MULTILATERAL

MEMORANDUM OF UNDERSTANDING

For the Deployment, Operation and Security
of the Belle II Computing Grid

Among the Institutions listed in Appendix 2

8th January 2014

<div align="center">**MEMORANDUM OF UNDERSTANDING**</div>

1. Preamble

The Belle II experiment will operate at the SuperKEKB accelerator at KEK in Tsukuba, Japan. The data taking is scheduled to start in 2016, after the completion of the accelerator and the detector. Belle II plans to use computing resources at remote computer centres, in addition to KEK, with the help of the Grid Computing technology, termed the Belle II Computing Grid, to meet the anticipated needs of the experiment. The purpose of the Belle II Computing Grid is to provide the computing resources needed to process and analyse the data gathered by the experiment, through the establishment of the Grid infrastructure by assembling multiple inter-networked computer centres. It has been found useful to classify the computer centres in Tiers according to their functions and responsibilities (see Appendix 1). Tier0 is at KEK, the Host Laboratory. It holds the responsibility of receiving raw data from the experiment and of recording them to the permanent storage. Tier1 Centres provide grid-enabled data service to receive data from Tier0, and may archive a copy of raw data in their permanent storage. They are also responsible for regional support for Grid Operations. Tier2 Centres play a major role in simulation and end-user analysis, which are also performed at Tier0 and Tier1 Centres.

An agreement to deploy and operate the computer centres in the Belle II Computing Grid is made through the conclusion of this Memorandum of Understanding ("MoU"), which defines the Belle II Computing Grid and its objectives, and the rights and obligations of the participating Institutions (hereafter referred to as "the Members") that provide computing resources. This MoU is not legally binding, but the Members shall make their best effort to serve the Belle II Computing infrastructure. Participating Institutions are anticipated to have a separate agreement to define the amount of computing resources that they will provide over years.

2. Purpose

The purpose of this MoU is to establish a management agreement regarding the deployment, operation and security of the Belle II Computing Grid, and to define the responsibilities of the Members.

3. Duration

3.1 The initial period of validity of this MoU governs the expected term of the construction and operation phase of the Belle II experiment, i.e. from the date hereof until 31 December 2022.

3.2 The validity of this MoU shall be extended automatically, each time by a period of two years, except in the case where any of the Members shall determine otherwise.

Notwithstanding this provision, this MoU shall terminate if and when the Belle II experiment programme is declared closed by KEK.

3.3 Any Institution that wishes to join the Belle II Computing Grid shall accept this MoU and any related agreement that is disclosed and that is in place between the Members. In order to (continue to) qualify for membership of the Belle II Computing Grid, each Institution shall comply with the minimal levels-of-service criteria (hereinafter referred to as "Computing Resources and Service Levels") specified in Appendix 3. Initial signatories shall comply with the Computing Resources and Service Levels at least one year prior to the start of the physics run foreseen in 2016.

3.4 The Institutions are expected to remain the Members of the Belle II Computing Grid for the duration of the Belle II experiment programme. In particular, the long-term commitment of Tier1 Centres is crucial to maintain the Belle II Grid infrastructure. Nevertheless, any Institution may withdraw from the Members of the Belle II Computing Grid, by giving not less than twelve months' notice in writing to the other Members. In such an event, the Institution shall make alternative storage arrangements with other Members and move its unique data to them before closing access.

4. The Aims of Belle II Computing Grid

4.1 The Institutions shall pledge "Resources" and "Services" separately, specifying all of the parameters relevant to each element (e.g. size, speed, number, effort, as the case may be). As far as possible they shall associate with each element key qualitative measures such as reliability, availability and responsiveness to problems.

4.1.1 "Resources" shall be specified for each Institution by the needs of the computing model of the Belle II experiment. However, the minimal resource levels for each Tier Centres are defined by this MoU from the operational point of view, which are detailed in Appendix 3.

- Processing capacity.

- Grid-enabled data storage capacity. Performance of data access to the storage shall be also ensured.

- Networking. It is important for the grid that each Institution provides appropriate network capacity to other Institutions for the data transfer.

