

18. März 2021

**Stellungnahme zum  
Leibniz-Institut für Pflanzenbiochemie, Halle (IPB)**

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## Vorbemerkung

Die Einrichtungen der Forschung und der wissenschaftlichen Infrastruktur, die sich in der Leibniz-Gemeinschaft zusammengeschlossen haben, werden von Bund und Ländern wegen ihrer überregionalen Bedeutung und eines gesamtstaatlichen wissenschaftspolitischen Interesses gemeinsam gefördert. Turnusmäßig, spätestens alle sieben Jahre, überprüfen Bund und Länder, ob die Voraussetzungen für die gemeinsame Förderung einer Leibniz-Einrichtung noch erfüllt sind.<sup>1</sup>

Die wesentliche Grundlage für die Überprüfung in der Gemeinsamen Wissenschaftskonferenz ist regelmäßig eine unabhängige Evaluierung durch den Senat der Leibniz-Gemeinschaft. Die Stellungnahmen des Senats bereitet der Senatsausschuss Evaluierung vor.

Für die Bewertung einer Einrichtung setzt der Ausschuss Bewertungsgruppen mit unabhängigen, fachlich einschlägigen Sachverständigen ein. Ihr stand eine vom IPB erstellte Evaluierungsunterlage zur Verfügung. Die wesentlichen Aussagen dieser Unterlage sind in der Darstellung (Anlage A dieser Stellungnahme) zusammengefasst.

Wegen der Corona-Pandemie musste der für den 2. und 3. Juli 2020 vorgesehene Evaluierungsbesuch am IPB in Halle abgesagt werden. Die Bewertung erfolgte im Rahmen eines schriftlichen Ersatzverfahrens, das der Senatsausschuss Evaluierung (SAE) am 17. April 2020 in Umsetzung eines Grundsatzbeschlusses des Senats der Leibniz-Gemeinschaft vom 31. März 2020 eingerichtet hatte. Der Senat hält im Grundsatzbeschluss fest, dass das Ersatzverfahren ein Notbehelf ist und ausschließlich auf Einrichtungen angewendet wird, die im Regelturnus von sieben Jahren evaluiert werden. Die Bewertungen, auf deren Grundlage der Senat Stellung nimmt, sind auf zentrale Kernfragen der Entwicklung und Perspektive einer Leibniz-Einrichtung fokussiert. Ausführliche Einschätzungen und Schlussvoten zu Teilbereichen und Planungen für „kleine strategische Sondertatbestände“ müssen regelmäßig entfallen.

Die Bewertungsgruppe erstellte den Bewertungsbericht (Anlage B). Die IPB nahm dazu Stellung (Anlage C). Der Senat der Leibniz-Gemeinschaft verabschiedete am 18. März 2021 auf dieser Grundlage die vorliegende Stellungnahme. Der Senat dankt den Mitgliedern der Bewertungsgruppe und des Senatsausschusses Evaluierung für ihre Arbeit.

## 1. Beurteilung und Empfehlungen

Der Senat schließt sich den Beurteilungen und Empfehlungen der Bewertungsgruppe an.

Das Leibniz-Institut für Pflanzenbiochemie (IPB) erforscht die Mechanismen der Pflanzenresilienz, indem es Methoden und Kenntnisse von grundlagenorientierter molekularer Pflanzenbiologie und anwendungsorientierter Natur- und Wirkstoffchemie zusammenführt. Die interdisziplinären Arbeiten zielen auf eine ressourcenschonende Pflanzenproduktion sowie die Entwicklung von innovativen Biotechnologien und Wirkstoffen ab. Das Institut umfasst vier Abteilungen (mit insgesamt 20 Forschungsgruppen), außerdem

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<sup>1</sup> Ausführungsvereinbarung zum GWK-Abkommen über die gemeinsame Förderung der Mitgliedseinrichtungen der Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e. V.

zwei unabhängige Nachwuchsgruppen und zwei abteilungsübergreifende Service-Einheiten.

Das IPB hat sich seit der letzten Evaluierung sehr erfolgreich weiterentwickelt. Es entspricht dem kollegialen Leitungsprinzip der Satzung, dass die wissenschaftliche Geschäftsführung 2017 vom Leiter der Abteilung „Natur- und Wirkstoffchemie“ an den Leiter der Abteilung „Molekulare Signalverarbeitung“ weitergegeben wurde. Beide Abteilungen erbringen nach wie vor äußerst überzeugende **Leistungen**. Wie empfohlen wurde das Profil der dritten Abteilung („Stoffwechsel- und Zellbiologie“) deutlich geschärft, so dass sich die Leistungen verbesserten. Der Leiter der sehr erfolgreichen vierten Abteilung („Stress- und Entwicklungsbiologie“) wurde vor einiger Zeit emeritiert. Diese Leitungsposition wurde 2019 mit einer sehr ausgewiesenen Wissenschaftlerin neu besetzt. Die Abteilung wird seitdem unter dem Namen „Biochemie pflanzlicher Interaktionen“ überzeugend neu ausgerichtet.

Die Publikationsleistung wurde seit der letzten Evaluierung empfehlungsgemäß quantitativ und qualitativ gesteigert. Dieser positive Trend sollte fortgesetzt und in allen Gruppen das Potential für hochrangige Publikationen ausgeschöpft werden.

Die Drittmittel stiegen absolut gesehen seit der letzten Evaluierung und liegen nun im Jahresschnitt bei ca. 18,8 %<sup>2</sup> des Budgets für laufende Maßnahmen. Es wird begrüßt, dass der in der Institutsstellungnahme angegebene Zielkorridor inzwischen im Programmbudget auf 30 % erhöht wurde, wie die zuständigen Fachressorts erläuterten. Nun sollte das IPB vor allem mehr Mittel in Verfahren der DFG oder der EU einwerben.

Die **strategischen Planungen** sind überzeugend und sollten vor allem mit Blick auf die interdisziplinäre Zusammenarbeit von Biologie und Chemie in neuen, gemeinsamen Projekten vorangetrieben werden. Ein wichtiger Bestandteil der Strategie ist das geplante *Center for Plant Metabolomics and Computational Biochemistry*. Das IPB sieht vor, in diesem *Center* bestehende Infrastrukturen zu bündeln und mit zusätzlichen Mitteln der institutionellen Förderung erheblich auszubauen. Die vorgelegten Planungen wurden positiv bewertet. Wie das IPB erläutert (s. Anlage C), wurde inzwischen ein entsprechender Antrag in dem dafür vorgesehenen Verfahren vorgelegt. Aufgrund der begrenzten Raumkapazitäten sehen das IPB und seine Gremien im Zusammenhang mit dem Aufbau des neuen *Center* zudem einen Erweiterungsbau vor.

Das IPB hat angemessene Instrumente für das **interne Qualitätsmanagement** etabliert. Der Senat begrüßt, dass wie empfohlen die leistungsorientierte Mittelvergabe künftig stärker ausdifferenziert wird und auch im nächsten Beirats-Audit über die Abteilungen hinaus die einzelnen Gruppen eingeschätzt werden.

Unter den wissenschaftlich Beschäftigten ist der Frauenanteil in den vergangenen sieben Jahren von 40 % auf 45 % gestiegen. 2012 waren von den 23 leitenden wissenschaftlichen Positionen vier, nun sind acht mit Wissenschaftlerinnen besetzt. 2019 wurde erstmals

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<sup>2</sup> Einschließlich der Mittel, die an der Universität Halle-Wittenberg verwaltet werden sowie von externen Mitteln für Stipendien (s. Anlage A, Anhang 3).

eine der vier Abteilungsleitungen mit einer Wissenschaftlerin besetzt. Anstehende Neubesetzungen sollten genutzt werden, um den positiven Trend bei der **Gleichstellung der Geschlechter** fortzusetzen.

Der **wissenschaftliche Nachwuchs** wird am IPB sehr gut betreut. Die zwei unabhängigen Nachwuchsgruppen erzeugen zusätzliche wissenschaftliche Dynamik und erweitern das Forschungsprofil des IPB in sinnvoller Weise. Die Leiter der drei beendeten Nachwuchsgruppen wechselten erfreulicherweise auf weiterführende Positionen an Universitäten. Es wird begrüßt, dass für die Promovierenden 2018 ein strukturiertes Promotionsprogramm eingerichtet wurde. Jedoch muss die durchschnittliche Promotionsdauer von 5,6 Jahren verkürzt werden.

Alle vier Abteilungsleitungen sind gemeinsam mit der **Universität Halle-Wittenberg** auf Professuren (W3) berufen. Darüber hinaus kooperiert das IPB in verschiedenen Verbundprojekten mit der Universität, insbesondere in dem 2011 etablierten Leibniz-WissenschaftsCampus Halle „Pflanzenbasierte Bioökonomie“.<sup>3</sup> Das IPB und die Universität werden ermutigt, die daran anschließenden Bemühungen zur Einrichtung eines großen gemeinsamen Vorhabens, z. B. eines Sonderforschungsbereichs, fortzusetzen. International ist das IPB gut vernetzt. Die Zahl der Gastaufenthalte am IPB sowie von Beschäftigten des IPB an anderen Einrichtungen sollte erhöht werden.

Die gravierenden Rückwirkungen des Klimawandels auf die Bewirtschaftung von Pflanzen erfordern es in hohem Maße, deren Anpassung und Veränderung an neue Umweltbedingungen zu erforschen. Mit seinen langfristig angelegten Forschungsinfrastrukturen und seiner interdisziplinären Ausrichtung bietet das IPB dafür sehr gute Möglichkeiten. Die Arbeiten können in dieser Form nicht an einer Hochschule durchgeführt werden. Eine Eingliederung in eine Hochschule wird daher nicht empfohlen. Mit seinen Leistungen und Strukturen erfüllt das IPB die Anforderungen, die an eine Einrichtung von überregionaler Bedeutung und gesamtstaatlichem wissenschaftspolitischen Interesse zu stellen sind.

## 2. Zur Stellungnahme des IPB

Der Senat begrüßt, dass das IPB beabsichtigt, die Empfehlungen und Hinweise aus dem Bewertungsbericht bei seiner weiteren Arbeit zu berücksichtigen.

## 3. Förderempfehlung

Der Senat der Leibniz-Gemeinschaft empfiehlt Bund und Ländern, das IPB als Einrichtung der Forschung und der wissenschaftlichen Infrastruktur auf der Grundlage der Ausführungsvereinbarung WGL weiter zu fördern.

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<sup>3</sup> Ebenfalls beteiligt: „Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung“ (IPK), „Leibniz-Institut für Agrarentwicklung in Mittel- und Osteuropa“ (IAMO).

## Annex A: Status report

### Leibniz Institute of Plant Biochemistry, Halle (IPB)

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## 1. Key data, structure and tasks

### Key data

Year established:	1958
Admission to joint funding by Federal and <i>Länder</i> Governments:	1992
Admission to the Leibniz Association:	1998
Last statement by the Leibniz Senate:	2014
Legal form:	Foundation under Public Law ( <i>Stiftung des öffentlichen Rechts</i> )
Responsible department at <i>Länder</i> level:	Ministry of Economy, Science and Digitalisation of the State of Saxony-Anhalt
Responsible department at Federal level:	Federal Ministry of Education and Research (BMBF)

### Total budget (2019)

- € 14.9 m institutional funding
- € 2.5 m revenue from project grants
- no revenue from services

### Number of staff (2019)

- 91 individuals in research and scientific services
- 66 individuals in service positions
- 10 individuals in administration

### Mission and tasks

According to the Statutes of the Foundation the purpose of the IPB is to promote science and research. Its mission is to carry out basic and applied plant research with a scientific focus on modern cell and molecular biology, biochemistry, and chemistry of natural products. The Foundation attains its purpose mainly via research projects, organisation of scientific events, advanced training of foremost young scientists, and transfer of research results and information. The IPB may pursue additional, however, purpose-related objectives. The IPB shall promote scientific cooperation with institutions at home and abroad.

### Organisation

The IPB is organised in one chemistry and three biology-oriented departments, each comprising 4-6 research groups (see annex 1 and Chapter 7 for details):

- Department Bioorganic Chemistry (established 2000)
- Department Molecular Signal Processing (established 2009)
- Department Cell and Metabolic Biology (established 2010)

- Department Biochemistry of Plant Interactions (established 2019)

The Chairs are responsible for the departmental research agenda and its strategic integration into the IPB research program. The departments are complemented by two independent Junior Research Groups (see Chapter 7). In addition, there are two Synergy Research Groups (see Chapter 7) and two technology platforms, which support the research activities by providing expertise and technical infrastructure in the areas of proteomics, metabolomics, cell biology, bioinformatics, and research data management.

