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Evaluation Report

Konrad-Zuse-Zentrum für Informationstechnik Berlin (Zuse Institute Berlin, ZIB)

CONFIDENTIAL DOCUMENT

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Members of review board and guests; representatives of collaborative partners

Preamble

The ZIB was founded in 1984 by law as a non-university research institution of the State of Berlin, its initial mission and mandate being to provide High-Performance Computing facilities to the (West) Berlin research communities, in combination with Scientific Computing research. In the last thirty years, ZIB has developed into a Competence Centre with a service and research agenda wider than depicted originally. In contrast to most research institutions in whatever kind of organizational frame, ZIB has never undergone an external evaluation, apart from the annual visits of ZIB's Scientific Advisory Board. On the occasion of the current significant transition phase in ZIB's leadership (retirement of the founding president Peter Deuflhard in 2012, upcoming retirement of the former vice-president and current president Martin Grötschel, commencement of the current vice-president Christof Schütte in 2013), the Senate of Berlin therefore decided to initiate an independent evaluation. This evaluation had to address primarily three major issues: (1) the quality of ZIB's services and research, (2) ZIB's agenda, both in the past and for the future, against the background of its embedding into the regional, national, and international research landscape, including the role of the supercomputer consortium HLRN, and (3) the appropriateness of ZIB's present internal organization and of its institutional frame.

The evaluation consists of the provision of several documents by ZIB, of a two-day on-site review meeting end of November in Berlin, and of this final report by the evaluation committee. It closely follows the standard evaluation process of the Leibniz Association (WGL) for its institutes, which has been adopted for other purposes before.

1. General Concept and Profile, Main Recommendations

ZIB conducts very successful fundamental research and offers highly demanded consultancy and services in application-driven mathematics and computing. Its three divisions A (“Mathematics for Life and Material Science”, until recently “Numerical Mathematics”), B (“Mathematical Optimization and Scientific Information”, until recently “Discrete Mathematics”), and C (“Parallel and Distributed Computing”, until recently “Computer Science”) contribute significantly to the regional, national, and international research landscape via both high-level research and high-quality services, the latter in particular via the operation of facilities of the North German Supercomputer Consortium (HLRN).

Given the recent and upcoming changes in ZIB leadership, ZIB’s strategic decisions on an evolutionary adaption of its internal structure (re-naming of the divisions, introduction of the cross-divisional focus areas) appear to be promising. Although attempts of increasing flexibility (e.g., concerning the internal allocation of resources or the use of permanent positions) have already been made, further steps in that direction will be necessary. If the budget situation stays stable (budget comprising here the regular funding by the Senate as well as special funds for specific services), ZIB seems very well prepared for the future.

The present and the intended future positioning of ZIB are considered to be excellent. ZIB’s profile and reputation are driven by those of its leading personnel, which ensures a sound grounding in high scientific competence. ZIB’s services and research are highly demanded and esteemed by industry and academia. Dealing with the complete vertical stack from basic research to industry applications, keeping the balance between service provision and research, as well as placing algorithmic research directly around a tier-2 HPC facility (including rich software activities) altogether form a unique selling point of ZIB – at a local, regional, national, and international scale. All future activities should build upon and further strengthen this unique selling point.

The previous few years revealed certain discrepancies between ZIB’s legal framework and formal mandate having been defined thirty years ago on the one hand and the lived and successful reality on the other hand. Although the review panel feels neither competent nor mandated to depict a concrete way to go, it is obvious that the institutional situation has to be carefully re-considered. For the respective discussion, some cornerstones are evident: ZIB must be preserved as one independent institution with its current research threads; a design as a Fraunhofer institute is not an option; in contrast to that, a future within Leibniz Association should not be a priori excluded; however, also the current setting can be a viable path, if certain adjustments will be made. The review panel strongly recommends that all players involved find a solution quickly, but nevertheless with the appropriate carefulness. Concerning ZIB’s name, the review panel does not see any necessity to change ZIB’s name, for example to let it better reflect its real profile. If the structural discussion, however, should suggest a name change, the review panel recommends to keep the name and add “Centre for Application-Driven Mathematics and Computing” as a “second line.”

