World Premier International Research Center Initiative (WPI)
FY2023 WPI Project Progress Report

Host Institution	Hiroshima University	Host Institution Head	Mitso Ochi
Research Center	International Inst. for Sustainability with Knotted Chiral Meta Matter ($SKCM^2$)		
Center Director	Ivan I. Smalyukh	Administrative Director	Shin-ichi Tate

Common instructions:
* Unless otherwise specified, prepare this report based on the current (31 March 2024) situation of your WPI center.
* So as to execute this fiscal year's follow-up review on the "last" center project plan, prepare this report based on it.
* Use yen (¥) when writing monetary amounts in the report. If an exchange rate is used to calculate yen amount, give the rate.
- Prepare this report within 10-20 pages (excluding the appendices, and including Summary of State of WPI Center Project Progress (within 2 pages)).

Summary of State of WPI Center Project Progress (write within **2 pages**)

Reforming the research/education platforms. WPI-$SKCM^2$ engages ~150 talented scientists, graduate students, administrators and staff members in an ambitious institute-building experiment aiming to learn how the World's best research and education practices can be successfully fused within a single globally visible center & then used to seed successful reforms within HU, entire Japan & beyond. So far we established a new Graduate Program, a Co-mentored Postdoctoral Fellowship, an Internknotship program modeled based on the best practices of US & UK graduate programs and postdoctoral/doctoral exchanges & apprenticeships. We developed promotional videos & brochures, wrote introductory articles in Science, Nature & other magazines & web pages, as well as used social media platforms in order to bring the unique opportunities at $SKCM^2$ to the attention of talented young researchers globally. We were successful in attracting brilliant young people not only from Japan but from entire World. Our reform research & education while building on the best practices, with help of international PIs & co-PIs. For example, we implemented a meritocracy scheme first within the WPI, which is now being perfected & soon will be adopted within entire HU. Procedures related to meritocracy are discussed extensively with PIs, University administrators, External Advisory Board and Site Visit and Program committees - feedback on its further improvement is welcome so that valuable suggestions can be accounted for when this procedure will be applied again at the end of each fiscal year.

Advancing research of the highest level. WPI-$SKCM^2$ is the only center globally that develops artificial analogs of atoms and smaller building blocks of nature to gain deeper understanding of the World around us & to introduce designable materials with desirable properties not encountered in nature. WPI-$SKCM^2$ also creates interdisciplinary foundations for technological innovation to solve global problems & enable a sustainable future. WPI-$SKCM^2$ is quickly emerging as the premier global center contributing to sustainability through highly fundamental research and education. Our WPI is unique in that it connects people with knot-&-chirality-related backgrounds from different disciplines, from top institutions around the world. Our WPI introduces the paradigm of "knotted chiral meta matter", striving to deepen fundamental understanding of natural phenomena through creating their pre-designed analogs, as well as help solve the "knotty" Global problems of growing energy demand & climate change by designing matter with highly desirable material properties. Within ~1.5 years since establishment, our WPI center successfully engaged ~150 dedicated members, including 16 PIs, 12 co-PIs & 65 faculty-level Affiliate members from all over the world, creating the $SKCM^2$ partnership of top researchers at Hiroshima Univ., RIKEN, Tokyo Tech, Keio Univ., MIT, CU-Boulder & Georgia Tech, Univ. Lisbon, Utrecht Univ., Cambridge Univ., Max Plank Inst., Univ. of Wroclaw, Tel Aviv Univ., Academia Sinica & dozens of other top institutions. They pursue collaborations while jointly co-mentoring postdoctoral fellows & Ph.D. students, working on highly interdisciplinary projects within the WPI's scope. The WPI-$SKCM^2$'s affiliation appeared on over 200 research articles/reviews, including in premier journals like *Science, Nature Materials, Nature Physics, Nature Energy, PNAS,* and many others. Our WPI was featured in feature articles in *Nature* and several magazines, on covers of top international journals (Nature Energy, Ang. Chemie, Advanced Materials, etc.), as well as career opportunities at our WPI were advertised broadly, e.g. through several dedicated symposia in Europe & USA advertisements in *Science*. WPI researchers strive to pursue highly ambitious goals that contribute to sustainability. Our researchers disseminate the outcomes via publications in the very top high-impact journals as well as via plenary, keynote & invited presentations at the top-level scientific meetings. Our work attracted a

great deal of excitement. WPI-SKCM^2 developed, refined based on feedback of site visit & committees & members, & then implemented for the 2nd time the Meritocracy Principles that encourage members to collaborate, educate/mentor young researchers & pursue challenging/ambitious scientific efforts. ***Securing the center's long-term development.*** To enhance productivity & interdisciplinary interactions, efforts within the last year were devoted to securing funding & a new building, an under-one-roof home needed to have everyone work collaboratively. The fundraising & planning efforts are successful, so that the new building for the institute is now scheduled to be completed by the end of 2025. While currently temporarily using an existing building on campus, we have secured various sources of funding for the building construction & equipment including from MEXT, HU & private sources. We have formally introduced SKCM^2 as a new institute at HU, with its regulations and bylaws suitable to serve its very important role. We have established the administrative office while building on the best practices of other WPIs & top research centers around the world. Three Deputy Directors & the Admin Director support the Director to ensure smooth operation and swift decision-making. Further, External Advisory Board Meetings with WPI leadership, Director meetings with President Ochi, PI/co-PI meetings & Steering Committee meetings, are regularly held to discuss the WPI functioning & external funding opportunities, which are being pursued. HU provided 5 skilled administrative staff. Overall, HU is committed to providing future full-fledged support, treating WPI as an important permanent institute. ***Fusion of research fields.*** Fusion of diverse disciplines is at the core of our activities. To promote collaborations that lead to fusion of research fields, we implemented procedures that require all WPI-supported students & postdocs have three co-mentors each (a primary mentor & 2 co-mentors), where these co-mentors have to represent different disciplines & at least one of the co-mentors has to be from a WPI node outside Japan. Weekly seminar series that we organize feature world-renowned speakers often particularly famous for their interdisciplinary research scope, & are designed to inspire & initiate cross-disciplinary international collaborations. Similarly, we organize a series of Symposia, conferences and schools that feature knot/chirality focused talks given by representatives of different fields who are fusing interdisciplinary knowledge in their research, inspiring our students & postdocs, as well as the PIs to collaborate. Fundamentally, our center integrates knot topology and chirality, which manifest themselves in phenomena on many length and time scales, across the natural hierarchy, from elementary particles to biological and cosmic systems, as well as in pure math, in planetary sciences, cosmology & so on. Focusing on significant new discovery, we are elucidating the emergent synergy of knot topology and chirality while dealing with a hierarchy of length and time scales as well as with the creation of entirely new concepts, laws & generalizations, which are only possible within international WPI research network. This motivates us bringing together researchers representing different fields but sharing common knots/chirality interests to create a new interdisciplinary knotted chiral meta matter research domain that is not a branch of physics, chemistry, biology, or material science, nor that is a subfield of engineering, but rather is an intrinsically interdisciplinary mixture of these, a pursuit in which substantial progress is made simultaneously in the context of all these fields. Our WPI holistically explores the co-enabling role of chirality and knot topology at subatomic-to-cosmic scales, with a focus on tabletop research and translation of fundamental knowledge into applications that could enable technological breakthroughs. While the bulk of our research is on experimentally accessible systems, like liquid crystals, colloids, magnets & biopolymers, our findings have immediate impacts on studies of phenomena on less accessible scales, like cosmology & elementary particles. Conversely, theories of particle physics & cosmology inspire us to develop deeper understanding & utility of phenomena based on these accessible systems. Anticipated future technological applications enabled by our fundamental research range from sustainable energy-efficient building technologies to materials for extraterrestrial habitats to biomedical detection, treatment of diseases & to spintronics & storage devices. WPI researchers produced many discipline-fusing research works, often co-authored by multiple PIs. ***International research environment.*** We have been successful in establishing a robust, highly effective environment with optimal conditions for international collaborations and young researcher exchanges. For this, we hired bilingual support staff & established infrastructure to receive international scholars at HU. PIs from international institutions have their research group footprints at HU & direct collaborative research, mentoring & co-mentoring postdocs & students at HU, & sending internKNOTshipers to HU. Close communication among members is the top priority promoted by efforts like (1) international research exchanges, schools, conferences & forums, (2) organizing visits of renowned scholars to HU, (3) efforts to hire 20% of staff from outside of Japan to benefit from the best administrative practices in other countries, (4) efforts to assure handling paperwork & all WPI activities in English, (5) setting an effective environment for international engagements of foreign researchers, including things like schooling of children, & (6) developing procedures for effective sample exchanges & visitor support.

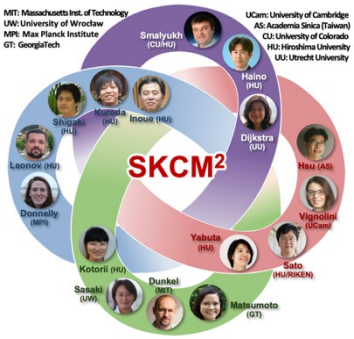
* Describe clearly and concisely the progress being made by the WPI center project from the following viewpoints.

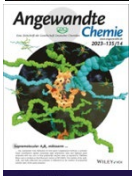
1. World-Leading Scientific Excellence and Recognition

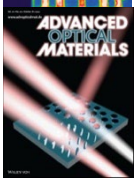
1-1. Advancing Research of the Highest Global Level

* Among the research results achieved by the center, concretely describe those that are at the world's highest level. In Appendix 1, list the center's research papers published in 2023.
* Regarding the criteria used when evaluating the world level of the center, note any updated results using your previous evaluation criteria and methods or any improvements you have made to those criteria and methods.

Our WPI institute brings together top scientists (see the diagram below) from around the world and is making strong efforts to promote groundbreaking research of the highest quality and visibility level, which is encouraged through means ranging from defining explicit requirements in terms of postdoc and graduate student co-mentoring to meritocracy procedures. Among the criteria and metrics that we use are many of the standard ones, like journal impact factor, interest attracted by organizers of major international conferences and international awards and citations by peers, as well as the assessment by our experts on the External Advisory Board and other top experts. About 10% of articles published by our WPI members in 2023 were in the World's highest-impact-factor journals like *Science*, *Nature, Advanced Materials, Nature Energy, Nature Materials, PNAS, Nature Physics, Nature Communications* and others with impact factors well above 10; more than half of publications were in journals of impact factor above ~5. The works of our members attracted very significant interest as evidenced by immediate waves of citations by peers, many highlight articles, and followings by press and social media. For example, the development of transparent aerogels comprising entangled cellulose nanofibers [*Nature Energy* **8**, 381-396 (2023)], one of the recent papers appear with our WPI's affiliation (downloaded ~30,000 times, received over 130 highlights, and was referenced over 50 times within less than a year), is generating the online attention that is in the 98th percentile of all the 430,210 tracked articles of a similar age in all journals. At this moment, all PIs (see the diagram) and co-PIs as well as many affiliate members already published with our WPI institute's affiliation that we instructed our members to be "International institute for sustainability with knotted chiral meta matter (WPI-SKCM^2), Hiroshima Univ." Many high-impact articles come from the newly recruited members who were not affiliated with HU before the establishment of the center but now share our SKCM^2 affiliation with other top international research centers, like Max Planck Institute, Univ. Utrecht, Cambridge Univ., etc.







Another indicator of the early success of our center is the success of SKCM^2-supported postdocs in securing faculty and senior researcher jobs in top international institutions. The specific examples include Ziga Kos (co-mentored by primary mentor PI Dunkel, SKCM2 at HU/MIT & now starting as an Assistant Professor at U Ljubljana in Slovenia), Fabrizio Camerin (co-mentored by PI Dijkstra, SKCM2 at HU/UUtrecht & now starting as an Assistant Professor at Lund Univ, Sweden), Shigehiro Yasui (co-mentored by PI Sasaki, SKCM2/HU & now moving to Tokyo in a professorial position), Vlad Cherpak (SKCM2 at HU & now moving to NREL, USA), Satoshi Yano (co-mentored by PI Shigaki, SKCM2 at HU & staying at HU but now in a professorial position). On the other hand, several postdocs affiliated with our WPI were successful in obtaining prestigious postdoctoral fellowships that are now the main sources of support for them (Luke Turnbull, Marisel Di Pietro, etc). Despite the institute's relatively short existence of only ~1.5 years, the first works published by our WPI members since its establishment illustrate how our WPI introduces the new paradigm of knotted chiral meta matter, with its own analogs of fundamental particles and antiparticles, with profoundly deep insights ranging from the inner workings of the world to the origins of life and to fundamental breakthroughs capable of enabling green technologies needed for sustaining it. Among examples of very recent breakthroughs, SKCM^2 researchers discovered a new topological field configuration that is a hybrid structure of a soliton & an unknot of twist disclination with the topology of the Möbius strip [*NATURE PHYS.* **19**, 451-459 (2023)], explained Pulsar glitches while considering quantum vortex networks [*Scientific Reports* **14**, 7857 (2024)], uncovered the light-steering powers of nematic vortices in guiding solitonic laser light with potential technological utility in storing energy [*NATURE MATER.* **22**, 64-72], probed (within a large external collaboration) macromolecular organic matter of a carbonaceous asteroid samples brought to earth [*Science* **379**, 790 (2023)], as well as demonstrated how aerogels formed by entangled nanocellulose fibers exhibit extreme thermal

insulation and high transparency at the same time [*Nature Energy* **8**, 381-396 (2023)] & [*Nature Energy* **8**, 327–328 (2023)], where all these papers appear with our WPI's affiliation. Other examples include the study of monopoles and skyrmion dynamics in colloidal ferromagnets [*Science Advances* 2024, DOI: 10.1126/sciadv.adj9373], uncovering of the role of nematodyamics in mesoscale motions [*Nature Communications* **15**, 1220 (2024)], applying knot theory to better understand knitted materials [*Nature Communications* **15**, 2622 (2024)], probing structure-function relationships of highly glycosylated coronavirus spike proteins (Proteomics, 2023) and presenting a user-friendly and computationally efficient tool, GlycoSHIELD, to generate fully glycosylated protein models [*Cell*, **187**, 1296-1311. e26, (2024)], and so on. Our works attracted a great deal of excitement already. For example, *Nature Energy* **8**, 381-396 (2023) was featured over 130 times (including on the journal cover). PI Danny Hsu reported the crystal and NMR structures of the smallest and most complex topologically knotted protein, Q9PR55, with a 7_1 knot (JBC, 2024), and the use of enzymatic ligation to generate a truly knotted protein without open ends (BBRC, 2024). He wrote a review on the current progress in knotted protein research in a prestigious journal (Curr. Opin. Struc. Biol., 2023), as well as his team integrated experimental and computational tools to investigate the structure-function relationships of highly glycosylated coronavirus spike proteins and presented a user-friendly and computationally efficient tool, GlycoSHIELD, to generate fully glycosylated protein models [*Cell*, **187**, 1296-1311. e26, (2024)]. Generally, aiming to create entirely new embodiments of everything, from fundamental (anti)particles to quasi-atoms and quasi-molecules to both liquid & solid crystals of knots and to materials with highly unusual properties, our WPI's knotted chiral meta matter paradigm deepens fundamental understanding of natural phenomena through creating their pre-designed analogs, as well as aims to solve the knotty Global problems of growing energy demand & climate change by designing matter & unusual, highly desirable materials. This paradigm builds on particle-like quasi-atom properties of topological knot solitons, knotted vortices and knots in colloidal or (bio)polymer molecular strands, with our PIs (knot diagram) being the international inter-disciplinary team of global research leaders in this emergent new field working as a team. Pursued by our highly interdisciplinary international team of PIs, the fusion of topology & chirality research in this paradigm-changing context allows for new concepts and material/structural design strategies that may otherwise seem impossible. For example, our combined experimental and theoretical studies reveal what types of topological knot solitons can be stabilized by chirality in material systems, providing insights into topologically similar objects in other, experimentally less accessible systems, like particle physics and cosmology. While the bulk of our research focuses on experimentally highly accessible systems, like colloids, magnets and biopolymers, our findings will have immediate impacts for the study of objects and phenomena on less accessible scales, like the still elusive types of elementary particles and cosmic strings, for which even their very existence remains unknown. Conversely, theories of particle physics and cosmology inspire us to develop a deeper understanding and practical utility of related phenomena based on these highly accessible condensed matter and biological systems. Thus, our research efforts have the potential to lead to breakthroughs in many fields of science, in addition to the research paradigm that we strive to create.

