The Belle II experiment at SuperKEKB: input to the European Particle Physics Strategy (update 2018-2020) - Appendix

European Institutions within Belle II Collaboration*
Endorsed by Belle II Collaboration
Prepared by the Belle II ESPP preparatory group†

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1 Appendix A: Interested Community

The Belle II collaboration is currently composed of 871 researchers from 113 institutions and 26 countries/regions. Belle II is a CERN recognized experiment, a list of collaborating European institutions is presented in Tab. 1.

The European contribution plays a major role in the collaboration; around 45% of its members are from European institutes (Austria, Czech Rep., France, Germany, Israel, Italy, Poland, Russia, Slovenia, Spain, Turkey and Ukraine). Their contributions are

- involvement in the construction of most of the detectors (in VXD, with leadership in both SVD and PXD, as well as for PID detectors, with leadership for the ARICH and endcap KLM);
- participation in the construction, monitoring and data analysis of the BEAST, a set of detectors installed around the interaction region in charge of understanding the beam background during the nanobeams collision commissioning (phase 2)
- development of the software (leading role for simulation and reconstruction, as well as software services at DESY)
- contributions to computing (described in more details in App. B)
- important contribution to physics studies (as an illustration, half of the conveners of the working physics groups are from European institutes).

European institutes are also preparing for possible contributions to the Belle II upgrade (including DAQ, inner detectors, forward ECL calorimeter) needed to face higher luminosity conditions.

2 Appendix B: Computing Requirements

Outline of the Belle II computing model The raw data coming out of the DAQ system are permanently stored, calibrated and processed. The fully reconstructed events, coming from the raw data processing step, are stored in the miniDST format. Monte Carlo events are simulated and reconstructed using the same software used to process detector events and then also stored in miniDST format. Detector and Monte Carlo events miniDST are then "skimmed" to create subsets of selected events that suit a specific physics analysis group. During the skimming step, additional information is computed and then added to the events. The output of the skimming step consists of deep copies of events in uDST format. The understanding of the detector and the quality of the software

*The list with principal investigators is presented in App. A.

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	Laboratoire de Laccelerateur lineaire (LAL) Orsay	Francois Rene Le Diberder
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	Technical Univ. of Munich(Technische Universitaet Muenchen)	Stephan Martin Paul
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	INFN and Federico II Univ. Napoli	Guglielmo De Nardo
	INFN and Univ. Pisa	Francesco Forti
	INFN and Univ. Padova	Ezio Torassa
	INFN and Univ. Trieste	Lorenzo Vitale
	INFN and Univ. Torino	Roberto Mussa
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	Univ. of Ljubljana	Peter Krizan
	Univ. of Maribor	Peter Krizan
	Univ. of Nova Gorica	Samo Stanic
Turkey	Middle East Technical Univ.	Mehmet Tevfik Zeyrek
Ukraine	Taras Shevchenko National Univ. of Kiev(Kyiv)	Igor Mykolayovuch Kadenko

Table 1: European institutions participating in the Belle II collaboration and involved in the preparation of the present document.

will improve over time, resulting in new releases of the software and better knowledge of the detector condition and calibrations that will require reprocessing of the data to exploit the improvements. Reprocessing of detector data is expected to trigger the re-creation of the corresponding Monte Carlo data samples and of the skimming of these new data samples. We plan to permanently store two copies of raw data (referred to as "Tape" in tables 2 and 3) in different geographical locations for safety. To avoid bottlenecks in the analysis, we plan to store (referred to as "Disk" in tables 2 and 3) two copies of mDST and uDST that will be the input to the analysis step. Tables 2 and 3 contain the currently planned required computing resources for the entire experiment and the European component respectively. This numbers have been accepted by the funding agencies, although formal approval of the pledged resources will be performed on a yearly basis to adapt to the actual collected data.

Year	2018	2019	2020	2021	2022	2023	2024	2025
Tape (PB)	1.2	7.8	21.2	42.0	69.7	98.6	127.4	156.2
Disk (PB)	2.2	8.7	18.7	23.7	42.7	64.1	85.5	107.5
CPU (kHS06)	121	226	394	516	717	974	1095	1321

Table 2: Estimated computing resource levels for the entire Belle II collaboration

Year	2018	2019	2020	2021	2022	2023	2024	2025
Tape (PB)	0.5	3.1	8.5	16,8	27,9	39.4	51.0	62.5
Disk (PB)	0.9	3.5	7.5	9.5	17.1	25.6	34.2	43.0
CPU (kHS06)	48	90	158	206.4	287	390	438	528

Table 3: Estimated European contribution to the Belle II computing resource levels, corresponding to about 40% of the total