There are a couple of issues where the review panels does see a potential for improvement, and it recommends to ZIB to further work on these: the internal decision process for industry projects (there are a relatively large number of small and short-term projects, which tend to have a poor cost-benefit ratio and to lead to short employment contracts); the use of permanent positions; the length of employment contracts; the provision of an appropriate amount of structure to PhD projects through automatic graduate school membership. Furthermore, a larger symmetry in its international relations should be aimed at (currently, there is a bias toward incoming

exchanges; and there is a tendency towards “home-grown” researchers), and in-house collaboration should be intensified – the focus areas are a good step in that direction.

There have been and still seem to be misunderstandings and diverging perspectives between the Senate administration on the one hand and ZIB leadership and staff on the other hand – concerning ZIB’s flexibility to spend money for different purposes, to finance positions, to define the length of contracts, to transfer money to the next fiscal year, or to build up reserves to a certain extent. Since a constructive interplay of both parties as well as an appropriate scope of action are vital for ZIB’s fruitful development, the review panel strongly recommends that both parties quickly find a consensus on the issues mentioned.

The review panel also recommends the next external evaluation to be scheduled either in seven years or three years after the successor of Martin Grötschel will have started at ZIB – whatever occurs earlier.

Overall, it shall be concluded that the review panel received an excellent impression of ZIB.

2. Divisions of ZIB

DIVISION A: “MATHEMATICS FOR LIFE AND MATERIAL SCIENCE” (FORMERLY “NUMERICAL MATHEMATICS”)

This division of ZIB has conducted research at a top international level for three decades. The research is rooted in numerical analysis and applied mathematics, but contrary to classical university research in these fields, ZIB has focused on a few demanding real-life applications that have helped to drive the development of technologies with a large practical and scientific potential. ZIB’s research activity has been embedded in long-term projects with industry, aimed at solving challenging problems identified by industry. As a consequence, the research has to cover the whole “simulation pipeline”: problem formulation, data acquisition, model development, algorithm development, mathematical/numerical analysis, software implementation, visualization, and system integration. The end product has often been a software system to be used in daily practice, usually maintained and further developed by a spin-off company. The papers, software, candidates, and applications from ZIB are internationally highly recognized.

Our primary comment on the research quality of Division A is that they conduct excellent research on industrially and societally important topics. The output covers all types of results expected from an excellent research institution: papers in top journals, master’s and doctoral candidates, professors for permanent academic positions, and perhaps most important: industry-quality software packages that bring expert knowledge to a broader audience.

Research quality is to an increasing extent globally measured by various metrics, e.g., publication volume or citations per person year of labor. The evaluation report lists number of papers (typically 65 per year) and all employees (around 85), but we find it difficult and not particularly fruitful to compute and discuss quantitative measures based on these data. The main reason is that ZIB has a strong focus on challenging applications and close collaboration with industry, a feature that leads to much more expensive research, in particular when measured as number of papers per person year, compared to mainstream university research. Instead, we will comment upon a few glimpses of scientific achievements with significant international impact.

In the Computational Medicine group, ZIB research has produced adaptive methods for PDE-constrained optimal control problems with increased computational speed and reduced storage.

This result is of great importance in advanced applications in this and other ZIB groups (molecular design, surgery planning, control of defibrillation, shape optimization, implant positioning).

Rooted in adaptive meshless discretizations and software developments, the Computational Molecular Design group has, together with collaborators, developed a new drug and submitted a patent. A particularly promising research is the Markov State Modeling of non-equilibrium molecular dynamics, which may yield sufficiently efficient models to study biochemical reactions.

Within Computational Nano-Optics, ZIB is well known for their software based on the reduced basis method for 3D Maxwell problems and for efficient computation of scattering in unbounded domains.