## 2. Overall concept, activities and results

### *Research Program*

Research at the IPB focuses on the chemical diversity, biosynthesis, biological roles, and mechanisms of action of plant and fungal natural products, with an emphasis on specialized metabolites and chemical mediators. IPB conducts discovery-driven and application-oriented interdisciplinary research on plant model systems as well as on selected wild, medicinal and cultivated plant species. The aim is to develop a comprehensive molecular understanding of the adaptive metabolic and developmental processes plants evolved as consequence of their dynamic interactions with the environment. The resulting phenotypic and chemotypic changes are analysed by interdisciplinary approaches at the genome, proteome, and metabolome level. The knowledge is used to facilitate sustainable crop production, innovative biotechnology, and drug development for improving the health and nutrition of humans, animals and plants.

The programmatic focus on plant-related small molecules, the synergy of chemical and biological competencies, and the combination of fundamental and translational research define the unique research profile of the Institute. In pursuit of its research mission, current strategic directions of interdisciplinary research and close thematic cooperation in the IPB focus on four program areas: (i) Bioactive natural products from plants, fungi, and associated microorganisms; (ii) Chemical mediators and regulatory macromolecules; (iii) Functional interactions of small molecules at the molecular, metabolic, cellular and organismic level; and (iv) Synthetic biology and (metabolic) bioengineering.

### *Research Infrastructure*

Four units of organized research infrastructure, two Synergy Research Groups (SRG) and two technology platforms (TP), support IPB research activities:

SRG Proteome Analytics. The SRG meets the increased demand for targeted and deep discovery proteomics at the Institute. In addition to pursuing its own research direction, the group also functions as a core facility that conducts small to large-scale proteomics studies in collaboration with IPB and external scientists.

SRG Bioinformatics & Scientific Data. The SRG meets the growing demand for bioinformatics support of collaborative projects and expert analysis of large data sets. The group develops new methods in computational metabolomics, advances the adaptation of FAIR research data, and supports research in plant biochemistry with state-of-the-art bioinformatics approaches.

TP Metabolome Analytics. The IPB operates a range of NMR and mass spectrometers as well as chromatographic separation front-ends (LC, GC) across all four departments. The decentralized platform coordinates the different capabilities of each department in targeted metabolite analysis (chemical analytics) and untargeted metabolite profiling (metabolomics) and offers opportunities for internal and external collaborations.

TP Cellular Imaging. The platform offers access to state-of-the-art technologies for cellular and live-cell imaging. It is equipped with an array of conventional and advanced light microscopes (e.g., CLSM, light-sheet), a laser micro-dissection device and supporting infrastructure, such as various microtomes and micromanipulators.

Other relevant research infrastructure, key expertise and methods include:

Germplasm Collections. The Institute maintains several hundred accessions of model, medicinal and cultivated plant species as well as several thousand dried or frozen plant and mushroom samples collected from field studies or worldwide expeditions.

Compound Libraries and Databases. Department Bioorganic Chemistry hosts a collection of >20,000 compounds and several thousand crude or fractionated extracts as reference samples. A database of known chemical structures (>1 million) and pre-calculated isomers and conformations (>120 million) provides a basis for virtual screening and study of small molecule-protein or small molecule-membrane interactions.

Computational Chemistry/Cheminformatics. Department Bioorganic Chemistry provides expertise in 3D protein homology modelling, including quantum mechanical calculations to cover electronic transitions to support mechanistic calculations in enzyme actions.

Structure Elucidation and Synthesis. Department Bioorganic Chemistry provides equipment and expertise for the identification and structural elucidation of metabolites and other chemical compounds. It supports IPB groups by providing tailor made compounds and tools that are not commercially available.

Modular Cloning. Department Cell and Metabolic Biology further developed the Golden Gate Cloning technology into a modular cloning tool for plants, yeast, and bacteria.

Calcium Imaging and FRET-based Sensors. Department Biochemistry of Plant Interactions provides expertise for calcium imaging and FRET (Förster resonance energy transfer) sensors to study intra- and intermolecular changes in protein interactions. Other FRET-based sensors are used for hormone detection at the cellular level and identification of interaction partners in signaling pathways.

## **Results**

### *Research*

Between 2013 and 2019, the IPB delivered at average 104 publications per year, of which 90 % appeared in peer-reviewed journals. Mostly book chapters (monitored and edited for quality) contributed to the remaining fraction. Publications with principle (first and/or corresponding) authorship by IPB scientists account for almost 60 % of peer-reviewed articles. Since 2013, one-quarter of the reviewed articles resulted from collaborations with the Martin Luther University Halle-Wittenberg (MLU). More than one third of



the articles were published in journals indexed as Impact Factor >4 and about 10 % in journals of Impact Factor >8. The latter periodicals are either transdisciplinary in scope (e.g., PNAS, Nat Commun, Nat Immun, Dev Cell) or are leading journals in their discipline (e.g., Mol Plant, Plant Cell, J Am Chem Soc, Angew Chem).

#### *Development of Research Infrastructure*

The IPB developed algorithms and solutions, including databases and software, such as innovative applications in computational metabolomics. Usually made available as open source, the tools are sometimes withheld (IP protection) to maintain a competitive edge. The IPB maintains a *MassBank* European site and developed *PhytoBase*, *ChemFrag*, *MetFrag*, *MetFusion* and *MetFamily*, which were further developed as cloud-native infrastructures. For cell biology, automated image analysis software packages were developed.

#### *Technology Transfer*

Between 2013 and 2019 the IPB filed 19 patent applications either as single or as co-applicant, or IPB scientists registered as co-inventors. 14 patents were granted (6 Europe, 4 USA, 2 Japan, 1 Canada, 1 Australia), which resulted in four license agreements with industrial partners.

The IPB stresses the importance of knowledge and technology transfer via minds (*Transfer über Köpfe*), which is realized at the IPB by the steady support of junior research group leaders and their professional advancement to leadership position in science-related areas elsewhere.

The IPB communicates its research activities to the public and stakeholders through various outlets including press releases, printed materials, outreach activities and educational events, as well as content creation for website and social media.

### **3. Changes and planning**

#### **Development since the previous evaluation**

During the past seven years, the portfolio and research themes of the departmental and independent research groups have changed due to the departure, reorientation, and arrival of leading scientific personnel.

At the last evaluation, the Department Bioorganic Chemistry consisted of six Research Groups (RG), of which two RG have been continued (*Natural Products & Metabolomics* and *Computational Chemistry*). The other four groups have been re-structured into four new RG in 2015. As a result, the department still consists of six RG.

The Department Molecular Signal Processing was composed of four RG at the last evaluation. Since then, two groups have been discontinued and three new RG have been established. As a result, the department now consists of five RG. In addition, one RG is associated with the Martin Luther University Halle-Wittenberg (MLU) as its group leader (formerly employed by the department) is now affiliated with the MLU.

The Department Cell and Metabolic Biology consisted of five RG, of which one has been discontinued. The department now consists of four RG.

The Department Biochemistry of Plant Interactions has been established in 2019 after the head of the former Department Stress and Developmental Biology retired. The department consisted of five RG at the last evaluation. Two groups have been discontinued and one group has been transformed into a Synergy Research Group (SRG). In addition, two new RG were established. The department now consists of four RG.

Furthermore, three independent Junior Research Groups (JRG) were successfully discontinued (advancement of the group leaders to professorship positions elsewhere) and two new JRG were established.

### **Strategic work planning for the coming years**

The IPB states that it will advance the strategic scope of its research program. The long-term direction shall investigate the Chemical Basis of Plant Resilience in adverse and deteriorating growth habitats and climates as the central theme. Application of the acquired knowledge should enhance plant health and crop performance and generate value-added plant products or novel bioactive molecules for promoting human health and well-being.

In terms of research, the IPB plans to intensify its focus on the chemistry, biochemical networks, and biological activities of small molecules in plants, fungi, and associated microorganisms. A second focus will study the functionally related proteins that catalyse or regulate the biosynthesis of small molecules, mediate their transport or turnover, or are themselves targets of bioactive metabolites.

The mid-term programmatic development of the IPB, derived from its long-term strategic plan, should advance successful and newly established research trajectories. Research activities in all scientific departments and independent research groups are specifically addressing at least two areas of the research program (Natural Products, Chemical Mediators, Interactions, Bioengineering), which embodies an impact pathway from fundamental to translational research. Understanding the Chemical Basis of Plant Resilience and harnessing the acquired knowledge for the benefit of society will be the central theme and goal.

### **Planning for additional funds deriving from institutional funding**

To realize the potential of inherent synergies at the IPB, the Institute plans to conceptually develop and gradually establish the new Program Center Plant Metabolomics and Computational Biochemistry (MetaCom). The center shall spatially consolidate major analytical equipment, merge dedicated personnel from all scientific departments, and recruit additional scientific staff. The IPB plans to accommodate four units in a new center building:

- The Metabolomics Facility will consolidate the currently decentralized Technology Platform *Metabolome Analytics* (clusters of major equipment in all departments).
- The Analytical Laboratory for natural products, which will be part of the Metabolomics Facility, will assist in and conduct the isolation and chemical characterization of relevant metabolites.

- The current SRG *Bioinformatics & Scientific Data* will evolve into the Computational Plant Biochemistry Unit. This unit will also integrate and coordinate the respective cheminformatics and metabolomics expertise of the existing RG *Computational Chemistry* and RG *Data & Resources*. The latter RG will not be continued.
- A jointly appointed Junior-Professor (W1) will establish the independent JRG Metabolomics of Plant Resilience as a component and research unit of the Program Center.

For the implementation of the Program Center MetaCom, the IPB plans to reassign 9 existing positions (5 Scientists, 4 Technical Assistants) and to consolidate existing major analytical equipment of all departments in a new building. Furthermore, the IPB plans to apply for a permanent increase of its institutional funding (“Extraordinary Item of Expenditure”, see table below) for 13 positions (1 Junior-Professor, 5 Postdocs, 2 Data Manager, 1 IT-Specialist and 4 Technical Assistants) as well as funds for IT Investments, start-up funds for the JRG and consumables.

„Extraordinary item of expenditure“: summary of funds planning

	2022	2023	2024	2025	Permanently
<b>Own funds + additional funds = „extraordinary item of expenditure “</b>	1,506 k€	1,717 k€	2,129 k€	2,085 k€	2,145 k€
<b>Own funds</b> from existing funding by institution (at least 3 % of core budget)	670 k€	691 k€	711 k€	733 k€	755 k€
<b>Additional funds</b> of institutional funding	836 k€	1,026 k€	1,418 k€	1,352 k€	1,390 k€

Establishment of the Program Center MetaCom will proceed in two stages. In Phase I, the IPB will implement the repositioning of metabolomics and bioinformatics, which will be supported by the addition of scientific staff and the formation of a new independent junior research group. The reassignment and co-localization of IPB personnel as well as the redirection of IPB funds will partly accomplish the reorganisation. In Phase II, the IPB envisions the construction of a new building that merges all functionalities necessary for the Program Center.

## 4. Controlling and quality management

### Facilities, equipment and funding

#### *Funding*

In 2019, the IPB’s institutional funding (excluding construction projects) was approx. 14.9 M€ (see annex 3).

Additional revenues from project grants amounted to 2.5 M€ (corresponding to 17 % of the institutional funding). These revenues split into 1.2 M€ from Federal or *Länder* grants, 1 M€ from the DFG and funds from the EU (91 T€), the competitive procedure of the Leibniz Association (68 T€) and other sponsors.

In 2019, externally managed third-party funds directed to the institute (e.g., doctoral stipends of Research Training Groups) amounted to 856 T€.

### *Facilities and Equipment*

The IPB premises, owned by the State of Saxony-Anhalt, are located on the Weinberg Campus of the Martin Luther University Halle-Wittenberg (MLU). In walking distance to the IPB there are most of the MLU Institutes of Natural Sciences Faculties I-III, five non-university research institutes (Max Planck Society, Fraunhofer Society, Helmholtz Association, and Leibniz Association), numerous start-up and small companies in the Weinberg Campus Technology Park. The property includes outdoor facilities, the indoor nursery, garden areas (3.3 ha), and woody plants (0.5 ha). The usable building area currently amounts to 9,007 m<sup>2</sup> and provides space for scientific laboratories, service facilities and offices. The administration and all scientific departments are housed in three major buildings of the IPB complex. Several satellite buildings accommodate the independent research groups, the library with a magazine and reading rooms, and scientific as well as technical service facilities.

The IPB operates two state-of-the-art environmentally controlled greenhouse complexes with 26 compartments and a total area of 1.828 m<sup>2</sup>. The Institute has available 22 walk-in phytochambers. In 2018, nine phytochambers were refurbished. Numerous controlled plant growth cabinets (ca. 40), three outdoor greenhouses for vocational training (horticulturists), and a small test field supplement the plant growth facilities at the IPB.

### *IT Infrastructure*

In 2012, the IPB developed an IT strategy that is regularly updated. For safety and availability concerns, the IPB uses standard software and special software only when necessary. For scientific computing, the IPB operates a local computer cluster and uses European clouds as well as the German de.NBI bioinformatics cloud. To ensure continuous operation and minimize downtime, the infrastructure components have been upgraded over the last years to a redundant or high-availability architecture, including servers, storage and backup systems, network backbone, internet connection, firewall and power supply. All instruments generating primary data are connected to a dedicated network storage archive. Backup-to-disk and tape is available for all file services, virtual servers, databases and instrument computers with full and incremental backups. All implemented measures comply with the current IT security guidelines of the Federal Office for Information Security (BSI).

