Host Labs' Computing Support Status

Brookhaven
National Laboratory

Jefferson Lab

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EIC-RRB May 6, 2024

EIC Computing and Software Joint Institute

- Brookhaven National Laboratory (**BNL**) and Thomas Jefferson National Accelerator Facility (**JLab**), as Electron-Ion Collider host labs, have established a collaborative entity, the **EIC Computing and Software Joint Institute** (**ECSJI**).
  - This joint institute is designed to support the computing and software needs and activities of the EIC.
  - The Institute was created fall of 2023

- ECSJI will leverage **complementary expertise at the two labs** and provide needed visibility to the respective lab management and stakeholders.
  - *The advantages of such a structure also include increased reliability and availability of resources for the ePIC collaboration and other future collaborations.*

- The success of the EIC, an international scientific endeavor, will benefit from contributions from international partners towards its computing effort.

- To facilitate efficient coordination, the Institute will administer the EIC International Computing Organization (EICO), which will include all the contributors to the EIC computing effort.
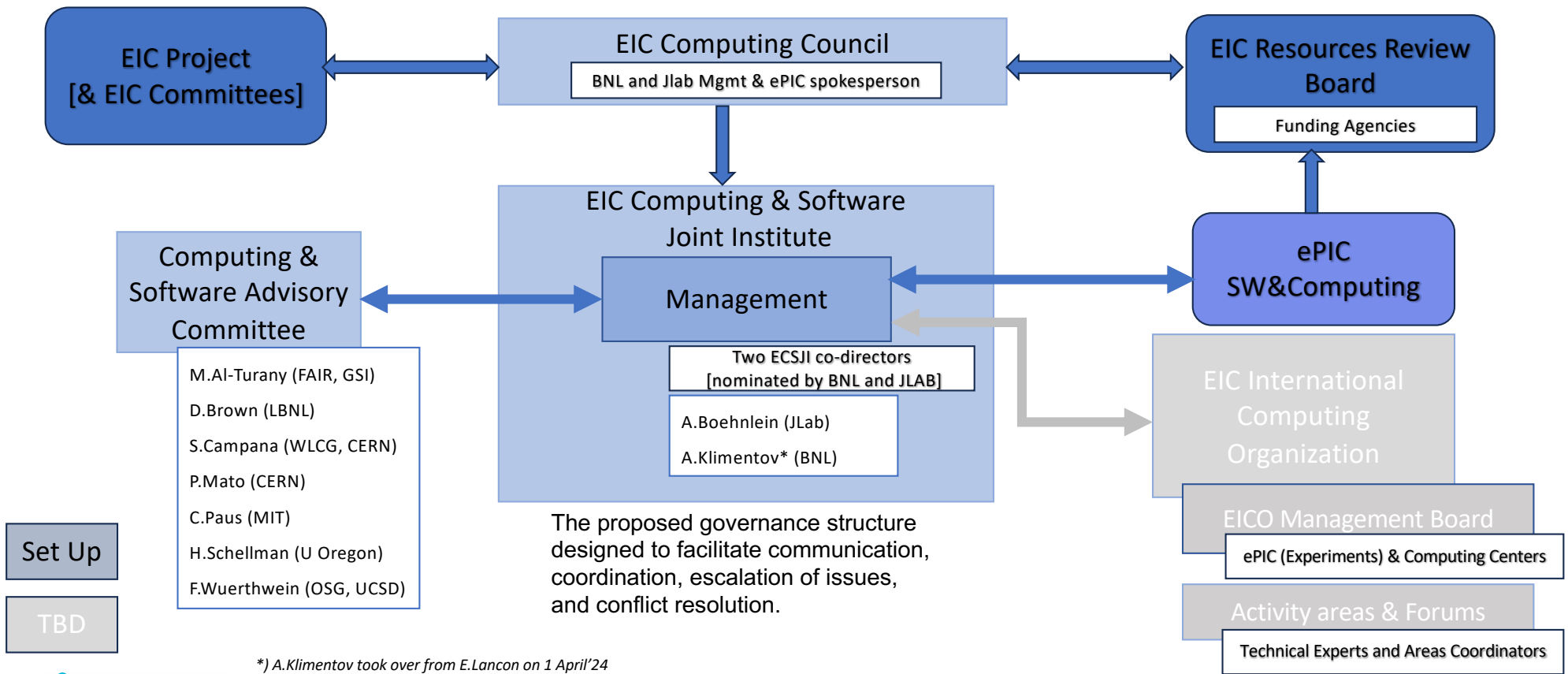
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ESCJI : Scope

The Institute will provide for EIC computing and software matters:

1) A single entity to interface with the EIC project, the ePIC collaboration, theoreticians, and future collaborators.

