

5. 点検評価と課題

2025 年 10 月 3 日に国際諮問委員会を開催し、分子研の研究所としての立ち位置、組織構造、研究者数、構成員の多様性、所内研究者間の交流、大学院生の獲得など、多岐に亘る意見交換を行った。委員会の議論を受けて、組織改革に関するワーキンググループを立ち上げると共に、所員の研究交流を促すランチョンセミナーの開催、定年教員の後任人事の加速など、2026 年以降の様々な施策に反映させることとした。なお、諮問委員は以下の方々である。

菊地 昇博士（座長、株式会社トヨタコンポジット研究所 代表取締役所長）、Mischa BONN 教授（Max Planck Institute for Polymer Research, Germany）、David A. LEIG 教授（The University of Manchester, UK）、James M. LISY 教授（University of Illinois Urbana-Champaign, USA）、David E. MANOLOPOULOS 教授（University of Oxford, UK）、Matthias WEIDEMÜLLER 教授（Heidelberg University, Germany）

（渡辺芳人）

5-1 国際諮問委員会による点検評価

分子科学研究所の現状と将来に関する評価・提言を受けるため、国際諮問委員会を組織し、2025年10月3日に、委員が一堂に会して委員会を開催した。評価委員は分子科学の広い領域をカバーするよう委員の専門分野の分布を考慮して、各分野で業績と見識のあるシニアの研究者に依頼した。委員会はハイブリッド形式で実施され、現地参加とオンライン参加の両方で行われた。委員構成は以下の通りである。

諮問委員

菊池 昇	株式会社トヨタコンポ研究 代表取締役所長 (Chair)
Mischa BONN	Director and Professor, Max Planck Institute for Polymer Research, Germany
David A. LEIGH	Royal Society Research Professor & Sir Samuel Hall Chair of Chemistry, The University of Manchester, UK
James M. LISY	Research Professor, University of Illinois Urbana-Champaign, USA
David E. MANOLOPOULOS	Professor of Theoretical Chemistry, University of Oxford, UK
Matthias WEIDEMÜLLER	Full Professor, Physics Institute and Heidelberg Center for Quantum Dynamics, Heidelberg University, Germany

委員会当日には、各研究領域、センター、施設の長がそれぞれの現状と課題等について説明し、質疑を受けた。最後に渡辺所長が研究所の現状と戦略的方向性について説明を行い、包括的な討論が行われた。

Program of IMS Advisory Committee 2025

October 3 (Fri)

SESSION 1: OPENING & PRESENTATION Part1

Research Centers & Departments

13:00–13:05	Greetings from Director General, Opening Remarks Yoshihito WATANABE, Director General Noboru KIKUCHI, Chair
13:05 - 13:15	Center for Mesoscopic Sciences Hiromi OKAMOTO, Director
13:15 - 13:25	Research Center of Integrative Molecular Systems (CIMoS) Shuji AKIYAMA, Director
13:25 - 13:35	Department of Photo-Molecular Science Kenji OHMORI, Director
13:35 - 13:45	Department of Theoretical and Computational Molecular Science Shinji SAITO, Director
13:45 - 13:55	Department of Materials Molecular Science Toshihiko YOKOYAMA, Director
13:55 - 14:05	Department of Life and Coordination-Complex Molecular Science Ryota IINO, Director

SESSION 2: PRESENTATION Part2

Featured topic, Interdisciplinary research center, Facilities, and SOKENDAI

14:15 - 14:25	Exploratory Research Center on Life and Living Systems (ExCELLS) Koichi KATO, Deputy Director
14:25 - 14:35	Division of Research Innovation and Collaboration Takunori TAIRA, Project Professor
14:35 - 14:45	UVSOR Synchrotron Facility Satoshi KERA, Director
14:45 - 14:55	Research Center for Computational Science Masahiro EHARA, Director

14:55 - 15:05	Instrument Center Toshihiko YOKOYAMA, Director
15:05 - 15:15	Equipment Development Center Hiroshi YAMAMOTO, Director
15:15 - 15:25	The Graduate University for Advanced Studies, SOKENDAI Ryota IINO, Chair of SOKENDAI