### **Organisational and operational structure**

Governance of the IPB follows the principle of collegial directorship. The four scientific Department Chairs and the Head of the Department Administration and Infrastructure constitute the Board of Directors. The Managing Director (a scientific department chair appointed typically for five years on a rotating basis) and the Head of Department Administration and Infrastructure legally represent the Institute as the IPB Management. The Managing Director oversees all academic activities of the Institute. The Head of Department Administration and Infrastructure who is also the Chief Budgetary Officer autonomously manages all operational administrative processes.

The Scientific Council, which comprises all research group leaders and representatives of the doctoral and postdoctoral researchers, advises the Board of Directors. The Staff Council represents all employees of the Institute.

The Managing Director prepares and calls for regular (monthly) board meetings attended by the five Department Chairs (voting rights), the representative of the Scientific Council (Chair), and the Deputy of the Administrative Director. Decisions are made based on discussions and by mutual agreement. The Chairs of the Departments and Scientific Council inform the relevant IPB members in separate meetings. The Board of Directors reviews major decisions and monitors their implementation in subsequent board meetings.

The heads of department-independent research groups (JRG and SRG) directly report to the Board of Directors who regularly monitor their progress and offer mentorship and advice. Each director manages his/her department and associated units independently and is legally liable for them. The budgets for departments and research groups are allocated based on clearly defined performance criteria. Budget management and third-party fundraising are mainly the responsibility of individual research groups.

### **Quality Management**

The IPB revised its internal Procedures for Safeguarding Good Scientific Practice in January 2020. The Institute follows the 19 guidelines stipulated in the DFG Code of Conduct in a legally binding manner. The employment contracts of all IPB personnel in the science sector explicitly state compliance with Good Scientific Practice as a contract obligation. The department chairs and research group leaders are responsible for implementing and monitoring adherence to these guidelines. A senior scientist who is not member of the IPB Board of Directors serves as elected IPB Ombudsperson.

### *Research Data Management*

Since 2015, the IPB operates an archival solution for primary research data covering nearly all instrumentation producing digital research data. For the documentation of experiments, all researchers maintain personal hard-copy notebooks to be archived for at least 10 years in the respective department. A project group is currently preparing the acquisition and introduction of an electronic laboratory documentation system and electronic notebook across the IPB.

### *Publication Strategy*

For the IPB, peer-reviewed publications in various formats are the prime venue for making its knowledge accessible to the public and scientific community, for demonstrating its research capacity and quality, and for gaining increased international visibility. The publication strategy includes: Research Quality Assurance, Promoting High-Quality Publications and Open Access Publishing.

### *Technology Transfer*

The IPB Patent Guideline (based on the German Employee Invention Act) delineates han-

ding of intellectual property, procedures for patent applications, and inventor remuneration. Scientists must assess their research results for inventive potential as early as possible. Department chairs review pending publications of any kind for contract relevant interests and intellectual property rights. The Transfer & Funding Officer sensitizes scientists and other employees to the protection of intellectual property.

### *Internal Performance Incentives*

Since 1992, the IPB has established a system for performance-based allocation of departmental funds. The procedure regulates distribution of select budget titles of institutional funding (e.g., funds for consumables or fixed-term salaries) to the four scientific departments. Based on departmental performance of the preceding year, 40 % of the available budget is allocated according to the performance index, the remainder is equally distributed between the scientific departments. Since 2015, IPB has implemented an internal regulation that rewards acquisition of extramural funds by IPB scientists with an individual performance bonus. In case of patent applications, the IPB pays a one-time reward of 400 € after disclosure.

## **Quality management by advisory boards and supervisory board**

### *Scientific Advisory Board (SAB)*

The SAB is composed of 6-12 expert scientists who cover the disciplinary spectrum of IPB research activities. The SAB assesses the IPB performance and research strategy on a regular (typically annual) basis. The SAB provides recommendations to the Board of Directors and advises the Board of Trustees on scientific matters and technical questions. The SAB supports the Institute and is involved (consulting mandate) in all major decisions on long-term scientific planning, acquisition of large-scale equipment, recruitment of new department chairs, permanent appointments of research group leaders and senior scientists, the establishment of independent junior research groups, or the initiation of national and international collaborations and initiatives. Between two external evaluations, the SAB conducts a mid-term audit of all scientific departments and research groups.

### *Board of Trustees*

The Board of Trustees consists of two representatives of the state of Saxony-Anhalt, two representatives of the Federal Republic, the Rector of the MLU Halle-Wittenberg, and two representatives of the scientific community. The Board of Trustees oversees the Board of Directors and activities of the Foundation. It reviews the economic management and annual financial statements, and it grants final approval of the preceding fiscal year. The Board of Trustees, chaired by a representative of the state of Saxony-Anhalt (Ministry of Economy, Science and Digitalisation) and co-chaired by a federal representative (Ministry of Education and Research) authorizes by consent: (a) long-term plans of research, development and expansion; (b) annual economic plan, medium and long-term fiscal planning; (c) appointment and dismissal of department chairs; (d) changes in the organisational structure of the IPB; (e) adoption of internal regulations and procedures; (f) principles for utilizing the results generated at the IPB; (g) measures related to employment contracts

and social arrangements; and (h) extraordinary legal transactions beyond the scope of current business operations.

## 5. Human Resources

On 31 December 2019, IPB had 167 employees (without student assistants, apprentices and scholarship recipients, see annex 4). 91 persons worked in research (including 35 doctoral candidates), 66 persons in service positions and 10 persons had administrative tasks.

### Management

The Board of Trustees orderly rotated the position of Managing Director by August 1, 2017. One Department Head and the Head of Administration retired in 2018 and 2019, respectively. The positions were filled by February 2019 and August 2019 respectively.

The Martin Luther University Halle-Wittenberg (MLU) and the IPB jointly appoint scientific department chairs as University W3-Professors. The four IPB Department Chairs and adjunct Professors are affiliated with the MLU Institutes of Biology, Biochemistry & Biotechnology, Pharmacy, and Chemistry.

### Postdoctoral staff

As of December 31, 2019, the IPB hosted 25 early-to-mid-career postdoctoral research associates.

The IPB states that it aims to provide appropriate measures and budgets for professional support and career development for each career stage. Such measures include but are not limited to: (1) Assignment of internal and possibly external mentors to discuss career path options and monitor qualification milestones (e.g., publications, external funding, and special experimental skills). (2) Enrolment in external mentorship programs. (3) Supporting participation in national and international conferences. (4) Encouraging research periods abroad. (5) Supporting participation in various workshops to train and sharpen professional skills. (6) Providing enough leeway for conducting independent research. (7) Offering measures for dual career and family support.

The IPB currently hosts two Independent Junior Research Groups (JRG) on a fixed-term basis. The Board of Directors and Scientific Advisory Board closely monitor their progress and development into highly visible scientists. Upon positive midterm evaluation, the Institute offers six years of support and optional bridging funds for up to two years (3+3+2 model). The heads of three discontinued JRG were appointed to professorship positions elsewhere (one at MLU, one at the University of Osnabrück and one Interim-Professorship at the University of Freiburg).

Depending on arising vacancies and scientific developments, each department chair may opt to appoint fixed term Departmental Junior Research Group Leaders, either by promotion of successful project leaders or via open calls for applications. The first such group has been established in 2011 and since then seven more have been established. Out of the eight group leaders four were recruited externally. Permanent appointments must comply with the IPB Guidelines for Permanent Tenure, which call for internal review (Board of

Directors), external evaluation and approval (Scientific Advisory Board) of the candidate's dossier (record of publications, external funding, supervision, contribution to research infrastructure). Out of the eight groups three are now funded permanently, one has been discontinued (the head accepted a professorship at the University of Applied Sciences Merseburg), one group head is now employed at MLU (but the group is still associated to IPB) and three are still active as Departmental Junior Research Group (heads employed on a fixed-term basis).

### **Doctoral candidates**

As of December 31, 2019, 35 doctoral candidates were employed at the IPB. Between 2017 and 2019 a total of 43 theses were completed. The time needed to complete the dissertation (including public defence) was 5.6 years on average.

The IPB adopted a supervision agreement that is an integral part of the doctoral training program. Each doctoral candidate has a thesis advisory committee consisting of at least three members: a research supervisor, an academic supervisor, and one or more mentors. Additionally, the IPB implemented a doctoral training program in 2018. It consists of the core program and the extended program called Leibniz Research School (LRS) PlantBioChem. All doctoral candidates at the IPB must complete basic mandatory activities. Additionally, a participation in the LRS PlantBioChem program is encouraged. It requires mandatory and optional training elements, which are recorded and honoured by the Certificate of Completion award. IPB graduates can join the MLU Alumni Network. A formal IPB Alumni Network is in the planning stages.

### **Non-scientific staff**

Various providers commissioned by the IPB offer training programs to all employees. The spectrum ranges from subject-specific seminars, training, qualifications, workshops and meetings to expert conferences. Employees on parental leave are encouraged to take advantage of these opportunities.

The IPB actively engages in dual vocational training. The institute provides training in five occupations: biology and chemistry laboratory assistants, horticulturists, IT specialists (system integration or application programming), and office management assistants. Twelve IPB employees are certified and involved as official trainers. On average, the IPB employs up to 10 trainees per year. Between 2017 and 2019, eight trainees completed their dual education and training programs.

### **Equal opportunities and work-life balance**

As of December 31, 2019, 41 of 91 employees in research and scientific services were female (45 %). One of the four department chairs was female, 7 out of 17 group leaders (41 %) and none of the two independent junior research group leaders. 17 out of 35 doctoral candidates (49 %) were female.

The IPB has implemented the Cascade Model, which calls for increasing the share of female scientist employment in a cascading fashion upwards the professional career ladder. The institute additionally implemented its own internal regulations on gender equality. It



created the position of IPB Equal Opportunities Officer in 1994. The Officer and Deputy are members of the IPB-funded Equal Opportunities and Diversity Committee.

Measures of work-life balance at IPB include flexible working hours, flex-time arrangements, deviations from the 5-day working week, part-time jobs, teleworking (home office), family-friendly scheduling of seminars and other academic events, individual parental leave agreements, numerous and tailor-made training opportunities, use of special leave or work breaks, assistance in securing and arranging day-care places, parent-child rooms, and other family-friendly actions. Since October 2010, the IPB has been a member of the network *Dual Career Mitteldeutschland*, which supports professional integration of couples. Since 2010, the IPB holds the title Total E-Quality, which was uninterruptedly awarded for the fourth time in 2019 and, for the first time, with the additional distinction Diversity.

## 6. Cooperation and environment

### Cooperation

#### *Cooperation with the Martin Luther University Halle-Wittenberg (MLU)*

The IPB names MLU as the most important partner of the IPB for long-term collaboration in research, teaching, and outreach. The MLU and IPB jointly appointed all 4 Department Chairs as University W3-Professors (see Chapter 5). Furthermore, two IPB scientists are appointed as extraordinary Professors at the MLU and one independent Junior Group Leader as W1-Professor. All professors participate in MLU-administered teaching activities (lectures, seminars, practical courses, examinations) of regular curricula (biochemistry, biology, pharmacy, chemistry, and bioinformatics), which are offered in lecture rooms and laboratories of both partners. Each IPB Department Chair is expected to teach two SWS (hours taught per week per semester). In total, each year, IPB scientists support MLU teaching activities with about 45 SWS.

The IPB is a partner in MLU-coordinated research networks, such as Collaborative Research Centers (CRC) and Research Training Groups (RTG):

- CRC 648 *Molecular Mechanisms of Information Processing* (until 2016), three projects
- RTG 1026 *Conformational Transitions in Macromolecular Interactions* (until 2014), two projects
- RTG 1591 *Post-transcriptional Control of Gene Expression* (until 2019), one project
- RTG 2467 *Intrinsically Disordered Proteins: Molecular Principles, Cellular Functions, and Diseases* (since 2019), one project
- RTG 2498 *Communication and Dynamics of Plant Cell Compartments* (since 2019), four projects.

#### *Cooperation with Other Universities*

Freie Universität (FU) Berlin: The chair of the Department *Biochemistry of Plant Interactions* and large parts of the research group were previously at the FU and will continue to

participate in the DFG-funded CRC 973 *Priming and Memory of Organismic Responses to Stress* (FU Berlin) as a satellite group. The chair of Department *Biochemistry of Plant Interactions* will also continue the role of the Vice-Speaker of CRC 973.

Bielefeld University (BU): An IPB-BU cooperation agreement is under review, which will formalize joint professorships, dissertation research, and collaborations in chemistry, biology, scientific informatics and biotechnology. The IPB participates in a CRC, which is currently under final evaluation by the German Science Foundation.