2) Execution of host lab technical computing responsibilities (slide 5).

3) Maintenance of service level agreements and statements of work outlining the host labs' contribution to the ePIC collaboration concerning computing resources, services, and personnel assigned to work on ePIC computing and software deliverables.

4) A coordinating body for interacting with international partners, providing computing resources as in-kind contributions, including:

   – Assessing resources.

   – Managing the agreements with the sites delivering resources (including service levels).

   – Facilitating and assessing the delivery against the agreements.

The scope may evolve over time and the organization of the institute as well

EIC Computing Organization & Governance

EIC Project [& EIC Committees]

EIC Computing Council
BNL and Jlab Mgmt & ePIC spokesperson

EIC Resources Review Board
Funding Agencies

Computing & Software Advisory Committee
- M.Al-Turany (FAIR, GSI)
- D.Brown (LBNL)
- S.Campana (WLCG, CERN)
- P.Mato (CERN)
- C.Paus (MIT)
- H.Schellman (U Oregon)
- F.Wuerthwein (OSG, UCSD)

EIC Computing & Software Joint Institute

Management

Two ECSJI co-directors [nominated by BNL and JLAB]
- A.Boehnlein (JLab)
- A.Klimentov* (BNL)

The proposed governance structure designed to facilitate communication, coordination, escalation of issues, and conflict resolution.

ePIC SW&Computing

EIC International Computing Organization

EICO Management Board
ePIC (Experiments) & Computing Centers

Activity areas & Forums
Technical Experts and Areas Coordinators

Set Up

TBD

*) A.Klimentov took over from E.Lancon on 1 April'24
Many thanks to Eric for his excellent work and his crucial role in setting up the Institute.

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The primary technical responsibilities of host Labs

Oversight for ePIC software and computing designs and execution to provide assurance functions for the host labs and DOE.

Provisioning and operating standard infrastructure solutions consistent with supported lab infrastructures and community best practices.

Support for the EIC International Computing Organization.

Interface for local resources and policies at the respective labs.

On-going computing operations in support of the accelerator and detector design and construction.

Operational support functions for:
- ✓ Experimental data curation.
- ✓ First-pass processing.
- ✓ Data analysis.
- ✓ Support of collaboration(s) and users.
- ✓ Accelerator and detector simulations .

EIC Computing Organization & Governance II

- ## Computing Council (ECC)
  - Review the ECSJI strategic direction and support leadership in managing effective interfaces of the ECSJI to the EIC project and ePIC collaboration.
  - Authority: Approve the ECSJI strategic direction, leadership changes, annual budgets, resource allocations, and performance milestones.

- ## The Institute Management [two co-directors, each nominated by one lab]

  - Regular meetings are organized with

    - ePIC management and ePIC software & computing coordinator

    - EIC co-directors of the experimental program

  - Duties and accountability:

    - *The management is responsible for organizing the Institute to deliver defined responsibilities.*

    - *The management will maintain a multi-year operation plan for the host labs, providing matrixed staff members to support activities.*

    - *Institute management will provide a yearly report to the host labs' management.*

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EIC Computing Organization. Computing and Software Advisory Committee

- **Computing and Software Advisory Committee** (ECSAC)
  - The **ECSAC's** role is to provide advice, guidance, and counsel on the strategy and objectives of the Institute and of the EIC International Computing Organization.
  - Strong connection to International Computing and Software community
    - ECSAC has members from US Laboratories, US Universities and International Laboratories (CERN, GSI)
  - The first review by ECSAC was held in October 2023, the second one will be organized by fall of 2024 to review ePIC computing model
    - *ECSAC October 2023 review recommendations*

M.Al-Turany (FAIR, GSI)

D.Brown (LBNL)

S.Campana (WLCG, CERN)

P.Mato (CERN)

C.Paus (MIT)

H.Schellman (U Oregon)

F.Wuerthwein (OSG, UCSD)

Recommendations:

We recommend that ECSJI verify the readiness of simulation and reconstruction for the TDR by May 2024.

We recommend that ePIC document a first computing needs assessment by the next ECSAC review, in roughly one year.

Recommendations:

We recommend that the ePIC collaboration start by the time of the next year's ECSAC review an evolving list of software dependencies that includes the packages, who the primary supporters are, and what the ePIC collaboration contributes to them.

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International Computing Organization (EICO)

- The EICO is still to be established, jointly with the international partners that are getting involved in EIC Computing (*no significant progress since December 2023*). The EICO is led by the Institute's co-directors and administered by the ECSJI. Its purpose is to provide computing resources and infrastructure to the ePIC collaboration and potentially address other computing needs related to the EIC.