Ongoing research efforts. WPI-SKCM2 is a young institute, less than 1.5 years old, but already gaining high visibility & reputation globally. It comprises four research thrust areas shown in the knot diagram. Within the research thrust area on LCs, colloids & gels, the goal is to develop new forms of knotted soft matter. New chiral LCs & nano-colloidal systems are synthesized by Haino; Smalyukh uses them as host media for novel solitons, vortices and crystals, & exploits such solitonic active matter to gain insights into the behavior of knot quasi-atoms in an out-of-equilibrium setting. Additionally, LCs with designable high-dimensional order parameter spaces are modeled & co-implemented by Dijkstra, Smalyukh, Haino & co-PI Tasinkevych. Sato synthesizes new breeds of knotting-enabled high-porosity gels, like hydrogels & aerogels, & collaborates with Smalyukh to control & understand properties like infrared reflectivity, visible-range transparency and thermal conductivity, as needed for future building envelope applications. The research thrust of quantum matter knots explores multi-dimensional topology in both real and momentum spaces in spin systems and quantum chromodynamics (QCD). Inoue leads synthesis of new magnetic materials designed to host multi-dimensional topological solitons and their crystals. These efforts are guided by modeling of stability diagrams by Leonov & Smalyukh & culminate in direct 3D experimental visualizations/mapping by Donnelly. Sasaki, Nonaka & Leonov collaborate to explore fundamental synergies between the phase diagrams in spin systems and QCD, and then Shigaki works with Inoue and Donnelly to experimentally probe these insights from the condensed matter and nuclear physics perspectives. Kuroda & Kimura study the momentum-space multi-dimensional topology, once again developing synergies with particle physics related to Weyl and

Dirac semimetals in the solid state, working closely with Sasaki, Smalyukh and Leonov. Within the (bio)polymer thrust, Yabuta studies the topology of nano-sized organic matter in extraterrestrial materials (e.g. from meteorites), as well as carries out an enantiomer analysis of not only amino acids but a larger suite of organic compounds in extraterrestrial objects to reveal how molecular chirality in Space played a role in chemical evolution toward the origins of life. Hsu studies the role of knotting & solitonic configurations in biopolymers like RNA & DNA & in defining protein structures in contexts ranging from fundamental properties of biopolymer knotting & linking to Alzheimer's disease & Coronavirus mutations. Sato synthesizes molecules "programmed" for knotting & linking in controlled ways, as well as for the self-assembly into materials with unusual mesoscale structures enabled by chirality-controlled spontaneous knotting/linking. Vignolini & Smalyukh study how knot solitons can emerge in both the natural photonic structures (like in cuticles of beetles) and in hierarchically self-assembled cellulose nanocrystal based chiral LCs. We work to address many fundamental, inter-disciplinary questions on relations between chirality and the different knots (& their crystals) in vortices, colloids, LCs, proteins & so on. This study of various knots & solitons in diverse physical, chemical & biological systems will be integrated through the deep connections with mathematical knot theory modeling by Kotorii, Sasaki, Dunkel & Matsumoto & the co-PIs from the entire Hiroshima knot theory group. We intend to expand the current cohort of 16 PIs by bringing in 5-10 new hires at HU, further enhancing & integrating these research thrusts to further boost cross-pollination between the diverse research fields. Research thrusts currently include:

(1) High-energy nuclear physics: Shigaki (PI), Sasaki (PI), Nonaka (coPI), Nitta (coPI).
(2) Quantum matter physics: Kuroda (PI), Donnelly (PI, Max Planck Inst.), Kimura (CoPI).
(3) Knotted polymer metamaterials: PIs Haino, Sato, Matsumoto (GeorgiaTech), Shokef (Tel Aviv U).
(4) Chiral magnets: PIs Leonov, Donnelly (Max Plank Inst) & Inoue, coPI Nitta (Keio U).
(5) Biophysics group: Hsu (Academia Sinica), Vignolini (Cambridge U) & Dunkel (MIT).
(6) Pure Math group: PI Kotorii & coPIs Kalman, Teragaito, Koda and Nozaki.
(7) Knotted/soft meta matter: PIs Haino, Smalyukh, Dijkstra & coPIs Yasuda & Tasinkevych (Lisbon).

The above projects are just examples of many activities that are now pursued, so diverse that some may say they are unrelated. However, they are all inter-knotted & inter-linked by the topology, chirality & knot theory foundations on which the progress builds via cross-pollination.

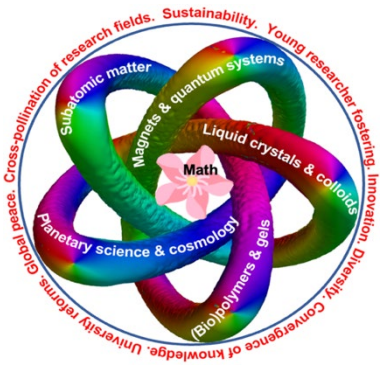
1-2. Generating Fused Disciplines

* Describe the content of measures taken by the center to advance research by fusing disciplines. For example, measures that facilitate doing joint research by researchers in differing fields. If any, describe the interdisciplinary research/fused discipline that have resulted from your efforts to generate fused disciplines. You may refer to the research results described concretely in "1-1. Advancing Research of the Highest Global Level."

Every aspect of SKCM2's operations is designed to strongly encourage interdisciplinary collaborations, as the Director has made fusion research a top priority for our center. For example, (1) graduate students and postdocs are required to have co-mentors representing disciplines different from that of the primary mentor/advisor, (2) meritocracy procedures encourage PI-level co-authorship within the WPI, (3) international exchanges of students/postdocs have interdisciplinary collaboration expectations, (4) the winter and summer schools have series of tutorials that introduce key concepts essential for interdisciplinary collaborations in our field, (5) the new building is constructed and facilities are being assembled with the fusion research in mind (e.g. shared student/postdoc offices), (6) the required attendance of seminars and coffee/tea-time meetings that promote interdisciplinary communications, (7) community-building activities like hiking and poster sessions promote fusion studies through more informal interactions, and more.

Every day we work to establish our WPI as an institute without walls, a Center of research excellence with prominent global presence and visibility. Specific efforts include bringing world-renowned scientists as seminar and symposium speakers, attending major global meetings and visiting top institutions while promoting the WPI during plenary/keynote or similar high-visibility presentations, disseminating our findings through very top international journals, engaging the very best scientists in our area as PIs/co-PIs or other collaborators, and so on. Specifically, we have successfully engaged international PIs with the highest research visibility and from top institutions globally, who already actively participate in our WPI's effort. While we have no international satellites, we strongly engage the international PIs and co-PIs, as well as the young researchers, as key contributors to all research and education missions of our WPI center. This is done by inter-knitting our activities through joint advising/mentoring of young researchers who mediate inter-PI interactions & partnerships. Young researchers are in the process of being hired through international searches while HU PIs are making the selections/recruitments jointly

with PIs at the international nodes, so that candidates for these positions can meet everyone's high expectations, as needed for fruitful international collaborations. The Director oversees key decisions related to internationalization, including personnel, hiring, etc. His leadership team assists with the implementation of the vision and goals of the proposed project. HU supports foreign PIs strongly in an effort to increase the time they can spend at HU, e.g. through long-term sabbatical & other stays, cross-appointment, consulting & various other agreements. Foreign PIs are the primary advisors for their postdocs hired at HU, who are planning to spend 50% time abroad in the labs of these PIs. All Center-supported PhD candidates have foreign PI co-mentors (currently, in most cases still in the process of selection), spending 6 months or more time abroad within their Ph.D. career. We do everything to ensure that joining a research group within our WPI is like becoming a family member for our Center's PIs, so that the foreign PIs will be all inter-knotted with family-like links & knots to their HU-employed group members. Welcoming new group members is what foreign PIs look forward to (see their commitment letters); for example, Claire Donnelly at Max Planck Institute hosts a newly hired postdoc at HU, whose co-mentor is Kenta Kuroda. International PIs will be great role models for HU young researchers to follow, giving them global research perspectives & collectively integrating knowledge of best practices in mentoring from ~100 top institutions globally. Young researchers connect the top global research centers with HU & erase disciplinary boundaries between the fields (by working with multiple co-mentors), ranging from math to physics & planetary science. A regular in-person seminar series at HU has a Zoom component, allowing international researchers to join, with the timing to start at noon chosen to make this comfortable for WPI members in US & Asian time zones while recording all the presentations to provide access for European members of our WPI.



A robust and highly effective environment with optimal conditions for collaborations and young researcher exchanges is being established. PIs from international institutions have their research group footprints at HU and direct collaborative research, mentoring & co-mentoring postdocs & students at HU. We have established regular research seminars & other meetings every week online to share progress with WPI members both at HU & abroad. The close communication among the members is the top priority in this WPI management. The frequent exchange of ideas at various organized occasions will ensure productive inter-disciplinary research in a cross-pollinating way. We also pursue efforts to foster young researchers in order to contribute to advancing their career paths while taking advantage of our global network. Gender balance is one of the top priorities, and we work hard to hire talented women researchers at all levels, from Ph.D. candidates to new PIs, where we benefit from the great experiences of our international colleagues. We have formed an External Advisory Board to advise the Director on the best practices related to realizing a diverse, welcoming International Research Environment, with the very helpful feedback provided at the most recent Board Meeting in March. The director noted that interdisciplinary collaborations are rather unusual for pure math members of the center, where research often focuses on rather abstract concepts and constructs. Taking into account the Site Visit Committee's feedback, he therefore spent many long hours introducing suitable collaborative opportunities to the mathematicians as a group and on an individual basis. Even though more progress is still needed, the current research efforts of mathematicians already involve the systems at the focus of our WPI's activates, like knotted vortices in nematic liquid crystals and knotted proteins. Even though more work is needed, the collaborative links between PI-level researchers already look like a big single highly complex knot. Not connecting with it through a large enough number of links would mean that the Director would reduce the level of involvement of the given PI/coPI, say transitioning to affiliate member status and reducing allocation of resources, which can be then used to boost engagement of other members.

Some research groups have intentionally started to work together to boost the original interdisciplinary research through collaboration among the members. PI Prof. Haino (organic chemistry) has sent his Ph.D. student to PI Dr. Hsu (biophysics) in Academia Sinica to analyze the polymer structure with cryoEM, which gave the student excellent technical training opportunity. The other collaboration between PI Dr. Hsu, former PI Prof. Tate (biophysics) and PI Prof. Haino focuses on the Amyloid b proteins that contain one or two D-amino acids. In this work, Haino's Ph.D. student collected AFM data needed to determine the chirality-defected Amyloid β structures. PI Prof. Shigaki, PI Prof. Sasaki, and coPI Prof. Nonaka (all in high-energy physics) have been working together since the project started. Sasaki and Nonaka contribute theoretically to analyze the data Shigaki collected in high-energy physics

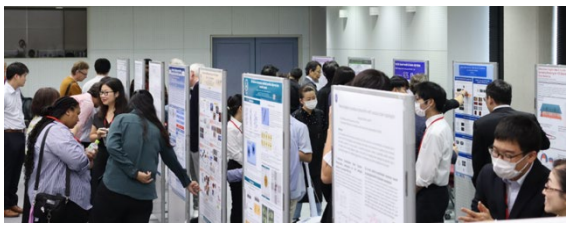
facilities such as CERN. PI Kotorii (math) and PI Matsumoto (soft matter theory) started discussions to collaborate. Kotorii has also collaborated with former PI Tate to classify the protein entanglement in protein condensates, in which affiliate member Prof. Panagiotou (math) also engages. Co-PI Kalman (math) and co-PI Prof. Shokef (soft matter physics) started a collaboration to apply the topological concepts to explain the deformation patterns found in soft matter. As shown above, collaborations among the members of the WPI-SKCM^2 are emerging. We will report progress in the next site visit.

2. Global Research Environment and System Reform

2-1. Realizing an International Research Environment

* Describe what's been accomplished in the efforts to raise the center's recognition as a genuine globally visible research institute, along with innovative efforts proactively being taken in accordance with the development stage of the center, including the following points, for example:
- Efforts being developed based on the analysis of number and state of world-leading, frontline researchers (in Appendix 2); exchanges with overseas entities (in Appendix 4); number and state of visiting researchers (in Appendix 5)
- Proactive efforts to raise the level of the center's international recognition and to obtain diversity within the center including gender balance.
- Efforts to make the center into one that attracts excellent young researchers from around the world (such as efforts fostering young researchers and contributing to advancing their career paths)

Research meetings, symposia, and schools to boost international collaborations. We have invited many outstanding researchers from around the globe who work in fields related to the WPI-SKCM^2's missions to the annual institutional meetings (autumn and spring), symposia (five times), winter school, and weekly seminars (a total of 55 talks, 37 foreign speakers) during FY2023. We have invited 80 foreign researchers (women researchers, 14) in total to those activities. Through these uninterrupted activities, we have promoted our institute to world-renowned scholars, ultimately boosting the global recognition of the WPI-SKCM^2.



Engagement of members. We have engaged PI, coPI, and affiliate members from all over the world. For example, during the meeting on 11 and 12 September 2023, the number of attendees was 69 (PI/coPI 24, affiliates 10, Postdoctoral fellows 17, InterKNOTshipper 1). Foreign visitors were 18 (26%), including one student coming from one of the foreign PI laboratories. On this occasion, each member had a poster presentation (51 presentations) to share their research with the project reviewers and the other members of WPI-SKCM^2. This provided the catalyst for various interdisciplinary and international collaborations. This event, with the kick-off symposium (20-22 March 2023), energized all the members, particularly students, and showed them that SKCM2 has a global research network connecting outstanding researchers worldwide.

Spring symposium at Nara. The spring symposium (8-10 March 2024) at Nara invited 16 speakers (13 foreign speakers). We had 106 participants in the symposium (28 foreign participants). Researchers and students ha d poster presentations to discuss their progress with foreign

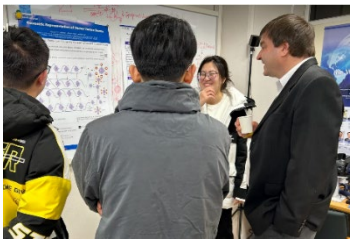
scholars. During the symposium, we had a panel discussion with invited scholars about how to promote interdisciplinary collaboration based on their experiences in different institutes. The discussion suggested different approaches, from personal-level collaboration with intimate communication in the same space to establishing a coordinated collaboration system adopted at the Kavli Institute for Theoretical Physics (KITP) at Univ. of California, Santa Barbara, to which Prof. Mark Bowick, one of our external advisors, belongs as a Deputy Director. In the discussion, it was emphasized that students benefit significantly from engaging in interdisciplinary collaborations led by two or three principal investigators (PIs/coPIs). It is particularly effective when students spend at least six months in a foreign laboratory, fostering their development as interdisciplinary researchers.

The panel discussion also focused on how pure mathematicians engage in interdisciplinary collaboration. In this topic, the emphasis was on teaching mathematics to non-mathematicians to support researchers in the topology-based research conducted in SKCM^2. Aside from teaching, pure mathematicians are expected to communicate with professionals in other disciplines to drive interdisciplinary efforts that amplify the scope and visibility of their research. The discussion also highlighted that successful collaboration with mathematicians may take years to come to fruition, but it is crucial to maintain ongoing dialogues with other researchers.

On this occasion, we discussed the management of the WPI-SKCM2 with external advisors, which include Prof. Bowick (KITP, UCSB), Prof. Zumer (U. Ljubljana), Prof. Yang (U. Pennsylvania), Prof. Dennis (U. Birmingham), and Prof. Kurokawa (GRIPS). From our side, we had the director, two deputy directors, Profs. Inoue and Yabuta, along with the administrative director.

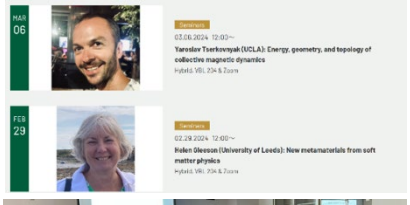
We discussed how to raise the number of student applicants to the SKCM2 graduate school, how to disseminate the institute's activity worldwide, and how to connect the institute to the private sector based on advisors' experiences. They also provided some ideas to promote outreach activities to invite young students to the research running in SKCM^2, which include forming partnerships with local museums to display the research outcomes and organizing a science fair for students to work on hands-on subjects. Regarding fostering partnerships with companies, they proposed establishing *a citizen laboratory* in the new WPI-SKCM^2 building, which is set to open in December 2025. A citizen laboratory encourages interaction with individuals in the private sector by sharing laboratory spaces and facilities, allowing ideas to flow in and out regularly.

SKCM^2 winter school 2023. The Winter School, held from 11 Dec. 2023 to 12 Jan. 2024, featured tutorials and research reports by 39 lecturers, including 18 foreign scholars. Lectures were also delivered online to allow the audience to attend remotely. Besides the SKCM^2 graduate program students, 12 students (11 foreign students, e.g. from Harvard U and MIT) from outside Hiroshima University attended the lectures. During the school, students had poster presentations to share their research with the other students from the other institutes. The contents delivered in the Winter School are available:
https://docs.google.com/document/d/1hGJ1hzbpijKfyd3DuhPtru10iBi1e0pttWUAAXHuPGk/edit



The tutorial lectures provided excellent introductions for students and researchers to interdisciplinary research. In particular, Prof. Kauffman's lectures on topology mathematics and its linkage to material science, chemistry, and biology made non-mathematical researchers accessible to mathematical techniques for grasping entangled observables through numerical treatments with topological polynomial invariants.

The quality and quantity of the delivered lectures during one month of school are incredibly high and cover a wide range of research fields. This style of schooling is unique in Japan, although it is not uncommon in the US and Europe. We noticed that Japanese students in the WPI-SKCM^2 graduate program appreciated a series of high-quality lectures and tutorials outside their field, which are not usually accessible in regular classes. We financially supported foreign students, not members of the WPI-SKCM2, if our PIs, coPIs, and affiliate members recommended them to SKCM2. This should help disseminate our activities and attract them to join the WPI-SKCM^2 after they get their degrees.



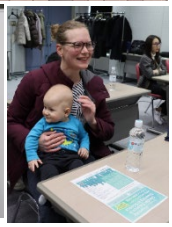
This unique in-person & online knotted chiral meta matter schooling should raise the visibility of the WPI-SKCM^2 to talented students worldwide. All the lectures are archived and open for the internal members of the SKCM^2; some of them are accessible as YouTube videos when we secured permissions to make the material open to the public. Accumulating these lecture videos will help young researchers/students joining SKCM^2 in the following years.

Weekly SKCM² seminar series. Our weekly seminars constitute another excellent resource to foster interdisciplinary researchers. As noted, over 60% of talks are given by leading-edge foreign researchers. Researchers and students in SKCM² can join stimulating talks and discussions every week. In FY2023, we had 51 seminars, reaching the number of weeks in a year (365/7~ 52). After the seminar, we have lunchtime, where the attendees can continue the discussion with the invited speakers in a relaxed/informal but stimulating environment. The weekly seminars will help construct an international research environment that is not available in Hiroshima University's existing departments and institutes.

Career development symposia to promote diversity. We encourage gender balance and diversity, helping young women researchers to build their careers. We had symposia for promoting women researchers twice in FY2023. These symposia were organized in collaboration with the HIRAKU-Global program that helps early-stage researchers develop their careers; HIRAKU-Global is supported by MEXT.

