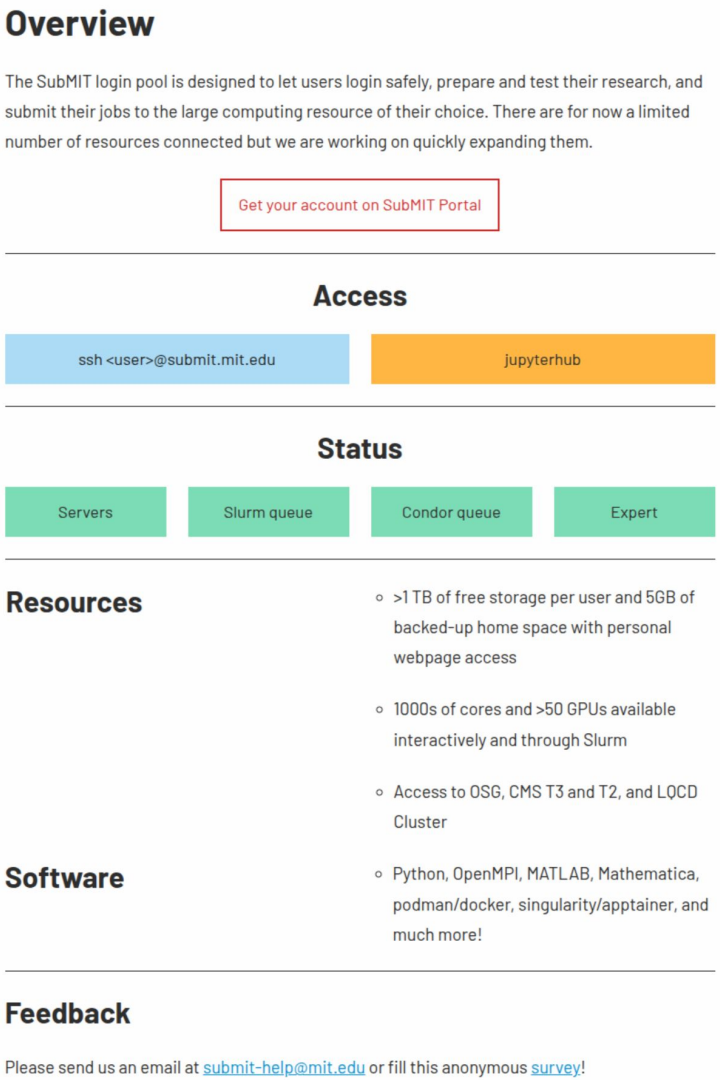
https://submit.mit.edu/

Webpage



Central access point

- Project description & overview
- Direct access to JupyterHub
- Monitoring system usage
- User support: Guide; A2rchi (LLM)
- News



https://submit.mit.edu/

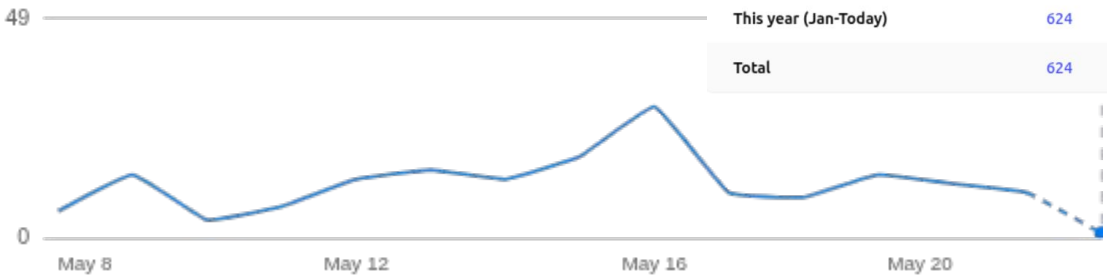
Webpage news: block posts

Reach out to users

- Gather information
- Inform about status of SubMIT
- Advertise meetings/ other useful information

Monitor webpage access

	Visitors	Views
Today	1	3
Yesterday	10	24
Last 7 days	85	1.57K
Last 30 days	447	3.71K
This year (Jan-Today)	624	4.12K
Total	624	4.12K



Introducing Globus on SubMIT

by **Xuejian Shen** – May 16, 2025

We are excited to announce that Globus data transfer services are now available on SubMIT. Globus provides a fast, secure, [...]