ZIB is also famous for its work on visualization algorithms and their implementations. The Amira visualization software has cutting-edge functionality, but is closed source and commercial. To maximize international impact, ZIB and its spin-off software companies should consider new, modern business models, where the core libraries are open source and maintained by a broader scientific community and the commercial aspect is centered around consulting and problem solving services.

After Peter Deuffhard's retirement in 2012, the division made new strategic plans and changed name to "Mathematics for Life and Material Sciences." From the evaluators' point of view, the scientific change is modest. ZIB has made many well-known contributions to adaptive, multi-level discretizations and continues this research, but now in a multi-scale and multi-physics setting to match typical international trends. There is also an increased focus on real-world applications of greater complexity. Such a focus leads to an expansion into new topics for large-scale data analysis, including uncertainty quantification, parameter estimation, optimal control, and model reduction. These data analysis techniques are naturally phrased in a stochastic framework. The plans are very compatible with the international mainstream research on predictive modeling of complex processes. A particular focus on verification and validation is not explicitly mentioned in the evaluation report, but must have been an important topic in industry projects and will certainly be a focal point when moving into more complex problem settings.

As ZIB's budget is not likely to be significantly increased, the expanded focus relies heavily on close, successful collaboration with various partners. The plans should take into account that some collaborations will not be sufficiently feasible to allow more long-term expansion into some of the new topic areas.

Molecular and biological processes: ZIB has developed a strong competence in molecular dynamics, especially in modeling large-scale biological chemical reactions by approximate and computationally efficient network models. This is a very promising line of research, because it overcomes the strict limitations of fully resolved molecular dynamics models, while still providing a modeling approach in biology at the molecular level. How to bridge the gap between the organ level and the molecular level is still an open question, but an extremely relevant and challenging task that ZIB is strongly encouraged to pursue.

Solutions for individualized medicine: Mathematical modeling and data analysis are key to individualized medicine and put ZIB in a strong position within this growing field. The plans appear as a natural continuation of ZIB's modeling efforts in biology and medicine.

Robust solution under uncertainty: This is a recent topic at ZIB with promising emerging activity. The plans and topics look sound and compatible with international trends. As the activity will affect the entire division, it is important to recruit a senior scientist with experience in modern

techniques for large-scale data analysis, who can implement a strong focus on the new topics across departments.

Materials and optical processes: The focus is on nanotechnology and methods based on partial differential equations and image analysis. The group already has a successful approach to time-harmonic scattering problems for nano-optics, building on the strong finite element knowledge at ZIB, but new methods and modeling techniques are most likely needed as a broader spectrum of nanotechnology is addressed.

Modeling, Simulation, and Optimization for multiscale systems: The plans outline very important multiscale applications, which constitute a natural evolution of current research. The modeling and visualization techniques to be pursued are not described in sufficient detail to be assessed as feasible or not. Nevertheless, true coupling of multiple scales is one of the most challenging topics of applied mathematics in this century.

ZIB emphasizes collaborations across divisions. To the evaluators' great satisfaction, the poster sessions on November 24 featured many Division A projects that utilized discrete optimization techniques from Division B. The coupling to HPC was not so clearly demonstrated. However, we realize that the plans involve topics that naturally will require a close collaboration with HPC research and services, especially in molecular dynamics, individualized medicine, uncertainty quantification, and visualization.

The Einstein Center for Mathematics (ECMath) and MATHEON appear as excellent instruments for accelerating mathematical sciences in the Berlin area and drive collaboration between ZIB and the neighboring universities. Division A successfully obtained funding for 9 MATHEON projects in 2013, together with FU Berlin and/or TU Berlin.