The symposium for promoting female researchers was held on 19 August 2023 at Hiroshima University. We had 13 invited speakers and 78 participants, including remote attendees. All the invited young women researchers work in the Chugoku-Shikoku area (the eastern region of the main island of Japan), who are the selected outstanding researchers supported by HIRAKU-global. The successful women PIs/coPI of SKCM² talked about their career development, focusing on their thought process when making critical decisions in their career paths. Their stories should be valuable guides to early-stage young women researchers and graduate students who attended the symposium. After the meeting, the mixer encouraged the women researchers to share what challenges they face in their careers, & best practices of overcoming them.

The other symposium with the same aim was help on 27 Feb. 2024 under the title 'Symposium to promote gender balance & diversity in science' at Hiroshima University. In this symposium, we invited Prof. Helen Gleeson (U. Leeds, UK) to provide a keynote lecture about the activities of the Bell Burnell Graduate Scholarship Fund, which has been encouraging greater diversity in physics by assisting Ph.D. physics students from underrepresented groups to promote Equality, Diversity, and Inclusion (EDI) in physics.

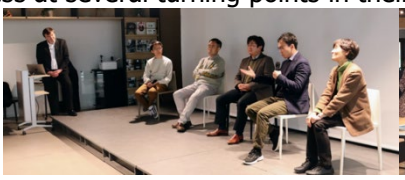


Established women researchers discussed their careers and how they established their status, including two current executive vice presidents of Hiroshima University, Profs. Tanaka and Suzuki, the former president of the Japan Physics Society, Prof. Tajima, the former executive vice president of Hiroshima University, Prof. Aida, and the emeritus professor of the University of Tokyo and a member of the Royal Swedish Academy of Sciences, Prof. Kuroda. One female PI of SKCM², Prof. Yabuta, and a selected female student in physics also had research talks combined with career highlights.

People shared how things have changed in the career development of female scientists. They also talked about how things are progressing in Japan and the UK to promote female scientists' careers in science and how the universities and academic communities are working to improve the situations surrounding female scientists. This symposium had nine invited speakers and 74 participants, including 28 online attendees.

Young researchers' career forum. In the winter school, we held a forum to help young scientists prepare for their future careers. We had a panel discussion, consisting of five young researchers who shared their career progression and advice and established professors who were invited as lecturers. In this session, we aimed to share men's and women's career developments in different countries and at different career stagess This forum was organized with the help of the Global Career Design Center of Hiroshima University.

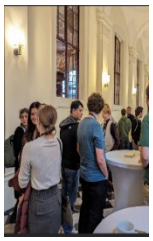
Two Global Career Design Center staff members, Dr. Misu, and Dr. Tanaka, introduced how their center supports the career development of Ph.D. graduates in finding academic jobs and research positions in companies in Japan, with the analyses of the current job markets. They also talked about their careers and their thought process at several turning points in their career paths.



The panellists' experiences in their career paths gave various examples of career development, which impressed how the established researchers thought about their research and decided to take further steps. Those discussions should have been helpful for the graduate students in the SKCM^2 program to build their professional future and navigate the career paths. The mixer after the forum helped the participants in the winter school exchange their ideas.

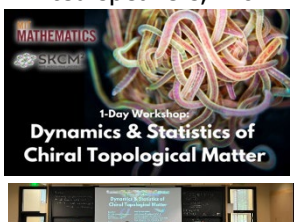
Workshops to disseminate SKCM^2 activities and attract young talent globally. Our foreign PIs organized science workshops to disseminate SKCM^2's research and promote collaboration with foreign researchers by exchanging graduate students and young researchers. In 2023, we had two foreign symposia at Wroclaw University in Poland (14 Oct. 2023) and the Massachusetts Institute of Technology (MIT) in the US (21 Oct., 2023).

Prof. Sasaki (PI) organized the workshop at the auditorium of Wroclaw University. She invited nine speakers (some joined remotely) and 15 young researchers. The young researchers had short presentations. The presented topics covered a wide range of subjects, from elementary particle physics to biomolecular chemistry. We had 35 participants in the symposium, including the dean of the science department of Wroclaw University. The symposium successfully built a linkage between Polish and SKCM^2 researchers, which helped disseminate the SKCM^2 research and promoted the exchange of young researchers. One of the participants from the University of Lyon (Lyon1) will stay at SKCM^2 this summer using the JSPS Summer Program 2024.



One of the graduate students (M1) in the SKCM^2 graduate program was invited to give a short talk as part of SKCM2's researcher-fostering activities. We also supported the travel expenses for three students living outside of Poland to join the event as they expressed interest in SKCM2-related career opportunities.

Prof. Dunkel (PI, MIT) held a symposium at MIT that focused on chiral topological matter. We had 50 participants, including 12 invited speakers. The workshop attracted young researchers. Some of them traveled from other states; we supported the travel expenses of five PhD students. From them, the WPI-SKCM^2 graduate program selected one student to give a flash talk in the workshop. This workshop helped expand the collaboration of SKCM^2 with the researchers in the US. One of the invited speakers, Prof. Eleni Panagiotou (Arizona State U.), found her interest as a topology mathematician in working with the people in SKCM^2. She delivered her tutorial lectures in the winter school and visited SKCM^2 in February 2024. On her occasion visit to SKCM^2, she had a discussion with the biophysics members in SKCM^2 to work on protein condensates. Prof. Kotorii (PI and Deputy Director), a mathematician, also started discussing a potential collaboration with Prof. Sabetta Matsumoto (PI, Georgia Tech U.) when she joined this workshop. The workshop helped her expand her research focus to other fields besides pure mathematics.



Coffee/Tea time for getting together. We strongly encourage students and young researchers to meet for coffee/tea time every day from 15:00 to 16:00. We think informal discussions among young people will harness the motivation to work on interdisciplinary research. Coffee/tea time is an essential daily event in SKCM^2 to ensure 'cross-pollination' among the research running in SKCM^2. We periodically use coffee/tea time for the students' short presentations or mini-poster sessions to share the research among the

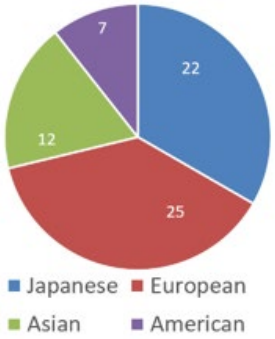
students who attend the events in SKCM^2, such as winter school. Even without any events, students, young researchers, and sometimes the invited speakers who gave a seminar talk come to the coffee room to discuss various subjects. It is interesting to see the whiteboards telling us what they discussed during the coffee/tea time. Young people are getting acquainted with the way global researchers live their lives.

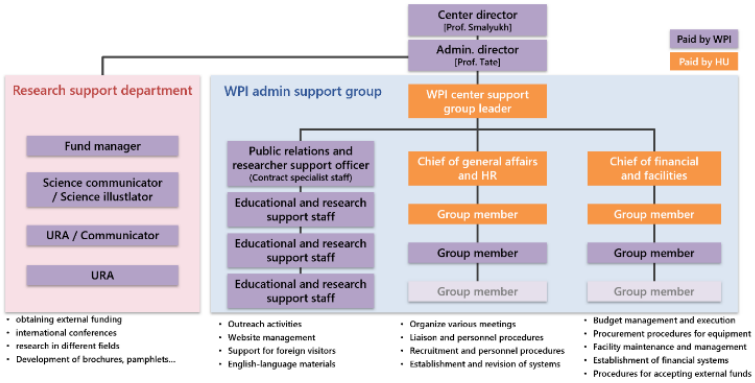
2-2. Making Organizational Reforms

* Describe the system reforms made to the center's research operation and administrative organization, along with their background and results.
* If innovated system reforms generated by the center have had a ripple effect on other departments of the host institutions or on other research institutions, clearly describe in what ways.
* Describe the center's operation and the host institution's commitment to the system reforms.

Reformation to the research operation

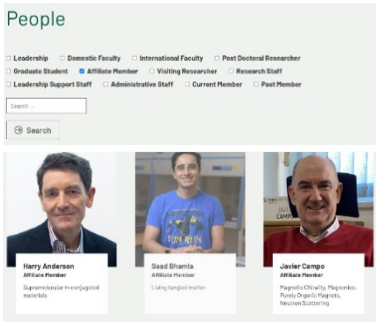
Affiliate members to work with PIs/coPIs to expand interdisciplinary research. The research in SKCM^2 covers a wide range of research fields. We intentionally work to build unique research fields based on chiral and topological matters, which require interdisciplinary collaboration to go beyond the existing research. To encourage researchers to pursue new research subjects, we need to provide various chances for them to see outstanding researchers in different fields. One of the efforts is a seminar series to have a speaker from around the world to give a talk every Thursday. We invited some of the speakers to be affiliate members who will join our research activities to achieve collaborations with the PIs/coPIs of SCKM^2. We now have 66 affiliate members. The affiliate members offer a fresh perspective on research subjects, insights, and techniques that complement the expertise of the PIs/coPIs, facilitating unique interdisciplinary collaborations to raise the visibility of SKCM^2 in the worldwide academic community.





Affiliate members can accept students in the SKCM^2 graduate program and postdoctoral fellows in their laboratories. We also support the travel expenses of the affiliate members to attend the events organized by SKCM^2, which expand the opportunities for young researchers and students to work with experts in broader fields. Diversity in the nationality of the researchers is also considered to build an international research environment. Over 70% of researchers, including PIs, coPIs, and postdoctoral fellows (as of Nov. 2023), are non-Japanese. Inclusion of the affiliate members will raise the ratio of non-Japanese researchers engaging in the WPI-SKCM^2.

The significant change in the reformed operation at SKCM^2 is that foreign affiliate members, not employed by Hiroshima University, can obtain an E-rad ID number. This enables them to be eligible to apply for Japanese funding, such as KAKENHI. URAs will help foreign affiliates prepare funding applications. Affiliate members are encouraged to seek Japanese funding to support collaboration with postdoctoral fellows and PIs/coPIs at SKCM^2 to develop new interdisciplinary fields. This SKCM^2 approach to promote international collaboration with aid from Japanese funding should evoke similar actions to facilitate international collaboration and student/faculty exchanges. We will share the outcomes of this approach and how it worked with the other faculties at Hiroshima University after a few years of operation.



The host institution's commitments to administrative operations

Allocation of experienced staff members dedicated to the WPI-sssSKCM^2 administration. The host institution's commitment to running the WPI-SKCM^2 is substantial under the strong support of President Ochi. In FY2023, Hiroshima University allocated five well-experienced office members to

manage the department operations, including budget handling and personnel. To run the WPI-SKCM^2 as one of the independent Institutes of Hiroshima University, the administration office has to keep in touch with various departments in the university head office.

The director and the administrative director have been discussing with the staff members how to amend the existing rules to implement things to reform the administration required for the WPI-SKCM^2 operation. The staff members will negotiate with the representatives in responsible departments of the head office to ensure the successful execution of missions within WPI-SKCM^2. Their dedication to reforming the existing rules and systems is indispensable. They keep the connection to the university head office to help the SKCM^2 operate in cooperation with the entire direction of the university.

In the administrative operation, we consider gender balance and diversity. Our supporting office leader is female. The administration office consists of a support office (8), a secretary team (5), and URAs (5); the numbers in parenthesis indicate the number of members, including the people hired by the WPI-SKCM^2. 14 out of 18 (78%) are female staff members, and 2 out of 18 (11%) are members of foreign origin.

Construction of a new building for the WPI-SKCM^2 research under one roof is secured. With the strong support of President Ochi, we secured the funds for constructing the WPI-SKCM^2 research center building. The five-story building for the WPI-SKCM^2 will be launched in December 2025. The head office made great efforts to secure the funds to make the WPI-SKCM^2 building a reality. Their commitment to this is substantial.

Working with the headquarters' building department, we started designing the floors for the research areas to facilitate interdisciplinary collaborations using advanced instruments. The new building for WPI-SKCM^2 also has facilities to accommodate collaborations with private companies commercializing the innovations of the researchers of the WPI-SKCM^2. The new building will help promote fundamental research oriented to the values of the future.

WPI-SKCM^2 New Building

WPI-SKCM^2 New Building location in the Higashi-Hiroshima Campus

WPI-SKCM^2 New Building appearance

Meritocracy-based bonus bank system, Version 2.0. Building on best practices from around the World, we have introduced the meritocracy-based bonus system to encourage excelent contributions to the WPI-SKCM2 activities, also aiming to reform the existing management system. This year we have updated the meritocracy procedures based on both internal and external feedback, including that from the 2023 Site Visit. While the annual salary of WPI members is set by their home institutions, including in cases of joint/cross appointments, our WPI strives to reward exceptional contributions to WPI's development and Global visibility by bonuses allocated based on merit-focused evaluations. To implement this bonus-assigning procedure, at the end of the fiscal-year-based performance period, the Institute's Evaluation Panel performs qualitative evaluations of contributions to research, education, internationalization, reforms, outreach and dissemination, and other missions of the WPI while taking into account aspects like student mentoring and grant application efforts. The Evaluation Panel, Jointly with Admin Director, Director and the Internal Director's Advising Committee then calculates the so-called "PI Performance Index of WPI" (PIPI$_{\text{WPI}}$, denoted as Π^2_{WPI}) based mainly on criteria that can be quantitatively assessed, as well as while using the Evaluation Panel's scores assessing service contributions of PI/coPI-level researchers and staff members. Then, the two forms of evaluations are integrated to assign bonuses in the end of each fiscal year on an annual basis, along with the Director's Award-like Outstanding Fusion Research Contributions Bonus, as detailed below. The net total bonus that a WPI member will receive includes three components:

$$\beta_{total} = \beta_{SB} + \beta_{ME} + \beta_{OFRC} \quad (1)$$

where β_{SB} describes the salary boost based on Evaluation Panel's assessment and as a fraction of the individual's annual salary, β_{OFRC} describes outstanding fusion research contributions bonus (treated as an Award, allocated by Director, with coPI Muneto Nitta being the recipient this year) and β_{ME} describes the bonus assignment based on the meritocracy equation. The procedures, developed and refined each year with the input from the External Advisory Board & HU President, used in calculating the terms are detailed below.

The WPI-SKCM^2 Evaluation Panel reviews overall performance of the SKCM^2 researchers and staff members, including aspects of performance that are hard to assess quantitatively. This evaluation will be modeled based on the best practices of performance evaluations used in the USA and Europe. To assist with these evaluations, the institute members will be asked to provide needed materials and information, which will then be used in the evaluation process by both the Evaluation Panel and the Director's Internal Advising Committee. Each year the Evaluation Panel first meets to discuss the process, timeline, scoring scale/method and elect the committee chair. The evaluation scores are then used to determine the salary boost within the boost ranges set up by the Director. For the fiscal year ending in March 2024, the upper-limit salary boost was set to 40% of annual total for PIs and 25% for co-PIs.

The following expression for this Π^2_{WPI} index will be used by the Internal Advising Committee:

$$\Pi^2_{WPI} = \sum_{i=1}^{n} (\rho_{collab}\delta_i\eta_i)/\pi^2 + \pi\sum_{j=1}^{m}\chi_j + \pi^2\sum_{k=1}^{l}\Omega_k + \pi^3(\Delta - \pi Z) + \pi^4\left(\sum_{i=1}^{n}\delta_{math,i}\eta_i + \varepsilon_{math}\sum_{j=1}^{m}\chi_j/\pi\right)/10. \quad (2)$$