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Help Us Highlight SubMIT-Enabled Research

by **David Walter** – April 28, 2025

The SubMIT analysis facility was built to empower cutting-edge research in the Physics Department—and now we want to showcase the [...]

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System Maintenance Completed

by **Zhanqier Wang** – April 18, 2025

On Thursday afternoon, April 17, we performed scheduled system maintenance to apply a series of important upgrades. This required temporarily [...]

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How to scale your workflow on SubMIT

by **Matthew Heine** – April 7, 2025

A special SubMIT Users Meeting will take place Tuesday, April 22 at 10am in the Marlar Lounge (37-252) + Zoom. [...]

Continue reading »

Publications usings SubMIT

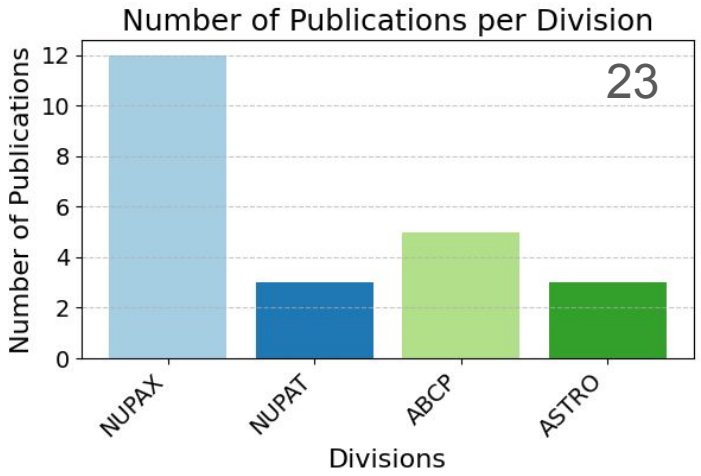
Based on user survey

2025 (6 ...)

- **F. E. Taylor**, *Determination of F_L at $x=Q^2/s$ with HERA data*, Phys. Rev. D 111, 052001, 2025. DOI.
  Division: Experimental Nuclear & Particle Physics | **Center:** LNS
- **J. F. Du Plessis, D. Pablos, and K. Rajagopal**, *Holographic Heavy Quark Energy Loss in the Hybrid Model*, 2025. arXiv.
  Division: Theoretical Nuclear & Particle Physics | **Center:** CTP
- **M. Geier, K. Nazaryan, T. Zaklama, and L. Fu**, *Is attention all you need to solve the correlated electron problem?*, 2025. arXiv.
  Division: Theoretical Condensed Matter Physics | **Center:** CMT
- **CMS Collaboration**, *Search for the Higgs boson decays to a ρ^0, ϕ, or K^{*0} meson and a photon in proton-proton collisions at $\sqrt{s}$ = 13 TeV*, Phys. Lett. B, 862, 139296, 2025. DOI.
  Division: Experimental Particle Physics | **Center:** LNS
- **CMS Collaboration**, *Measurement of inclusive and differential cross sections for W^+W^- production in proton-proton collisions at $\sqrt{s}$ = 13.6 TeV*, Phys. Lett. B, 861, 139231, 2025. DOI.
  Division: Experimental Particle Physics | **Center:** LNS
- **M. Kim, A. Timmel, L. Ju et al.**, *Topological chiral superconductivity beyond pairing in Fermi-liquid*, Phys. Rev. B, 111, 014508, 2025. DOI.
  Division: Theoretical Condensed Matter Physics | **Center:** CMT

2024 (13)