4.1.2 "Services"

- All Members of the Belle II Computing Grid shall agree the list of common software to be installed and maintained, updating the list from time to time as may be necessary to match the needs of the Belle II experiment. If and when any software cannot be installed for technical or operational reasons, alternative

solutions shall be negotiated through the Belle II Collaboration and the Belle II Computing Grid.

- The specific responsibilities of KEK as the Host Laboratory for the Belle II Computing Grid are detailed in Appendix 3.1. The responsibilities of the Institutions that provide Tier1 (Tier2) Centres are described in Appendix 3.2 (3.3).

- Grid Operations Services, which shall be served in most cases by Tier0 and Tier1 Centres, are described in Appendix 3.4. The integrity of Grid Operations services must be preserved.

5. Communications

Frequent communications are essential to ensure the successful management and operation of the Belle II Computing Grid. All Members agree to designate and provide contact information for managerial and technical leads for their respective systems. In addition, the Members agree to safeguard the confidentiality, integrity and availability of the connected systems and provide notice of specific events within the time frames indicated below:

- **Security Incidents.** Members must immediately notify the Belle II Computing Grid by telephone and/or email when a security incident(s) is detected, so other Members can take steps to determine whether any systems have been compromised and take appropriate security precautions. The compromised site must inform the other Members by email of the closure/disposition of the incident and any follow on activity that is needed as well as lessons learned. Members should also follow the security procedures provided by the existing grid infrastructure, and use them to control the incident.

- **Disasters and Other Contingencies.** Members must immediately notify the Belle II Computing Grid by telephone and/or email in the event of a disaster or other contingency that disrupts the normal operation of the connected systems.

- **Changes to System Configurations.** Planned technical changes to the system architecture with the potential for security impact must be reported to other Members before such changes are implemented. The initiating Member must conduct a risk assessment based on the change, as appropriate.

- **Personnel Changes.** The Members shall provide notification of the separation or long-term absence of their respective technical lead and/or any changes in their point of contact information.

- **Maintenance**. Each Member shall inform the appropriate contacts of the other Members of normally scheduled or emergency downtime including maintenance and upgrades that would affect the availability of the computer centre. The period of scheduled downtime is to be

notified to the other Members not less than 48 hours before. If the downtime will last longer than 1 week, the Institution must consult the Belle II Computing Grid.

All Members agree to work together to ensure the joint security of the connected systems. The concrete procedure for these events is given in the Belle II Grid web site. The contact addresses of the Members are listed in Appendix 4.

6. Amendments

6.1 All Members of the Belle II Computing Grid shall make every effort to ensure that the information contained in the Appendices hereto is kept up-to-date.

6.2 This MoU may be amended any time with the agreement of the Members in writing.

7. Liability

7.1 The Members shall have no liability towards each other for any loss or damage resulting from their use of the Belle II Computing Grid and related computing resources.

7.2 For the avoidance of doubt, it is understood that KEK is under no obligation to provide insurance cover for any of the Members, including in particular third party liability cover.

8. Appendices

All the Appendices are an integral part of the MoU. They are understood to be the planning basis for the deployment and operations of the Belle II Computing Grid. All of the Appendices are subject to update as provided for in the paragraph 6.1.

The following Institution agrees to become a Party to the 8 January 2014 Memorandum of Understanding for the Deployment, Operation and Security of the Belle II Computing Grid.

Institution:

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Signatory Name:

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Signature:

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Date:

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Appendix 1: Categorization of Computer Centres

In Belle II computing model, the computer centres are categorized according to their roles and responsibilities as listed below:

- **Raw Data Centre**: This is where raw data from the experiment is recorded and (re)processed. It also serves as "Regional Data Centre" and as "MC Production Site", both of which are described below. A full set of the raw data is archived on permanent storage in two Raw Data Centres for redundancy, one at High Energy Accelerator Research Organization (KEK) in Japan, the Host Laboratory, and the other at Pacific Northwest National Laboratory (PNNL) in U.S.A.
  - ➢ **KEK Data Centre**: receives and processes raw data from the online system of the experiment, and sends all the raw data to PNNL.
  - ➢ **PNNL Data Centre**: receives and processes the copy of raw data from KEK Data Centre. In addition, raw data will be reprocessed when necessary.
- **Regional Data Centre**: Large computing centre where a copy of reconstructed data from Raw Data Centres is stored. Regional Data Centre also serves as MC production site.
- **MC Production Site**: Computing centre where Monte-Carlo (MC) data is produced. End-user analysis is performed as well. All computing centres except Raw Data Centres and Regional Data Centres are categorized into this.