    - EICO Management board composition : Reps from ePIC and International Partners
        - EICO Management Board provides the main technical directions for EIC Computing Technical Activity Areas
    - EICO organizes AHM and other meetings
    - EICO defines activity areas and technical forums
    - EICO collects ePIC requirements, produce accounting reports and supervises SLA

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EICO and ePIC Streaming Computing Model

[ePIC streaming computing model](#)* is a primary document for preparing MoUs with International partners (and to define roles for Computing Centers)

- Role of Echelon 2 and 3 centers may evolve with time

- Data placement and number of data replicas (data distribution between sites is TBD)

- ESCJI will organize ePIC Computing Model review by fall of 2024
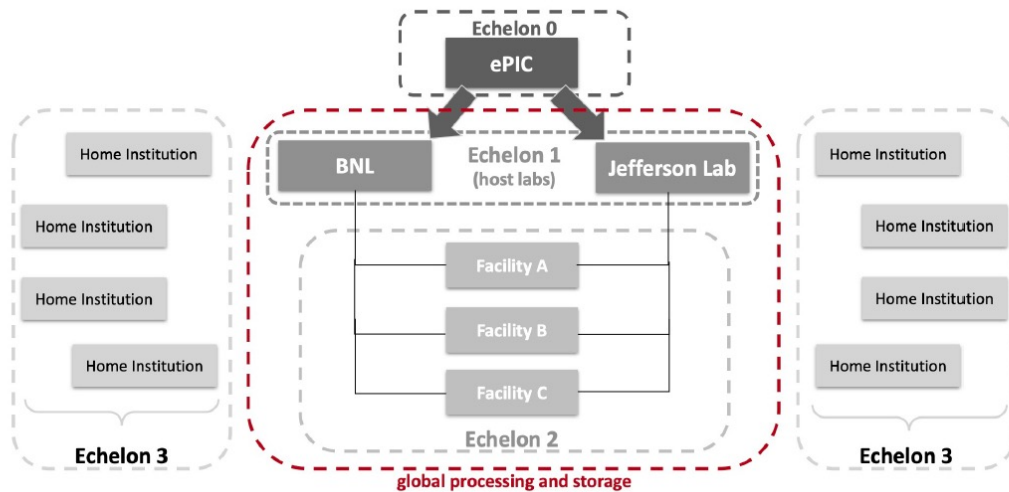
ePIC Streaming Computing Model (M.Diefenthaler talk)

2010

2015
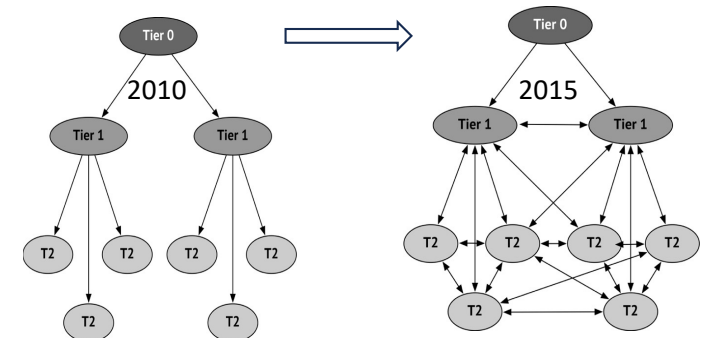
LHC Computing Model Evolution from Run1 to Run2 [reducing complexity. WAN bandwidth increased by x10 in 10 years and federated, network-centric computing is even more important for the future]

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EIC International Computing Organization Status

ECSJI and ePIC management are collaborating to define 'external partners' for inclusion in the drafting EICO charter.

- The ECSJI plans to apply for observer status to the WLCG
  - discussions with WLCG are in progress
    - ECSJI can get observer status at WLCG Management Meeting in May
    - Evolution of the WLCG towards a federation of autonomous computing institutes (LHC, DUNE, Belle II, EIC, SKA,…) is under discussion [WLCG long-term strategy and evolution will be discussed at DESY next week]
  - Utilization of WLCG network infrastructure by EIC computing is one of the first topics to be addressed
    - Relations with network providers are very important for NP&HEP computing (and bi-directional)

- HEP experiments are at the same scale as EIC computing, we must co-exist

- Cooperation and collaboration with WLCG (and FAIR) is beneficial and natural
  - It will let all experiments not to reinvent existing solutions
    - LCF/HPC and clouds integration into Computing Model
    - Use accelerators or/and co-processors for specific workflows
    - In addition new models of compute and storage provisioning may be arriving
      - e.g. dynamic composability of hardware and software systems, cluster co-processors etc., storage in the network (ESnet proposed R&D to evaluate data caching in the network)
        - Not forgetting quantum computing …
    - All of this requires significant investment in software and training, as well as policy, scheduling, infrastructure and service adaptations