SESSION 3: OVERVIEW & COMPREHENSIVE DISCUSSION

15:35 - 15:50	Present status & Future perspective of IMS Yoshihito WATANABE, Director General
15:50 - 16:50	Comprehensive Discussion All Committee Members (On-site and Online) Noboru KIKUCHI, Chair
16:50 - 17:00	Summary & Closing Remarks Noboru KIKUCHI, Chair

以下に諮問委員会から提出された報告書を掲載する。

Advisory Report

to the

Institute for Molecular Science

Advisory Committee 2025

October 3, 2025

Committee Members:

Professor Noboru KIKUCHI (Chair)
President, Toyota Konpon Research Institute, Inc.

Professor Mischa BONN
Director and Professor, Max Planck Institute for Polymer Research, Germany

Professor David A. LEIGH
Royal Society Research Professor & Sir Samuel Hall Chair of Chemistry, The University of Manchester, UK

Professor James M. LISY
Research Professor, University of Illinois Urbana-Champaign, USA

Professor David E. MANOLOPOULOS
Professor of Theoretical Chemistry, University of Oxford, UK

Professor Matthias WEIDEMÜLLER
Full Professor, Physics Institute and Heidelberg Center for Quantum Dynamics, Heidelberg University, Germany

Introduction

This report presents evaluations and recommendations of the International Advisory Committee for the Institute for Molecular Science, based on its October 3, 2025 meeting in Okazaki, Japan, conducted in hybrid format with both on-site and online participation. The committee evaluates the current state of IMS's research activities, organizational structure, and strategic direction under Director General Yoshihito Watanabe. The assessment draws from presentations by Director General and directors of research departments, centers, and facilities, comprehensive discussions, and additional comments subsequently provided by committee members. The evaluation coincides with IMS's 50th anniversary, providing an opportunity to assess current strengths and address challenges for continued excellence. The committee's recommendations aim to support IMS in strengthening its position as Japan's premier molecular science research institution.

Report Structure:

- Part I: Assessment and recommendations for 13 research departments, centers, and facilities
- Part II: Institutional Initiatives and Strategic Challenges

Part 1: Assessment of Research Departments, Centers, Divisions, and Facilities**1.1 Center for Mesoscopic Sciences**

The Center for Mesoscopic Sciences develops innovative measurement and analysis methods for multi-hierarchical molecular systems, addressing the mesoscopic regime where microscopic and macroscopic properties mutually influence each other.

Assessment

The Center demonstrates world-leading technical capabilities in both chiral optical microscopy and atomic-scale near-field spectroscopy. These achievements represent exceptional research contributions at the forefront of the field.

However, organizational challenges threaten the Center's potential. With only two full-time faculty members overseeing multiple collaborative laboratories, Director Okamoto identified insufficient communication among groups as a significant operational challenge. This isolation prevents achieving critical mass, limits collaborative opportunities, and fails to realize synergistic potential with related groups across IMS.

The committee notes great potential for joint projects with other IMS groups, which should be explored more intensively. The Center clearly demonstrates strong technical competence; articulating a more cohesive scientific mission addressing key scientific challenges or unifying questions would help communicate its importance within IMS and to external partners.

Recommendations

- Reinstate regular internal seminars (biweekly or monthly) and annual mini-workshops to restore communication and promote information sharing within the Center.
- Articulate a unified scientific vision that explicitly connects the Center's technological developments to major scientific challenges.
- Actively pursue joint projects with other IMS groups in optical and spectroscopic domain.

1.2 Research Center of Integrative Molecular Systems (CIMoS)

Established in 2013, CIMoS promotes interdisciplinary research integrating life sciences and materials sciences, analyzing molecular systems to understand the logic behind information sharing and control.

Assessment

Individual research groups produce unquestionably high-quality, internationally competitive scientific output.

However, CIMoS has yet to fully realize synergistic value beyond the sum of individual PI contributions. Director Akiyama acknowledged that while initial large membership provided abundant cross-disciplinary opportunities, current smaller membership makes achieving genuine interdisciplinary synergy difficult. The committee questions what added value the center provides to affiliated researchers beyond what they would achieve independently.