Anhalt University of Applied Sciences (FH), Köthen: In addition to cooperative research projects involving interns, bachelor and master students, an IPB employee has been an Honorary Professor for Plant Biotechnology at FH Köthen since 2013 teaching biochemistry and plant biotechnology to bachelor and master students.

University of Concepción, Chile: Since 2013, an IPB employee has been teaching two graduate courses annually in the Department of Botany (Faculty of Natural Sciences and Oceanography).

#### *Cooperation within the Leibniz Association*

Leibniz Science Campus Halle (WCH): The Leibniz Science Campus Halle *Plant-based Bioeconomy* (WissenschaftsCampus Halle Pflanzenbasierte Bioökonomie) is a regional (southern Saxony-Anhalt) network of the four founding members, i.e. three Leibniz institutes and the MLU and seven associated non-university institutes. In 2011, the WCH was established.

Leibniz Research Alliances: The IPB has been a member of three Leibniz Research Alliances (LFV) and one Leibniz Research Network (LFN):

- LFV *Bioactive Compounds and Biotechnology*, which coordinates the activities of 16 Leibniz Institutes in the area of bioactives development and biotechnology
- LFV *Sustainable Food Production and Healthy Nutrition*, a network of 12 Leibniz Institutes with the goal to understand at various levels the complexities of food production and human nutrition
- LFV *Biodiversity*, founded in 2008 and now organised as an LFN, bundles the skills of institutes across all sections of the Leibniz Association to study biodiversity and its relevance in all facets with the goal to derive recommendations for sustainable solutions
- LFN *Leibniz Omics-Network* (LiON).

Leibniz Research Cluster: The IPB is one of five Leibniz member institutes of the BMBF-funded (BMBF Biotechnology 2020+) Leibniz Research Cluster (LRC) *Bio/Synthetic Micro-Productions Units – New Ways in Drug Development*

Since 2012, the IPB coordinated two collaborative research networks of five partner institutions each, *Chemical Communication in the Rhizosphere* (2011-2015) and *St. John's Wort against Alzheimer* (2015-2020). The IPB has been a partner of three collaborative research networks since 2017 (*DiSeMiNation*), 2018 (*Cystein-selective bioconjugation for next gen-*

eration antibody drug conjugates), and 2020 (*KETCHUP: Climate-Enhanced Tomato breeding Capturing Heat stress resilience using integrative Phenotyping*). Other Important Collaborations

German Center for Integrative Biodiversity Research (iDiv): The IPB is one of the 12 founding members of iDiv (established by the DFG in 2012) to study the basis for the sustainable management of our planet's biodiversity

BMBF-funded Consortia: The IPB has participated in *Biodiversity & Health* (Indonesia), *InfectControl2020*, *BioCatalysis2021*, and the *German Network for Bioinformatics Infrastructure* (de.NBI), which joined ELIXIR in 2016 to establish ELIXIR Germany as a national node.

The IPB is a member of the *Agrochemical Institute Piesteritz* (AIP), a consortium of the MLU, IPB, IPK and several companies, foremost the SKWP (*Stickstoffwerke Piesteritz*). Its main purpose is to fund research on molecular tools, e.g. plant protectants, to improve fertilizer and crop performance upon climate change.

Since 2018, the IPB has been involved the *National Research Data Infrastructure* (NFDI) program of the Joint Science Conference (GWK). The IPB is a member of the Chemistry Consortium in the NFDI (NFDI4Chem), which is expected to be funded effective 2020.

Since 2013, IPB scientists have secured as coordinators or collaborators several EU-funded projects: ERA-CAPS HIP; Horizon 2020 Chic, and Newcotiana; ERA-Syn Bio; and others such as PhenoMenAI, Cosmos, or several COST Actions. The IPB is member of the EU- and State-funded consortium *Autonomy in Old Age – The Model Region of Saxony-Anhalt*, and it is member of the *German African network TriSustain*. Additionally, the IPB joined in 2019 the *C4-Rice Consortium* funded by the Bill & Melinda Gates Foundation.

### **Institution's status in the specialist environment**

According to the IPB its research program reveals only minimal conceptual overlap with other institutes in the plant sciences. Thematic intersection may be intermittent or on purpose when addressing major societal challenges in collaborative efforts. Regular communication between institutes of similar scope (e.g., via membership on scientific advisory boards or in Leibniz Research Alliances/Network) facilitates coordination of research programs and avoids programmatic redundancies or converging developments. Examples are:

- Leibniz Institute of Plant Genetics and Crop Plant Research (IPK Gatersleben).
- Leibniz Institute of Vegetable and Ornamental Crops (IGZ Großbeeren).
- Leibniz Institute for Natural Product Research and Infection Biology (HKI Jena).
- Max Planck Institute for Plant Breeding Research (MPI Cologne).
- Max Planck Institute for Molecular Plant Physiology (MPI Golm).
- Max Planck Institute for Chemical Ecology (MPI Jena).
- John Innes Centre (JIC), Norwich, UK.
- The Sainsbury Laboratory (TSL), Norwich, UK.

- Boyce Thompson Institute for Plant Research (BTI), Ithaca, USA.
- Noble Research Institute, Ardmore, USA.
- Institute of Plant and Microbial Biology (IPMB), Academia Sinica (Taiwan).
- RIKEN Center for Sustainable Resource Science (CSRS), Yokohama, Japan.

## 7. Subdivisions of IPB

### **Department Bioorganic Chemistry** (since 2000)

[Staff as of 31 December 2019: 34.1 FTE, thereof 11.1 FTE Research and scientific services, 12 FTE Doctoral candidates, and 11 FTE Service staff]

Since the department's restructuring in 2015, the work is performed in five research groups (RG) and one infrastructural group:

- RG Bioactives (since 2000),
- RG Biotechnology (since 2016),
- RG Natural Products & Metabolomics (since 2000),
- RG Biofunctional Synthesis (since 2010),
- RG Computational Chemistry (2001 till 2019),
- RG Data & Resources (since 1992).

Research focuses on the identification, understanding and production of small molecules and the study of their effects. This includes the application of chemical compounds to probe and modify biological systems. The analysis, isolation, characterization, and modification of secondary metabolites and enzymes from plants and higher fungi is the basis of efforts to understand the properties of these compounds or to disclose their function in nature, and finally to explore their use in chemistry, biology and medicine. The development of analytical tools, e.g. for metabolic profiling, and their computational analysis often is at the start of a project. Applications are driven by the discovered properties and include such diverse areas as plant protectants, lead structures for medicinal chemistry or novel food ingredients, biological research tools, or the utilization of enzymes as biocatalysts. Three main lines of research are followed to achieve this:

- 1) To learn from nature's chemistry through both the elucidation of natural structures and the understanding of basic principles of nature's application of chemistry in a biological context.
- 2) To use synthetic chemistry and biology to provide access to natural products and derivatives for applications in biology, medicine, nutrition, and plant protection.
- 3) To try to increase an understanding of molecular interaction processes and develop new tools including computational ones, probes, model, and recognition compounds to study these.

In general, the major effort for the coming years will be to understand (analyse), utilize, and ideally control the molecular complexity and what small molecules do in the context

with each other and how they act on their targets.

Over the period 2017-2019, the department published on average 55 articles per year in peer-reviewed journals. In addition, on average, one patent per year has been granted. During the same period, the department's average yearly revenue from third-party funding was 1.1 M€, with 360 K€ from Federal and *Länder* governments, 300 K€ through scholarships, 215 K€ from the Leibniz-Association, 135 K€ through externally managed funds (e.g. by MLU). Between 2017 and 2019, 18 department members received their doctoral degree.

### **Department Molecular Signal Processing** (since 2009)

[Staff as of 31 December 2019: 24.7 FTE, thereof 9 FTE Research and scientific services, 7.2 FTE Doctoral candidates, and 8.5 FTE Service staff]

The department consists of 5 research groups (RG) and one RG associated with the MLU:

- RG Nutrient Sensing (since 2009),
- RG Cellular Coordination (since 2010),
- RG Signal Integration (since 2011),
- RG Jasmonate Signaling (since 2016),
- RG Symbiosis Signaling (since 2019),
- RG Regulatory RNAs (2014-2016).

The unifying research theme of the department seeks to understand the complexity and underlying molecular networks of plant-environment interactions at the biochemical to systems level, a topic of heightened importance for fundamental and translational plant research in the face of accelerating global climate change. The department is principally interested in exploring how plants monitor their surroundings, perceive fluctuations in external parameters, decode, transmit and integrate this information, and ultimately deploy appropriate metabolic as well as developmental responses to shifting physical and chemical conditions, or to co-evolving biological competitors, for optimal plant growth and survival.

Converging directions of departmental research focus on select plant response systems to investigate molecular determinants of plant survival and resilience in adverse habitats, such as

- 1) the perception of relevant environmental cues (e.g., changing nutrient availabilities, metal toxicities, or wounding),
- 2) the action of select plant hormones and second messengers (e.g., jasmonates, auxin, calcium ions, or reactive oxygen species), and
- 3) the coordination of metabolic and cellular processes during adaptive plant growth and development (e.g., adjustment of central and peripheral metabolism, of cell and organ shape, or of root growth behavior).

Over the period 2017-2019, the department published on average 14 articles per year in

peer-reviewed journals. During the same period, the department's average yearly revenue from third-party funding was 350 K€, with 140 K€ by the DFG, 110 K€ through funds administered by the MLU, 90 K€ through scholarships. Between 2017 and 2019, 5 department members received their doctoral degree.

### **Department Cell and Metabolic Biology** (since 2010)

[Staff as of 31 December 2019: 29.6 FTE, thereof 14.7 FTE Research and scientific services, 5.2 FTE Doctoral candidates, and 9.7 FTE Service staff]

The department consists of 4 research groups (RG):

- RG Glandular Trichomes and Isoprenoid Biosynthesis (since 2010),
- RG Synthetic Biology (since 2012),
- RG Jasmonate Function and Mycorrhiza (since 1999),
- RG Phenylpropanoid Metabolism (since 1993).

The intra-departmental interaction is supported by expertise available in the different RG in a set of technical/technological areas. These include cell biology, enzymology, metabolomics and modular cloning methods, which also contribute to the technological platforms and interdepartmental activities of the IPB. Together, the four RG contributed to the following three aims of the department:

- 1) to elucidate and understand the biosynthesis of plant specialized metabolites that have relevance for the interaction of plants with other organisms and/or that are beneficial for humans,
- 2) to design and implement metabolic engineering strategies in plants and microorganisms for the production of these metabolites, and
- 3) to investigate the development of specific plant organs or tissues (flower, trichomes, laticifers), in particular via phytohormones.

In the future, the department plans i) to understand how plant specialized metabolites contribute to plant resilience in challenging environments (biotic and abiotic stresses); ii) to exploit the enzyme/gene space accessible through transcriptome and genome sequence data to discover novel enzymatic activities and to explore the chemical space by combinatorial biosynthesis using modular cloning; iii) to understand how specialized metabolic cell factories develop and function, including topics such as connectivity between primary and specialized metabolism and transport; and iv) to investigate the role of plant hormones in coordinating organ development and production of specialized metabolites.

Over the period 2017-2019, the department published on average 15 articles per year in peer-reviewed journals. During the same period, the department's average yearly revenue from third-party funding was 800 K€, with 340 K€ from Federal and *Länder* governments and 165 K€ from the DFG and 115 K€ from the EU. Between 2017 and 2019, 7 department members received their doctoral degree.

### **Department Biochemistry of Plant Interactions** (since 2019)

[Staff as of 31 December 2019: 21.1 FTE, thereof 12.5 FTE Research and scientific services, 2.6 FTE Doctoral candidates, and 6 FTE Service staff]

The department started in February 2019 in succession of former Department *Stress and Developmental Biology* (SEB). In the transition from the old department to the new department, the organisational changes were made as described in Chapter 3. The department now consists of four RGs:

- RG Calcium-Dependent Protein Kinases (CDPKs) (since 2019),
- RG Cellular Signaling (since 2004),
- RG Metabolite-Based Defense Mechanisms (since 1995),
- RG Nuclear Processes in Plant Defense (since 2019).

Research of the department centers on interactions within plants, of plants with biotic attackers, and between plants and their abiotic environment. The department aims on plant health by elucidating and understanding perception, signaling and transcriptional and metabolite changes in plant immunity in response to biotic (microbial and herbivore) stressors. This topic will be investigated in all four research groups. In addition, a new research focus addresses plant health and development in the context of sustainable plant growth under adverse environment, climate, or nutrient conditions.

The department will continue its long-standing scientific and technical expertise in ligand/receptor-based recognition, cellular signaling whereby MAPK-mediated signaling will be newly complemented by calcium-regulated protein kinase signaling, transcriptional regulation, and the role of specialized metabolites in plant defense, covering both pattern-triggered immunity (PTI) and effector-triggered immunity (ETI). The department will extend and newly develop additional methodologies to integrate the study of biochemical processes such as protein folding, post-translational modifications of proteins, and protein structure elucidation, which are prerequisite to in planta protein function. The key objective within Department BPI is the elucidation of biochemical regulatory principles (calcium decoding, phosphorylation, ADP-ribosylation) as well as of key components (genes, proteins, metabolites), which contribute to plant resilience and guarantee plant growth and survival. Once successful, the department seeks a translation of its research from the biochemical determinant (or component) to its potential application in agriculture and beyond.

