MEMORANDUM OF UNDERSTANDING

between

The University of Tokyo,
Information Technology Center

and

The Regents of the University of California, as Management and Operating Contractor for Lawrence Berkeley National Laboratory

Concerning Collaboration on High Performance Computing, Computational Science and Engineering

This Memorandum of Understanding (MOU) is between the University of Tokyo, Information Technology Center (UTokyo), with a registered address at 2-11-16 Yayoi, Bunkyo-ku, Tokyo 113-8658, Japan, and The Regents of the University of California, in its capacity as the manager and operator of the Lawrence Berkeley National Laboratory(LBNL), with a registered address at One Cyclotron Road, Berkeley, CA 94720, USA. UTokyo and The Regents are referred to collectively as "Participants" or individually as "Participant."

1. Objective

The Participants recognize the benefits to be derived from increased collaboration, cooperation, and interaction for the promotion and understanding of high performance computing (HPC), computational science, and engineering (hereafter collectively referred to as the "Field").

The purpose of this MOU is to foster collaboration between UTokyo and LBNL in the Field with a view to benefiting from each other's initiatives and working procedures and to support potential collaboration among the researchers associated with both Participants.

2. Proposed Forms of Cooperation

The Participants intend to pursue collaboration on fundamental academic research related to HPC, computational science, and optimization of applications performance on HPC systems, with any future collaborative research to be undertaken pursuant to an appropriate written agreement therefor. More specifically, Participants intend to:

2.1 Provide mutual access to facilities for the fundamental academic research related to numerical libraries and scientific applications. Any such activities, including any employee exchanges mentioned in 2.3 below, are subject to compliance with the access requirements of the receiving Participant.

2.2 Encourage collaboration on projects involving scientists, engineers, and personnel from the user communities associated with each Participant.

2.3 Offer an employee exchange opportunity intended to share and further the scientific and technical know-how of both Participants.

3. Areas of Collaboration

The Participants intend to collaborate in one or more of the following areas:

3.1 Numerical libraries for scientific computation

- Evaluate performance and robustness of numerical libraries for scientific computation in the Participants' respective facilities, such as "Xabclib", "ppOpen-HPC," and the "DOE ACTS Collection"

3.2 Couplers for multi-physics simulations

- Exchange information on couplers for multi-physics simulations, especially in geophysics

3.3 Scientific computing benchmarks

- Exchange information on scientific computing benchmarks for research of performance of HPC systems

3.4 Parallel programming models for post-peta/exascale systems

- Exchange information on future parallel programming models for post-peta/excascale systems, such as flat MPI, OpenMP/MPI hybrid, OpenACC and others.
- Develop models for performance analysis and estimation on scientific applications using various types of parallel programming models

3.5 Auto-tuning technologies on scientific computing

- Exchange information on auto-tuning technologies for optimization of sparse matrix computation kernels, and algorithmic parameters on sparse and dense matrix libraries

3.6 Parallel algorithms for eigenvalue calculations and sparse direct/iterative solvers for systems of linear equations

- Exchange information on parallel algorithms for sparse and dense eigenvalue calculations
- Exchange information on parallel direct algorithms for the solution of sparse linear systems
- Exchange information on parallel iterative preconditioning methods for the solution of sparse linear systems
- Exchange information on fault-tolerant algorithms for parallel linear solvers
- Exchange information on performance models for parallel linear solvers

3.7 Runtime System for Post-peta/Exascale Systems

- Exchange information on communication and parallel file I/O systems.

4. General Considerations

This MOU does not create any legally binding obligations between the Participants.

4.1The conduct of collaborative research and development is to be conducted under appropriate written agreements or contracts.

4.2 Treatment of intellectual property rights developed through collaborations under this MOU should be determined between the Participants through mutual consultation and separate written agreements on a case-by-case basis.

4.3 Each Participant should conduct the cooperation under this MOU in accordance with all applicable laws, regulations and other requirements to which it is subject, and international agreements to which its Government is party, including, without limitation, export control laws and environment, health and safety laws and regulations.

4.4 The conduct of cooperative activities contemplated by this MOU is subject to the availability of funding, personnel, and other resources.

4.5 Each Participant is responsible for the costs it incurs in participating in cooperative activities under this MOU.

5. Exchange of Information

The Participants do not anticipate the need to exchange any business-confidential information. If the Participants decide that a particular activity may lead to the exchange of business-confidential information, they should consult with each other and make appropriate written arrangements for the protection of such information.

6. Commencement, Modification and Discontinuation

6.1 Cooperative activities under this MOU may commence upon signature and continue for a period of three (3) years unless discontinued in accordance with paragraph 6.2.

6.2 The Participants may discontinue this MOU at any time by mutual written consent. Alternatively, a Participant that wishes to discontinue its participation in this MOU should endeavor to provide at least thirty (30) days written notice to the other Participant.

6.3 This MOU may be modified or extended for additional periods by mutual written consent of the Participants.

Signed in duplicate.

For The University of Tokyo, Information Technology Center:	For The Regents of the University of California:
By H. Nakamura	By Michael Witherell
Prof. Hiroshi Nakamura	Michael Witherell
Director	Laboratory Director
Date April 21, 2016	Date March 21, 2016
Place Tokyo JAPAN	Place Berkeley, CA, USA