Here $\pi \approx 3.14$ and the first ($the\ \pi^0\ term$) term $\sum_{i=0}^{n}\delta\eta_i$ intends to reward for promoting the WPI Institute's global visibility enabled by publications with the SKCM^2 International Institute listed as an affiliation, with δ_i being the number of PIs and co-PIs (and affiliate members starting from 2026) of the center involved as co-authors of a given publication; η_i is the impact factor of a journal in which the i-th article is published, summed for n articles published by a PI in a given year. This term encourages collaborative (within members of SKCM^2) publications in high-impact journals; furthermore, it encourages collaborations within the WPI-SKCM^2 members by an additional multiplication factor $\rho_{\text{collab}} = \pi^2$ when the ratio of authors who are our WPI members to the ones who are not is 0.01 or higher and $\rho_{\text{collab}} = \pi$ when it is 0.001 or higher, but $\rho_{\text{collab}} = 1 = \pi^0$ otherwise. Only articles published in peer-reviewed journals with an official Impact Factor of 0.1 or higher will be counted. To be counted, the articles with the affiliation "International Institute for Sustainability with Knotted Chiral Meta Matter" must be published in print or online, with the official publication date within a fiscal year under evaluation and before the cutoff date in March of each fiscal year (determined each year as specified below). Articles published after the cutoff date shall be counted towards the next fiscal year's meritocracy evaluations and bonus assignments. The second term (the $\pi^1\ term$) rewards additional research grants that the PIs will secure to supplement the WPI grant from the JSPS, where χ_j is the amount of each grant divided by 10 M JPY in a grant secured, m is the net total number of research grants received within a given fiscal year. All grants received by PIs, co-PIs and affiliate members at Hiroshima University will count. Grants from international funding agencies (with the net total re-calculated in yen) obtained outside Japan can be included in this term as only if they are for directly related research and benefit the SKCM^2 efforts in a major way(for example, fully support students or postdocs who come to HU for extended stays and research collaborations, support SKCM^2 conferences and schools, etc.); regular grants of international PIs/coPIs spent at their home institutions on efforts unrelated to our WPI will not be accounted for. The 3rd term (the $\pi^2\ term$) rewards major national and international awards received by PIs in a given year (the internal awards within individual institutions of PIs will not count). Here Ω_k=Ω_{Int}+Ω_{Dom}, where factors Ω_{Int}=2 are assigned for each international and Ω_{Dom}=1 for each domestic award; this term and factors help to reward the institute members for promoting the international visibility of SKCM^2 via receiving major awards, where awards must be for research and education accomplishments. This term $\pi^2\sum_{k=1}^{l}\Omega_k$ summed over the net total number of

such awards (l) in a given fiscal year period (to count, the Awards need to be announced within the given fiscal year's performance period and before the cutoff date). The 4th term (the $\pi^3\ term$) is intended to reward for contributions related to service on committees for PIs or as part of regular administrative and supporting staff duties, and other creative contributions that benefit the WPI. The positive and negative signs in front of $\Delta \text{ and } \mathrm{Z}$ roughly quantify positive (milestones accomplished ahead of the expected timelines, better than expected or meeting expectations…) and negative (not meeting expectations, missing deadlines, etc.) contributions to the WPI development. The coefficient Δ quantifies positive contributions on a scale up to Δ=1, with Δ=0.5 corresponding to "meets expectations" (Δ=1 corresponds to performance "always exceeding expectations"), Δ=0-0.5 range reflecting acceptable performance that leads to accomplishment of goals but sometimes with delays and in a less perfect way. Negative impacts Z (expected to be highly uncommon) are quantified on a scale up to Z=1, where Z=1 would correspond to performance constantly causing the WPI miss major opportunities or impacting its reputation in a negative way. These factors are qualitatively evaluated by the Evaluation Panel, the Admin Director and the Internal Advising Committee and with input from Administrators and PIs/co-PIs/affiliates. For certain WPI-employed staff members, the maximum value of Δ can be up to 2, as determined by the Director along with the Internal Advising Committee, though Δ=2 is expected to be extremely rare). For researchers, the maximum value of Δ can be up to 1, as determined by the Evaluation Panel jointly with the Admin Director and Director. The last term ($\pi^4\ term$) is the next-order correction term introduced in order to account for the specifics of the mathematics field that tends to have single-author articles and small impact factor journals; here $\delta_{math}\ is\ the$ number of mathematicians authoring the paper, taking value one for mathematicians and zero for members of other research fields; ε_{math} takes value one for mathematicians and zero for members of other research fields. This term also corrects for the fact that successful mathematicians normally receive smaller research grants. To promote fusion research where pure math members work together with physicists, chemists biologists and material scientists, starting from evaluations in 2025 this correction will be applied only in cases when pure math researchers also engage in interdisciplinary research (e.g. additionally publish in interdisciplinary journals, secure research grants jointly with non-math PIs, etc.). This meritocracy scheme will be perfected and updated each year based on experience and recommendations from the External Advisory Board, Site Visit Committee, HU President, Internal Advising Committee and External Advisory Board. To distribute the bonus bank, a spreadsheet will be produced by the internal advising committee and Admin Director, with the terms calculated for each member according to the above principles and using data supplied by SKCM^2 members by filling the spreadsheet forms. Members of the SKCM^2 will provide requested information when needed and will be informed about the procedures. The final spreadsheet of β_{ME} −values will be provided to financial officers by COB on the cutoff day of each fiscal year, which will then be used to pay the bonuses. The meritocracy-based evaluations are normally done based on performance within each fiscal year (April 1-March 31). However, processing the bonus bank payment within a given fiscal year requires time of 2-3 weeks. Therefore, there will be a cutoff date for evaluations determined by Financial Officers of HU and the WPI purely based on the time period needed to process payments. For the 2023-2024 fiscal year, the cutoff date is March 12, 2024. Each year the bonus notification email is accompanied by a web-based form allowing each member to provide feedback and suggestions for the implementation of the meritocracy procedures to be accounted next year.

Meetings with the external advisory board. Throughout the year and during the Nara Symposium (in person), we held meetings involving Director & Deputy and Admin Directors, and, separately, the entire Knot Steering Committee meeting with the External Advisory Board. The participating external advisers, including Profs. Mark Dennis (UK), Mark Bowick (US), Slobodan Zumer (Slovenia), Kiyoshi Kurokawa (Japan) and Shu Yang (USA) provided valuable suggestions related to running the WPI center. All the representatives of the Knot Steering committee attended the meeting moderated by with the center director. External advisors, each of whom has profound experience in managing interdisciplinary research promotion programs in the fields related to topological meta-matters, gave valuable suggestions in terms of recruiting Ph.D. students, introducing the new graduate program, gender balance, fostering early-stage researchers, and dissimilating the research outcomes to the public. This discussion with the external advisers helped us forge strategic initiatives for administration in the SKCM^2. We will plan to have many informal and regular annual meetings with advisory board members in the following years of the WPI implementation, seeking their feedback and insights.

3. Values for the Future
3-1. Creating and Disseminating the Societal Value of Basic Research

* Describe the content of measures taken by the center to widely disseminate the results of its basic research to the general public.
* Describe what was accomplished in the center's outreach and other activities last year and how they have contributed to creating the Societal Value of Basic Research. In Appendix 6, describe concretely the contents of these outreach activities. In Appendix 7, describe media reports or coverage, if any, of the activities.

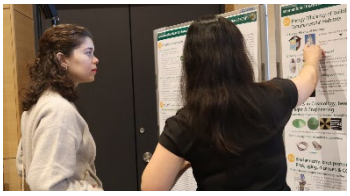
Disseminating SKCM² research in high schools. Our outreach team (Prof. Kotorii, deputy director, in charge) had outreach events in high school to introduce the chiral and topological sciences to the next generation. We had six outreach events in different schools in Hiroshima prefecture in FY2023. One of them was a junior high school at Fukuyama city, held on 8 Nov. 2023. Besides the lectures on chiral


and topological matters by Prof. Inoue (PI, deputy director), we showed the topological shapes created by a 3D printer and 3D visualizations of topological strings in Virtual Reality (VR). This allows students to experience the complex yet beautiful knots tangibly.

Dissemination to the public. We had an outreach event at Miyajima titled "Touch the Knot" on 26 Dec. 2023. The event was coupled with an Outreach Symposium geared towards scientists. Six invited speakers talked about their experience engaging the public, including public outreach events, working with the UN, international press, and the 3 Minute Thesis Competition.

Following this, we had a hands-on session where the public could experience making 'Mizuhiki', traditional Japanese knots, and experiencing knotted string in 3D VR.



The event was organized in the middle of the winter school. Foreign attendants to the winter school enjoyed the event, which facilitated communication among the winter school students.

Dissemination of the WPI-SKCM² project in a Nature highlight. We have published the center's advertisement in *Nature* to raise the visibility of this institute. In this advertisement, we described how our fundamental research in various fields realizes a sustainable future. https://www.nature.com/articles/d42473-023-00423-y

Using social media/networks to disseminate the daily activities in the WPI-SKCM². We disseminate the research and event information through X, Facebook, Instagram, and YouTube. The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Untangling pressing global problems using knots

A branch of pure mathematics that analyses knots promises to seed new solutions for realizing a sustainable future in a range of different fields.

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SKCM² WPI HIROSHIMA UNIVERSITY

dedicated pages are updated frequently to promote WPI-SKCM^2 activities, like seminars, meetings, awards, etc.

3-2. Human Resource Building: Higher Education and Career Developments

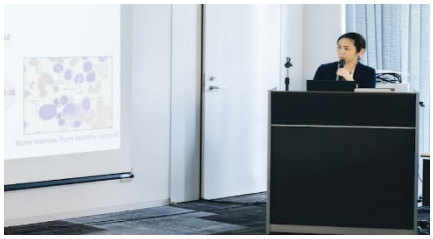
* Describe the content of measures taken by the center to foster young researchers, including doctoral students, through their participation in a research system that creates new interdisciplinary domains within a rich international environment.

Co-mentor system for the students in the WPI-SKCM^2 graduate program. We have launched the WPI-SKCM^2 graduate program. We currently have 19 graduate students (M: 12, D: 7). The number of female students is 5 (26%). Five students come from foreign countries (26%). All the students are financially supported. Each student is supervised by a primary mentor and two co-mentors who are experts in different fields. They can choose co-mentors from all the PIs/coPIs, including members of foreign institutes. Ph.D. students will have graduate training opportunities in foreign institutes, including the Topological Design Ph.D. training course at the University of Birmingham. The recruitment of doctoral fellows in the WPI-SKCM2 graduate program was advertised in *Science* (23 Feb. 2024).

Students in this graduate program are encouraged to attend weekly seminars, schooling, and symposia organized by the WPI-SKCM^2. We highly recommend that students attend the daily coffee/tea time from 15:00 to 16:00. This is a great opportunity to interact with young researchers and postdoctoral fellows at WPI-SKCM^2 to introduce them to interdisciplinary research. We give the students who enthusiastically join these events to cultivate their interdisciplinary minds the chance to attend the symposia organized by foreign members of the WPI-SKCM^2. In FY2023, we selected two students to send the symposia to Wroclaw University in Poland and MIT in the US, respectively.

PROGRAM FEATURES

- Interdisciplinary research opportunity
- International exchange visits develop students' global perspectives
- Choose co-mentors from WPI-SKCM^2 nodes (MIT, U Colorado, Cambridge U, and other institutions of our international PIs and co-PIs)
- Graduate training modeled based on best practices of PhD programs in the USA and UK
- Support to attend WPI-SKCM^2-sponsored Summer and/ or Winter Schools to learn from world leaders in the fields related to topology and chirality
- Sustainability among many missions
- Stipends available, supported by WPI-SKCM^2



Career developments of young researchers. We collaborate with the HIRAKU-Global program of Hiroshima University, which has been working to foster early-stage researchers by adopting the advantages of the foreign researcher development training successfully established at the Gladstone Institutes in the US. One of our steering committee members, Prof. Aida, directs this program, which is funded by JST. HIRAKU-Global currently fosters 27 young faculty members in the universities in prefectures neighboring Hiroshima, including Tokushima, Ehime, and Yamaguchi Universities.

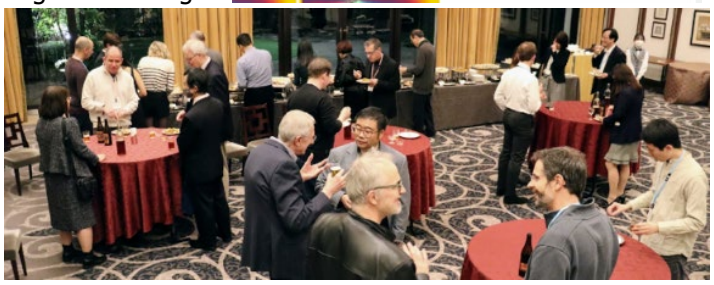
As described above, we held three symposia focusing on the career development of young researchers in collaboration with HIRAKU-Global. They are the "Joint Symposium to Promote the Active Participation of Female Researchers" (19 Aug. 2023), the "Career Forum" held in the winter school (25 Dec. 2023), and the "Symposium to Promote Gender Balance and Diversity in Science" (27 Feb. 2024). In the symposia focusing on female researchers' career development, young female faculty members selected by the HIRAKU-Global program had talks and shared their experiences. Some female researchers were invited to join the WPI-SKCM^2 as affiliate members.

3-3. Self-sufficient and Sustainable Center Development

* Describe the state of implementation of the host institution's mid-to-long term measures for supporting the center toward becoming self-sufficient and sustainable after the 10-year funding period ends, such as reforming the host institution's organization, providing personnel with priority allocation of tenured posts to the center, providing fundamental financial support, and material support including land and buildings.

Raising external funds by involving foreign members of the WPI-SKCM². We reformed the eligibility rules for the grant application to allow foreign members of the WPI-SKCM² who are not directly hired by Hiroshima University to obtain an eRad-ID. All foreign PIs and coPIs work for the WPI-SKCM² under a consultancy contract. We encourage foreign PIs/coPIs with a high academic profile to apply for Japanese funding to support collaboration at WPI-SKCM² in Hiroshima University. We also encourage foreign affiliates to apply to the Japanese funds to achieve their collaborations in the WPI-SKCM2; several have applied already. URAs supports their budget applications. We are increasing our funding by increasing collaborations among WPI-SKCM² members—including PIs/coPIs, postdoctoral researchers, and affiliates. Our goal is to gradually exceed the funding levels provided by the WPI program, ensuring the long-term sustainability of WPI-SKCM² beyond the initial support phase. In this plan, we are considering applications to foreign funds, including NIH, NSF in the US; The director has started preparations to apply for the Global Centers Fund from NSF, which is in conjunction with JST-ASPIRE.

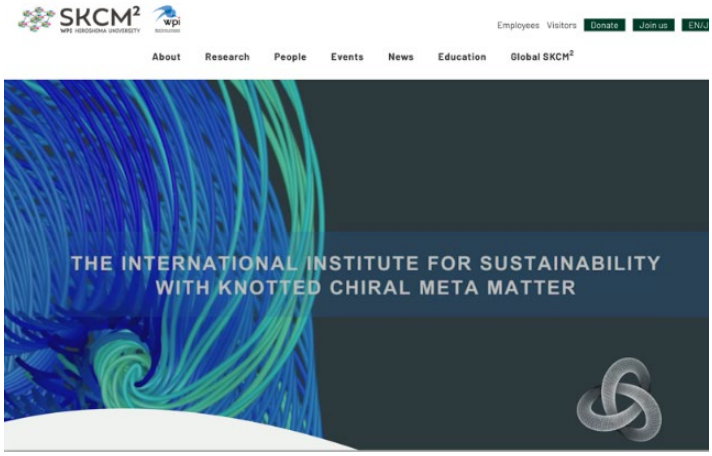
Building connections to the private sector for funding. Making connections to private companies has also been considered, linking our research outcomes to society's future values. Our new building, which will be launched in December 2025, has rental office/laboratory spaces for private companies. In collaboration with the head office of Hiroshima University, we will invite companies that are interested in working with us after opening the building. We will collaborate with the researchers in the Hiroshima branch of the National Institute of Industrial Science and Technology (AIST) on nano-cellulose (the collaboration contract is underway). Through this collaboration, we will build connections to companies in this region. Consolidating connections with companies will add funds to sustain WPI-SKCM² after the funding period of the WPI program. One effort to connect with companies in FY2023 was the networking event in Osaka on 11 Mar 2024. We will keep connecting with the companies through various measures to obtain suitable partnerships, including donatiuons for the new building and research efforts.



4. Others

* In addition to the above 1-3 points, if there is anything else that deserves mention regarding the center project's progress, please note it.

Web page updated. Our Web page was updated to disseminate information more attractively. We reformed the page to give site visitors more information at a glance on the front page with an attractive movie banner of the research conducted at WPI-SKCM².
https://wpi-skcm2.hiroshima-u.ac.jp/



Video archives of lectures delivered at WPI-SKCM^2. We are archiving the lecture videos taken at weekly seminars and tutorials in the winter/summer schools. These videos are shared among the people of the WPI-SKCM^2. Furthermore, some video lectures are open through YouTube if the presenters approve the public delivery, while the others are only internally accessible to every member of the WPI-SKCM^2. These video archives are a valuable treasure for students and researchers who want to learn various aspects of the chiral and knot sciences in depth. These resources may help promote interdisciplinary research & will help with the global visibility of our WPI.

5. Center's Response to Results of Last Year's Follow-up

* Transcribe the item from the "Actions required and recommendations" section in the site visit report and the Follow-up report, then note how the center has responded to them.
* If you have already provided this information, indicate where in the report.

Actions required and recommendations

Overall SKCM2 has made a very good start in its first year of operation. There are some points that should be addressed for promoting further progress.

1) It may be too early to discuss its scientific achievements in the first year, but the center should present the original research achievements of its members as a whole next year.

The report above highlights many examples of collaborative research efforts that would not take place without the establishment of our WPI. While some of these efforts were meticulously planned from the time of communications at early stages of proposal writing, there are many examples that can be tracked to discussions at the poster sessions of the kickoff symposium or winter school, or to coffee/tea-time presentations by students or to community-building weekend hikes at our local trail in Kagamiyama Park. The Director spent many long hours introducing to mathematicians how abstract math concepts are related to topology of vortices and solitons, so that they can now apply pure math techniques to predict possible structures like knots of vortices in various ordered media, including biaxial and chiral liquid crystals and magnets studied by our WPI. The majority of ~200 publications emerging from our center so far would not be possible without the establishment of WPI-SKCM^2. The new paradigm of knotted chiral meta matter emerges as a hot research topic globally, with our center at the forefront of fascinating new developments and breakthroughs. The fusion of mathematical knot theory and chirality knowledge along with the sustainability focus of the values for the future are the unique defining features of our international institute that are widely noticed by international research community. While this reporting document has limited space allocated, we look forward to present and discuss in detail at the forthcoming site visit presentations and poster session, fully addressing this remark with the help of young researchers and PIs.

2) The connection between the sustainability of society and the center's research mission and plans is not obvious and should be more clearly articulated.

Our fundamental research project covers/integrates a wide range of research fields, including both theoretical and experimental studies. This may give the impression that the project's focus on sustainability is not strongly defined. Research at WPI-SKCM^2, however, is largely inspired by sustainability-related challenges and open problems. For example, we develop new materials from tangled/knotted cellulose fibers that reduce building's energy consumption to help mitigate the growing energy demand and global warming. The materials include a super thermal super-insulators that the director the WPI Director already made and is further developing, and the devices using knotted magnetic order emerging in chiral magnets as information carriers on which PI Prof. Inoue (chemistry), and PI Prof. Leonov (condensed matter physics) work currently. Nano-cellulose research conducted by PI Prof. Vignolini (biomolecular chemistry) and the director will

also provide materials made of cellulose to reflect infrared radiation, in addition to providing other desired properties and features. The gold- and silver-looking organic materials intended to be placed on the building walls will block the sunlight, impairing the building's heating in strong sunlight and thus reducing the need for air conditioning electricity in the summer. Further, the director assembled a team to apply to the Global Centers program to the NSF in the USA, JST in Japan and other similar agencies in Korea, Canada, UK and Finland. This grant, if funded will involve 5 PIs/coPIs at CU-Boulder and 5 at HU (our WPI members), as well as many postdoc/exchange students working on more applied aspects of research, in addition to many researchers in 4 other countries, the complementary sustainability-via-bioeconomy effort will allow our WPI center to make our sustainability focus even more visible and appreciated. Beyond this, our outreach efforts will emphasize this important aspect of our research activity. We look forward to highlighting our sustainability related efforts in both research and education during the site visit this year.