Over the period 2017-2019, the department published on average 15 articles per year in peer-reviewed journals. During the same period, the department's average yearly revenue from third-party funding was 550 K€, with 220 K€ from the DFG, 110 K€ from the EU, and 100 K€ from Federal and *Länder* governments. Between 2017 and 2019, 8 department members received their doctoral degree.

### **Synergy Research Groups (SRG) and Independent Junior Research Groups (IRG)**

[Staff as of 31 December 2019: 15.6 FTE, thereof 7 FTE Research and scientific services, 4.8 FTE Doctoral candidates, and 3.9 FTE Service staff]

The *SRG Proteome Analytics* (since 2012) investigates the plasticity of the plant's proteome landscape in various biological scenarios, primarily in immunity and its trade-off with growth. The group's main analytical tool is liquid chromatography-mass spectrometry (LC-MS) based proteomics. The SRG conducts both collaborative (60 %) and individual (40 %) research. While maintaining its collaborative component, the SRG is associated with the recently established Department *Biochemistry of Plant Interactions*.

The *SRG Bioinformatics & Scientific Data* (since 2005) is working on Computational Plant Biochemistry. The mission of the group is to 1) develop new methods in computational metabolomics, 2) advance the adoption of FAIR research data, and 3) support research in plant biochemistry with state-of-the-art bioinformatics approaches. The group was part of the former Department Stress- and Developmental Biology (RG *Bioinformatics & Mass Spectrometry*). In the transition from this department into the new department Biochemistry of Plant Interactions the group has been restructured into the independent SRG. The SRG will evolve into Computational Plant Biochemistry unit of the planned Program Center MetaCom.

The *JRG Bioorganic Chemistry* (since 2016) is funded by the IPB and the BMBF within the *Leibniz Research Cluster Bio/Synthetic Multifunctional Micro-Production Units – New Ways in Drug Development*. This Cluster consists of 5 groups at five Leibniz institutes and aims to develop new “artificial” cascades in cell-free environment and consists of five junior research groups. The IPB has the task to identify novel or even non-natural enzymatic reactions. The enzymes shall further be developed by directed evolution to be applied in cascade reactions of the Leibniz Research Cluster.

The *JRG Designer Glycans* (since 2019) is funded by the IPB and is focused on discovering how plant carbohydrates are synthesized and dynamically modulated in order to produce tailored glycan structures and functions. The group addresses questions in glycobiology, e.g., about the control points of polysaccharide elongation, branching and decoration or about the impact of remodeled glycans on cell wall architecture and function. Advances of such fundamental biochemical knowledge will pave the way for the assembly of sugar units into tailor-made polysaccharides with desirable properties for industrial applications.

Over the period 2017-2019, the two SRG and JRG published on average 18.3 articles per year in peer-reviewed journals. During the same period, the average yearly revenue from third-party funding was 700 K€, with 230 K€ from Federal and *Länder* governments, 100 K€ from the DFG, 50 K€ from the Leibniz-Association, and 220 K€ through funds externally administered (e.g., by the MLU). Between 2017 and 2019, 5 members of the four groups received their doctoral degree and 1 completed a habilitation.

## 8. Handling of recommendations from the previous evaluation

IPB responded as follows to the 9 recommendations of the last external evaluation (highlighted in italics, see also statement of the Senate of the Leibniz Association issued on 20 March 2014, pages B-3/B-4):



- 1) *In the medium term, IPB has the potential to further improve the excellent performance of the Institute. To this end, IPB Management should further promote the development of scientifically excellent areas using **suitable instruments of co-allocation**. An appropriate measure would be to increase the share **of performance-related funding**. The recent flexibility of the personnel plan below department chair level should be used to staff innovative areas of research.*

Effective 2015, the IPB has implemented an internal regulation that rewards IPB scientists with an individual performance bonus. If successful, scientists of pay scales E13-E15 receive an allowance of 1 % of the total funding amount granted, paid in 12 monthly instalments. In addition, based on TV-L, outstanding performance by individual IPB employees may be rewarded by a one-time special payment of up to 10 % of the annual salary. These measures augment the established system of performance-based allocation of departmental funds (see Chapter 4).

- 2) *The Institute's publication performance is very good overall, but the number of **publications in high-ranking journals** should be further **increased**.*

A bibliometric analysis and comparison of the previous (2006-2012) and current (2013-2019) evaluation period shows that the IPB has increased its publication performance, in both quantity and quality (i.e., impact factor and citations, see Chapter 3).

- 3) *The IPB must continue to **increase its third-party funding**, especially in the two new departments. Given its high level of interdisciplinary expertise, the Institute should become **more visible as an initiator and coordinator of collaborative projects at national and international level**. In particular, the Institute should take advantage of the opportunity to initiate project proposals together with its university partners within the framework of DFG funding lines such as Collaborative Research Centers, even if it is not the lead applicant.*

The IPB explains that, a comparison of the previous (2006-2012) and current (2013-2019) evaluation period shows that acquisition of third-party funding increased by 35 %. Relative to the institutional funding of 2019, the share of extramural funds (including stipends and funds not directly managed by the Institute) approached one-quarter (23.7 %). During the current evaluation period, the IPB has expanded its participation in local, national and international research networks and consortia, funded by the DFG, BMBF, Leibniz Association, and the EU (see Chapter 6).

- 4) *An important point for the long-term development of the IPB will be the **replacement of the management position** of the very successful department "Stress and Developmental Biology" in 2018, which is necessary due to retirement of its chair.*

The IPB has recruited a new head of the department. See Chapter 3.

- 5) *It is positive that the four department chairs, together with the University of Halle, are joint-professors in various disciplines (chemistry, biology, biochemistry/ biotechnology and pharmacy). Below the departmental management level, **positions should also be provided for jointly appointed (University of Halle) professors at the W1 or W2 level**.*

In 2016, the university and the IPB jointly appointed an adjunct Junior-Professor (W1, tenure-track) to establish the independent junior research group *Bioorganic Chemistry* at the IPB. Currently, exploratory discussions are underway to recruit and appoint a second adjunct Junior-Professorship (W1) at the IPB and the university.

6) *Two **professorships at the University of Halle** in the field of organic chemistry and bioinorganic chemistry are currently vacant. At the time of visitation, it was unclear whether the two professorships in this area would be filled. If not, the potential of the IPB to form local alliances with the University of Halle at the interface of chemistry and biology would be severely limited, which would negatively affect plans of the University to develop biosciences as an area of special emphasis.*

The university appointed a Heisenberg Scholar of the University of Erlangen as W3-Professor for Organic Chemistry and Functional Materials, effective September 1, 2019.

7) *It is welcomed that the approximately 55 doctoral students at IPB participate in an institute-specific doctoral framework programme. However, the IPB should **implement binding supervision agreements**. This may also contribute to **reducing the average doctoral period** until the oral defence of currently about 4 years.*

The Institute has restructured its IPB Doctoral Training Program and has been enforcing a formalized supervision agreement (see Chapter 5).

8) *In addition, the IPB should strive, together with the University Halle, to **expand the structured graduate program** in a subject-specific manner. The extent to which the ScienceCampus Halle can provide a suitable framework should be checked.*

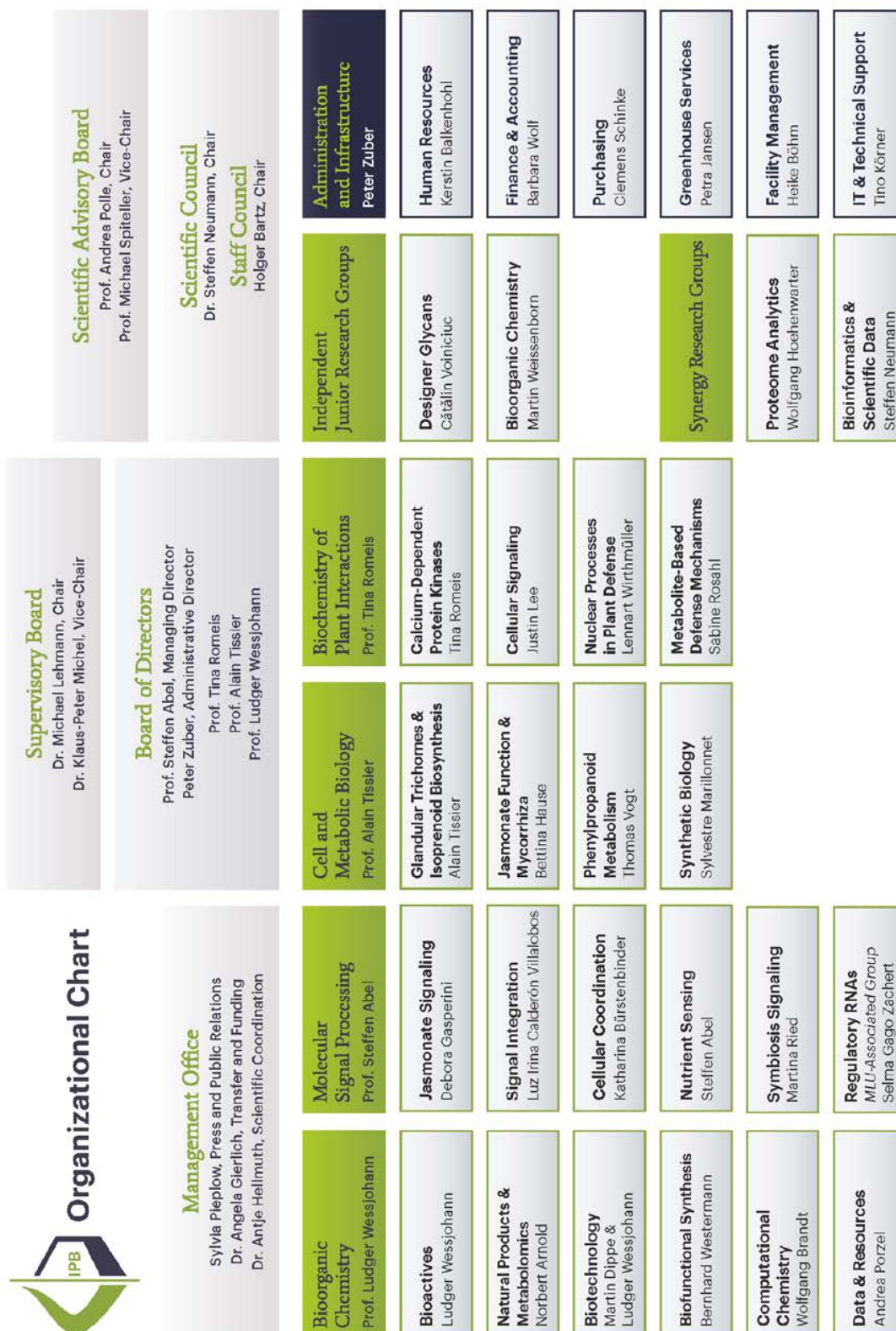
The IPB Doctoral Program and its Board of Doctoral Representatives coordinate with programs offered by the MLU International Graduate Academy (InGrA), the Leibniz Science Campus Halle, and with externally administered structured graduate programs.

9) *The IPB **statutes should be amended** with regard to membership of the Chair of the Scientific Advisory Board on the Board of Trustees. Such membership shall be without voting right as is customary at Leibniz institutes.*

The Statutes of the Foundation, the IPB, were amended accordingly in 2015.

Appendix 1

Organisational Chart



## Appendix 2

## Publications, patents, and expert reviews

	Period		
	2017	2018	2019
<b>Total number of publications</b>	<b>118</b>	<b>98</b>	<b>132</b>
Monographs	0	0	0
Individual contributions to edited volumes	8	4	13
Articles in peer-reviewed journals	109	87	116
Articles in other journals	1	7	3
Working and discussion papers	0	0	0
Editorship of edited volumes	0	0	0

<b>Industrial property rights <sup>1)</sup></b>	<b>2017</b>	<b>2018</b>	<b>2019</b>
Patents (granted/applied)	2/2	1/2	1/2
Other industrial property rights (granted/applied)	0/0	0/0	0/0
Exploitation rights/licences (number)	0/2	0/2	0/1

	<b>2017</b>	<b>2018</b>	<b>2019</b>
Number of expert reviews	0	0	1

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<sup>1</sup> Concerning financial expenditures for revenues from patents, other industrial property rights and licences see Appendix 3.