- Infrastructures & centres likely to be common between HEP & NP (WLCG and EIC)

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EIC International Computing Organization Status. Cont'd

- In the fall of 2023 contacts with international partners in Italy, Canada and UK
  - Canada: Wouter Deconinck
  - Italy: Pietro Antonioli, Andrea Bressan, Domenico Elia
  - UK: Peter Jones, David Britton (GridPP)

- So far discussions covered the following points:
  - Organization of funding for Nuclear Physics (NP) computing at the national level.
  - Structure of computing for the EIC and for ePIC within each respective country.
  - Existing support and commitment for EIC computing.
  - Schedule and the specified level of contribution for formalizing contributions to EIC computing through agreements.
  - Follow-up discussions will be organized (aligned with EIC-RRB cadence)

- Computing centers of Italy, Canada and UK were already included in large-scale simulation efforts for the EIC.

Status and Computing Resources for EIC

Presently, support and computing resources for the EIC at BNL and JLab are provided mostly opportunistically

- – at Jefferson Lab, 2000 job slots and 1PB of storage allocated for the EIC, at BNL HPC cluster is set up to support EIC project

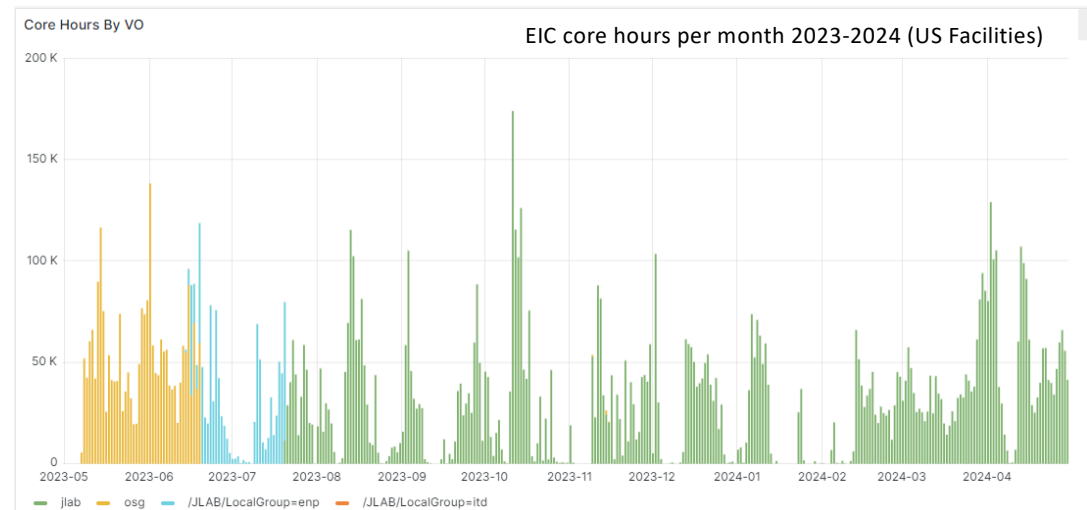- Local funding (*at limited scale*) is available at both Labs for computing and software development
- The EIC is using the Open Science Grid (OSG) and anticipating the inclusion of partners from WLCG-affiliated institutions and DOE ASCR Facilities
  - – EIC will use WLCG networking infrastructure : LHCOPN/LHCONE - one of areas where we need a discussion and collaboration with WLCG

Core Hours By VO — EIC core hours per month 2023-2024 (US Facilities)

jlab · osg · /JLAB/LocalGroup=enp · /JLAB/LocalGroup=itd

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Status and Computing Resources for EIC. Cont'd

- We started to integrate and leverage software, tools, and services developed by the WLCG community for EIC
  - Data Management and workflow management
    - Rucio for data management adopted by ePIC, de facto standard for HEP experiments @LHC and Belle II
    - PanDA for workflow management in use for AI based EIC detector design project funded by DOE NP, will be evaluated by ePIC
    - EIC Rucio instances are installed at BNL and JLab, PanDA instance is installed at BNL (available to ePIC and EIC project)
- Very promising discussion about AI/ML for EIC at BNL in April (AI/ML for detector design, DAQ, accelerator, analysis)
    - AI/ML for EIC is a well-developed activity area (cf. AI4EIC workshop series) with promising recent discussions to grow AI/ML activities further and provide support
- Ongoing discussion and prototyping of collaborative tools for ePIC (including comanage features)
  - User Database, Document Database, Document Development Platform, Web Hosting
    - *ePIC collaboration needs many collaborative tools to function that have to be realized and maintained. Since few of the available solutions fulfill all of ePICs requirement, the development of collaborative tools is required. These items are the responsibility of the hosting labs.*
- Ongoing discussion between the ePIC (DAQ, SW&C) and the Institute about computing model