DIVISION B: "MATHEMATICAL OPTIMIZATION AND SCIENTIFIC INFORMATION" (FORMERLY "DISCRETE MATHEMATICS")

Ever since its foundation in 1991, the Discrete Mathematics division of ZIB, led by Martin Grötschel, has played a major role in the development of high-performance optimization tools for the solution of real-world problems of high economic impact for society. ZIB is well known worldwide for its groundbreaking research in branch-and-cut integer programming approaches that, among others, led to the development of SCIP, one of the world-leading optimization tools for mixed integer programming. SCIP is not only widely used in academics, but also heavily used by many companies, among them Siemens, SAP and Google.

The division's scientific orientation towards applied Mathematical Optimization is unique in Berlin, and only rarely seen at other institutions in Germany and beyond. It is characteristic for ZIB that a typical project not only deals with the development of mathematical ideas to approach a given problem, but also contains the (very time-consuming) task of making the resulting approaches work in practice on real-world instances. This is demonstrated by the impressive track record of industry-funded projects acquired by the division. The concentration of such a large number of projects in one institute is unique for Discrete Optimization in Germany, as is the close cooperation with industry partners often leading to long-term contracts (as in the Forschungscampus Modal) and to the presence of permanent guests from private companies at ZIB. The approach to Mathematical Optimization pursued at ZIB also served as a blueprint for many MATHEON projects, which increased ZIB's visibility in the scientific community even further.

Both for visibility and talent scouting, ZIB's involvement in several graduate schools is highly relevant, as is the block course "Combinatorial Optimization at Work" that attracts students at the Master's or PhD level from all over the world and gives them some insight into the real-

world application of Combinatorial and Discrete Optimization. The last such block courses were offered in 2005 and 2009, the next one follows in 2015.

In the evaluation period, the Research Group “Traffic and Logistics” extended classical approaches to handle connectivity and assignment problems to a hypergraph setting. The results were successfully applied to train composition problems and network design problems. A second direction of the group’s research was game theory; in future, it is planned to integrate game theoretic models into optimization approaches for public transport in order to describe passenger behavior.

In the “Telecommunications” Research Group, the focus is on developing optimization models for so-called FTTx networks, for which a planning tool has been developed, which will be maintained by the spin-off company atesio in the future. Another topic is energy efficiency, being addressed in cooperation with industry partners.

The Research Group “Linear and Non-Linear Mixed-Integer Programming” is responsible for developing the MIP solver SCIP, which by now is the most successful non-commercial code for mixed integer optimization worldwide. It is used intensively both in academia and by companies (in the latter case individual fees apply). The capabilities of SCIP have been constantly extended, recently the focus shifted to non-linear mixed-integer optimization. A major step was the parallelization of SCIP in cooperation with Division C. Moreover, the Research Group has strong connections with the most relevant companies producing optimization software worldwide (Gurobi GmbH, GAMS GmbH, FICO Ltd.), originally established informally by former ZIB members who moved to these companies and often stayed at ZIB as permanent guests. These connections have recently been formalized by the SynLab within Modal, where all companies mentioned above are represented.

Finally, research in the “Energy” group is concentrated on the optimization of gas networks and on the cooperation partner Open Grid Europe. The latter is funding a large project being performed at several German universities and research institutes, including ZIB. A prototype system is currently being developed. Citing various ZIB researchers involved in the project, the fact that gas network optimization has significant non-linear and uncertain components can be considered an important motivation for the division to extend its research focus beyond mixed-integer linear optimization.

The subdivision “Scientific Information” concentrates on services for various communities (museums, library networks, digitalization, conference organization). Clearly, such service-oriented decisions should not be evaluated by scientific output (number of papers, etc.), but by user satisfaction. It was a pleasure to see that this obviously is the case here.

Division B has a very strong track-record in terms of third-party funding, the Mathematical Optimization branch alone attracted 2.64 M Euro income from third-party grants in 2013, about half of it from private companies. In 2012, the third-party income of the Mathematical Optimization branch was much lower at 1.32 M Euro; for 2014 another sharp increase to 3.90 M Euro is expected according to the ZIB report and development plan.