## Appendix 3

## Revenue and Expenditure

Revenue		2017			2018			2019		
		k€	%	% <sup>1</sup>	k€	%	%	k€	%	%
<b>Total revenue (sum of I, II. and III.; excluding DFG fees)</b>		<b>26.835</b>			<b>27.340</b>			<b>25.215</b>		
<b>I.</b>	<b>Revenue (sum of I.1., I.2. and I.3)</b>	<b>16.940</b>	100 %		<b>17.331</b>	100 %		<b>17.372</b>	100 %	
1.	<u>INSTITUTIONAL FUNDING (EXCLUDING CONSTRUCTION PROJECTS AND ACQUISITION OF PROPERTY)</u>	14.537	86 %		14.746	85 %		14.894	86 %	
1.1	Institutional funding (excluding construction projects and acquisition of property) by Federal and <i>Länder</i> governments according to AV-WGL	14.537			14.746			14.894		
1.2	Institutional funding (excluding construction projects and acquisition of property) not received in accordance with AV-WGL	0			0			0		
2.	<u>REVENUE FROM PROJECT GRANTS</u>	2.403	14 %	100 %	2.585	15 %	100 %	2.478	14 %	100 %
2.1	DFG	497		21 %	471		18 %	998		40 %
2.2	Leibniz Association (competitive procedure)	495		21 %	431		17 %	68		3 %
2.3	Federal, <i>Länder</i> governments	821		34 %	1.106		43 %	1.183		48 %
2.4	EU	307		13 %	361		14 %	91		4 %
2.5	Industry	101		4 %	30		1 %	25		1 %
2.6	Foundations	19		1 %	22		1 %	26		1 %
2.7	other Sponsors ( <i>WorldVeg Center; DAAD, LFV, Stadt HAL</i> )	164		7 %	165		6 %	86		3 %
2.8	For information only: Externally managed funds to IPB	320			408			432		
2.9	For information only: Scholarships to IPB	612			524			424		
3.	<u>REVENUE FROM SERVICES</u>	0	0 %		0	0 %		0	0 %	
3.1	Revenue from commissioned work	0			0			0		
3.2	Revenue from publications	0			0			0		
3.3	Revenue from exploitation of intellectual property without industrial property rights	0			0			0		
	<b>Miscellaneous revenue</b>	<b>7.895</b>			<b>10.008</b>			<b>7.844</b>		
	- Self-management funds (carry-over)	4.987			6.650			4.333		
	- Cash balances (carry-over)	2.823			3.282			3.427		
	- Misc. Income (e.g., rental income)	85			76			84		
<b>II.</b>	<b>Revenue for construction projects</b> (institutional funding by Federal and <i>Länder</i> governments, EU structural funds, etc.)	<b>2.000</b>			<b>0</b>			<b>0</b>		
<b>Expenditures</b>		<b>k€</b>			<b>k€</b>			<b>k€</b>		
<b>Expenditures (excluding DFG fees)</b>		<b>16.545</b>			<b>19.209</b>			<b>21.389</b>		
1.	Personnel	9.206			9.270			10.025		
2.	Material expenses	3.823			4.247			4.743		
2.1	<i>Proportion of these expenditures used for registering industrial property rights (patents, utility models etc.)</i>	47			33			81		
3.	Equipment investments	2.037			2.706			2.318		
4.	Construction projects, acquisition of property	776			2.256			3.694		
5.	Other operating expenses (specified under)	703			730			608		
DFG fees (if paid for the institution – 2.5% of revenue from institutional funding)		351			358			362		

## Appendix 4

## Staff

(Basic financing and third-party funding / proportion of women (as of: 31.12.2019))

	Full time equivalents		Employees		Female employees		for- eigners
	Total	on third- party funding	Total	on tem- porary con- tracts	Total	on tem- porary con- tracts	Total
	Number	Percent	Number	Percent	Number	Percent	Num- ber
<b>Research and scientific services</b>	<b>75,5</b>	44,7	<b>91</b>	79,8	<b>41</b>	85,5	<b>30</b>
1 <sup>st</sup> level (department leaders or equi.) <sup>1</sup>	4,0	0,0	4	25,0	1	100,0	1
2 <sup>nd</sup> level (group leaders or equi.)	16,4	0,0	17	29,0	7	29,0	5
Junior research group leaders (if applicable)	2,0	100,0	2	100,0	0	0,0	1
Scientists in non-executive positions (A13, A14, E13, E14 or equivalent)	29,9	62,0	33	90,0	16	94,0	12
Doctoral candidates (A13, E13, E13/2 or equi.)	23,2	57,0	35	100,0	17	100,0	11
<b>Service positions</b>	<b>63,2</b>	4,6	<b>66</b>				
Laboratory	31,2	6,0	32				
Chemical storage	1,0	0,0	1				
Library	0,9	0,0	1				
Information technology - IT	8,0	13,0	8				
Greenhouse Services	4,0	0,0	5				
Facility Management	9,7	0,0	10				
Management Office	2,6	0,0	3				
Secretariats	5,9	0,0	6				
<b>Administration</b>	<b>9,8</b>	0,0	<b>10</b>				
Head of administration	1,0	0,0	1				
Staff positions (Group leaders)	3,0	0,0	3				
Staff positions (E9 to E6)	5,8	0,0	6				
<b>Student and scientific assistants</b>	<b>5,2</b>	35,0	<b>17</b>				
<b>Trainees</b>	<b>9,0</b>	0,0	<b>9</b>				
<b>Scholarship recipients at the institution</b>	<b>10,5</b>	100,0	<b>15</b>		<b>9</b>		<b>12</b>
Doctoral candidates	8,5	100,0	13		7		10
Post-doctoral researchers	2,0	100,0	2		2		2

<sup>1</sup> One of the four scientific department chairs is appointed by the Board of Trustees as Managing Director of the Institute, typically for five years on a rotating basis.

## Annex B: Evaluation Report

### Leibniz Institute of Plant Biochemistry, Halle (IPB)

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Appendix:

Members of review board

## 1. Summary and main recommendations

IPB successfully studies plants and fungi and their interactions, with a strong focus on natural products. By combining basic research with application-oriented questions, IPB aims to achieve a comprehensive molecular understanding of the adaptive and developmental processes that plants have evolved as a consequence of their dynamic interaction with the environment. The results are used to facilitate sustainable crop production, innovative biotechnology, and drug development for improving the health and nutrition of humans, animals and plants.

IPB's overall concept is well thought through. The research is organised into one chemistry- and three biology-oriented departments, each housing four to six groups. The departments work together in four programme areas and make great efforts to capitalize on their complementary expertise.

IPB has developed very positively since the last evaluation and responded well to all recommendations. The main change was caused by the retirement of a very successful department head. The institute appointed an excellent successor in 2019. Her department, renamed the Department for Biochemistry of Plant Interactions, is still in a transitional phase. The thematic orientation is very promising and some very good results have already been published. The other three departments have sharpened their profiles and further improved their performance. The position of Managing Director passed from one department head to another in 2017, as part of a rotating system.

The common research theme of all four departments in the coming years will be understanding the chemical basis of plant resilience. A central aspect of IPB's strategy is the establishment of a new Program Center for Plant Metabolomics and Computational Biochemistry (MetaCom). In this centre, IPB plans to consolidate major analytical equipment in one place, merge personnel from all scientific departments, and recruit additional scientific staff. In the long term, IPB envisions the construction of a new building to consolidate all the functions necessary for the Program Center.

IPB has well-established and strong links with the University of Halle-Wittenberg. All four department heads are jointly-appointed professors (W3). IPB is very supportive of young researchers. The fixed-term independent Junior Research Groups (JRGs), in particular, have proved to be a very successful instrument. All three JRG heads who have left IPB since the last evaluation now have leading positions at German universities. Currently, IPB hosts two JRGs, both of which are internationally competitive and an asset to IPB.

Special consideration should be given to the following main recommendations in the evaluation report (highlighted in **bold face** in the text):

### Overall concept and results (chapter 3)

1. The number of peer-reviewed publications has risen markedly since the last evaluation, as has the proportion of lead author papers. More papers are being published in internationally well-known journals and insofar better visible in the scientific community. IPB should continue on this positive trajectory. In doing so, the institute should aim to achieve a more equal distribution of publications across the individual research groups.



### Changes and planning (chapter 3)

2. Work planning for the coming years makes sense and is well thought through. The common research theme of all four departments will be understanding the chemical basis of plant resilience. This field of research has great potential, not only for basic research but also for knowledge transfer, especially when anticipating the challenges linked to climate change. The interdisciplinary expertise at the institute, especially in chemistry, is a very strong asset when it comes to pursuing this important path. IPB should deepen this strategy further with the aim of further increasing the number of cross-departmental projects and, in turn, publications.
3. The planned MetaCom Program Center aligns well with the overall strategic plan and the aims are ambitious and timely. It will create synergy, both with respect to resources and important computational expertise. It will also further strengthen interdisciplinary and cross-departmental research, as well as IPB's international visibility. The institute should continue with its efforts for this project.

### Controlling and quality management (chapter 4)

4. As recommended at the last evaluation, IPB has improved the revenue from third-party funding but, at 14 % of the annual budget, it is still low and should be further increased. As planned, IPB should take a more strategic approach to identifying potential funding initiatives and strive for more prestigious grants, especially from the EU and DFG.
5. The current system for the performance-based allocation of funds seems generally to follow the performance of departments. IPB should consider giving more weight to the performance of individual groups. Within a transparent index of performance indicators, IPB should also consider shifting the metrics so that high-ranking third-party funds are rewarded even more highly. The groups should be evaluated at annual appraisal meetings and the Scientific Advisory Board should also assess these groups in more detail during the audits held at Leibniz institutes between external evaluations.

### Human resources (chapter 5)

6. IPB has implemented suitable mentoring and supervision structures for the promotion of doctoral candidates. A structured programme was established in 2018. However, IPB should implement measures to reduce the average time to complete a PhD, which was rather long at 5.6 years.

### Cooperation and environment (chapter 6)

7. Even though the chemistry department at the University of Halle-Wittenberg has a stronger focus on material sciences than on plant sciences, there are several good opportunities to further strengthen the existing close collaboration, for example in the fields of plant metabolic biology, bioengineering and computational chemistry. Based on the activities within the Plant-Based Bioeconomy Leibniz ScienceCampus, whose funding will end in 2020, IPB and the university should continue their efforts to raise funding for a large regional cluster, such as, for example, a DFG-funded Collaborative Research Center.

8. All IPB departments have established numerous collaborations with top international institutes worldwide and also in developing and emerging countries. To further improve IPB's international visibility as a whole, the number of guest visits by foreign scientists and by IPB scientists to international institutes should be increased.

## 2. Overall concept, activities and results

IPB successfully studies plants and fungi and their interactions, with a strong focus on natural products. By combining basic research with application-oriented questions, IPB aims to achieve a comprehensive molecular understanding of the adaptive and developmental processes that plants have evolved as a consequence of their dynamic interaction with the environment. The results are used to facilitate sustainable crop production, innovative biotechnology, and drug development for improving the health and nutrition of humans, animals and plants.

IPB's overall concept is well thought through. The research is organised into one chemistry- and three biology-oriented departments. The departments work together in four programme areas: (i) Bioactive natural products from plants, fungi, and associated microorganisms; (ii) Chemical mediators and regulatory macromolecules; (iii) Functional interactions of small molecules at the molecular, metabolic, cellular and organismic levels; and (iv) Synthetic biology and (metabolic) bioengineering. All departments make great efforts to capitalize on their complementary expertise.

### Results

#### *Research*

**The number of peer-reviewed publications has risen markedly since the last evaluation, as has the proportion of lead author papers. More papers are being published in internationally well-known journals and insofar better visible in the scientific community. IPB should continue on this positive trajectory. In doing so, the institute should aim to achieve a more equal distribution of publications across the individual research groups.**

#### *Research Infrastructure*

The research infrastructure is outstanding and highly competitive. It has been continuously extended to keep pace with research requirements. The infrastructure is currently organized into four units: the two Synergy Research Groups (SRGs) Proteome Analytics and Bioinformatics & Scientific Data (see chapter 7) and the two Technology Platforms (TPs) Metabolome Analytics and Cellular Imaging. The plans for reorganising the research infrastructure within MetaCom make sense.

Other relevant research infrastructure, key expertise and methods are present within the departments. These include e.g. the germplasm collections, compound libraries and databases, expertise in 3D protein homology modelling, structure elucidation and synthesis, modular cloning and calcium imaging and sensors based on Förster resonance energy transfer.

IPB should consider factoring cost recovery for platforms into all grant applications that involve their use, with the aim of achieving an overall target level of external funding for the platforms.

### *Transfer Activities*

IPB successfully translates research results into applications. It has developed algorithms and solutions, including databases and software, such as innovative applications in computational metabolomics (MetFrag and MetFlow). Although they are usually made available as open source materials, the tools are sometimes withheld (IP protection) to maintain a competitive edge. Between 2013 and 2019, IPB filed 19 patent applications – either as a single or as a co-applicant, or with IPB scientists registered as co-inventors. 14 patents were granted, which resulted in four licence agreements with industrial partners.

The institute is very active in consulting and shaping public debate in its field, and its members are well connected in scientific societies. IPB could enhance its efforts in terms of local public outreach.