SCIENTIFIC DATA MANAGEMENT

RUCIO

PanDA

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Talk Title Here

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Summary

- Strong support for EIC and ePIC computing in host laboratories

- Strong interest in EIC and ePIC computing in the scientific community (US and international).
  - This week's EIC RRB meeting, kindly hosted by INFN, gives us the opportunity to discuss the international aspects of EIC computing with our colleagues from many countries.

- BNL and JLab, as Electron-Ion Collider host labs, have established a collaborative entity, the EIC Computing and Software Joint Institute.
  - The Institute is an active participant in EIC and ePIC computing.

- The ECSJI Computing and Software Advisory Committee (with strong international participation) has been formed and conducted the first ePIC SW&C review in fall 2023.

- The first version of the ePIC streaming computing model is ready and will be reviewed by the ECSJI computing and advisory committee in fall 2024.
  - ePIC streaming computing model is a primary document for preparing MoUs with International partners (and to define roles for Computing Centers)

- The priorities for this year :
  - Organise ePIC computing model review
  - Identify possible international contributors
  - Work on the EIC International Computing Organization Charter
  - Work on agreements legal content, identify signing authorities in various countries
  - Establish accounting mechanism for contributions to EIC computing

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Backup Slides

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The EIC Computing and Software Joint Institute (ECSJI)

Brookhaven National Laboratory (BNL) and Thomas Jefferson National Accelerator Facility (JLab), as EIC host Labs, are creating a joint structure, the EIC Computing and Software Joint Institute (ECSJI), incorporating parts of BNL and JLab facilities to support the EIC and computing and software needs and activities. ECSJI will leverage complementary expertise at the two Labs and provide needed visibility to the respective Lab management and stakeholders. The advantages of such a structure also include increased reliability and availability of resources for the ePIC collaboration.

The success of the EIC, an international scientific endeavor, will benefit from contributions from international partners towards its computing effort. To facilitate efficient coordination, the institute will administer the EIC International Computing Organization (EICO), which will include all the contributors to the computing effort.

Scope of the EIC Computing and Software Joint Institute
This institute will provide for EIC computing and software matters:
1) A single entity to interface with the EIC project and the ePIC collaboration,
2) Maintains Service Level Agreements and statements of work outlining the host labs' contribution to the ePIC collaboration concerning computing resources, services, and personnel assigned to work on ePIC computing and software deliverables,
3) A coordinating body for interacting with international partners providing computing resources as in-kind contributions. This includes assessing resources, managing the MOUs with the sites delivering resources (including service levels), and facilitating and assessing the delivery against the MOUs,
4) Execution of host Lab responsibilities as detailed below.

Organization & Governance
The institute aims at providing efficient support to the EIC while acknowledging the differences in the organization at the two Labs. The proposed governance model ensures that the EIC experiment(s) are well supported in matters of computing and software, the institutes' performance is monitored, and reporting is clearly defined.

The Institute Management
- *Composition:* the management will comprise two co-Directors; each is nominated by one Lab. The co-directors are currently Eric Lancon (BNL) and Amber Boehnlein (JLab).
- *Reporting:* the institute's management will report jointly to the two host Lab management.
- *Duties and accountability:*
  - The management will be responsible for organizing the institute to deliver on the responsibilities defined above.
  - The management will maintain a multi-year operation plan for the host Labs, providing matrixed staff members to support the activities.
  - The management will provide a yearly report to the host Lab's management.

1

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Lancon, Eric | elancon@bnl.gov

Responsibilities
The Host Lab's Responsibilities
The primary technical responsibilities of host Labs include and are not limited to the following:
- Oversight for ePIC software and computing designs and execution to provide assurance functions for the host Labs and DOE,
- Provisioning and operating standard infrastructure solutions consistent with supported Lab infrastructures and with community best practices,
- Support for the EICO,
- Interface for local resources and policies at the respective Labs,
- On-going computing operations in support of the accelerator and detectors design and construction,
- Operational Support Functions for:
  - Experimental data curation,
  - First-pass processing,
  - Data analysis,
  - Support of collaboration(s) and users,
  - Accelerator and detector simulations.

ePIC Collaboration Responsibilities
The ePIC collaboration responsibilities include and are not limited to the following:
- Developing and documenting a cost-effective computing model tailored to the experiment's needs, with the concurrence of the host Labs,
- Developing and maintaining multi-year resource plans,
- Report ePIC status in computing and software to the EIC-RRB,
- Identifying with input from the host Labs, a Computing and Software coordinator who serves as Point of Contact to ECSJI,
- Developments of Software Algorithms,
- Production operations.