The situation of Division B in terms of publications reflects its successful emphasis on applications, which is good. However, in light of the fact that the division also supervises eight students with fellowships from graduate schools, one would expect more publications in high-impact journals and conferences. Also, while the sheer number of publications was reasonable in 2012 and 2013 it dropped significantly for 2014: only 16 such publications were reported for the first 9 months. Moreover, only 17 Technical Reports have been reported for 2014, compared with 51

(50) in the years before. An obvious explanation for this as well as the comparably low number of supervised Bachelor's and Master's theses might lie in the close retirement of the head of the division. This is completely fine and natural and no reason to worry. However, for a future prospering of the division this trend needs to be reversed.

Concerning the future of Division B, the name change of the first branch of the division to "Mathematical Optimization" reflects a general tendency to be observed in Germany and worldwide, namely that the formerly clearly separated Discrete and Continuous Optimization communities are increasingly growing together. This is also visible in some of the Research Focus Areas identified by ZIB, including "Combinatorics and MINLP" and "Robust Solution under Uncertainty"; in the development of SCIP, it is natural to concentrate on extensions taking nonlinear model components and uncertainty into account. This careful re-orientation of research in Division B is necessary both in order to keep up with the development of fundamental research in Mathematical Optimization and in order to satisfy future needs of project partners from industry.

Nevertheless, it is not possible at this point to predict the medium- to long-term development of Division B or to evaluate its future plans, as the latter will strongly depend on the successor of Martin Grötschel as head of the division, who is still unknown. In particular, it is not clear whether he/she will continue to work in a similar direction or whether he/she will change the direction of research in Division B significantly. However, we believe that ZIB is well prepared for both cases.

DIVISION C: "PARALLEL AND DISTRIBUTED COMPUTING" (FORMERLY "COMPUTER SCIENCE")

From its very beginning, ZIB was among the leading HPC centers in Germany, with special focus on massively parallel systems. Division C, headed since 1998 by Alexander Reinefeld, is placed in the core of ZIB's mission "Fast Algorithms – Fast Computers." The "fast algorithms" part of the rubric is earned in Division C by algorithms for graphs, trees, and data bases, which complements the historic strengths of ZIB in fast algorithms for discrete optimization and scalable solvers in the other two Divisions. The "fast computers" part was historically earned by a tradition of distributed memory Cray T3 systems based on 3D torus networks. After an interregnum of IBM and SGI systems, ZIB renewed its standing in the Top 500 list with a powerful Cray XC system with the tightly coupled dragonfly network in 2013. Thus, Division C has a strong track record in operating state-of-the-art HPC systems, with a twenty-year success story. During this time it has identified and helped set trends in the Computer Science of large systems beyond large-scale simulation, such as, e.g., grid computing and managing "big data."

By now a unique selling point for ZIB has been created by establishing a synergetic link between high quality HPC service and research. A special focus is on hardware-aware mathematical algorithms for modern supercomputers. The two departments "Distributed Algorithms and Supercomputing" headed by Reinefeld and Schintke and "Datacenter Infrastructure" headed by Pyszkalski each combine in an excellent way service and research. As a result, the research that is performed is often oriented towards improved services to users. This is rare relative to academic Computer Science units and creates an attractive environment for many of ZIB's start-up companies and local industry.

A variety of highly visible research groups exists within the area of parallel and distributed systems, with special focus on scalable algorithms and data sciences including distributed data management. The steady increase in complexity and size of modern computer architectures results in a need for new algorithms. Fault tolerance and massive scalability are of crucial importance. These aspects are investigated in several research projects such as, e.g., within the DFG-funded

German Priority Programme 1648. Reinefeld is one of the principal investigators of the project “A fast and fault tolerant microkernel-based system for exa-scale computing.”