The committee identifies fundamental conceptual challenges. Critical ambiguity exists regarding “integrative”—does it refer to research on complex molecular systems, or to integrative collaborative efforts between groups? This ambiguity may be the source of questions regarding “added value” and whether the center becomes more than its parts. The committee further questions whether

the center's current two research directions—"identifying key molecules governing entire system behavior" and "optimizing hierarchical structures of molecular systems"—effectively promote interdisciplinary collaboration or inadvertently hinder such integration. By further clarifying and aligning its mission and research directions, CIMoS has the opportunity to evolve from a network of excellent individual researchers into a fully integrated, synergistic research entity.

Recommendations

- Review and revise the selection process for affiliated members to actively recruit outstanding researchers, thereby increasing CIMoS's global visibility.
- Redefine the center's mission by resolving the conceptual ambiguity of 'integrative.'

1.3 Department of Photo-Molecular Science

The Department of Photo-Molecular Science comprises three research groups led by Professors Okamoto (concurrent with Center for Mesoscopic Sciences), Ohmori, and Kera (concurrent with UVSOR Synchrotron Facility), plus Assistant Professor Nagasaka.

Assessment

Individual research groups demonstrate exceptional scientific achievements with strong international recognition. The committee recognizes the Ohmori Group as exceptional with far-reaching innovative projects, strong international visibility, and many PhD students and postdocs from worldwide. The group achieved breakthrough advances in neutral atom-based quantum computing featured in Science magazine (July 2025) as one of few world-leading groups in this field.

However, the committee sees a critical opportunity: Articulating a clearer, unifying scientific vision could help connect these excellent individual efforts into a more coherent and visible departmental profile. This fragmentation limits opportunities for collaborative interactions, preventing advances beyond individual achievements.

Recommendations

- Articulate a clear vision for how groups collaborate under the foundation of photo-molecular science to generate synergistic effects.

1.4 Department of Theoretical and Computational Molecular Science

The Department of Theoretical and Computational Molecular Science encompasses five research groups covering quantum chemistry, biophysics, and statistical mechanics.

Assessment

The committee recognizes the department's research as of the highest international quality, with all researchers playing leading roles in their respective fields. The committee notes with appreciation the fruitful application of machine learning and artificial intelligence methods, with Professor Hatanaka's work exemplifying this integration.

However, critical structural challenges exist. Despite scientific excellence, group sizes are viewed as too small (approximately three members each) with few postdocs and PhD students, limiting research capabilities. Director Saito emphasized that long-term sustainable growth and global competitiveness require institute-wide recruitment of top international students and postdocs to form properly-sized groups that will attract promising young faculty.

These challenges are compounded by faculty transitions. Until recently, three professors—Ishizaki, Saito, and Ehara—together spanned the full breadth of theoretical molecular science: Quantum dynamics, statistical mechanics/simulation, and electronic structure

theory. The loss of Professor Ishizaki (transferred to the University of Tokyo) and the approaching retirements of Professors Saito and Ehara create critical gaps across these core competencies.

Recommendations

- Recruit three professors within six years to replace retiring faculty, prioritizing an electronic structure theorist to manage the computer cluster when Professor Ehara retires. Recruitment policy might include seeking PIs with strong international profiles to enhance global competitiveness.
- Expand joint appointment strategies with universities, following Professor Hatanaka's successful model, to provide theoretical groups—which fundamentally depend on graduate students—access to students who spend substantial time at IMS.
- Establish a regular theoretical seminar program with invited speakers from across Japan and internationally to foster student interaction across different topics, essential for theoretical groups to thrive.

1.5 Department of Materials Molecular Science

The Department of Materials Molecular Science comprises three divisions covering electronic structure, electronic properties, and molecular functions, with seven principal investigators plus three visiting members.

Assessment

The committee expresses strong appreciation for the breadth of outstanding, future-oriented science in this department, including the excellent new hires, Professor Shimizu and Associate Professor Shinokita.

However, critical structural challenges threaten sustainability. Professor Yokoyama retires in March 2026, and Professor Onishi leaves in October 2026, while Shimizu and Shinokita establish laboratories. Director Yokoyama identified that group sizes are too small, and the committee raised concerns that this limits capacity to compete effectively with university and international research groups. The committee notes that the Sugimoto group, with its large complement of students and staff, might serve as a role model—alongside the Ohmori group—on strengthening IMS's international research visibility through building substantial research groups. Additionally, no internal promotions are allowed, constraining career advancement pathways.