3) Fusion studies are still in the developing stage. The center director should carefully monitor progress in the key areas currently supported within the center to ensure that they evolve into topics with genuine connections to the center's intellectual core.

The WPI director has made fusion research a top priority for our center. Every aspect of the SKCM^2's functioning strongly encourages interdisciplinary collaborations. For example, (1) graduate students and postdocs are required to have co-mentors representing disciplines different from that of their primary mentor/advisor, (2) meritocracy procedures encourage PI-level co-authorship within the WPI, (3) international exchanges of students/postdocs have interdisciplinary collaboration expectations, (4) the winter and summer schools have series of tutorials that introduce key concepts essential for interdisciplinary collaborations in our field, (5) the new building is constructed and facilities are being assembled with the fusion research in mind (e.g. shared student/postdoc offices), (6) the required attendance of seminars and coffee/tea-time meetings that promote interdisciplinary communications, (7) community-building activities like hiking and poster sessions promote fusion studies through more informal interactions, and more. Following the last year's site visit and feedback received from the site visit committee, the director noted that interdisciplinary collaborations are rather unusual for pure math members of the center, where research often focuses on rather abstract concepts and constructs. Taking into account the Site Visit Committee's feedback, he therefore spent many long hours introducing suitable collaborative opportunities to the mathematicians as a group and on an individual basis. Even though more progress is still needed, the current research efforts of mathematicians (pure math members of the WPI) already involve the systems at the focus of our WPI's activities, like knotted vortices in nematic liquid crystals and knotted proteins. Even though more work is needed, the collaborative links between PI-level researchers already look like a big single highly complex knot. Not connecting with it through a large enough number of links would mean that the Director would reduce the level of involvement of the given PI/coPI, say transitioning to affiliate member status and reducing allocation of resources, which can be then used to boost engagement of other members. The approach that our WPI takes here is to offer great opportunities to everyone globally who is eager to engage with our institute in pursuing our ambitious research and education goals, and we will continue being innovative and adaptive to maximize the positive impact that our fundamental research and collaborations can have, including in terms of sustainability- and fusion-research-related goals.

4) In relation to the director’s appointments at HU and University of Colorado, a specific agreement needs to be exchanged on intellectual property assignment.

The initial agreements that, among other things, involved IP-related matters were signed in the early stages of the WPI-SKCM2 at the end of 2022 and in early 2023, where the Director and HU administrators signed the standard forms developed by CU-Boulder, among other documents. However, the scope of collaborative opportunities evolves further with the recent development of the new Global Centers proposal with the sustainability/bioeconomy focus (submission deadline of June 11, 2024 with 6 countries including the USA and Japan participating). Because this grant application, if funded (by US NSF and JST in Japan, among other funding agencies) will involve 5 PIs/coPIs at CU-Boulder and 5 at HU/AIST, as well as many postdoc/exchange students working

on more applied aspects of research, in addition to many researchers in 4 other countries (Canada, UK, Korea, Finland), a new overarching agreement will be developed and signed once we learn the outcome (expected to be known in September, 2024). Further, to collaboratively teach graduate courses, the possibilities of SKCM2 graduate students registering for courses at CU-Boulder (& MIT & Georgia Tech), with the tuition paid from Global Centers or WPI grants, have been discussed and will be pursued along with the IP agreement depending on the outcome of the Global Centers competition.

5) The lack of suitable international schools near the campus for supporting long-term stays of foreign researchers with families is a basic infrastructure problem outside of major cities in Japan. While this is an urgent problem, the solution will not be easy; we hope the host university will continue to work closely with the local community to find a solution as soon as possible.

We appreciated this feedback. Indeed, similar to other overseas researchers, the director himself strongly needs an international school near the campus; his family with two children stayed at the Higashi-Hiroshima campus and had to drive a long distance to bring the children to school, taking a 3-hour back-and-forth drive every day. Early negotiations with the Hiroshima International School's (HIS) Director had to be put on hold because he recently retired from the position, so the negotiations will now need to be re-started with the new HIS school leadership. The matter is also being pursued by the university president, Ochi sensei, the leadership of local international companies like Micron, the Higashi-Hiroshima city mayor, and the governor of Hiroshima prefecture. President Ochi is now working with them to invite the international school to establish a presence near the HU campus. As part of discussions of the new building and the use of the current VBL building the international schooling and daycare needs are being discussed as well, as part of creating an environment suitable for stays of international scholars with school-age children. We are hopeful that our efforts will soon lead to a sustainable resolution of this challenging problem.

6) There is an urgent need to construct a new research building for $SKCM_2$ as soon as possible, which will greatly contribute to productive interdisciplinary collaborative research, particularly by foreign PIs at HU.

The strong support of President Ochi and the staff members in the head office of Hiroshima University allowed us to secure the budget (from two different sources) to construct a building for the under-one-roof WPI-$SKCM^2$ research activity. The new building is now in the advanced stages of design/planning and will be launched in December 2025. We are very excited about building's features like shared offices for young researchers, open labs and shared facilities. We are challenged by the increased costs of construction materials and labor due to inflation but we hope to address these challenges in a timely manner. For example, we are working to secure additional funds from donors and funding agencies for decoration and instrumentation, making sure that it will become a global hub of research on knotted chiral meta matter, and that the building will serve its function of being a research home for an active research community of our WPI's global membership.

Appendix 1 FY 2023 List of Center's Research Results and Main Awards

1. Refereed Papers

- List only the Center's papers published in 2023. (Note: The list should be for the calendar year, not the fiscal year.)

(1) Divide the papers into two categories, A and B.
   A. WPI papers
      List papers whose author(s) can be identified as affiliated with the WPI program (e.g., that state "WPI" and the name of the WPI center (WPI-center name)). (Not including papers in which the names of persons affiliated with the WPI program are contained only in acknowledgements.)
   B. WPI-related papers
      List papers related to the WPI program but whose authors are not noted in the institutional affiliations as WPI affiliated. (Including papers whose acknowledgements contain the names of researchers affiliated with the WPI program.)

      Note: On 14 December 2011, the Basic Research Promotion Division (the Basic and Generic Research Division at present) in MEXT's Research Promotion Bureau circulated an instruction requiring paper authors to include the name or abbreviation of their WPI center among their institutional affiliations. From 2012, the authors' affiliations must be clearly noted.

(2) Method of listing paper
- List only refereed papers. Divide them into categories (e.g., original articles, reviews, proceedings).
- For each, write the author name(s); year of publication; journal name, volume, page(s) (or DOI number), and article title. Any listing order may be used as long as format is consistent. (The names of the center researchers do not need to be underlined.)
- If a paper has many authors (say, more than 10), all of their names do not need to be listed.
- Assign a serial number to each paper to be used to identify it throughout the report.
- If the papers are written in languages other than English, underline their serial numbers.
- Order of Listing
   A. WPI papers
      1. Original articles
      2. Review articles
      3. Proceedings
      4. Other English articles

   B. WPI-related papers
      1. Original articles
      2. Review articles
      3. Proceedings
      4. Other English articles

(3) Submission of electronic data
- In addition to the above, provide a .csv file output from the Web of Science (e.g.) or other database giving the paper's raw data including Document ID. (Note: the Document ID is assigned by paper database.)
- The papers should be divided into A or B categories on separate sheets, not divided by paper categories.

(4) Use in assessments
- The lists of papers will be used in assessing the state of WPI project's progress.
- They will be used as reference in analyzing the trends and whole states of research in the said WPI center, not to evaluate individual researcher performance.
- The special characteristics of each research domain will be considered when conducting assessments.

(5) Additional documents
- After all documents, including these paper listings, showing the state of research progress have been submitted, additional documents may be requested.

A. WPI papers

[Original articles]

1. Shigenaga, T; Leonov, AO. Harnessing Skyrmion Hall Effect by Thickness Gradients in Wedge-Shaped Samples of Cubic Helimagnets. *Nanomaterials* 2023, 13(14), doi: 10.3390/nano13142073
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2. Invited Lectures, Plenary Addresses (etc.) at International Conferences and International Research Meetings

- List up to 10 main presentations during FY 2023 in order from most recent.
- For each, write the date(s), lecturer/presenter's name, presentation title, and conference name.

Date(s)	Lecturer/Presenter's name	Presentation title	Conference name
Nov. 6, 2023	Chihiro Sasaki	Signals for Chiral Symmetry Restoration	EMMI Symposium, GSI, Darmstadt, Germany
Sept. 23, 2023	Marjolein Dijkstra	From twist-bend and splay-bend nematic phases to baby skyrmions and polar blue phases in systems of colloidal bananas	International Soft Matter Conference 2023, Osaka, Japan
Sep. 19, 2023	Yuta Nozaki	A non-commutative Reidemeister-Turaev torsion of homology cylinders	Mapping class groups: pronilpotent and cohomological approaches SRS, Switzerland
Aug. 6, 2023	Elisabetta Matsumoto	Mathemalchemy	Moves, MoMath, New York, New York, USA
Jul. 7, 2023	Claire Donnelly	Imaging of three dimensional magnetic systems - and their dynamics!	Gordon Research Conference on Spin Dynamics, Switzerland
July 3, 2023	Ivan Smalyukh	Topological Steering of Light by Liquid Crystal Defects and Solitons Session Title: Perspectives in Soft Matter Optics and Photonics	44th PIERS (PhotonIcs & Electromagnetics Research Symposium), Prague, Czech Republic
July 2023	Jorn Dunkel	Topological statistics of living and non-living matter.	New statistical physics in living matter: non equilibrium states under adaptive control. Isaac Newton Institute, Cambridge (UK)
Jun. 13, 2023	Hikaru Yabuta	Organic Matter in the Samples of Asteroid Ryugu Returned by the Hayabusa2 Spacecraft	The 2023 Gordon Research Conference on Origins of Solar Systems, USA.
May. 6, 2023	Katsuya Inoue	Chirality and Topology of Spin System	the 8th International Conference on Superconductivity and Magnetism- ICSM2023, Liberty Lykia Hotel Fethiye-Oludeniz, Türkiye
March 2023	Silvia Vignolini	Structurally colored pigments via the hierarchical self-assembly of cellulose nanocrystals.	National Spring Meeting of the ACS – Indianapolis CA, USA

3. Major Awards

- List up to 10 main awards received during FY 2023 in order from the most recent.
- For each, write the date issued, the recipient's name, and the name of award.
- In case of multiple recipients, underline those affiliated with the center.

Date	Recipient's name	Name of award
Mar. 22, 2024	Claire Donnelly	Heinz Maier Leibnitz Award
Mar. 1, 2024	Ivan Smalyukh	2024 Gray Medal of the British Liquid Crystal Society, United Kingdom
Oct. 26, 2023	Jorn Dunkel	Schmidt Science Polymath Award 2023, Schmidt Futures
Oct. 2023	Ivan Smalyukh	Optica Fellow selection
Aug. 2023	Ivan Smalyukh	IOP Publishing 2023 Top Cited Paper Award for the article "Review: knots and other new topological effects in liquid crystals and colloids"
Jun. 15, 2023	Katsuya INOUE	Molecular Chirality Award 2023
May 2023	Claire Donnelly	IEEE Magnetics Society Early Career Award

Appendix 2　FY 2023 List of Principal Investigators

NOTE:

*Underline names of principal investigators who belong to an overseas research institution.

*In the case of researcher(s) not listed in the in the latest report, attach a "Biographical Sketch of a New Principal Investigator"(Appendix 2a).

*Enter the host institution name and the center name in the footer.

<Results at the end of FY2023> **Principal Investigators Total: 16**

Name	Age	Affiliation (Position title, department, organization)	Academic degree, specialty	Effort (%)*	Starting date of project participation	Status of project participation (Describe in concrete terms)	Contributions by PIs from overseas research institutions
Center director: Ivan I. Smalyukh	51	(1) Professor/Department of Physics, MSE and Renewable Sustainable Energy Institute/University of Colorado at Boulder (2) Director / SKCM2, Hiroshima University	Ph.D., Topological solitons, knotted matter, self-assembly, predesigned building blocks of matter, soft matter	80	Nov. 11, 2022	He stays at the center (over 50%) while also directing WPI-related activities at HU and at Univ Colorado and Globally	He organizes the center and directs its overall activities
Deputy director for Education: Katsuya Inoue	59	Professor/Academy of Hiroshima University, Graduate School of Advanced Science and Engineering, Chemistry/Hiroshima University	Ph.D., Experimental material sciences, chemistry	70	Nov. 11, 2022	He usually stays at the center.	
Deputy director for Outreach & Dissemination: Yuka Kotorii	39	(1) Associate Professor/Academy of Hiroshima University, Graduate School of Advanced Science and Engineering, Mathematics/Hiroshima University (2) Visiting Scientist/Interdisciplinary Theoretical and Mathematical Sciences Program (iTHEMS)/RIKEN	Ph.D., Mathematics (topology, knot theory)	70	Nov. 11, 2022	She usually stays at the center.	
Deputy director for Science: Hikaru Yabuta	49	Professor/Academy of Hiroshima University, Graduate School of Advanced Science and Engineering, Earth and Planetary System Science/Hiroshima University	Ph.D., Cosmochemistry, geochmistry	70	Nov. 11, 2022	She usually stays at the center.	

Claire Donnelly	32	Lise Meitner Group Leader/Max Planck Institute for Physical Chemistry of Solids	Ph.D., 3D topology in magnets, nanoscale imaging	30	Nov. 11, 2022	She usually stays at Max Planck Institute as a partner institute and visits the center	She co-mentors postdocs and students at HU & hosts one postdoc from HU since July 2023.
Kenta Kuroda	37	Associate Professor/Academy of Hiroshima University, Graduate School of Advanced Science and Engineering, Physical Science/Hiroshima University	Ph.D., Solid state physics, momentum-space topology in quantum matter	70	Nov. 11, 2022	He usually stays at the center.	
Elisabetta Matsumoto	37	Associate Professor/School of Physics/Georgia Institute of Technology	Ph.D., Geometry and topology of soft matter	25	Nov. 11, 2022	She usually stays at Georgia Institute of Technology as a partner institute and visits the center	She co-mentors postdocs and students at HU & sent her student to HU.
Hiroshi Sato	43	(1) Specially Appointed Professor/Academy of Hiroshima University, SKCM2/Hiroshima University (2) Unit Leader/Emergent Molecular Assembly Research Unit, Cross-Divisional Materials Research Program/RIKEN Center for Emergent Matter Science	Ph.D., Chemistry, material science	100	Nov. 11, 2022	He usually stays at RIKEN as a partner institute and visits the center every three months.	
Silvia Vignolini	42	Professor/Department of Chemistry/University of Cambridge	Ph.D., Chiral bio-materials, self-assembly	30	Nov. 11, 2022	She usually stays at University of Cambridge as a partner institute and visits the center	She co-mentors postdocs and students at HU.
Andrey Leonov	43	Associate Professor/Academy of Hiroshima University, Graduate School of Advanced Science and Engineering, Chemistry/Hiroshima University	Ph.D., Condensed matter physics theory	70	Nov. 11, 2022	He usually stays at the center.	
Chihiro Sasaki	46	Professor/ Hiroshima University & Institute of Theoretical Physics/University of Wroclaw	Ph.D., High energy particle physics (theory)	70	Nov. 11, 2022	She usually stays at University of Wroclaw as a partner institute and visits the center	She mentors two postdocs at HU & co-mentors postdocs and students at HU. She organized the SKCM2's syposium at Univ. of Wroclaw.

Jörn Dunkel	47	Professor/Department of Mathematics/ Massachusetts Institute of Technology	Ph.D., Applied mathematics, and topoloty	25	Nov. 11, 2022	He usually stays at Massachusetts Inst. Tech. as a partner institution and visits the center	He co-mentors postdocs and students at HU & sent his postdoc to HU. He organized the SKCM2's workshop at MIT.
Shang-Te Danny Hsu	48	Research Fellow, Deputy Director/Institute of Biological Chemistry/Academia Sinica	Ph.D., Biophysical chemistry, structural biology, knotted proteins, COVID-19	30	Nov. 11, 2022	He usually stays at Academia Sinica as a partner institute and visits the center	He mentors a postdoc at HU & co-mentors postdocts and students at HU.
Kenta Shigaki	56	Professor/Academy of Hiroshima University, Graduate School of Advanced Science and Engineering, Physics/Hiroshima University	Ph.D., High energy particle physics (experiment)	70	Nov. 11, 2022	He usually stays at the center.	
Marjolein Dijkstra	56	Professor/Faculty of Science, Debye Institute for Nanomaterials Science/Utrecht University	Ph.D., Condensed matter theory, toplogy	30	Nov. 11, 2022	She usually stays at Utrecht University as a partner institute and visits the center once a year.	She mentors a postdoc at HU & co-mentors postdocs and students at HU. She sent her postdoc and student to HU.
Takeharu Haino	59	Professor/Academy of Hiroshima University, Graduate School of Advanced Science and Engineering, Chemistry/Hiroshima University	Ph.D., Chiral supramolecular chemistry	70	Nov. 11, 2022	He usually stays at the center.	