- **O. Kitouni, N. Nolte, V. Samuel Pérez-Díaz, et al.**, *From Neurons to Neutrons: A Case Study in Interpretability*, ICML, 2024. DOI.
  Division: Experimental Nuclear & Particle Physics | **Center:** IAIFI, LNS
- **S. Abe, T. Araki, K. Chiba et al.**, *Search for Majorana Neutrinos with the Complete KamLAND-Zen Dataset*, 2024. arXiv.
  Division: Experimental Nuclear & Particle Physics | **Center:** LNS
- **J. Du Plessis, Z. Janelidze, B. Wessels**, *A Primer on Chainmails: Structures for Point-free Connectivity*, 2024. arXiv.
  Division: Theoretical Nuclear & Particle Physics | **Center:** CTP
- **B. Binks, H. Guenther**, *TESSILATOR: a one-stop shop for measuring TESS rotation periods*, MNRAS, 533, 2024. DOI.
  Division: Astrophysics | **Center:** MKI
- **H. Guenther, P. Cheimetz, C. DeRoo et al.**, *Arcus X-ray telescope performance predictions and alignment requirements*, JATIS, 11, 2024. DOI.
  Division: Astrophysics | **Center:** MKI
- **J. Munoz, S. Udrescu, R. Garcia Ruiz**, *Discovering Nuclear Models from Symbolic Machine Learning*, 2024. arXiv.
  Division: Experimental Nuclear & Particle Physics | **Center:** IAIFI, LNS
- **J. Han, E. Lake, S. Ro**, *Scaling and localization in multipole-conserving diffusion*, Phys. Rev. Lett., 132, 137102, 2024. DOI.
  Division: Atomic, Biophysics, Condensed Matter & Plasma Physics | **Center:** Physics of Living Systems
- **M. Geier, F. Nathan**, *Self-correcting GKP qubit in a superconducting circuit with an oscillating voltage bias*, 2024. arXiv.
  Division: Theoretical Condensed Matter Physics | **Center:** CMT
- **CMS Collaboration**, *Search for soft unclustered energy patterns in proton-proton collisions at 13 TeV*, Phys. Rev. Lett., 133, 191902, 2024. DOI.
  Division: Experimental Particle Physics | **Center:** LNS
- **CMS Collaboration**, *High-precision measurement of the W boson mass with the CMS experiment at the LHC*, Submitted to Nature. arXiv.
  Division: Experimental Particle Physics | **Center:** LNS
- **G. Billis, J. Michel, F. Tackmann**, *Drell-Yan q_T spectrum at N^3LL' and approximate N^4LL with SCETlib*, 2024. arXiv.
  Division: Theoretical Nuclear & Particle Physics | **Center:** CTP
- **J. Villarreal, D. Winklehner, D. Koser and J. M Conrad**, *Neural networks as effective surrogate models of radio-frequency quadrupole particle accelerator simulations*, Mach. Learn.: Sci. Technol., 5, 025009, 2024. DOI.
  Division: Experimental Nuclear & Particle Physics | **Center:** PSFC
- **J.R. Pybus, T. Kolar, B. Devkota et al.**, *Search for axion-like particles through nuclear Primakoff production using the GlueX detector*, Phys. Lett. B, 855, 138790, 2024. DOI.
  Division: Experimental Nuclear & Particle Physics | **Center:** LNS