Regarding recruitment strategy, the department identified the need for a professor in functional material synthesis and molecular fabrication. The committee strongly supports broadening the scientific scope of new appointments to attract excellent talent.

Recommendations

- Seek outstanding researchers who fit the department's scope broadly rather than narrowly defining search criteria around functional material synthesis.
- Share successful strategies for building substantial research groups across the department (see also Section 1.13).

1.6 Department of Life and Coordination-Complex Molecular Science

The Department of Life and Coordination-Complex Molecular Science encompasses four divisions with seven principal investigators spanning biomolecular functions, biomolecular sensing, complex catalysis, and functional coordination chemistry.

Assessment

The department achieves outstanding research outputs with equipment and instrumentation exceeding many world-class laboratories in the USA and Europe. The department demonstrates remarkable success in developing talent, with many researchers starting independent careers at IMS before moving to highly successful positions at other universities.

However, the committee identifies a fundamental structural challenge. Director Iino frankly noted that the complicated name itself indicates the department's challenges. The department is divided into two very different fields—life science and chemistry—making the establishment of common goals extremely challenging and preventing truly integrated function.

The committee welcomes the appointment of Professor Sawai as cross-appointment member, noting this excellent hire addresses gender diversity—an issue affecting all IMS departments.

Recommendations

- Explore whether realignment of the department's life science and chemistry components with other IMS departments would benefit both areas by creating more coherent organizational structures that facilitate common goal setting.

1.7 Exploratory Research Center on Life and Living Systems (ExCELLS)

Established in 2018, ExCELLS explores the fundamental question “What is life?” through collaboration across three Okazaki institutes (IMS, National Institute for Physiological Sciences (NIPS), and National Institute for Basic Biology (NIBB)) with many joint appointments.

Assessment

The committee recognizes ExCELLS as an impressive initiative addressing one of science's grand challenges, noting substantial progress despite having been created less than ten years ago. There is significant commonality among research and, while not quite yet visible, strong potential for collaboration and cross-fertilization, particularly studying life under extreme environments (pressure, temperature, radiation, vacuum) that may yield results reshaping our views.

However, the committee raised fundamental questions about operational coherence and added value: How diverse activities focus on the overarching question “What is life?” what mechanisms ensure coherent research rather than an assembly of excellent projects, what concrete added value the center provides, and how researchers concretely achieve cross-fertilization. Deputy-director Kato explained ExCELLS recruits researchers sharing the goal of understanding life and conducts project research bringing experts from different fields together around specific subjects. While this approach demonstrates collaborative intent, clearer integrative frameworks would strengthen coherence.

Recommendations

- Articulate the center's unique added value and why ExCELLS is necessary beyond assembling excellent individual research groups.
- Establish concrete mechanisms for researchers to come together, discuss results, and achieve cross-fertilization that ensures coherent research toward the fundamental question “What is life?”

1.8 Division of Research Innovation and Collaboration

The Division of Research Innovation and Collaboration led by Project Professor Taira, focuses on compact high-power laser technology. The division is scheduled to close at year's end, with activities transitioning to the newly established company TIRA.

Assessment

The committee recognizes impressive technological achievements demonstrating remarkable potential for combining basic research with technological progress. The committee notes the division's tight focus on laser development with substantial commercial and scientific applications.

However, the committee raised fundamental questions about how institutes focused on basic science can effectively transfer innovation

to society by founding companies, and how IMS could support such transfer. Professor Taira noted that starting the company represented one approach but emphasized that discussion is needed on maintaining IMS's advantages in basic science while enabling effective societal transfer. The committee further questions to what extent technology transfer is integral to IMS's genuine institutional strategy.

Recommendations

- Define the strategic role and priority of translating basic science into technological applications and transferring them to society within IMS's core institutional mission.
- Establish institutional frameworks supporting this translation and transfer process from fundamental research to societal application.