As a measure of the distinction of ZIB in high performance computer architecture, ZIB was one of the first five Intel Parallel Computing Centers (IPCC) worldwide, through its early focus on the programming of many-core processors, which are today essentially the only kind of processors on the market for scientific computing. There are now 43 such IPCC centers worldwide, with Munich and Dresden added to Germany’s in 2014. ZIB does not limit its pathfinding research to one vendor’s designs, however. It is also pursuing GPU programming with NVIDIA, especially the challenging domain of irregular problems, which is antithetical to the historical “sweet spot” of single-instruction/multiple-thread (SIMT) GPU programming.

In the form of the XC-30, “Konrad”, ZIB through Division C hosts and runs part of HLRN, one of the German “Tier-2” systems providing supercomputing resources for seven federal states. This service offer is important for Berlin as a State and includes high quality consulting. Roughly 40% of Konrad, having a peak performance of 0.99 Petaflop/s and almost 2 000 nodes and 45 000 cores, is used by local research institutes. The expertise and the long experience of the consulting team is relevant in several cutting edge simulation research projects covering a wide range of different applications, such as, e.g., astrophysics, molecular dynamics, material science, nanotechnology, and earth systems. The consulting group offers a wide range of specially designed and high level training courses on many-core and GPU systems to prepare the HLRN users for the future exascale computing era.

Without the dedication and commitment of members of the Division C, the Berlin metropolitan area network (BRAIN) would not have its current extent and quality of service. BRAIN is of crucial importance and largely used by all the Berlin universities and many academic and cultural institutions.

Division C research has ended up in an enviable series of software products, including XtreamFS, a fault-tolerant distributed filesystem, and Scalaris, a distributed data base system. The commercial filesystem product Quobyte, based on XtreamFS research, was created by three former ZIB post-docs who returned from Google with their engineering knowledge refined with extremes in practice.

The prospects for continued research performance of Division C are bright due to the dynamic young contributors and the dynamic applications, ranging from traditional computational science to the bioinformatics and the digital humanities. Division C is prepared to master the new challenges in hardware-fault-tolerant simulation software and data intensive computing, which constitute its two major research directions in the approach to exascale computing.

On the service side, ZIB will play a key role in offering data intensive storage services for the larger Berlin community. Several of the Berlin universities and research-oriented institutes will have a high demand for this service and depend on robust, reliable and fast solutions.

3. Collaboration and networking

Collaboration with universities

ZIB’s relations to the three big public Berlin universities Freie Universität (FU), Technische Universität (TU), and Humboldt Universität (HU) are multi-faceted and intense. First, ZIB staff makes a significant contribution to teaching; second, ZIB provides services to the academic communities – especially HPC, but also data-related; third, ZIB plays a key part for collaborative research, in particular CRC’s of DFG or BMBF’s Berlin Big Data Centre; fourth, all university part-

ners point out that Berlin's success with the DFG Forschungszentrum MATHEON and later in the Excellence Initiative (Berlin Mathematics School, e.g.) probably would not have been possible without ZIB's contributions. The three division head positions are considered as key positions for the universities, too.

Collaboration with other institutions in Germany and abroad

First, ZIB's Berlin network is far from being limited to the three main Berlin universities. For example, there are strong links with Charité / Berlin Institutes of Health, Helmholtz Zentrum Berlin, Max Planck Institutes, humanities-related institutions, as well as local industry. In these relations, ZIB defines its role to act as a competent partner everywhere where mathematics and computing are not part of the core business. Second, ZIB has a strong national and international network, in terms of both research institutions and industry. Here, "industry" comprises several (small) spin-offs, external SME's, as well as large companies. The review panel observes a certain asymmetry in international relations (far more people come to ZIB from other institutions than go from ZIB to these places) as well as certain tendency towards "home-grown" researchers.

4. Staff development and promotion of junior researchers

Staff development and personnel structure

ZIB has about eighty permanent positions via core funds, which currently make roughly 40% of the overall personnel (including student assistants). 27 of the permanent positions are scientist positions, the majority of them doing service tasks. This personnel structure seems balanced; however, the short employment contracts on the non-permanent positions are considered as problematic.