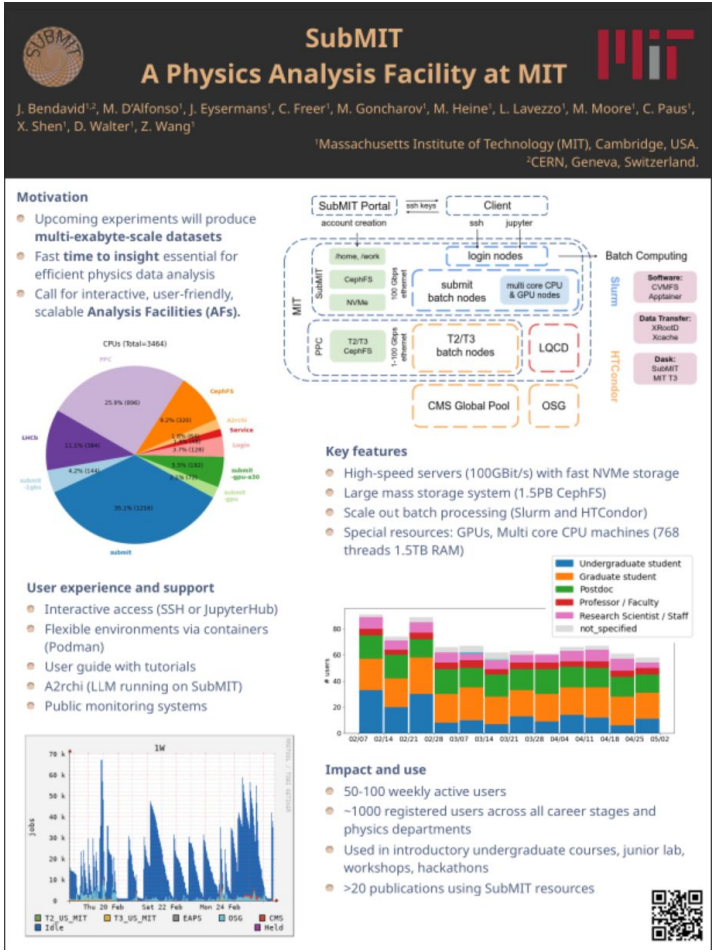


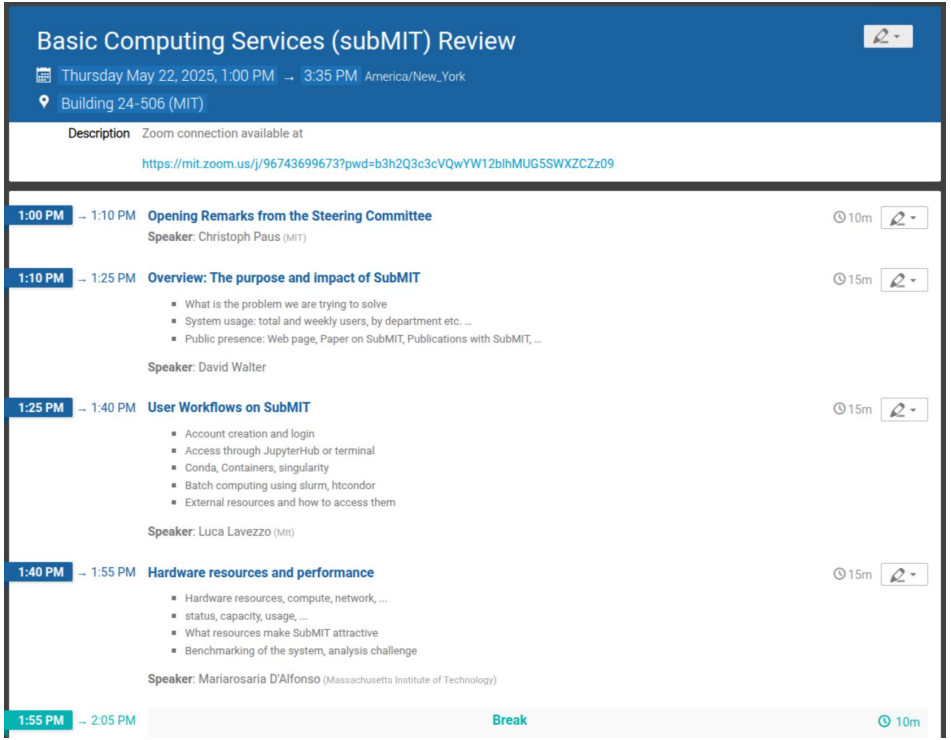
2023 (4)

- **H. Günther, P. Cheimets, E. Miller et al.**, *SPIE Proceedings Volume 12678, UV, X-Ray, and Gamma-Ray Space Instrumentation for Astronomy XXIII*, SPIE Proceedings, 12678, 126781D, 2023. DOI.
  Division: Astrophysics | **Center:** MKI
- **S. Liu, J. Miné-Hattab, M. Villemeur et al.**, *In vivo tracking of functionally tagged Rad51 unveils a robust strategy of homology search*, Nature Structural & Molecular Biology, 30, 1582–1591, 2023. DOI.
  Division: Biophysics | **Center:** Physics of Living Systems
- **CMS Collaboration**, *Search for direct production of a GeV scale resonance decaying to a pair of muons in proton-proton collisions at $\sqrt{s}$ = 13 TeV*, JHEP, 2023, 070. DOI.
  Division: Experimental Particle Physics | **Center:** LNS
- **CMS Collaboration**, *Measurement of $B_s^0 \rightarrow \mu^+\mu^-$ decay properties and search for the $B^0 \rightarrow \mu^+\mu^-$ decay in proton-proton collisions at $\sqrt{s}$ = 13 TeV*, Phys. Lett. B, 842, 137955, 2023. DOI.
  Division: Experimental Particle Physics | **Center:** LNS

Dissemination

- Publication about SubMIT
  - Submitted to arXiv
- Conference contributions
  - MIT postdoc poster symposium
  - Talk at High throughput computing 2025 (Madison, Wisconsin)
  - Talk at ACAT 2025 (Hamburg, Germany)
  - …





Basic Computing Services (subMIT) Review

Thursday May 22, 2025, 1:00 PM → 3:35 PM America/New_York

Building 24-506 (MIT)

Description Zoom connection available at

https://mit.zoom.us/j/96743699673?pwd=b3h2Q3c3cVQwYW12blhMUG5SWXZCZz09

1:00 PM → 1:10 PM **Opening Remarks from the Steering Committee** 10m

Speaker: Christoph Paus (MIT)

1:10 PM → 1:25 PM **Overview: The purpose and impact of SubMIT** 15m

- What is the problem we are trying to solve
- System usage: total and weekly users, by department etc. ...
- Public presence: Web page, Paper on SubMIT, Publications with SubMIT, ...