1.9 UVSOR Synchrotron Facility

UVSOR-III operates as a compact (53-meter ring) synchrotron facility inaugurated in 1983 with upgrades in 2003 and 2012, providing rare vacuum-ultraviolet radiation to the global community. The facility manages 13 beamlines serving approximately 400 users annually, including 10–15% international and 5–7% industrial users.

Assessment

UVSOR maintains excellent technical capabilities and is well-suited to the size of IMS, being largely operable with local resources, and integrated into the diverse scientific environment of IMS, while providing important added value. All researchers involved in UVSOR make a convincing case that the facility is well positioned in the landscape of synchrotron facilities, with some experiments—particularly in materials science and biological applications—performable exclusively at UVSOR using its exquisite detector infrastructure.

However, UVSOR faces a critical strategic challenge. The synchrotron represents part of IMS's *raison d'être*, yet it has become increasingly challenging to find the right positioning within domestic synchrotron frameworks. Japan now operates 10 facilities, with the government prioritizing the larger ones, particularly SPring-8 and NanoTerasu.

Even the modest UVSOR-III plus proposal (replacing aged components, USD 9 million) remains under negotiation with no progress, while the larger UVSOR-IV reconstruction (USD 100 million) faces even greater challenges. Director Kera noted the need to change the game with new concepts or evidence, such as international visibility, though acknowledged this remains politically difficult. Without successful funding, activities will shrink year by year.

Securing funding requires developing strategic planning procedures to maintain international importance. The committee emphasized that the foundation of any political strategy must be a compelling science case, suggesting it might be time to recalibrate UVSOR's scientific rationale. Yet current discussions addressing funding challenges remain very technology-driven with physics cases somewhat missing.

Director Kera explained ongoing efforts to develop new methodologies for complicated systems including biology, focusing on functional properties, with workshops already initiated. While this represents a scientific case, it did not appear to be sufficiently specific to demonstrate UVSOR's niche or competitive edge, as there is global interest in functional materials and biology. Instead, a promising direction was identified: IMS demonstrates exceptional strength across centers at the materials–life science interface, exploring how life affects materials and how materials affect life. Articulating this as a clear, forward-looking scientific case, specific to IMS and UVSOR, it could define the facility's unique positioning and give its renewal or upgrade strong momentum. The committee assessed developing this science case as challenging but certainly achievable.

Recommendations

- Define UVSOR's specific niche and competitive advantage among Japan's synchrotrons and why this is absolutely necessary, including exploration of potential direction changes beyond current trajectories to maintain international importance.

- Organize an international workshop on UVSOR, convening leading experts to define how the upgraded facility will maintain competitive status, identify frontier questions and key scientific areas for breakthrough discoveries, and establish scientific considerations from which design parameters should follow, while bringing together current and potential users to demonstrate worldwide interest to funding agencies. This would enhance visibility and build persuasive arguments for continued investment and differentiation, serving dual purposes of generating science case ideas while functioning as a political tool.
- Strengthen industry engagement, leveraging UVSOR's existing industrial user base.

1.10 Research Center for Computational Science (RCCS)

The Research Center for Computational Science serves as a national shared computer center providing computational resources to researchers throughout Japan. From FY2024, the center cooperates with the National Institute for Basic Biology (NIBB)'s Trans-scale Biology Center, sharing utilization programs.

Assessment

The committee expressed strong appreciation for RCCS, noting the center is very impressive and extremely well run. RCCS plays a vital role in providing large-scale computation services free of charge for academic use to researchers throughout Japan, serving 1,737 users and 429 groups in 2024—the largest among research field-based computer centers, with continuing growth in 2025. The center represents a very important asset to IMS's longstanding success.

Current challenges include rising electricity costs, which the center addresses through self-driven energy-saving efforts.

To expand capacity and share resources, collaboration with NIBB involves common interests and joint work, with the expectation that such collaboration should increase. As this collaboration develops, maintaining very high efficiency levels while actively fostering synergies with biological and life science research will be important. Supporting these efficiency goals, Director Ehara expressed interest in whether AI could evaluate the hundreds of computer time proposals, which currently takes considerable time.

Recommendations

- Develop shared utilization programs with NIBB and other Okazaki institutes further, ensuring sustained operational efficiency while enhancing collaborative synergies with biological and life science research.
- Implement AI-based systems for proposal evaluation to reduce administrative burden and improve efficiency.
- Explore opportunities to strengthen industry connections, leveraging RCCS's unique computational capabilities.