There are offers for a further qualification, in particular by FU, and there are options for ZIB staff to participate.

Promotion of gender equality

There are a couple of problematic issues concerning the gender topic. For example, ZIB's report reveals that none of the female researchers at ZIB has a permanent position. Actually, this and the problem of short-term contracts were also addressed in the meeting with the staff council and the women's representative. The number of women in leading positions is limited to one department head (non-scientific) and four group leaders. As a consequence, the lack of role models and a (maybe) sub-optimal attractiveness of career paths can be responsible for the relatively small number of applications by women at almost all levels, which was mentioned several times. Despite the fact that small numbers are not surprising in the respective scientific fields (unfortunately), the review panel thinks that ZIB leadership should increase its efforts to improve the situation.

Promotion of junior researchers

ZIB aims at recruiting students early and successfully attracts and hires a large number (currently about 50) of student assistants to or in the projects, respectively.

PhD candidates (currently about 70) form the bulk of researchers at ZIB, less than half of them being part of some structured program (via different graduate schools). Given their specific situation (external with respect to the university they will obtain their degree from; longer comple-

tion times; non-straightforward mapping of short projects to a PhD project; etc.), ZIB should aim at integrating all of them into a graduate school.

The postdocs at ZIB follow different career paths, from a classical academic career to entrepreneurship in some spin-off company. The impressive list of former ZIB researchers that got professorships at universities shows that ZIB offers very good perspectives to young researchers.

Vocational training for non-academic staff

Due to ZIB's research and service agenda, vocational training is not an issue of primary concern. Nevertheless, ZIB has been involved for more than ten years in dual training of a small number of students of the University of Economics and Law Berlin.

5. Quality assurance

Internal quality management

There are informal quality management (QM) measures as well as a formal QM procedure, covering project work, publications, project acquisition, and good scientific practice. Overall, the processes established look effective.

Quality management by the Scientific Advisory Board and Supervisory Board

ZIB's Scientific Advisory Board (SAB) plays an active role in quality management. Its nine members represent experts from science and industry, three come from outside Germany. Traditionally, the annual board meetings also comprise a complete visit of the institute, including presentations from all departments and discussions. After the meeting, the SAB delivers minutes of the meeting and a report on ZIB's current situation. This seems to be a well established and well running QM mechanism for ZIB.

Appendix

1. Review Board

Reviewers

Hans-Joachim Bungartz (Chair)	Department of Informatics, TU München
Christoph Buchheim	Department of Mathematics, TU Dortmund
Wolfgang Ehlers	Institute of Applied Mechanics, U Stuttgart
David Keyes	Computer, Electrical and Mathematical Sciences and Engineering, KAUST
Hans-Petter Langtangen	Simula Research Laboratory and Department of Informatics, University of Oslo
Angelika Steger	Department of Computer Science, ETH Zürich
Barbara Wohlmuth	Department of Mathematics, TU München

Representatives of the Senate of Berlin

Jutta Koch-Unterseher	Senatsverwaltung für Wirtschaft, Technologie und Forschung, Berlin
Bernd Lietzau	
Michaela Mautrich	
Ellen Fröhlich	Senatsverwaltung für Bildung, Jugend und Wissenschaft, Berlin

2. Guest

Representative of the Scientific Advisory Board

Jörg-Rüdiger Sack	Carleton University, Ottawa, Canada
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3. Representatives of partner institutions (one hour with review board and guest)

Christine Ahrend	Vice President for research, faculty appointment matters and promotion of young scientists, TU Berlin
Brigitta Schütt	Vice President, FU Berlin
Peter A. Frensch	Vice President for research, HU Berlin
Volker Mehrmann	Einstein Center for Mathematics, Berlin
Rupert Klein	Department of Mathematics and Informatics, FU Berlin
Jürgen Sprekels	WIAS, Berlin
Martin Vingron	Max Planck Institute for Molecular Genetics
Ludger Sax	Grid Optimization Europe GmbH