Speaker: David Walter

1:25 PM → 1:40 PM **User Workflows on SubMIT** 15m

- Account creation and login
- Access through JupyterHub or terminal
- Conda, Containers, singularity
- Batch computing using slurm, htcondor
- External resources and how to access them

Speaker: Luca Lavezzo (MIT)

1:40 PM → 1:55 PM **Hardware resources and performance** 15m

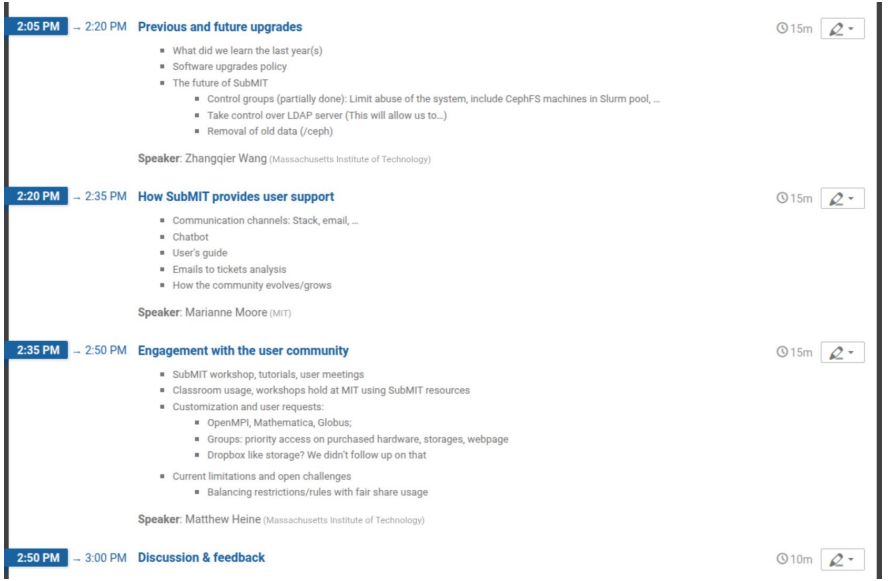
- Hardware resources, compute, network, ...
- status, capacity, usage, ...
- What resources make SubMIT attractive
- Benchmarking of the system, analysis challenge

Speaker: Mariarosaria D'Alfonso (Massachusetts Institute of Technology)

1:55 PM → 2:05 PM **Break** 10m

Today's agenda

- Don't hesitate to interrupt and discuss on specific topics



2:05 PM → 2:20 PM **Previous and future upgrades** 15m

- What did we learn the last year(s)
- Software upgrades policy
- The future of SubMIT
  - Control groups (partially done): Limit abuse of the system, include CephFS machines in Slurm pool, ...
  - Take control over LDAP server (This will allow us to...)
  - Removal of old data (/ceph)

Speaker: Zhangqier Wang (Massachusetts Institute of Technology)

2:20 PM → 2:35 PM **How SubMIT provides user support** 15m

- Communication channels: Stack, email, ...
- Chatbot
- User's guide
- Emails to tickets analysis
- How the community evolves/grows

Speaker: Marianne Moore (MIT)

2:35 PM → 2:50 PM **Engagement with the user community** 15m

- SubMIT workshop, tutorials, user meetings
- Classroom usage, workshops hold at MIT using SubMIT resources
- Customization and user requests:
  - OpenMPI, Mathematica, Globus;
  - Groups: priority access on purchased hardware, storages, webpage
  - Dropbox like storage? We didn't follow up on that
- Current limitations and open challenges
  - Balancing restrictions/rules with fair share usage

Speaker: Matthew Heine (Massachusetts Institute of Technology)

2:50 PM → 3:00 PM **Discussion & feedback** 10m

Backup