*Percentage of time that the principal investigator devotes to working for the center vis-à-vis his/her total working hours.

e.g., a) usually stays at the center,

b) stays at the center once a month, at XX satellite three times a week, and XX satellite once a year,

c) joins a videoconference from another institution two times a week.

e.g., send/accept young scientists to/from the WPI center (number/period)

Principal investigators unable to participate in project in FY 2023

Name	Affiliation (Position title, department, organization)	Starting date of project participation	Reasons	Measures taken
Tamás Kálmán	Associate Professor/Department of Mathematics/Tokyo Institute of Technology	Nov. 11, 2022	He transitioned to coPI based on personal request.	He continues to participate in project as Co-PI.
Bohdan Senyuk	Specially Appointed Professor/Academy of Hiroshima University, SKCM2/Hiroshima University	Nov. 11, 2022	He resigned due to family reasons.	Instead, Dr. YUAN Ye, having a similar research backgroud, has joined as Co-PI in February 2024.
Shin-ichi Tate	Professor/Academy of Hiroshima University, Graduate School of Integrated Sciences for Life, Mathematical and Life Sciences/Hiroshima University	Nov. 11, 2022	He was appointed as Administrative Director of the center from April 2023.	He continues to participate in project as Administrative Director.

Appendix 3-1 FY 2023 Records of Center Activities

1. Researchers and center staff, satellites, partner institutions

1-1. Number of researchers in the "core" established within the host institution

- Regarding the number of researchers at the Center, fill in the table in Appendix 3-1a.

Special mention

- Enter matters warranting special mention, such as concrete plans for achieving the Center's goals, established schedules for employing main researchers, particularly principal investigators.
- As background to how the Center is working on the global circulation of world's best brains, give good examples, if any, of how career paths are being established for the Center's researchers; that is, from which top-world research institutions do researchers come to the Center and to which research institutions do the Center's researchers go, and how long are their stays at those institutions.

Inviting affiliate members from all over the world to expand the international network to Sharing doctoral training course in Topological Design at the University of Birmingham.

Prof. Mark Dennis, one of the external advisors of the WPI-SKCM^2, directs the EPSRC Centre for Doctoral Training in Topological Design at the University of Birmingham, UK. The program fosters young researchers who develop interdisciplinary sciences connecting topology to other disciplines, including physics, chemistry, and biology. We will invite one of the young professors engaging in the program, Prof. Chakrabarti, as a visiting professor and coPI in the WPI-SKCM^2, to share their experience in fostering interdisciplinary researchers at the University of Birmingham with us. We are now preparing the contract with the University of Birmingham to start educational collaboration in 2024. We will send some Ph.D. students to join the Topological Design course at the University of Birmingham for their training.

MOU with foreign institutes to facilitate student exchange.

One of our missions is to foster young researchers who will become visible worldwide. We will give Ph.D. students the chance to stay at foreign institutes to carry out their research under the instruction/supervision of foreign members of the WPI-SKCM^2. Making an MOU with the foreign institute is essential to facilitate student exchange between the foreign institute and the WPI-SKCM^2. We have made an MOU with the University of Milano-Bicocca (an affiliate member Prof. Ricca hosts) to send a Ph.D. student in our WPI Ph.D. program. We will keep expanding educational network as well as research network to other foreign institutes of the members of the WPI-SKCM^2.

Inviting affiliate members from all over the world to expand the international network to facilitate the global circulation of researchers.

We invited affiliate members from all over the world to expand international collaborations and facilitate the exchange of researchers and graduate students. PI and coPI nominated outstanding researchers to invite. The director has selected the affiliate candidates and invited them to join the WPI-SKCM^2 research activities. The affiliate members can accept postdoctoral fellows or graduate students in their laboratories to work on the collaboration works. The affiliate members can get an E-Rad ID to apply to the Japanese budgets to promote their collaborations with the members in the WPI-SKCM^2. At the end of FY2023, we have 66 affiliate members, including 47 foreign researchers (71%) and 17 women researchers (26%).

Researchers got promotion in FY2023

Five researchers got promoted.

Dr. Ziga Kos was a coPI of the WPI-SKCM^2 and became an assistant professor in the Faculty of Mathematics and Physics of the University of Ljubljana in 2023. Now, he continues his contribution to the WPI-SKCM^2 as an affiliate member.

A postdoctoral fellow, Dr. Satoshi Yano (high-energy physics) will become an assistant professor in the Department of Physics of Hiroshima University in April 2024. He will be an affiliate member to keep working with us in the WPI-SKCM^2.

Dr. Shigehiro Yasui, a postdoctoral fellow in theoretical physics, will become an associate professor at Nisho-Gakusha University in Tokyo. He will continue collaborating with us as an affiliate member of the WPI-SKCM^2.

Dr. Vladyslav Cherpak was promoted to be a senior scientist at the National Renewable Energy Laboratory (NREL), USA.

Dr. Fabritio Camerin (soft matter), a member of the PI Prof. Dijkstra group, became an assistant professor at Lund University in Sweden. He will contribute to expanding our international community.

Satellites and partner institutions

- List the satellite and partner institutions in the table below.
- Indicate newly added and deleted institutions in the "Notes" column.
- If satellite institutions have been established overseas, describe by satellite the Center's achievements in coauthored papers and researcher exchanges in Appendix 4.

<Satellite institutions>

Institution name	Principal Investigator(s), if any	Notes

< Partner institutions>

Institution name	Principal Investigator(s), if any	Notes
Department of Physics, Colorado University	Ivan I. Smalyukh	Director of SKCM^2
Department of Mathematics, Massachusetts Institute of Technology	Jörn Dunkel	PI
Max Planck Institute for Physical Chemistry of Solids	Claire Donnelly	PI, accepting one postdoctoral fellow from Japan
Department of Chemistry, University of Cambridge	Silvia Vignolini	PI
School of Physics, Georgia Institute of Technology	Elisabetta Matsumoto	PI
Debye Institute for Nanomaterials Science, Utrecht University	Marjolein Dijkstra	PI
Emergent Molecular Assembly Research Unit/RIKEN Center for Emergent Matter Science	Hiroshi Sato	PI
Institute of Theoretical Physics, University of Wroclaw	Chihiro Sasaki	PI
Institute of Biological Chemistry, Academia Sinica	Shang-Te Danny Hsu	PI
University of Lisbon, Portugal	Mykola Tasinkevych, coPI	coPI
Tel Aviv University, Israel	Yair Shokef, co-PI	coPI

2. Holding international research meetings

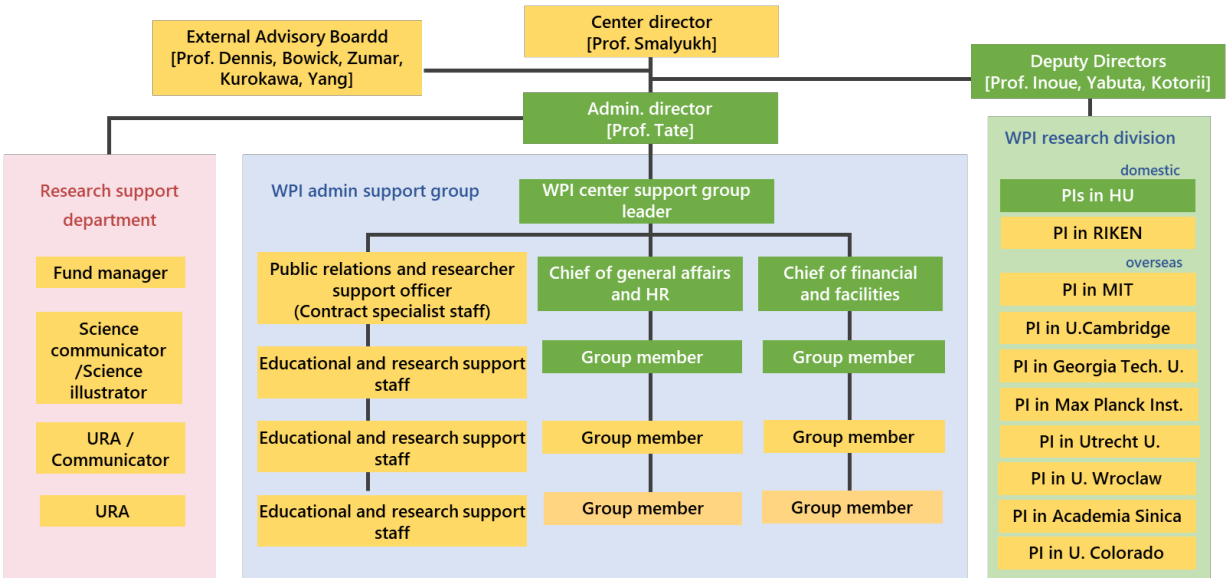
- Indicate the number of international research conferences or symposiums held in FY2023 and give up to three examples of the most representative ones using the table below.

FY 2023: 6 meetings

Major examples (meeting titles and places held)	Number of participants
WPI-SKCM² Spring Symposium, Nara Kasugano International Forum IRAKA	From domestic institutions: 78 From overseas institutions: 28
Workshop on the Dynamics & Statistics of Chiral Topological Matter, Massachusetts Institute of Technology	From domestic institutions: 3 From overseas institutions: 69
WPI-SKCM² Symposium for Young Scientists in Europe, University of Wrocław	From domestic institutions: 4 From overseas institutions: 33

3. Diagram of management system

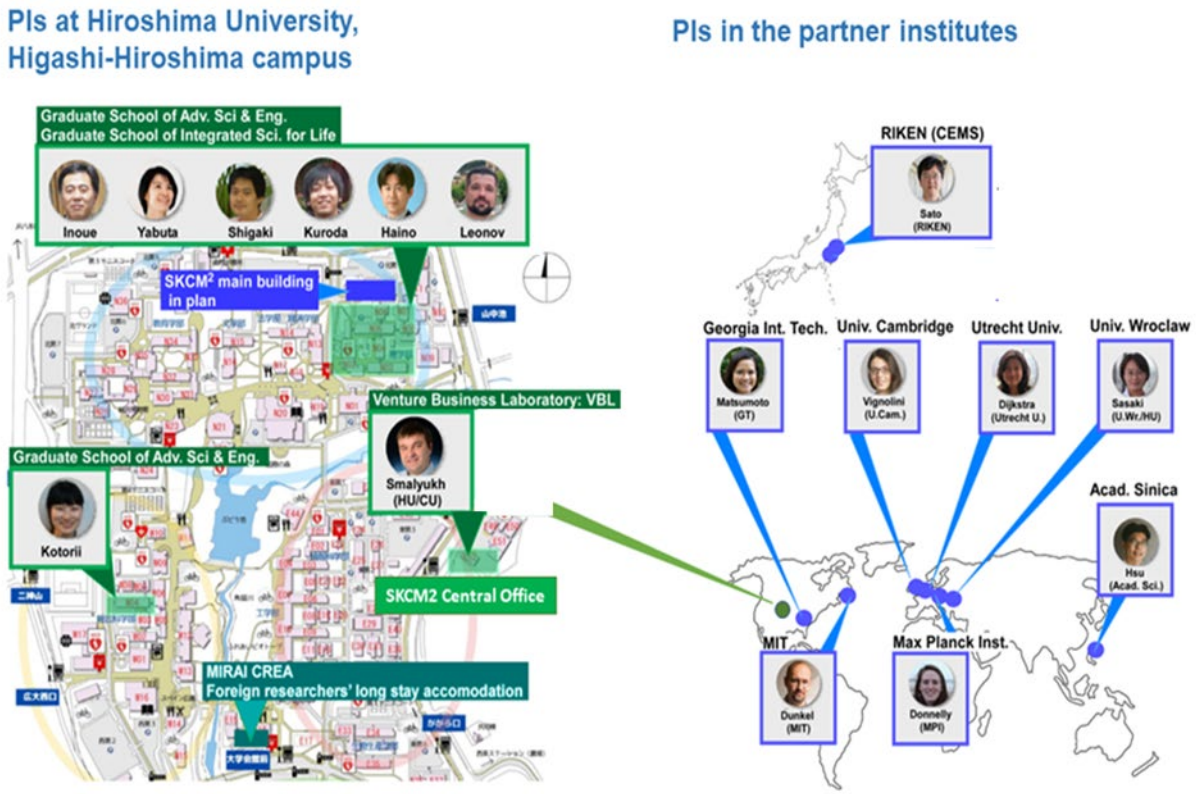
- Diagram the center's management system and its position within the host institution in an easily understood manner.
- If any new changes have been made in the management system from that in the latest "center project" last year, describe them. Especially describe any important changes made in such as the center director, administrative director, head of host institution, and officer(s) in charge at the host institution (e.g., executive vice president for research).



*Prof. Tate was appointed as Administrative Director of the center from April 2023.

4. Campus Map

- Draw a simple map of the campus showing where the main office and principal investigator(s) are located.



5. Securing external research funding*

External research funding secured in FY2023

Total: 444,983,000 yen

- Describe external funding warranting special mention. Include the name and total amount of each grant.
* External research funding includes "KAKENHI," funding for "commissioned research projects," "joint research projects," and for others (donations, etc.) as listed under "Research projects" in Appendix 3-2, Project Expenditures.

Type of Funding	Funding Amount
Project supported by other government subsidies, etc.	30,585,000 yen
Grants-in-Aid for Scientific Research (KAKENHI)	47,379,000 yen
Commissioned Research Projects	48,890,000 yen
Joint Research Projects	147,635,000 yen
Others (donation funds, etc.)	170,494,000 yen
Total* (total for above mentioned)	**444,983,000 yen**

Appendix 3-1a FY 2023 Records of Center Activities

Researchers and other center staff

Number of researchers and other center staff

* Fill in the number of researchers and other center staff in the table blow.
* Describe the final goals for achieving these numbers and dates when they will be achieved described in the last "center project."

a) Principal Investigators

(full professors, associate professors or other researchers of comparable standing)

(number of persons)

	At the beginning of project	At the end of FY 2023	Final goal (Date: April, 2027)
Researchers from within the host institution	9	8	10
Researchers invited from overseas	8	8	10
Researchers invited from other Japanese institutions	2	0	4
Total principal investigators	19	16	24

b) Total members

	At the beginning of project		At the end of FY 2023		Final goal (Date: April, 2027)	
	Number of persons	%	Number of persons	%	Number of persons	%
Researchers	30		109		156	
Overseas researchers	13	43	69	63	79	51
Female researchers	7	23	31	28	79	51
Principal investigators	19		16		24	
Overseas PIs	8	42	8	50	12	50
Female PIs	7	37	7	44	12	50
Other researchers	8		77		66	
Overseas researchers	2	25	51	66	34	52
Female researchers	0	0	18	23	34	52
Postdocs	3		16		66	
Overseas postdocs	3	100	10	63	33	50
Female postdocs	0	0	6	38	33	50
Research support staffs	2		5		6	
Administrative staffs	3		13		14	
Total number of people who form the "core" of the research center	35		127		176	

	At the beginning of project		At the end of FY 2023		Final goal (Date: April, 2027)	
	Number of persons	%	Number of persons	%	Number of persons	%
Doctoral students	0		19		72	
Employed	0	-	13	68.4	72	100.0

※b) The number of doctoral students in the lower table can be duplicated in the upper table of overall composition.

Appendix 3-2 Project Expenditures

1) Overall project funding

* In the "Total costs" column, enter the total amount of funding required to implement the project, without dividing it into funding sources.
* In the "Amount covered by WPI funding" column, enter the amount covered by WPI within the total amount.
* In the "Personnel," "Project activities," "Travel," and "Equipment" blocks, the items of the "Details" column may be changed to coincide with the project's actual content.

(Million yens)

Cost items	Details (For Personnel - Equipment please fill in the breakdown of fiscal expenditure, and the income breakdown for Research projects.)	Total costs	Amount covered by WPI funding
Personnel	Administrative director	14.2	1.1
	HU Principal investigators (no. of persons):9	79.0	35.4
	HU Co-PIs (no. of persons):4	13.6	0.0
	Domestic Co-PIs (no. of persons):2	1.4	1.4
	Posdoc (no. of persons):15	67.7	66.0
	RAs (no. of persons):17	16.7	16.7
	Research support staff (no. of persons):5	18.2	10.0
	Administrative staff (no. of persons):16	76.6	38.0
	Bonus bank	86.9	79.9
	Subtotal	374.3	248.5
Project activities	Rental fees for research space	17.6	0.0
	Accommodation fee (Usage fee for MIRAI CREA)	2.3	0.3
	Office furniture and equipment	76.1	76.1
	Facility maintenance costs (utility expenses, etc.)	5.6	0.0
	Startup funds (no. of persons):14	77.9	77.9
	Article publishing charge	6.4	6.4
	International Symposium	5.7	3.9
	Consulting Fee (Overseas PI, etc.)	131.1	62.1
	External advisory fee	6.4	6.4
	Public relations expenses	14.1	13.8
	Other costs	24.9	15.6
	Subtotal	368.1	262.5
Travel	Domestic travel costs	7.8	5.8
	Overseas travel costs	51.1	41.5
	Travel and accommodations cost for invited scientists (no. of domestic scientists):19、(no. of overseas scientists):19	11.3	11.3
	Travel cost for scientists on transfer (no. of domestic scientists):2、(no. of overseas scientists):9	4.1	4.1
	Subtotal	74.3	62.7
Equipment	Depreciation of buildings	52.6	7.9
	Depreciation of equipment	345.4	345.4
	Subtotal	398.0	353.3
Research projects (Detail items must be fixed)	Project supported by other government subsidies, etc. *1	30.6	0.0
	KAKENHI	47.4	0.0
	Commissioned research projects, etc.	48.9	0.0
	Joint research projects	147.6	0.0
	Ohers (donations, etc.)	170.5	0.0
	Subtotal	445.0	0.0
Total		1659.7	927.0

Costs (Million yens)

WPI grant in FY 2023	700.0
WPI grant Carried Over from FY 2022	227.0
Costs of establishing and maintaining facilities	52.6
Design costs for new facilities	44.6
(Number of facilities: , 3,395m²)	
Repairing facilities	7.9
(Number of facilities: , 1,514 m²)	
Others	0.1
Costs of equipment procured	345.4
Superconducting Quantum Interference Magnetometer	100.0
(Number of units:1)	
High Magnetic Field Ultra-low Vibration Cryogen-free Optical Cryostat	71.1
(Number of units:1)	
compact QTOF (MASS spectrometer)	43.8
(Number of units:1)	
Mass Photometer	30.9
(Number of units:1)	
High-performance oscilloscope	17.6
(Number of units:1)	
Optial Tweezing Microscope kit	14.1
(Number of units:1)	
Others	67.9

*1. Management Expenses Grants (including Management Enhancements Promotion Expenses (機能強化経費)), subsidies including National university reform reinforcement promotion subsidy (国立大学改革強化推進補助金) etc., indirect funding, and allocations from the university's own resources.
*2 When personnel, travel, equipment (etc.) expenses are covered by KAKENHI or under commissioned research projects or joint research projects, the amounts should be entered in the "Research projects" block.