This categorization represents major roles of computer centres, but it is slightly unclear to understand the relationship between the categories. For simplicity and from operational point of view, it is more convenient to classify the computer centres in Tiers. Hereafter, KEK Data Centre is called Tier0 Centre, PNNL Data Centre and Regional Data Centres are called Tier1 Centres, and MC Production Sites are called Tier2 Centres.

Appendix 2: List of Signatory Partner Organizations

- Tier0 Centre
    - High Energy Accelerator Research Organization (KEK), Japan

- Tier1 Centres
    - Pacific Northwest National Laboratory (PNNL), U.S.A
    - Karlsruhe Institute of Technology (KIT), Germany
    - Istituto Nazionale di Fisica Nucleare (INFN) Tier1 Center (CNAF), Italy

- Tier2 Centres
    - Deutsches Elektronen-Synchrotron (DESY), Germany
    - INFN Belle II Tier2 Federation, Italy
    - Korea Institute of Science and Technology Information (KISTI), Korea
    - Institute of High Energy Physics, Austrian Academy of Sciences, Austria
    - Jozef Stefan Institute (JSI), Slovenia

Appendix 3: Minimal Computing Resource and Service Levels to quality for membership of the Belle II Computing Grid

This Appendix describes the computing resource and service levels to be provided by the Host Laboratory (KEK), Tier1 and Tier2 Centres in order to fulfil their obligations to this MoU. Also described are the qualitative aspects of Grid Operations Services. All computer centres shall provide and support the Grid services and associated software, as requested by the Belle II experiment and agreed by the Belle II Computing Grid. A computer centre may also support additional Grid services.

Appendix 3.1: Host Laboratory services

The Host Laboratory shall supply the following services to support the offline computing system of the Belle II experiment according to the computing model.

i. Operation of the Tier0 computing facility providing:
> 1. high bandwidth network connectivity from the experimental area to the offline computing facility;
> 2. permanent storage in a mass storage system to archive one copy of the raw data throughout the lifetime of the Belle II experiment;
> 3. event reconstruction according to policies agreed with the Belle II experiment;
> 4. storage of the reconstructed data on disk and in a mass storage system;
> 5. distribution of an agreed share of the raw and reconstructed data to Tier1 and Tier2 Centres.

ii. Operation of a high performance, data-intensive analysis facility. Its services include end-user analysis and simulation without permanent storage.

iii. Coordination of the network operations between the Host Laboratory and other computer centres, in collaboration with national research networks and international research networking organisations.

iv. Administration of databases used to store physics data and associated meta-data.

v. Infrastructure for the administration of the Virtual Organisation (VO) associated with the Belle II Experiment.

vi. Overall management and coordination of the Belle II Computing Grid and the main contact with the Belle II experiment.

The following parameters define the minimum levels of service.

Service	Maximum delay in responding to operational problems			Average availability[1] measured on an annual basis	
	Service interruption	Degradation of the capacity of	Degradation of the capacity of	During accelerator	At all other

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[1] (time running)/(scheduled up-time)

		the service by more than 50%	the service by more than 20%	operation	times
Raw data recording	4 hours	12 hours	24 hours	98%	n/a
Networking service to other computer centres	6 hours	12 hours	24 hours	98%	95%
All other Tier0 services and VO infrastructure	12 hours	24 hours	48 hours	97%	95%
All other services – prime service hours[2]	4 hours	4 hours	8 hours	98%	95%
All other services – outside prime service hours	12 hours	24 hours	48 hours	95%	92%

The following parameters define the minimum levels of computing resource.

Resource	Minimum level
CPU (HEP-SPEC06)	10000
Disk (Tbytes)	1000
Network (Gbps)	10

Appendix 3.2: Tier1 Services

A Tier1 Centre plays a role as a regional centre in the Belle II Computing Grid. Each centre must provide grid-enabled services with large data storage with high reliability and availability, and also support the activities of the regional Tier2 Centres.