## 3. Changes and planning

### **Development since the previous evaluation**

IPB has developed very positively since the last evaluation and responded well to all recommendations. The main change was caused by the retirement of the head of the very successful Department for Stress and Developmental Biology. IPB managed to appoint an excellent successor in 2019. Her department, renamed the Department for Biochemistry of Plant Interactions, is still in a transitional phase. The thematic orientation is very promising and some very good results have already been published. The other three departments have sharpened their profiles and further improved their performance. As planned, IPB should now further strengthen the cross-departmental work (see below).

### **Strategic work planning for the coming years**

**Work planning for the coming years makes sense and is well thought through. The common research theme of all four departments will be understanding the chemical basis of plant resilience. This field of research has great potential, not only for basic research but also for knowledge transfer, especially when anticipating the challenges linked to climate change. The interdisciplinary expertise at the institute, especially in chemistry, is a very strong asset when it comes to pursuing this important path. IPB should deepen this strategy further with the aim of further increasing the number of cross-departmental projects and, in turn, publications.**

A central aspect of IPB's strategy is the establishment of a new Plant Metabolomics and Computational Biochemistry Program Center (MetaCom). The centre will consolidate major analytical equipment in one place, merge personnel from all scientific departments, and recruit additional scientific staff. In the long term, IPB envisions the construction of a new building to consolidate all the functions necessary for the Program Center. **The planned MetaCom Program Center aligns well with the overall strategic plan and**

**the aims are ambitious and timely. It will create synergy, both with respect to resources and important computational expertise. It will also further strengthen interdisciplinary and cross-departmental research, as well as IPB's international visibility. The institute should continue with its efforts for this project.**

#### 4. Controlling and quality management

##### Facilities, equipment and funding

###### *Funding*

The institutional funding of IPB is adequate. In 2019 it was approx. €14.9m (excluding construction projects).

**As recommended at the last evaluation, IPB has improved the revenue from third-party funding but, at 14 % of the annual budget, it is still low and should be further increased. As planned, IPB should take a more strategic approach to identifying potential funding initiatives and strive for more prestigious grants, especially from the EU and DFG.**

###### *Facilities and Equipment*

IPB's facilities and equipment are state of the art. The location, on the Weinberg Campus of the University of Halle-Wittenberg, in close proximity to other institutes and companies, is a major asset for research at IPB. (For the research platforms see chapter 2.)

##### Organisational and operational structure

The organizational and operational structures are appropriate and work well. The Board of Directors actively follows trends inside and outside the institute and implements adequate measures in a timely manner, e.g. individual performance bonus (see below), the hiring of personnel to support transfer activities and the raising of third-party funds.

The Scientific Council advises the Board of Directors. It comprises all research group leaders and representatives of the doctoral and postdoctoral researchers. The Staff Council represents all employees of the institute. Appropriate discussion and event formats have been established for decision-making and implementation purposes, both with regard to strategic issues and day-to-day scientific operations.

##### Quality Management

The measures for quality management and control are appropriate and well organised. The IPB revised its procedures for safeguarding Good Scientific Practice in 2020 and implemented important state-of-the-art measures regarding scientific integrity (e.g. contractual obligation).

The measures for quality management of research data are of the highest standards. With the planned introduction of electronic lab books in 2021, IPB addresses important quality management questions. These efforts are encouraged and should be strengthened. Its thoughts on the Nagoya Protocol and how it should be handled are supported.

IPB has established a system for performance-based allocation of funds to departments and groups, which takes into account the important metrics. IPB has also implemented an internal regulation that rewards acquisition of extramural funds by scientists with an individual performance bonus. This is another welcome measure. However, **the current system for the performance-based allocation of funds seems generally to follow the performance of departments. IPB should consider giving more weight to the performance of individual groups. Within a transparent index of performance indicators, IPB should also consider shifting the metrics so that high-ranking third-party funds are rewarded even more highly. The groups should be evaluated at annual appraisal meetings and the Scientific Advisory Board should also assess these groups in more detail during the audits held at Leibniz institutes between external evaluations.**

### **Quality management by advisory board and supervisory board**

The Scientific Advisory Board (SAB) fulfils its function as an external advisory body. In 2017, it conducted the audit usually held at Leibniz institutes between evaluations. IPB responded well to the recommendations of the SAB. The Supervisory Board also fulfils its role in an adequate manner.

## **5. Human Resources**

### **Management**

The management system is appropriate and works well. The Managing Director is appointed on a rotating basis from the four department heads, each acting for five years. The Managing Director and the Head of the Administration and Infrastructure Department legally represent the institute. Together with the other department heads they constitute the Board of Directors.

### **Postdoctoral staff**

The institute has implemented a number of very good measures to support postdocs (see status report). It could be advantageous to merge all these measures into one structured, transparent postdoc programme, from which everyone can choose according to their individual needs, including information about careers outside of academia. A potential additional instrument to promote postdocs would be an internal competitive procedure for postdocs planning to start their own projects, to prepare applications for third-party funding.

The fixed-term independent Junior Research Groups (JRGs) have proved to be a very successful instrument. All three JRG heads who have left IPB since the last evaluation now have leading positions at German universities. Currently, IPB hosts two JRGs, both of which are internationally competitive and an asset to IPB.

Since 2011, most newly established groups within the departments have started as departmental Junior Research Groups in connection with a tenure track procedure. Of the eight group leaders appointed since 2011, four were recruited externally. Furthermore, out of the eight groups, three are now funded permanently, one has been discontinued

(the head accepted a professorship at the Merseburg University of Applied Sciences), one group head is now employed at the University of Halle-Wittenberg (but the group is still associated with IPB), and three are still working as departmental Junior Research Groups at IPB.

### **Doctoral candidates**

The number of doctoral candidates is adequate. As of 31 December 2019, 35 doctoral candidates were employed at IPB. Between 2017 and 2019, a total of 43 theses were completed. **IPB has implemented suitable mentoring and supervision structures for the promotion of doctoral candidates. A structured programme was established in 2018.** All doctoral candidates at IPB must complete a basic mandatory core programme. Additionally, participation in the extended programme, called the Leibniz Research School (LRS) PlantBioChem is encouraged. **However, IPB should implement measures to reduce the average time to complete a PhD, which was rather long at 5.6 years.**

### **Equal opportunities and work-life balance**

IPB follows a very clear agenda to promote women in science at all levels and has made significant progress since the last evaluation. At the level of PhD students and postdocs, the balance of female to male scientists is at a good level (above 40% female). At the level of executive scientists, the proportion of female scientists needs to be increased further. Women account for one of the four department heads, 7 out of 17 group leaders (41%) and none of the two independent Junior Research Group leaders.

As expected, IPB has implemented the Cascade Model, which aims to increase the share of female scientists in employment in a cascading fashion up the professional career ladder. Work-life balance measures at IPB include flexible working hours, deviations from the 5-day working week, home working arrangements, individual parental leave agreements, assistance in arranging day-care places, parent-child rooms, and other family-friendly measures. IPB has been awarded the Total E-Quality award four times in a row.

### **Non-scientific staff**

IPB actively engages in dual vocational training in five occupations: biology and chemistry laboratory assistants, horticulturists, IT specialists (system integration or application programming), and office management assistants. On average, the IPB employs up to 10 trainees per year. Between 2017 and 2019, eight trainees completed their dual education and training programmes.

## **6. Cooperation and environment**

### *Cooperation with the University of Halle-Wittenberg*

IPB has well-established and strong links with the University of Halle-Wittenberg. All four department heads are jointly-appointed professors (W3) at the university. Furthermore, two IPB scientists are appointed as extraordinary professors at the university and one

independent Junior Group Leader as a W1 professor. IPB scientists are heavily involved in university teaching.

IPB is currently a partner in two DFG-funded Research Training Groups (*Graduiertenkollegs*). IPB and the university are encouraged to further develop their plans for a new Collaborative Research Center (*Sonderforschungsbereich*), after the last one came to an end in 2016. The two partners also collaborate in the Plant-Based Bioeconomy Leibniz ScienceCampus, which also involves the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK Gatersleben) and the Leibniz Institute of Agricultural Development in Transition Economies (IAMO Halle), as well as seven associated non-university institutes. The ScienceCampus was established in 2011 and, after an evaluation in 2015, Leibniz Association funding was extended until 2020. The Land is providing limited further funding until 2022, which is welcomed, and options for funding the network beyond 2022 are being explored.

**Even though the chemistry department at the University of Halle-Wittenberg has a stronger focus on material sciences than on plant sciences, there are several good opportunities to further strengthen the existing close collaboration, for example in the fields of plant metabolic biology, bioengineering and computational chemistry. Based on the activities within the Plant-Based Bioeconomy Leibniz ScienceCampus, whose funding will end in 2020, IPB and the university should continue their efforts to raise funding for a large regional cluster, such as, for example, a DFG-funded Collaborative Research Center.**

#### *Cooperation within the Leibniz Association*

IPB is well connected within the Leibniz Association. It has been a member of three Leibniz Research Alliances and one Leibniz Research Network. Individual collaborations exist, e.g. with the Leibniz Institute for Natural Product Research and Infection Biology (HKI Jena), the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK Gatersleben) and the Leibniz Institute of Agricultural Development in Transition Economies (IAMO Halle). The cooperation with IPK should be intensified. In particular, if the plans for MetaCom are realized, IPB should consider synergies with the infrastructure for metabolite imaging present at IPK.

#### *International cooperation and visibility*

IPB scientists have secured several EU-funded projects as coordinators or collaborators. Additionally, in 2019 IPB joined the C4-Rice Consortium funded by the Bill & Melinda Gates Foundation. **All IPB departments have established numerous collaborations with top international institutes worldwide and also in developing and emerging countries. To further improve IPB's international visibility as a whole, the number of guest visits by foreign scientists and by IPB scientists to international institutes should be increased.**

## 7. Subdivisions of IPB

### **Department of Bioorganic Chemistry** (since 2000)

[Staff as of 31 December 2019: 34.1 FTE, of whom 11.1 FTE research and scientific services staff, 12 FTE doctoral candidates, and 11 FTE service staff]

The department is very successful in the area of identification, understanding and production of small molecules and the study of their effects. In recent years, work focused mainly on the development of metabolic profiling, compound development, compound detection and chemical synthesis. The head of department was Managing Director of IPB until 2017. His group is clearly the top-performing group in the department.

Scientific highlights of the department include the establishment of metabolic profiling, the discovery of synergistic effects of phenolic compounds in cancer therapy, the development of Sakai and multicomponent reactions, as well as a method for calculating electronic transitions. The head of the very successful Research Group for Computational Chemistry retired in 2019. The work of this group should be continued, including within the planned MetaCom centre (see chapter 2). The thematic shift (away from quantum mechanics) is timely and in line with the requirements for a further development of the department. It will be very important to find another excellent researcher to lead the group. The other groups in the department should further sharpen their scientific profiles and increase their visibility.

The publication activity is very good, in some areas even excellent, in terms of both quality and quantity. The department has also been very successful in raising third-party funds. Between 2017 and 2019, the department successfully filed three patents.

### **Department of Molecular Signal Processing** (since 2009)

[Staff as of 31 December 2019: 24.7 FTE, of whom 9 FTE research and scientific services staff, 7.2 FTE doctoral candidates, and 8.5 FTE service staff]

The department's research is impactful, innovative and highly competitive. The focus is on understanding molecular networks of plant-environment interactions at the biochemical to systems level. The head of department has been the Managing Director of IPB since 2017.

Since the last evaluation, the department has attracted very good new group leaders and has contributed significantly to increasing the number of female group leaders at IPB. Collaboration with the other IPB departments has been increased. There is also a very fruitful collaboration with the University of Halle-Wittenberg via an associated research group. The department has very successfully developed new tools and further improved methodologies, including chemical analytics and metabolite profiling, which are beneficial for a broad scientific community.

The department has often published its research outcomes in high-ranking journals and has also been very successful in raising third-party funds. Moreover, two former Junior Group Leaders accepted competitive offers for high-profile positions at other institutions, which is an indication of a very successful upwards career path after working in this department.



**Department of Cell and Metabolic Biology** (since 2010)

[Staff as of 31 December 2019: 29.6 FTE, of whom 14.7 FTE research and scientific services staff, 5.2 FTE doctoral candidates, and 9.7 FTE service staff]

The department's research focuses on plant specialized metabolites (including roles in nature and translational value), metabolic engineering and plant development (the latter being clearly linked to both phytohormone-mediated signalling and to specialized metabolism). Since the last evaluation, excellent progress has been made overall. In a welcome move, the group dealing with carotenoid metabolism has been discontinued and the personnel has been re-allocated to other groups, as recommended. The coherence of the work in the department has been improved. Many of the projects within the department are interlinked and there is good synergy.

Of special note is the synthetic biology research (Golden Gate cloning). The results and developments have had a strong impact on the field and entailed many highly fruitful collaborations. The department is instrumental in developing the metabolomics and imaging facilities, whose contributions are of high value for the entire institute. Both facilities have been significantly strengthened since the last evaluation by acquiring new state-of-the-art instrumentation.