*1 運営費交付金(機能強化経費を含む)、国立大学改革強化推進補助金等の補助金、間接経費、その他大学独自の取組による学内リソースの配分等による財源
*2 科研費、受託研究費、共同研究費等によって人件費、旅費、設備備品等費を支出している場合も、その額は「研究プロジェクト費」として計上すること

2) Costs of satellites

(Million yens)

Cost items	Details	Total costs	Amount covered by WPI funding
Personnel	Principal investigators (no. of persons):OO		
	Other researchers (no. of persons):OO		
	Research support staff (no. of persons):OO		
	Administrative staff (no. of persons):OO		
	Subtotal	0	0
Project activities	Subtotal		
Travel	Subtotal		
Equipment	Subtotal		
Research projects	Subtotal		
Total		0	0

Appendix 3-2 Project Expenditures

1) Overall project funding

* In the "Total costs" column, enter the total amount of funding required to implement the project, without dividing it into funding sources.
* In the "Amount covered by WPI funding" column, enter the amount covered by WPI within the total amount.
* In the "Personnel," "Project activities," "Travel," and "Equipment" blocks, the items of the "Details" column may be changed to coincide with the project's actual content.

(Million yens)

Cost items	Details (For Personnel - Equipment please fill in the breakdown of fiscal expenditure, and the income breakdown for Research projects.)	Total costs	Amount covered by WPI funding
Personnel	Center director and administrative director		
	Principal investigators (no. of persons):OO		
	Other researchers (no. of persons):OO		
	Research support staff (no. of persons):OO		
	Administrative staff (no. of persons):OO		
	Subtotal	0	0
Project activities	Gratuities and honoraria paid to invited principal investigators (no. of persons):OO		
	Cost of dispatching scientists (no. of persons):OO		
	Research startup cost (no. of persons):OO		
	Cost of satellite organizations (no. of satellite organizations):OO		
	Cost of international symposiums (no. of symposiums):OO		
	Rental fees for facilities		
	Cost of consumables		
	Cost of utilities		
	Other costs		
	Subtotal	0	0
Travel	Domestic travel costs		
	Overseas travel costs		
	Travel and accommodations cost for invited scientists (no. of domestic scientists):OO (no. of overseas scientists):OO		
	Travel cost for scientists on transfer (no. of domestic scientists):OO (no. of overseas scientists):OO		
	Subtotal	0	0
Equipment	Depreciation of buildings		
	Depreciation of equipment		
	Subtotal	0	0
Research projects (Detail items must be fixed)	Project supported by other government subsidies, etc. *1		
	KAKENHI		
	Commissioned research projects, etc.		
	Joint research projects		
	Ohers (donations, etc.)		
	Subtotal	0	0
Total		0	0

Costs (Million yens)

WPI grant in FY 2023	0
Costs of establishing and maintaining facilities	0
Establishing new facilities	0
(Number of facilities: , OO m²)	
Repairing facilities	0
(Number of facilities: , OO m²)	
Others	0
Costs of equipment procured	0
Name of equipment	0
(Number of units:OO)	
Name of equipment	0
(Number of units:OO)	
Others	0

*1. Management Expenses Grants (including Management Enhancements Promotion Expenses (機能強化経費)), subsidies including National university reform reinforcement promotion subsidy (国立大学改革強化推進補助金) etc., indirect funding, and allocations from the university's own resources.
*2 When personnel, travel, equipment (etc.) expenses are covered by KAKENHI or under commissioned research projects or joint research projects, the amounts should be entered in the "Research projects" block.

*1 運営費交付金（機能強化経費を含む）、国立大学改革強化推進補助金等の補助金、間接経費、その他大学独自の取組による学内リソースの配分等による財源
*2 科研費、受託研究費、共同研究費等によって人件費、旅費、設備備品等費を支出している場合も、その額は「研究プロジェクト費」として計上すること

2) Costs of satellites

(Million yens)

Cost items	Details	Total costs	Amount covered by WPI funding
Personnel	Principal investigators (no. of persons):OO		
	Other researchers (no. of persons):OO		
	Research support staff (no. of persons):OO		
	Administrative staff (no. of persons):OO		
	Subtotal	0	0
Project activities	Subtotal		
Travel	Subtotal		
Equipment	Subtotal		
Research projects	Subtotal		
Total		0	0

Appendix 4 FY 2023 Status of Collaboration with Overseas Satellites

1. Coauthored Papers

- List the refereed papers published in FY 2023 that were coauthored between the center's researcher(s) in domestic institution(s) (include satellite institutions) and overseas satellite institution(s). List them by overseas satellite institution in the below blocks.
- Transcribe data in same format as in Appendix 1. Italicize the names of authors affiliated with overseas satellite institutions.
- For reference write the Appendix 1 item number in parentheses after the item number in the blocks below. Let it free, if the paper is published in between Jan.-Mar. 2024 and not described in Appendix 1.

Overseas Satellite 1 Name (Total: OO papers)

1) N/A
2)
3)
4)

Overseas Satellite 2 Name (Total: OO papers)

1) N/A
2)
3)
4)

2. Status of Researcher Exchanges

- Using the below tables, indicate the number and length of researcher exchanges in FY 2023. Enter by institution and length of exchange.
- Write the number of principal investigator visits in the top of each space and the number of other researchers in the bottom.

Overseas Satellite 1:

<To satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2023					

<From satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2023					

Overseas Satellite 2:

<To satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2023					

<From satellite>

	Under 1 week	From 1 week to 1 month	From 1 month to 3 months	3 months or longer	Total
FY2023					

Appendix 5 FY 2023 Visit Records of Researchers from Abroad

* If researchers have visited/ stayed at the Center, provide information on them in the below table.
* Enter the host institution name and the center name in the footer.

Total: 65

	Name	Age	Affiliation		Academic degree, specialty	Record of research activities (Awards record, etc.)	Time, duration	Summary of activities during stay at center (e.g., participation as principal investigator; short-term stay for joint research; participation in symposium)
			Position title, department, organization	Country				
1	NAYA RODRIGUEZ CARLOS	40	Assistant Professor, Jagiellonian University	Poland	PhD., Nuclear and Particle Physics	Integral identities and universal relations for solitons-2024, Carbon-12 in the generalized Skyrme model-2024	May 21 - May 27, 2023	Short-term stay for discussion and seminar
2	Oleg Prezhdo	54	Professor of Chemistry, and Physics and Astronomy, University of Southern California	USA	Ph.D., Theoretical chemistry	Promising Scientist Prize from the Centre de Mécanique Ondulatoire Appliquée, Kanazawa, Japan (2011), and the Friedrich Wilhelm Bessel Research Award of the Humboldt Foundation (2015)	June 1 - June 2, 2023	Short-term stay for discussion and seminar
3	Prasanna Ghalsasi	52	Professor, The Maharaja Sayajirao University of Baroda	India	PhD., Organic Chemistry	Effect of quasi hydrostatic and non hydrostatic pressure on long S–S bonded sodium dithionite (Na2S2O4): A Raman Spectroscopic study-2022	May 22 - June 29, 2023	Participation in discussion and seminar
4	Pramod Bhatt	40	Associate Scientist, Bhabha Atomic Research Centre	India	PhD., Molecular magnetism, X-ray and Neutron Scattering	magnetic behavior in co-precipitated Ni–Zn ferrite nanoparticles and their potential use for gas sensor applications-2020	May 14 - July 15, 2023	Participation in discussion and seminar
5	Pok Man Lo	40	Professor, University of Wrocł aw	Poland	PhD., Physics	Influence of dynamical screening of four-quarks interaction on the chiral phase diagram-2023	July 18 - Aug. 2, 2023	Short-term stay for discussion and seminar
6	Cristóvão Dias	40	Investigador Auxiliar, Faculty of Sciences of the University of Lisbon	Portugal	PhD., Physics and Chemistry	In silico simulation for designing hydrogels-2024	July 30 - Aug. 4, 2023	Short-term stay for discussion and seminar
7	Marjolein Dijkstra	57	Professor, Utrecht University	The Netherlands	PhD., The effect of entropy on the structure and stability of complex fluids	Inverse Design of Crystals and Quasicrystals in a Non-Additive Binary Mixture of Hard Disks-2024, Designing ultra rare, multimodal mechanical metamaterials-2024	Aug. 30 - Sept. 3, 2023	Short-term stay for discussion and seminar
8	Andrzej Wereszczynski	49	Professor, Jagiellonian University	Poland	PhD., Physics	Integral identities and universal relations for solitons-2024, Generalized skyrmion crystals with applications to neutron stars-2024	Sept. 10 - Sept. 16, 2023	Short-term stay for discussion and seminar
9	Nicholas Kotov	58	Professor, MICHIGAN ENGINEERING	USA	PhD., chemistry	2021 Thurnbull Lectureship (Materials Research Society) 2021 Nanoscale Science and Engineering Forum Award, (American Institute of Chemical Engineers) 2020 Alpha Chi Sigma Award (American Institute of Chemical Engineers) 2020 Newton Award (Department of Defense)	Sept. 6 - Sept. 22, 2023	Participation in CD2023 and discussion and short-term stay for discussion and seminar

10	Allison Wagner Teixeira	33	Postdoctoral Researcher, University of Lisbon	Portugal	PhD., Physics	Particle-based model of liquid crystal skyrmion dynamics-2024	Sept. 7 - Nov. 21, 2023	Participation in WPI-SKCM2 Site Visit, InternKNOTship program, outreach, discussion and seminar
11	Paul Leask	27	Postgraduate Researcher, University of Leeds	UK	PhD., Mathematics & Physics	mathematics & physics with a focus on topological solitons in gauge field theories	Nov.11 - Nov.19	Short-term stay for discussion and seminar
12	Cornelia Meinert	43	Research Director, NRS - University Côte d'Azur	France	Ph.D., Chemistry	Resolution and quantification of carbohydrates by enantioselective comprehensive two-dimensional gas chromatography-2024, Molecular Diversity and Amino Acid Evolution in Simulated Carbonaceous Chondrite Parent Bodies-2024	Mar.7 - Mar.12	Participation in SKCM² Spring Symposium: Nara, Japan, Networking event in Osaka
13	Mark Bowick	66	Kavli Institute for Theoretical Physics, University of California, Santa Barbara	USA	Ph.D., Theoretical physics	Fellow of the American Association for the Advancement of Science (2022)	Mar.7 - Mar.12	Participation in SKCM² Spring Symposium: Nara, Japan, Networking event in Osaka
14	Eleni Panagiotou	36	Assistant Professor, School of Mathematical and Statistical Sciences, Arizona State university	USA	PhD., Mathematics	The Jones polynomial in systems with periodic boundary conditions-2024, Mathematical topology and geometry-based classification of tauopathies-2024	Feb.21 - Feb.23	Short-term stay for discussion and seminar
15	Helen Gleeson	61	Professor, University of Leeds	UK	PhD., Mathematics	2018 Times Higher Education Outstanding Research Supervisor of the Year award 2013 British Liquid Crystal Society Gray Medal 2012 Société Française de Physique and Institute of Physics Holweck Medal and Prize	Feb.25 - Feb.29	Short-term stay for discussion and seminar
16	Yaroslav Tserkovnyak	49	Associate Professor, University of California	USA	PhD., Physics	mathcalPT symmetric quantum mechanics from dynamically coupled macrospins-2024, On the asymmetry of the magnonic Hanle effect in antiferromagnets-2024	Mar.2 - Mar.12	Participation in WPI-SKCM2 Spring Symposium, discussion and seminar
17	David Nelson	72	Professor, Harvard University	USA	PhD., Theoretical Physics	2019 recipient of the Niels Bohr Institute Medal of Honor	Mar.6 - Mar.12	Participation in WPI-SKCM2 Spring Symposium, discussion and seminar, Japan, and Networking event in Osaka
18	Zvonimir Dogic	51	Professor, UCSB	USA	PhD., Physics	Cozzarelli prize for outstanding paper published in Proc. Nat. Acad. Sci. National Academy of Sciences (United States, Washington D.C.) - NAS , 2001	Mar.6 - Mar.12	Participation in WPI-SKCM2 Spring Symposium, discussion and seminar
19	Bertrand Berche	60	Professor, Université de Lorraine	France	PhD., Physics and applied physics	The enigmatic exponent koppa and the story of finite-size scaling above the upper critical dimension-2024, Ralph Kenna's scaling relations in critical phenomena-2024	Mar.6 - Mar.15	Participation in WPI-SKCM2 Spring Symposium, discussion and seminar
20	Etienne Brasselet	49	CNRS Resercher, University of Bordeaux	France	PhD., Physics	Hyperspectral optical orbital angular momentum modulation from tunable structured waveplates-2024, Erratum: Direct Mechanical Detection and Measurement of Wave-Matter Orbital Angular Momentum Transfer (vol 123, 244301, 2019)-2024	Mar.8 - Mar.15	Participation in WPI-SKCM2 Spring Symposium, discussion and seminar
21	Malcolm Kadodwala	55	Professor, University of Glasgow	UK	PhD., Physics	Fluorescent carbazole-derived α-amino acids; structural mimics of tryptophan-2024, Tuning dipolar and multipolar resonances of chiral silicon nanostructures for control of near field superchirality-2024	Apr.23 - Apr.15	Short-term stay for discussion and seminar

22	Hsu / Shang-Te Danny	48	Associate Research Fellow, Institute of Biological Chemistry, Academia Sinica	Taiwan	Ph.D., Biophysical Chemistry, knotted proteins	Structural Insight into the ZFAND1-p97 Interaction Involved in Stress Granule Clearance-2024, Rapid simulation of glycoprotein structures by grafting and steric exclusion of glycan conformer libraries-2024	Jun.28 - Jun.30, Sept.10 - Sept.12, Feb.28 - Mar.3	Short-term stay for discussion and research, Participation in WPI-SKCM2 Site Visit.
23	Brian M Day	29	Undergraduate Research Assistant, Georgia Institute of Technology	USA	Undergraduate Research associate, Geometry and topology	Generalizing Deformable System Dynamics beyond Euclidean Geometry-2023	July.17 - July.22	Short-term stay for discussion, outreach and research
24	Mykola Tasinkevych	50	Senior Lecturer, School of Science & Technology, Nottingham Trent University	UK	Ph.D., Soft condensed matter theory	Collective variable model for the dynamics of liquid crystal skyrmions-2024, Particle-based model of liquid crystal skyrmion dynamics-2024	Aug.5 - Sept.13	Participation in discussion and research
25	Claire Donnely	32	Lise Meitner Group Leader, Max Planck Institute for Physical Chemistry of Solids	Germany	Ph.D., Material physics	2023 IEEE Magnetics Society Early Career Award	Sept.10 - Sept.12	Participation in WPI-SKCM2 Site Visit
26	Rodolfo Subert	25	PhD Student, Utrecht University	The Netherlands	PhD Student	Research theme: Liquid crystals of bent-shaped particles	Sept.9 - Sept.13	Participation in WPI-SKCM2 Site Visit
27	Fengshan Zheng	35	Professor, South China University of Technology	China	Ph.D., Experimental Physics	2022 Jülich Excellence Prize 2018 Chinese government award for outstanding self-finance students abroad	Mar.7 - Mar.9	Participation in SKCM² Spring Symposium: Nara, Japan
28	Elisabetta Matsumoto	38	Associate Professor, School of Physics, Georgia Institute of Technology	USA	Ph.D., Geometry and toplogy of softmatters	2020 Cottrell Scholar Award	Sept.9 - Sept.12, Dec.8 - Dec.15, Mar.6 - Mar.10	Participation in WPI-SKCM2 Site Visit, SKCM2 2023 Winter School and SKCM² Spring Symposium: Nara, Japan
29	Fabrizio Camerin	31	Postdoc researcher with prof. dr. ir. Marjolein Dijkstra, Utrecht Univ.	The Netherlands	Ph.D., Physical Chemistry	Depletion-induced crystallization of anisotropic triblock colloids-2024, Softness Matters: Effects of Compression on the Behavior of Adsorbed Microgels at Interfaces-2024	Sept.8 - Sept.14	Participation in WPI-SKCM2 Site Visit
30	Shokef Yair	48	Professor, Tel Aviv University	Israel	Ph.D., Physics	Bloch oscillations, Landau–Zener transition, and topological phase evolution in an array of coupled pendula-2024, Emergent clustering due to quorum sensing interactions in active matter-2024	Sept.10 - Sept.12, Mar.7 - Mar.12	Participation in WPI-SKCM2 Site Visit and SKCM² Spring Symposium: Nara, Japan
31	Ricca Renzo	64	Professor of mathematical physics at University of Milano-Bicocca	Italy	Ph.D., Applied Mathematics	2019 Erasmus Visiting Professorship, Erasmus+ (EC).	Sept.9 - Sept.12, Mar.7 - Mar.10	Participation in WPI-SKCM2 Site Visit and SKCM² Spring Symposium: Nara, Japan
32	Zhang Rui	39	Assistant Professor, Department of Physics The Hong Kong University of Science & Technology	China	Ph.D., Physics	Machine eye for defects: Machine learning-based solution to identify and characterize topological defects in textured images of nematic materials-2024, Blue phases on patterned surfaces-2024	Sept.9 - Sept.12	Participation in WPI-SKCM2 Site Visit
33	Guilhem Poy	32	CNRS permanent researcher, University of Montpellier	France	Ph.D., Physics	TIC Reorientation under Electric and Magnetic Fields in Homeotropic Samples of Cholesteric LC with Negative Dielectric Anisotropy-2023	Sept.8 - Sept.13	Participation in WPI-SKCM2 Site Visit
34	Liu Danqing	39	Visiting professor, South China Normal University	China	Ph.D., Physics	Spontaneous snap-through of strongly buckled liquid crystalline networks-2024, Photonic cognition of liquid crystal polymers for unlocking electrical locomotion-2024	Sept.10 - Sept.14	Participation in WPI-SKCM2 Site Visit