Haiyan Gao
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Haiyan Gao
Associate Laboratory Director
Brookhaven National Laboratory

David J. Dean
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David J. Dean
Deputy Director for Science
Jefferson Lab

The recommendations from the fall 2023 ECSAC review

Recommendations:

We recommend that ECSJI verify the readiness of simulation and reconstruction for the TDR by May 2024.

We recommend that ePIC document a first computing needs assessment by the next ECSAC review, in roughly one year.

Recommendations:

We recommend that the ePIC collaboration start by the time of the next year's ECSAC review an evolving list of software dependencies that includes the packages, who the primary supporters are, and what the ePIC collaboration contributes to them.

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Canadian infrastructure available for the EIC

- Digital Research Alliance of Canada: National computing resources supporting both HPC and HTC workflows
  - Operated through regional consortia
  - EIC Canada's computing contribution is operated by staff from Prairies, one of the five regional organizations

- *Annual resource allocation* competitions (with fast-track continuance option), Peer review process of access

- EIC Canada has held active allocation for 4 years
  - ~50 core-years/year, 100 TB during proposal and initial ePIC development phase
  - Supported majority of ATHENA simulations until Open Science Grid (5k-10k core-years)
  - Primary use for EIC Canada researchers and for international contribution proof of concepts

Digital Research Alliance of Canada | **Alliance de recherche numérique** du Canada

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Future? - Canadian infrastructure available for the EIC

- Canada aims for approximately 10% of the U.S. contribution to EIC computing.

- In the future, EIC Canada could have the opportunity to make a contribution through dedicated infrastructure.
  - Precedent exists in ATLAS Canadian Tier-1 located at Simon Fraser University (SFU).
  - SFU leads a consortium of Canadian institutions, including TRIUMF, operating the Tier-1 Data Centre, which receives funding from the Canada Foundation for Innovation (CFI).

- For EIC Canada to expand with dedicated "Tier-1"-like resources, a formal proposal is anticipated after the completion of detector subsystem construction (also requested of CFI).

Italian infrastructure available for the EIC

Andrea Bressan

- INFN operates its own Grid and Cloud services:

  - Nine medium-sized centers
  - One large national center at CNAF (Bologna) collocated with LEONARDO (pre-exascale supercomputer)
  - Successfully contributing to the WLCG for two decades and will support the LHC in the High Luminosity area

- A major national initiative has recently been approved: ICSC
  - National Research Centre for High-Performance Computing, Big Data, and Quantum Computing
  - The EIC could benefit from this global infrastructure

- Modest resources are available for EIC until detector construction is completed

- Italian EIC community has been yearly applying (and getting approved) for a share at CNAF since 2020

- Aiming at contributing at the level of ~10% to EIC computing effort
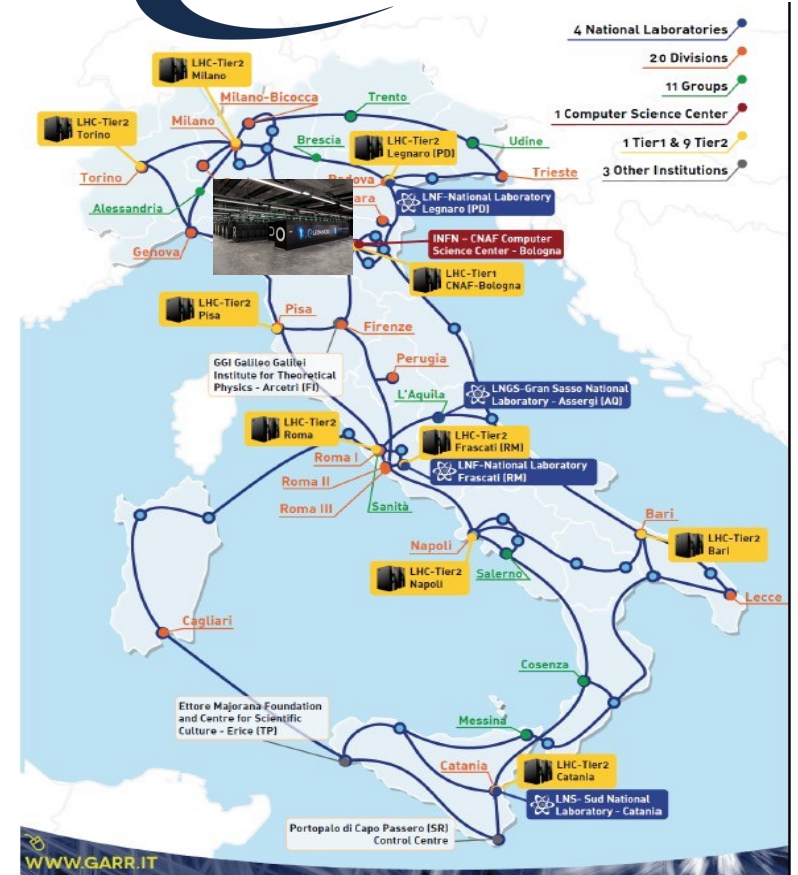
UK infrastructure available for the EIC