The publication output is very good with regard to both quantity and quality. The department has significantly increased its level of external funding, as well as the spectrum of third-party agencies since the last evaluation, even though there is still room for further improvement in some groups. Between 2017 and 2019, one patent was granted. The future scientific plans are well thought through. They follow a comprehensive, integrative approach, where fundamental research and application-oriented work are highly integrated for good mutual synergy.

**Department for Biochemistry of Plant Interactions** (since 2019)

[Staff as of 31 December 2019: 21.1 FTE, of whom 12.5 FTE research and scientific services staff, 2.6 FTE doctoral candidates, and 6 FTE service staff]

The department started in February 2019 and replaces the very successful Department of Stress and Developmental Biology (SEB). The department's structure has been in transition since then. It is clearly evident that IPB will benefit greatly from the recruitment of the new department head on all levels. She has a long-standing international reputation for research on calcium decoding mechanisms in stress regulation. The department's new emphasis on plant responses and resilience to environmental stress, with a focus on protein biochemistry, intracellular decoding of external cues and intracellular signalling cascades, complements other departments very well. This is an opportunity to create added value with metabolite analytics/synthetic chemists.

The newly established Research Group for Nuclear Processes in Plant Defence has great potential. Its work on nuclear mechanisms in stress signalling/resilience will help to further bolster protein work. The Research Group for Cellular Signalling creates the opportunity for greater synergy between protein-based studies and metabolite analytics. This research group could capitalize more on its metabolic expertise in steering research goals.

A promising future direction could lie in the area of calcium imaging or biotechnological transfer and translational research. The plan to associate the Synergy Research Group (SRG) for Proteome Analytics with this department is welcomed.

The department has already published interesting results in high-ranking journals. The new head has built productive collaborations, e.g. with the Max Planck Institute of Molecular Plant Physiology (MPI Golm) and the University of Münster and brings the expertise and experience that will be required for successful applications for collaborative funding schemes. The fact that the head of the department and large parts of her research group will continue to participate in a DFG-funded CRC at Freie Universität Berlin (FU Berlin) is welcomed.

### **Synergy Research Groups (SRGs) and Independent Junior Research Groups (JRGs)**

[Staff as of 31 December 2019: 15.6 FTE, of whom 7 FTE research and scientific services staff, 4.8 FTE doctoral candidates, and 3.9 FTE service staff]

#### SRG *Proteome Analytics* (since 2012)

This SRG investigates proteome-level plant adaptations to biotic and abiotic conditions. The association with the Department for Biochemistry of Plant Interactions is well thought through. The scientific results from projects within IPB and external collaborations (including contributions to non-plant studies) are published regularly. The SRG is internationally visible. In the future it should increase the added value of collaborations within the institute.

#### SRG *Bioinformatics & Scientific Data* (since 2005)

This SRG has complementary expertise to other departments and is crucial for the further development of the institute in terms of data management and the development of informatics approaches. The group's expertise in building computational biochemistry, metabolomics and open source tools is a key driver of the MetaCom plan (see chapter 2). Its scientific results regularly lead to high-quality publications.

#### JRG *Bioorganic Chemistry* (since 2016)

Established in 2016, this JRG brings a new dimension to IPB and is making good progress. The group has developed a visible research profile of its own and is definitely headed in a good direction. The scientific results are published regularly in high-ranking journals. The group coordinates a BMBF project.

#### JRG *Designer Glycans* (since 2019)

This group has been at the institute since 2019. The research topic is a very important field of research and is likely to foster high synergies at the institute. The group leader has previously published at a very high level and has secured funding for his own position. The plans to apply for an ERC grant are to be encouraged.

## **8. Handling of recommendations of the last external evaluation**

IPB has responded well to the recommendations made by the Leibniz Association Senate in 2014 (see status report, p. A-21f).

## Appendix

### 1. Review board

*Chair (Member of the Leibniz Senate Evaluation Committee)*

Andreas **Weber** Plant Biochemistry, University of Düsseldorf

*Deputy Chair (Member of the Leibniz Senate Evaluation Committee)*

Ulrike **Woggon** Institute of Optics and Atomic Physics, Technical University of Berlin, Germany

*Reviewers*

Eva **Benková** Institute of Science and Technology Austria, Klosterneuburg, Austria

Barbara Ann **Halkier** DynaMo Center, Dept. of Plant and Environmental Sciences, University of Copenhagen, Denmark

Anne **Osbourn** Norwich Research Park Industrial Biotechnology and Bioenergy Alliance, John Innes Centre, Norwich, UK

Jane **Parker** Max Planck Institute for Plant Breeding Research, Cologne, Germany

Andreas **Bechthold** Institute of Pharmaceutical Sciences, Department of Pharmaceutical Biology and Biotechnology, University of Freiburg, Germany

Karin **Schumacher** Centre for Organismal Studies Heidelberg, Heidelberg University, Germany

Roderich **Süssmuth** Institute of Chemistry, Technische Universität Berlin, Germany

Wilfried **Weber** Centre for Biological Signalling Studies and Chair of Synthetic Biology, University of Freiburg, Germany

*Representative of the Federal Government (Member of the Leibniz Senate Evaluation Committee)*

Frank **Reifers** Federal Ministry of Education and Research, Bonn

*Representative of the Länder Governments*

Bernd **Ebersold** Thuringian Ministry of Economy, Science and the Digital Society, Erfurt

17 November 2020

## **Annex C: Statement of the Institution on the Evaluation Report**

**Leibniz Institute of Plant Biochemistry, Halle (IPB)**

Das Direktorium des IPB dankt allen Mitgliedern der Bewertungsgruppe für ihr besonderes Engagement, eine konstruktive Überprüfung der Leistungs- und Zukunftsfähigkeit des IPB unter den Bedingungen der Covid-19 Pandemie in einem virtuellen Ersatzverfahren durchzuführen. Gleichfalls bedanken wir uns beim Referat Evaluierung der Leibniz-Gemeinschaft für die ausgezeichnete Begleitung des transparenten Begutachtungsprozesses.

Wir sind überaus erfreut, dass die Bewertungsgruppe die sehr positive Entwicklung des Instituts seit der letzten Evaluierung (2013) hervorhebt und eine vollständige Umsetzung aller zentralen Empfehlungen konstatiert. Besonders freuen wir uns über die explizite Anerkennung unserer Bemühungen, den wissenschaftlichen Nachwuchs (insbesondere Nachwuchsgruppen) erfolgreich zu fördern. Das IPB sieht sich mit der Würdigung und ausdrücklichen Unterstützung des geplanten „Program Center for Plant Metabolomics and Computational Biochemistry (MetaCom)“ in seiner konzeptionellen Ausrichtung und strategischen Arbeitsplanung für die nächsten Jahre durch die Bewertungsgruppe bestätigt und bestärkt. Mit Interesse greifen wir die im Bewertungsbericht enthaltenen Hinweise für unsere zukünftige Arbeit auf. Die Empfehlungen werden wir nach Beratung mit dem Wissenschaftlichen Institutsrat und unseren Gremien (Wissenschaftlicher Beirat, Stiftungsrat) aktiv umsetzen. Im Folgenden nehmen wir zu den acht zentralen Empfehlungen der Bewertungsgruppe (s. S. B-2 ff; hier z. T. verkürzt zitiert) Stellung:

#### Overall concept and results

1) *... the institute should aim to achieve a more equal distribution of publications across the individual research groups.*

Wir danken für den Hinweis und sind der Überzeugung, dass eine Anpassung der leistungsorientierten Mittelvergabe und ein regelmäßiges Feedback vom Wissenschaftlichen Beirat (s. Punkt 5), zu einer ausgewogeneren Publikationsleistung zwischen einzelnen Arbeitsgruppen führen kann. Größe und somit Output einer AG sind aber auch von der Karrierestufe ihrer Leitung abhängig.

#### Changes and planning

2) *... The common research theme of all four departments will be understanding the chemical basis of plant resilience. The interdisciplinary expertise ... is a very strong asset when it comes to pursuing this important path. IPB should deepen this strategy further with the aim of further increasing the number of cross-departmental projects and, in turn, publications.*

Als Teil der strategischen Arbeitsplanung entwickelten wir das langfristige, abteilungsübergreifende Thema „Chemical Basis of Plant Resilience“ sowie das Konzept für ein Programm-Zentrum MetaCom (s. Punkt 3). Wir sind überzeugt, dass beide Säulen unserer Arbeitsplanung und der Forschungsschwerpunkt „Bioengineering“ die Zusammenarbeit zwischen allen IPB-Abteilungen intensivieren und daher Ausdruck in gesteigerten gemeinsamen Publikationen finden wird.

3) *The planned MetaCom Program Center aligns well with the overall strategic plan and the aims are ambitious and timely... It will also further strengthen interdisciplinary and*

*cross-departmental research, as well as IPB's international visibility. The institute should continue with its efforts for this project.*

Wir danken der Bewertungsgruppe für die Unterstützung unserer MetaCom-Initiative, welche wir als kleinen strategischen Sondertatbestand (B1) zum 01.01.2021 beantragen werden.

#### Controlling and quality management

*4) As recommended at the last evaluation, IPB has improved the revenue from third-party funding but, at 14 % of the annual budget, it is still low and should be further increased. As planned, IPB should take a more strategic approach to identifying potential funding initiatives and strive for more prestigious grants, especially from the EU and DFG.*

Obwohl das IPB seit der letzten Evaluierung in der Drittmittelakquise Fortschritte erzielt hat, ist die Institutsleitung für eine kontinuierliche Erhöhung der Drittmittelquote (Zielkorridor 18-22%) hoch sensibilisiert und hat hierfür seine Strategie bereits in den Bewertungsunterlagen dargelegt. Wichtige Säulen der IPB-Drittmittelstrategie bilden die verstärkte Einwerbung von wissenschaftlich anspruchsvollen Fördermitteln (DFG, EU) oder Stipendien (z. B. Emmy Noether, Alexander- von-Humboldt-Stiftung), die Beteiligung an Forschungsverbänden (GRK, SFB; s. Punkt 7) als auch die Rekrutierung von hochtalentierten und produktiven Wissenschaftlerinnen und Wissenschaftlern auf vakante Stellen. Das Direktorium wird gemeinsam mit dem Wissenschaftlichen Institutsrat und dem Wissenschaftlichen Beirat über weitere Instrumente zur Erhöhung der Drittmittelakquise beraten.

*5) ... IPB should consider giving more weight to the performance of individual groups. Within a transparent index of performance indicators, IPB should also consider shifting the metrics so that high-ranking third-party funds are rewarded even more highly. The groups should be evaluated at annual appraisal meetings and the Scientific Advisory Board should also assess these groups in more detail during the audits held at Leibniz institutes between external evaluations.*

Das Direktorium greift die Anregung auf und wird die leistungsorientierten Mittelvergabe anpassen. Mit der Vorsitzenden des Wissenschaftlichen Beirats wurde bereits vereinbart, den wissenschaftlichen Teil der jährlichen Sitzungen für vertiefte Diskussionen und Feedback zu erweitern.

#### Human resources

*6) IPB has implemented suitable mentoring and supervision structures for the promotion of doctoral candidates. A structured programme was established in 2018. However, IPB should implement measures to reduce the average time to complete a PhD, which was rather long at 5.6 years.*

Das Direktorium ist sich dieser komplexen Problematik bewusst. Wir sind optimistisch, dass die Maßnahmen, welche wir 2018 mit der Etablierung eines strukturierten Doktoranden-Programms am IPB eingeführt haben (z.B. Betreuungsvereinbarung, stringente Konzipierung der Dissertationsthemen, u.a.), sich deutlich auf eine Verkürzung der Promotionszeiten auswirken werden.

### Cooperation and environment

7) ... *Based on the activities within the Plant-Based Bioeconomy Leibniz ScienceCampus, whose funding will end in 2020, IPB and the university should continue their efforts to raise funding for a large regional cluster, such as, for example, a DFG-funded Collaborative Research Center.*

Die MLU Halle-Wittenberg ist unser wichtigster lokaler Kooperationspartner. Das IPB ist in die Planung und Bildung regionaler Forschungsverbände beständig eingebunden. Zurzeit sind wir an Initiativen für einen neuen SFB sowie an der Etablierung eines neuen „WissenschaftsCampus“ beteiligt. Das geplante IPB MetaCom Zentrum wird zukünftig eine wichtige Rolle als Schnittstelle für lokale und regionale Kooperationen einnehmen (s. Punkt 3).

8) ... *To further improve IPB's international visibility as a whole, the number of guest visits by foreign scientists and by IPB scientists to international institutes should be increased.*

Das Direktorium nimmt diese wichtige Anregung sehr gern auf und wird über weitere Möglichkeiten beraten, wie nach der Covid-19 Pandemie der internationale Reiseaustausch von Gast- und IPB-Wissenschaftlerinnen und -Wissenschaftlern intensiviert werden kann.