1.11 Instrument Center

The Instrument Center provides public usage of advanced instruments, supplies liquid helium and nitrogen, serves as spokesperson for the national ARIM (Advanced Research Infrastructure for Materials and Nanotechnology) project supported by MEXT, and functions as the core organization of the Inter-University Network for Common Utilization of Research Equipment promoting instrument sharing throughout Japan.

Assessment

The committee recognized the Instrument Center as very impressive and important for IMS's success, playing a crucial role in national infrastructure.

Through ARIM program participation, the center accepted 142 external applications achieving 70% external sharing rate in FY2024. The Inter-University Network program achieved approximately 200,000 equipment reservations annually for 20,000 users in 2024.

Liquid helium supply in 2024 reached 52,000 liters—exceeding Nagoya University’s requirements—serving UVSOR, IMS research groups, and the Instrument Center.

Current challenges include enhanced ARIM activities that sometimes overwhelm the division director, requiring additional personnel assistance. Rising helium prices—currently four times higher than eight years ago—create a very severe situation. The center also faces difficulties in recruiting technical staff and managing staff, while needing to advance public use of stored experimental data and AI automation.

From the next fiscal year, the center will charge external users for usage fees as ARIM requires.

Recommendations

- Develop strategic solutions for managing rising helium costs and advancing public utilization of stored experimental data.
- Strengthen staffing through additional ARIM personnel, systematic recruitment approaches, and advancing AI and measurement automation for operational efficiency.

1.12 Equipment Development Center

The Equipment Development Center (EDC), celebrating its 50th anniversary in 2025, comprises approximately 10 staff members organized into four divisions: Machining, Electronics, Lithography, and Digital Engineering.

Assessment

The committee recognized the Equipment Development Center as outstanding and essential for IMS’s research capabilities. The center develops custom experimental equipment not commercially available and provides rapid turnaround for research needs. External requests totaling 380 in 2024 from 36 institutions, including 83 from the private sector, demonstrate significant growth and the center’s growing reputation and capability.

Current challenges include training and recruitment of engineers, while continuing to meet the challenge of implementing new technologies. Regarding cost recovery, the center receives approximately 2–3 million yen annually from external users based on material and engineer costs, which the director considers fair pricing to encourage continued use.

Recommendations

- Develop systematic training and recruitment programs for talented young engineers rather than ad hoc approaches.
- Consider periodic reassessment of cost recovery models to ensure sustainability while maintaining accessibility for productive scientific collaborations.

1.13 The Graduate University for Advanced Studies (SOKENDAI)

SOKENDAI, established in 1988 as Japan’s first national graduate university, awards PhD degrees through 20 programs provided by 20 research institutes. IMS provides the Molecular Science Program.

Assessment

The committee commended current recruitment efforts and assessed that proposed recruitment strategies could potentially attract more national and international talents to IMS. Recent stipend increases demonstrate positive effects on application numbers, showing that financial support levels significantly influence recruitment success.

However, the committee identified two critical challenges. First, SOKENDAI’s student enrollment remains very limited, with only 33 students in FY2024. Second, this imbalance in distribution among groups is rather striking, with half concentrated in just three research groups.

The most successful groups in graduate student recruitment are the Ohmori Group (8 students), Sugimoto Group (5 students), and Segawa Group (3 students), while many groups have zero to two students. The Ohmori Group established self-sustaining international student communities through strategic use of internship programs, while the Sugimoto Group recruited all current graduate students through prior internship participation.

Recommendations

- Expand current successful recruitment programs, including Open Campus, Short-term Internship, Technical College (Kosen) outreach, and International Internship initiatives.
- Document and systematically share successful recruitment strategies from the Ohmori, Sugimoto, and Segawa groups with all faculty.
- Encourage all faculty to engage actively in graduate student recruitment efforts and outreach activities.
- Consider creating a dedicated administrative position for recruitment support.

Part II: Institutional Initiatives and Strategic Challenges

Part II addresses institutional-level challenges and strategic priorities for IMS's continued development. While Part I evaluated individual research units, this section examines cross-cutting issues affecting collective impact and long-term sustainability.

