

Input of the German Community to the ESPP Update

in the area of Computing, Software & ML

Thanks to G. Duckeck, F. Gaede, L. Heinrich and T. Kuhr and the KET Computing and Software Panel for Input and Comments

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KET Concluding Workshop in preparation of the input to the ESPP update Bad Honnef 20.1. 2025

Reminder: Input to last ESPP Update

Advances in Technology

Research and development in accelerator and detector technologies, as well as in computing and software, are a prerequisite for all future projects.

Many of the topics and projects discussed above require substantial developments in the areas of accelerator, detector, computing and software technology. Examples in accelerator R&D are high field magnets, energy recovery structures and plasma wake field acceleration. Examples in detector R&D are extremely fast, radiation hard and cost-effective detectors with high granularity. Unprecedented data rates and volumes will require the exploitation of state of the art computer science methods to develop adequate computing concepts and innovative algorithms for data handling, reconstruction and analysis. Due to the very long time scales of many of the currently proposed projects, it will be essential to keep and further develop the technological expertise within the community.

9 lines abut R&D, 3 lines about computing and software out of 4 pages total text in original format

KET C&S panel thinks that this time we should aim for at a separate paragraph and longer statement The community input can have a total length of up to ten pages

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How did we get here?

- Presentation by Frank Gaede at KET (+ Terascale Alliance) Germany Community Meeting "Future Collider at CERN", Bonn, 22.-24.5. 2024
- Presentation by Lukas Heinrich at KET Strategy Workshop "The future of Collider Physics" in preparation of the ESPP update, DESY, 27.-29.11. 2024
- Preparation of first draft with input from selected people
 (F. Gaede, L. Heinrich, G. Duckeck, T. Kuhr) until 6.1. 2025
- Presentation and discussion in KET Computing&Software (C&S) Panel on 7.1. 2025 (Chair and Co-Chair: G. Duckeck, T. Kuhr)
- ▶ Iteration of draft within KET C&S Panel until 15.1. 2025

The KET C&S panel, which advices KET in all issues related to computing and software, reached consensus on the proposed draft text, which will be presented on the next three slides

Lines in green on the next slides not part of draft text but just headlines for the presentation.

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Draft proposal for discussion (1)

Introduction: motivation, exploitation of physics potential, increased requirements, environmental sustainability: The full exploitation of the unique physics potential of the to be collected data sets in the Exabyte regime requires the development and application of state-of-the-art software and machine learning methods and the provisioning of extended compute and storage resources beyond the increase provided by technological evolution. At the same time scientific computing has to become CO_2 -neutral by 2050 in order to mitigate the impact on climate change and to meet the agreed on climate goals within the European Union. Hence, a timely development of novel computing concepts and innovative algorithms for data handling, event generation, detector simulation, reconstruction and analysis taking into account the criteria of the magnitude of the to be collected data and of the required compute power and the criteria of environmental sustainability is imperative.

Provisioning of hardware resources, interdisciplinary usage, costing model for computing for future experiments:

WLCG, using mainly dedicated hardware resources, has been a great success over the last two decades. Nevertheless, the option of an interdisciplinary usage of large IT infrastructures (e.g. NHR[§] in Germany, EOSC at European level) shall be investigated and be carefully evaluated. Necessary software frameworks for orchestration and accounting shall be developed. The full costs for provisioning and operation of the required hardware resources shall be included in the financial planning of future experiments.

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Draft proposal for discussion (2)

Algorithms & software, potential of AI/ML, experiment-overarching common software stack for FC:

Modern AI concepts are essential for event generation, detector simulation, event reconstruction and data analysis. A flexible common experiment overarching software ecosystem for all these tasks, such as the turnkey softwarestack KEY4HEP, is vital for the development and optimisation of the next generation of detectors at future colliders. It is mandatory that the seamless and easy integration of modern AI algorithms is provided from the start. The development and maintenance of new concepts and software libraries for the above tasks shall continuously be supported.

Interdisciplinary cooperation:

Interdisciplinary cooperation on national (e.g. NFDI, DIG-UM[§] in Germany) and international level (e.g. WLCG, JENA, EOSC) shall be continued and further be enhanced.

Open science and data preservation:

The data and research results of the particle physics community create a unique legacy. Hence, it is mandatory to develop technical solutions for sustainable Open Science, Data Preservation and scientific reuse strategies in accordance with the FAIR principles.

[§]NFDI = National Research Data Infrastructure, DIG-UM = Digital Transformation in the Research of Universe and Matter universität freiburg

Draft proposal for discussion (3)

Recognition of work (by ECRs) in the area of computing & software:

To be able to profit from future technological developments in computing, software and data analysis, which may be fundamental and disruptive, it is essential to keep the relevant expertise in the community. This can only be achieved by a recognition of work in this area, in particular conducted by experimental early career researchers, at the same level as for R&D in detector and accelerator technologies and for data analysis.

For your reading pleasure (not considered as input to ESPP)

Global Average Temperature vs. Number of Pirates



Flying spaghetti monster

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