Tier1 Centres may record a copy of raw data in their permanent storage through a high-speed network connection to KEK. This must be negotiated with the KEK and the Belle II experiment as necessary.

The following services shall be provided by each of the Tier1 Centres:

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[2] Prime service hours for the Host Laboratory: 09:00-17:30 in the time zone of the Host Laboratory, Monday-Friday, except public holidays and scheduled laboratory closures.

i. provision of managed disk storage providing permanent and/or temporary data storage for files and databases;

ii. acceptance of an agreed share of reconstructed data from Tier0

iii. provision of access to the stored data by other centres of the Belle II Computing Grid;

iii. operation of an end-user analysis facility;

iv. provision of other services, e.g. simulation, according to agreed experiment requirements;

v. ensure network bandwidth and services for data exchange with other computer centres;

vi. regional management and coordination of the Belle II Computing Grid;

vii. participation in the overall management and coordination of the Belle II Computing Grid.

All storage and computational services shall be Grid-enabled according to standards agreed between the Belle II experiments and the computer centres.

The following parameters define the minimum levels of service.

Service	Maximum delay in responding to operational problems		Average availability measured on an annual basis
	Prime time	Other periods	
Networking service to other computer centres	4 hours	24 hours	98%
Acceptance of raw data from Tier 0 Centre during accelerator operation	8 hours	24 hours	98%
Analysis facility	4 hours	24 hours	95%
Other services	8 hours	48 hours	90%

The following parameters define the minimum levels of computing resource.

Resource	Minimum level
CPU (HEP-SPEC06)	2000
Disk (Tbytes)	250
Network (Gbps)	2

Appendix 3.3: The responsibilities of the Tier2 Centres

The following services shall be provided by each of the Tier2 as provided for in this MoU, according to policies agreed with the Belle II experiment:

i. provision of managed disk storage providing permanent and/or temporary data storage for files and databases;
ii. provision of access to the stored data by other centres of the Belle II Computing Grid;
iii. operation of an end-user analysis facility;
iv. provision of other services, e.g. simulation, according to agreed experiment requirements;
v. ensure network bandwidth and services for data exchange with other computer centres.

All storage and computational services shall be Grid-enabled according to standards agreed between the Belle II experiments and the computer centres.

The following parameters define the minimum levels of service.

Service	*Maximum delay in responding to operational problems*		*Average availability measured on an annual basis*
	Prime time	*Other periods*	
All services	12 hours	72 hours	90%

The following parameters define the minimum levels of computing resource.

Resource	*Minimum level*
CPU (HEP-SPEC06)	500
Disk (Tbytes)	50
Network (Gbps)	1

Appendix 3.4: Grid Operations Services

This Appendix lists services required for the operation and management of the Belle II Computing Grid.

● **Grid Operations Centres** – Responsible for maintaining configuration databases, operating the monitoring infrastructure, provision of accounting information, and other services that may be agreed upon. Each Grid Operations Centre shall be responsible for providing a defined sub-set of services, agreed by the Belle II Computing Grid. Some of these services may be limited to a specific region or period. Computer centres may share responsibility for operations as agreed by the Belle II Computing Grid.
● **User Support for Grid service operations**:
  - First level (end-user) helpdesks are assumed to be provided by the Belle II experiment and/or national or regional centres, and are not covered by this MoU.
  - **Grid Call Centres** – Provide second level support for Grid-related problems. These centres would normally support only service staff from other centres and expert users.

Each call centre shall be responsible for the support of a defined set of users and regional centres and shall provide coverage during specific hours.

Appendix 4: Contact List

KEK	dgteam@ml.post.kek.jp +81-298-864-5770
KIT	andreas.heiss@kit.edu +49-721-608-25639
DESY	grid@desy.de +49-40-8998-2732
KISTI	ssgyu@kisti.re.kr +82-42-869-0588
Institute of High Energy Physics, Austrian Academy of Sciences	Dietrich.Liko@oeaw.ac.at +43-1-544-73-28-32
Jozef Stefan Institute	grid.admin@ijs.si +386-1-477-3158