2.1 Institutional Initiatives and Progress

Since assuming the position in 2022, Director General Watanabe has implemented important strategic initiatives addressing key institutional challenges.

Communication and Collaboration Enhancement

To enhance communication and collaboration across divisions, IMS increased faculty meetings from quarterly to monthly, established Strategy Core Member Meetings with younger directors, and initiated annual IMS Presentations enabling cross-divisional research sharing.

Administrative Support Strengthening

To reduce administrative burden, IMS appointed a senior University Research Administrator in 2023 and added six assistant URAs, establishing a Research Strategic Office to cover institutional research, graduate programs, and congress support. URA support has demonstrated a measurable impact, enabling successful grants such as Professor Yamamoto's ERATO from Japan Science and Technology Agency.

Productivity Enhancement through Automation

To enhance research productivity, initiatives are underway, including automated sample preparation, physical property measurement, and synthesis systems, with the ultimate goal of 24/7 facility operation for UVSOR.

Financial Sustainability

External funding increased substantially, with grants beyond government subsidies and KAKENHI rising from 914 million yen (FY2019) to 2,473 million yen (FY2024), reflecting successful funding diversification.

Diversity Advancement

To improve gender and international diversity, IMS recruited three female professors through cross-appointments and launched a scheme covering 50 percent of personnel costs for female postdoctoral researchers and designated assistant professors. Female researcher representation improved from 8.3 percent to 11.2 percent (target: 17 percent by 2027), while international researcher

representation reached 20.2 percent, exceeding the 12 percent target.

The committee commends Director General Watanabe for successfully leading the institute through these challenging circumstances.

2.2 Strategic Challenges

2.2.1 Faculty Succession and Internal Promotion Policy

Critical retirements concentrate within six years: Professors Yokoyama and Okamoto (March 2026), Uozumi (March 2027), and Ohmori (March 2028). The Department of Theoretical and Computational Molecular Science faces acute challenges, having lost Professor Ishizaki to the University of Tokyo, with Professors Saito and Ehara approaching retirement.

IMS's no-internal-promotion policy presents a paradox. Over 50 years, more than 200 assistant professors were promoted elsewhere, fulfilling its inter-university mission. However, successful young staff must leave for promotion, placing IMS at a disadvantage in citations and awards. While prioritizing faculty mobility, IMS may sacrifice retention of exceptional talent by not allowing internal candidates to compete for positions. Heidelberg University provides precedent: Researchers demonstrating international competitiveness through European Research Council grants or prestigious offers become eligible for internal promotion.

Separately, the committee emphasizes that as the scientific landscape has become increasingly interdisciplinary and competitive, faculty appointments should be strategically coordinated across departments to maximize collaborative potential and ensure research synergies drive selection.

Recommendations

- Develop a strategic recruitment framework to coordinate appointments across departments, maximizing collaborative potential and prioritizing internationally visible PIs with research synergies.
- Complete internal promotion policy review within Director General's remaining term.

2.2.2 Research Group Capacity and Student Pipeline Development

Most IMS research groups have approximately 3 members, excluding the PI, which is significantly smaller than those of international competitors. Although research topics are well-suited for doctoral work, the number of postdocs and graduate students is very small. SOKENDAI enrolled only 33 students in FY2024, with a striking imbalance in distribution. Successful recruitment strategies exist within IMS, particularly through strategic use of internship programs (detailed in Part I Section 1.13).

The committee emphasizes cross-appointment arrangements where IMS faculty hold positions at universities with strong graduate programs. Cross-appointed IMS professors at universities would access larger pools of talented young researchers, providing essential new blood for scientific vitality and filling expertise gaps.

Recommendations

- Study recruitment strategies from leading institutions with similar structures (*e.g.*, physics department) to identify proven solutions that can be adapted to IMS's context.
- Establish proactive interactions with universities through cross-appointments and facility access to build a talent pipeline for excellent staff and students.
- Explore corporate sponsorship models from major United States universities to create sustainable funding for graduate student and postdoctoral researcher support.