- Science and Technology Facilities Council (STFC)
  - Part of UK Research and Innovation (UKRI)
  - Supports research in Nuclear Physics, Particle Physics and Astronomy
  - IRIS project set up in 2018 to improve federation of STFC digital infrastructure
  - Infrastructure partners include **GridPP** (High Throughput Computing) and **DiRAC** (High Performance Computing), amongst others
  - **GridPP** supports HTC needs of nuclear and particle physics, in particular the UK's contribution to the WLCG but also non-LHC experiments

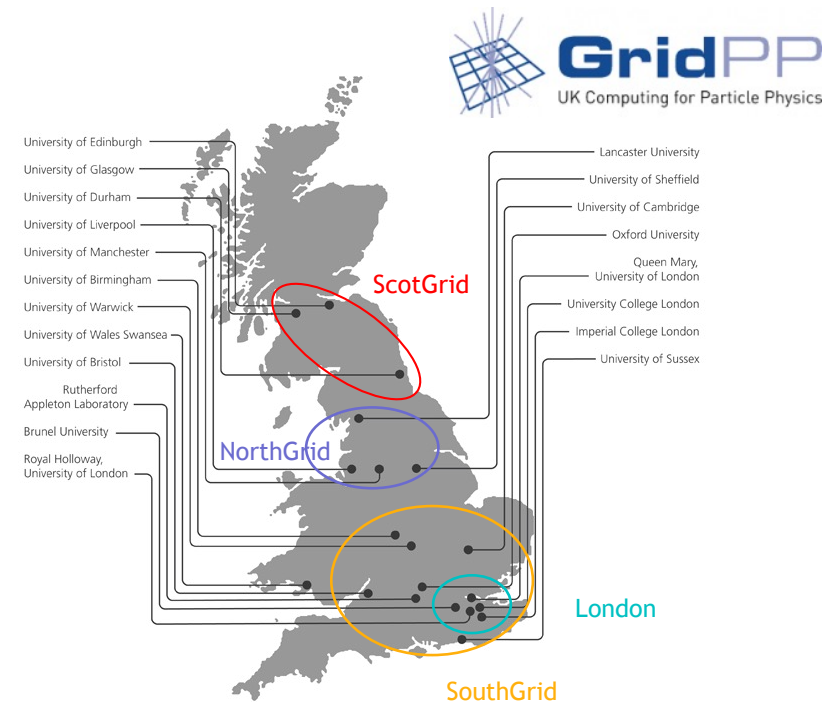www.ukri.org/councils/stfc/   www.iris.ac.uk   www.gridpp.ac.uk
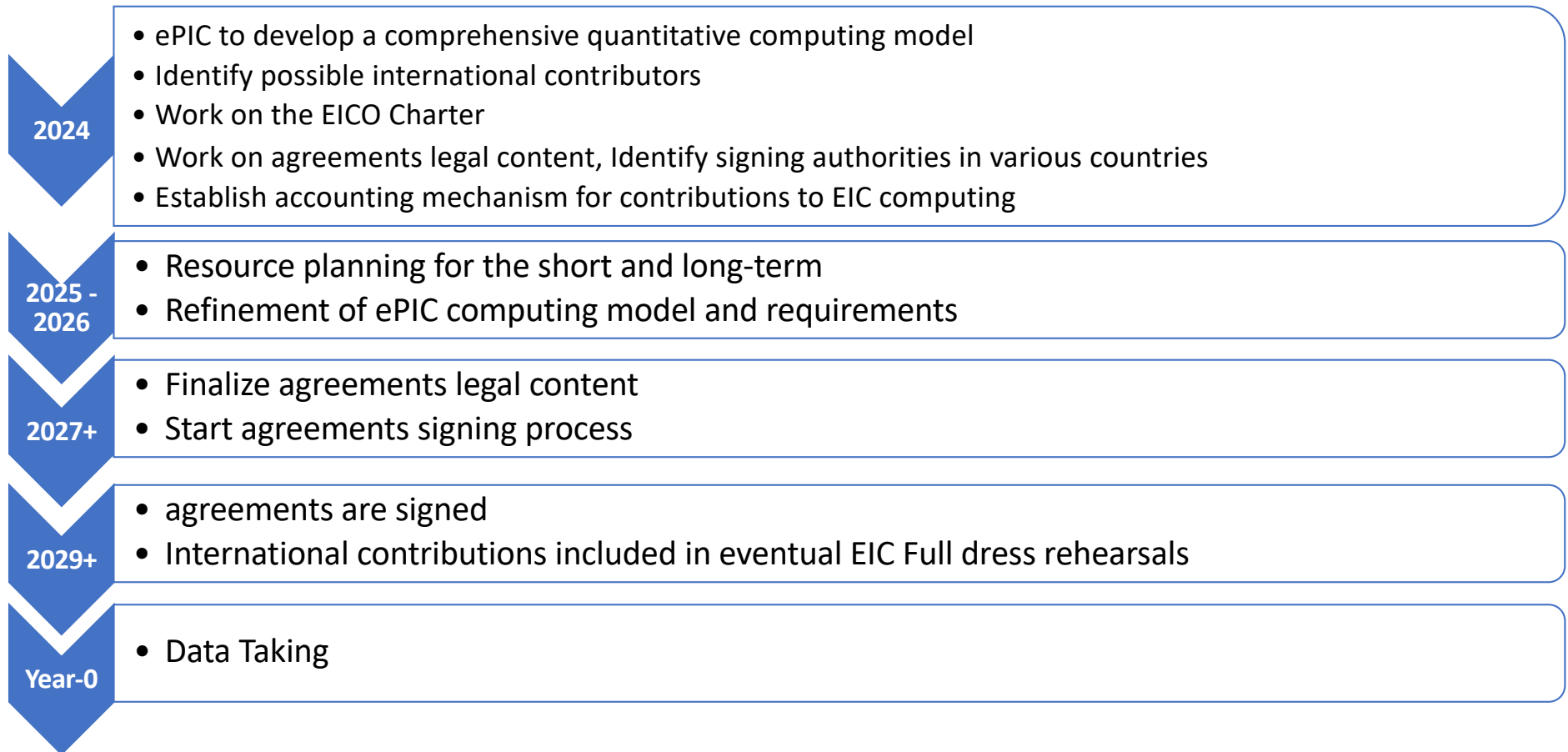
UK contribution to the EIC