See Also: Part I Section 1.13 (SOKENDAI)

2.2.3 Institutional Collaboration and Integration

The committee identifies organizational integration as critical for maximizing scientific impact. Given IMS's small group sizes, building critical mass through enhanced communication and collaboration across divisions could strengthen collective capabilities and enable cross-fertilization of ideas. The central challenge: How can IMS ensure the institute becomes more than the sum of its parts?

Director General Watanabe has implemented communication initiatives described in Section 2.1. However, no formal indicators assess their effectiveness.

IMS possesses outstanding capabilities at the materials–life science interface, a truly promising and internationally attractive area. Fostering stronger coordination among related initiatives—for example, CIMoS, Life and Coordination-Complex Molecular Science, and ExCELLS—could amplify impact and make cross-division collaborations more evident. Strategic focus on well-defined themes may increase international prominence. Creating regular, structured opportunities for interaction could spur new collaborations, integrate diverse expertise, and amplify institutional cohesion.

Recommendations

- Establish formal indicators to assess communication and collaboration initiative effectiveness.
- Establish regular interaction mechanisms—interdisciplinary seminars, lunch discussions, forums for ongoing work sharing, and collaborative project calls.
- Open evaluation presentations (including advisory committee sessions) to all institute members so everyone can see what others are doing and what they are proud of.

2.2.4 Organizational Structure and Strategic Direction

The committee sees an important opportunity to build on IMS's strengths by reflecting on whether the current, historically developed organizational structure remains the best fit for the future and its excellent, increasingly multidisciplinary research portfolio. As science evolves toward more collaborative, cross-disciplinary modes of working, thoughtfully and gradually adapting institutional structures to facilitate stronger interactions among groups can further enhance IMS's collective impact over time.

Looking toward the future requires reexamining IMS's mission, differentiation, and competitive edge to determine how structural evolution can happen while honoring tradition.

Recommendations

- Initiate a comprehensive review of organizational structure, considering IMS's mission, competitive advantages, and optimal configuration for multidisciplinary molecular science.
- Design structural evolution enabling collaborative productivity while maintaining research excellence.
- Consider coordination with NINS for broader structural reforms addressing competitive positioning.

2.2.5 International Engagement and Diversity

IMS has no international principal investigators despite 20 percent of researchers at the postdoc level and above being international. The currently weak yen makes Japanese salaries unattractive at the professorial level. The committee proposed satellite laboratories as an alternative, noting that such arrangements bring diversity not only in scientific approaches but also in institutional perspectives on how research is organized and conducted.

Gender diversity has made progress as described in Section 2.1. The committee expressed strong support for female cross-appointment initiatives and personnel cost support schemes, recognizing gender diversity as a critical issue for all departments.

Recommendations

- Explore satellite laboratory arrangements to attract international PIs.
- Consider participating in or leading World Premier International Research Center Initiative bids to provide funding for cross-national appointments.
- Continue diversity initiatives for female researchers and implement specific support mechanisms women identify as meaningful, such as addressing the no-internal-promotion policy impacts on family planning and providing postdoctoral support during childbirth.

Conclusion

The Institute for Molecular Science maintains outstanding research quality across all units, supported by exceptional facilities including the synchrotron and computing center. Strong leadership under Director General Watanabe and motivated researchers create the foundation for continued excellence. IMS's success in developing young researchers who progress to prestigious positions demonstrates its crucial role in the Japanese molecular science community.

While IMS maintains a strong foundation, several structural aspects could be strengthened to enhance its impact further. Many groups currently operate in relatively small, specialized units, which can limit opportunities for the critical mass and intellectual exchange that drive major advances in contemporary molecular science. Promoting deeper communication and collaboration across divisions will be key to realizing IMS's full potential as an integrated, innovative institution. Addressing interconnected issues such as faculty succession, graduate student recruitment, organizational cohesion, and facility renewal through coordinated strategic planning will help sustain the institute's excellence.

IMS's 50th anniversary provides an opportunity for strategic thinking about institutional development over the next 10–20 years. With bold planning, adequate resources, and sustained commitment to scientific excellence through enhanced collaboration, IMS can address current challenges and remain competitive internationally while building on its strengths as Japan's premier molecular science research institution.

Respectfully submitted,



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Chair, IMS Advisory Committee 2025

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