- 10% of GridPP resources are available to non-LHC experiments – EIC can request a share for development

- The resource is allocated through IRIS

- Future planning assumes EIC will apply for funding for its own allocation potentially starting in FY28/29, to be implemented by GridPP (e.g., as an extension of the Tier-1 site at RAL)

- Exploiting synergies with WLCG data management is highly desirable

- Aiming to provide a fair share percentage of EIC computing resources (TBD)

GridPP federates the Rutherford Appleton Laboratory (RAL) Tier-1 site and 16 Tier-2 sites

Proposed computing agreements timeline

2024
- ePIC to develop a comprehensive quantitative computing model
- Identify possible international contributors
- Work on the EICO Charter
- Work on agreements legal content, Identify signing authorities in various countries
- Establish accounting mechanism for contributions to EIC computing

2025 - 2026
- Resource planning for the short and long-term
- Refinement of ePIC computing model and requirements

2027+
- Finalize agreements legal content
- Start agreements signing process

2029+
- agreements are signed
- International contributions included in eventual EIC Full dress rehearsals

Year-0
- Data Taking

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Glossary and Abbreviations

- AHM – All Hands Meeting
- AI4EIC --- Artificial Intelligence for the Electron Ion Collider
- ECC - EIC Computing Council
- EICO – EIC International Computing Organization
- ESCJI – EIC Software and Computing Joint Institute
- LHCONE – LHC Virtual Overlay on national academic networks – managed by NRENs
  - Also used by many other "HEP & related" experiments
- LHCOPN – LHC Optical Private Network (connects CERN and WLCG T1 centers)
- OSG – Open Science Grid
- PanDA – Workflow Workload Management System (**P**roduction **an**d **D**istributed **A**nalysis)
- Rucio – Scientific Data Management System
- SLA – Service Level Agreement
- WLCG – World LHC Computing Grid

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