35	Viviana Mancuso	29	Graduate Research Student, University of Hawaii at Manoa	USA	Ph.D., Philosophy	Chemotactic behavior of a self-phoretic Janus Particle near a chemically emitting patch.	Sept.6 - Sept.13	Participation in WPI-SKCM2 Site Visit
36	Qian Cao	33	Postdoctoral Researcher at University of Shanghai for Science and Technology	China	Ph.D., Physics	High Spatiotemporal Resolution Quantitative Precipitation Estimation over the United Arab Emirates-2024	Sept.8 - Sept.13	Participation in WPI-SKCM2 Site Visit
37	Katarzyna Matczyszyn	48	Associate Professor, Faculty of Chemistry, Wroclaw University of Science and Technology	Poland	Ph.D., Physical Chemistry	Revealing two chemical strategies to tune bright one-and two-photon excited fluorescence of carbon nanodots-2024	Sept.9 - Sept.12, Mar.8 - Mar.12	Participation in WPI-SKCM2 Site Visit, SKCM² Spring Symposium: Nara, Japan, Networking event in Osaka
38	Matteo Pasquali	55	Professor, Rice University	USA	Ph.D., Chemical Engineering	Liquid Crystals and Macroscopically Aligned Fibers from Boron-Nitride Nanotubes-2024, Anisotropic Electron Transport in Highly Aligned Carbon Nanotube Films-2024	Mar.7 - Mar.12	Participation in SKCM² Spring Symposium: Nara, Japan, Networking event in Osaka
39	Javier Campo	56	Researcher, Spanish National Research Council (CSIC) and University of Zaragoza	Spain	Ph.D., Magnetism of disordered systems	High pressure studies of the T-P phase diagrams of erbium and thulium up to 30 GPa by using ac magnetization experiments-2024, Operando analysis of the positive active mass of lead batteries by neutron diffraction-2024	Nov.17 - Nov.18, Jan.9 - Jan.12,	Short-term stay for discussion and research, Participation in SKCM2 2023 Winter School
40	Jérémie Topin	44	Associate Professor, Université Côte d'Azur	France	Ph.D., Chemistry	M2OR: a database of olfactory receptor–odorant pairs for understanding the molecular mechanisms of olfaction-2024	Mar.7 - Mar.12	Participation in SKCM² Spring Symposium: Nara, Japan, Networking event in Osaka
41	Bart Kahr	63	Professor Of Chemistry, Department of Chemistry & Molecular Design Institute, New York University	USA	Ph.D.,Chemistry	Research and Development Magazine 100 Award 2013	Dec.9 - Dec.16	Participation in SKCM2 2023 Winter School
42	David Palmer	29	Postdoc, Mahadevan Lab at Harvard University	USA	Ph.D., Computer Science	the geometry and dynamics of topological defects in matter	Dec.10 - Dec.23	Participation in SKCM2 2023 Winter School
43	Shen Yijie	31	Assistant Professor, Nanyang Technological University	Singapore	Ph.D., Optical engineering	Intra-Cavity Laser Manipulation of High-Dimensional Non-Separable States (Laser Photonics Rev. 18 (4)/2024), Topologically controlled multiskyrmions in photonic gradient-index lenses-2024	Dec.10 - Dec.23	Participation in SKCM2 2023 Winter School
44	Lin Yi Hsin	47	Professor, National Yang Ming Chiao Tung University	Taiwan	Ph.D., Optics and Photonics	Electrically tunable gradient-index liquid crystal lenses: beyond the power law-2024, Electronic device-2024	Dec.17 - Dec.23	Participation in SKCM2 2023 Winter School
45	Liu Xin	48	Professor, Beijing Institute of Technology	China	Ph.D., Theoretical physics and Mathematics	Knots cascade detected by a monotonically decreasing sequence of values	Dec.22 - Dec.30	Participation in SKCM2 2023 Winter School
46	Wu Jin-Sheng	26	Ph.D. Student, University of Colorado Boulder	USA	Ph.D., CHEMISTRY	Topologically stable links and biaxiality in chiral nematic systems-2024, Field-controlled dynamics of skyrmions and monopoles-2024	Dec.10 - Jan.13	Participation in SKCM2 2023 Winter School
47	Madan Lal Sharma	30	Staff Engineer, Research and Development, Western Digital (WD), Indian Institute of Technology Delhi	India	Ph.D., Physics	Staff Engineer, Research and Development, Western Digital (WD), Indian Institute of Technology Delhi	Dec.24 - Jan.13	Participation in SKCM2 2023 Winter School
48	Zhong Jinzhan	28	Postdoc, University of Shanghai for Science and Technology	China	Ph.D., Engineering	Postdoc, University of Shanghai for Science and Technology	Dec.18 - Dec.30	Participation in SKCM2 2023 Winter School

49	Mai Zhijian	28	PhD Student, South China Normal University	China	Ph.D., Soft Matter Physics	Soft Matter Physics Smalyukh Research Group	Dec.10 - Jan.12	Participation in SKCM2 2023 Winter School
50	Alex Cohen	25	Postdoc, Massachusetts Institute of Technology	USA	Ph.D., ChemE-CSE	Data-driven control of airborne infection risk and energy use in buildings-2023, Learning heterogeneous reaction kinetics from X-ray videos pixel by pixel-2023	Dec.16 - Dec.28	Participation in SKCM2 2023 Winter School
51	Liu Yuanyuan	29	Postdoc, University of Shanghai for Science and Technology	China	Ph.D., Electronic Science and Technology	Postdoc, University of Shanghai for Science and Technology	Dec.25 - Jan.4	Participation in SKCM2 2023 Winter School
52	Lee Junghoon	26	PhD Student, UNIST	Korea	Ph.D., Lyotropic liquid crystals	PhD Student, UNIST	Dec.25 - Jan.4	Participation in SKCM2 2023 Winter School
53	Teng Houan	27	PhD Student, University of Shanghai for Science and Technology	China	Ph.D., Physics	PhD Student, University of Shanghai for Science and Technology	Dec.18 - Dec.30	Participation in SKCM2 2023 Winter School
54	Yu Wangke	29	PhD Student, University of Southampton	China	Ph.D., Electronics and Computer Science	Metasurface-integrated microring resonators for off-chip vortex beam generation	Dec.18 - Dec.30	Participation in SKCM2 2023 Winter School
55	Zhan Qiwen	50	Professor, School of Optical-Electrical and Computer Engineering, University of Shanghai for Science and Technology	China	Ph.D., Electrical engineering	Spatiotemporal sculpturing of light: a tutorial-2024, Generation of topological spin textures using light-induced radially polarized magnetic field-2024	Dec.18 - Dec.30, Mar.8 - Mar.12	Participation in SKCM2 2023 Winter School, SKCM² Spring Symposium: Nara, Japan, Networking event in Osaka
56	Ye Yuan	31	Postdoctoral Research Associate, ETH Zürich, Laboratory of Food and Soft Materials	Switzerland	Ph.D., Physics	Cholesteric Tactoids with Tunable Helical Pitch Assembled by Lysozyme Amyloid Fibrils-2024, Structural Colors from Amyloid-Based Liquid Crystals-2024	Dec.10 - Jan.12, Mar.7 - Jan.12	Participation in SKCM2 2023 Winter School, SKCM² Spring Symposium: Nara, Japan, Networking event in Osaka
57	Boris Malomed	69	Professor, Faculty of Engineering , Tel Aviv University	Israel	Ph.D., Theoretical physics	2023 - Research.com Physics in Israel Leader Award	Jan.3 - Jan.10	Participation in SKCM2 2023 Winter School
58	Guilherme Bittencourt	30	PhD Student, Universidade Federal de Viçosa (UFV)	BRAZIL	Ph.D., Applied Physics	PhD Student, Universidade Federal de Viçosa (UFV)	Mar.5 - Mar.11	Participation in SKCM² Spring Symposium: Nara, Japan
59	Zhichang Liu	43	Assistant Professor, Westlake University	China	Ph.D., Polymer chemistry	Lithiated cyclodextrin metal organic frameworks and methods of making and using the same-2024	Mar.8 - Mar.12	Participation in SKCM² Spring Symposium: Nara, Japan, Networking event in Osaka
60	Lech Longa	70	Prof. dr hab. Jagiellonian University in Krakó w	Poland	Ph.D., Theoretical Physics,	Splay-induced order in systems of hard tapers-2023, Conformational degrees of freedom and stability of splay-bend ordering in the limit of a very strong planar anchoring-2023	Jan.6 - Feb.4	Participation in SKCM2 2023 Winter School, Discussion and Research
61	Pierangelo Metrangolo	52	Professor, Politecnico di Milano	Italy	Ph.D., Industrial Chemistry	Young Observer at the 45th IUPAC General Assembly (2009) Journals Grant Award for International Authors (2005, Royal Society of Chemistry)	Mar.7 - Mar.12	Participation in SKCM² Spring Symposium: Nara, Japan, Networking event in Osaka
62	Mikko Möttönen	44	Associate Professor, Aalto University	Finland	Ph.D., Technology	Nokia Foundation award for quantum computing research in 2020.	Mar.7 - Mar.9	Participation in SKCM² Spring Symposium: Nara, Japan
63	Shu Yang	53	Professor, University of Pennsylvania	USA	Ph.D., Chemistry and Chemical Biology	Active-Textile Yarns and Embroidery Enabled by Wet-Spun Liquid Crystalline Elastomer Filaments-2024, Conforming 2D Composite Sheets To 3D Curved Surfaces With Optimal Mechanical Performance-2024	Mar.7 - Mar.12	Participation in SKCM² Spring Symposium: Nara, Japan, Networking event in Osaka

64	Anton Kuzyk	42	Professor, Aalto University	Finland	Ph.D., Technology	awarded an ERC Consolidator Grant for his project on "Electrically driven DNA- origami-based machines"	Mar.8 - Mar.11	Participation in SKCM² Spring Symposium: Nara, Japan, Networking event in Osaka
65	Rachel Won	48	Associate or Senior Editor, Nature Photonics	Malaysia	Ph.D., Optical Physics	optical fibre sensing, microwave photonics and fibre nonlinearities	Mar.8 - Mar.12	Participation in SKCM² Spring Symposium: Nara, Japan, Networking event in Osaka

Appendix 6 FY2023 State of Outreach Activities

* Fill in the numbers of activities and times held during FY2023 by each activity.
* Describe the outreach activities in the "3-1. Societal Value of Basic Research" of Progress Report, including those stated below that warrant special mention.

Activities	FY2023 (number of activities, times held)
PR brochure, pamphlet	17
Lectures, seminars for general public	8 (counted ones held at host institute only: For details, see "Symposiums" below.)
Teaching, experiments, training for elementary, secondary and high school students	5 (counted ones held in Hiroshima prefecture only: For details, see "School Visits" below.)
Participating, exhibiting in events	5 events
Press releases	7 times
Others（Winter School）	77 lectures
Others（Networking Event）	52 times
Others（Social Media Sites）	146 postings (YouTube, Facebook, X, Instagram)
Others（Contribute article to HU-plus 05 of host institute magazine）	3 professors
Others（VR demonstrations）	431 times

*If there are any rows on activities the center didn't implement, delete that (those) row(s). If you have any activities other than the items stated above, fill in the space between parentheses after "Others" on the bottom with the name of those activities and state the numbers of activities and times held in the space on the right. A row of "Others" can be added, if needed.

Outreach Activities and Their Results

List up to three of the Center's outreach activities carried out in FY 2023 that have contributed to enhancing the brand or recognition of your Center and/or the brand of the overall WPI program, and describe its concrete contents and effect in narrative style. (Where possible, indicate the results in concrete numbers.)

Examples:
- As a result of using a new OO press-release method, a OO% increase in media coverage was obtained over the previous year.
- By holding seminars for the public that include people from industry, requests for joint research were received from companies.
- We changed our public relations media. As a resulting of using OO to disseminate information, a OO% increase in inquiries from researchers was obtained over the previous year.
- As a result of vigorously carrying out OO outreach activity, ¥OO in external funding was acquired.

1) School Visits: By conducting outreach in the form of a science workshop at five(5) junior and senior high schools in Hiroshima prefecture, a total of 265 students interacted with Professors, InternKNOTshiper, Postdoctoral researchers, and graduate students from the WPI-SKCM$_2$, learned science related to knotted chiral meta matter, and experienced VR demonstration, microscope observation, poster presentation and more. We collected questionnaires from 253 participants in

total, of which 97% were very satisfied with the events. After a press release for a school visit to a junior high school affiliated with Hiroshima University located in Fukuyama, we received an interview offer from Chugoku Shinbun, a local newspaper. This outreach activity was covered in the newspaper.

世界最先端の研究 興味津々

広島大付属福山中で出前講座

井上教授（左端）の解説を熱心に聞く生徒たち

広島大（東広島市）の人工的にデザインすることで、これまでにない素材の開発が期待されている。超断熱材として窓ガラスに用いられるなど一キラルノット超物質は「持続可能性に寄与するキラルノット超物質拠点」が、福山市春日町の同大付属福山中で出前講座を開いた。受講を希望した同中の1～3年生約40人が世界最先端の研究の一端に触れた。

キラルノット超物質はその構造や性質を解明し、画期的な省エネや難治性疾患の治療法、老化の原因の解明などへの貢献を目指している。

出前講座では副拠点長で同大大学院の井上克也教授が、特定の物質に見られ、左右の手のように鏡に映した像が元の像と重ならない対の状態「キラル」などについて解説。井上教授は「知れば知るほど難しくなる変わった分野」と話し、「何事にも好奇心を持ち続けて成長してほしい」と呼びかけた。

2年大垣匡史さん(14)は「今まで聞いたことがないテーマで理解するのが難しかったが、貴重な経験だった。知らないからこそ興味が湧いた」と話していた。（浜村満大）

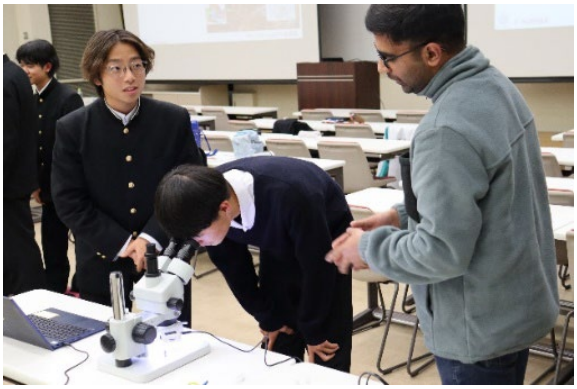
フロアホッケー 福山の6人闘志

全国大会へ抱負

長野市で18、19日、知的障害のある選手によるスポーツの全国大会「スペシャルオリンピックス」冬季大会が開かれるのを前に、フロアホッケー1県代表として出場する福山市内の6人が市役所を訪れ、健闘を誓った。

6人はNPO法人スペシャルオリンピックス日本・広島の笹希美理事長(51)や宮本恵理団長(64)たちと訪問した。同市沼隈町の沼隈特別支援学校の中学部3年杉原正斗希

冬季大会のフロアホッケー出場に向けて活躍を誓う選手たち



2) Outreach Event for General Prablic: The outreach event was held for the general public on

Miyajima Island. As a result, we were able to collect questionnaires from 31 participants, of which 94% were satisfied with the event. Approximately 60 participants from the public informally expressed interest in science conducted in WPI-SKCM^2 after engaging in Mizuhiki workshop, VR demonstrations, and poster presentations. The participants came from a variety of age backgrounds, ranging from under 10 to over 50, and many people from outside of the Chugoku region (including foreign tourists) also participated in the event. 600 leaflets were distributed to the general public.

Symposiums: By implementing eight(8) outreach events in a form of symposium, such as "Joint Symposium to Promote the Active Participation of Female Researchers ", "Career Forum", "Miyajima Symposium" and "Symposium to Promote Gender Balance and Diversity in Science" for scientists and general public. As speakers, both female

and male scientists in wide generations participated. Some of them were held in hybrid format. There were 245 participants in total. We were able to collect questionnaires from 86 participants, of which 95% were satisfied with the events.

Appendix 7 FY 2023 List of Project's Media Coverage

* List and describe media coverage (e.g., articles published, programs aired) in FY2023.

* Enter the host institution name and the center name in the footer.

	Date	Types of Media (e.g., newspaper, magazine, television)	Description
1	Mar. 17, Mar. 19, Mar. 20, Mar. 23, Mar. 24, Mar. 25, Aug. 18, 2023	Nouvelles du monde, PRX Energy, Tech Xplore, Science X, Phys.org, Phys.org Technology, Today Headline, News Azi, Interesting Engineering, CleanTechnica, EcoInventos, Anthropocene, daily geek show, Rinnovabili (11 online articles)	Highlights about a Nature Energy paper by Director Ivan Smalyukh (Highly transparent silanized cellulose aerogels for boosting energy efficiency of glazing in buildings)
2	Nov. 11, 2023	Chugoku Shinbun (newspaper)	School Visit for Hiroshima University Affiliate Junior High School in Fukuyama with PI Dr. Katsuya Inoue "World-leading Research: stimulating significant interests"
3	Dec. 11, Dec. 13, Dec. 19, 2023; Jan. 25, Jan. 26, Jan. 30, Jan. 31, Feb. 2, Feb. 4, Feb. 5, 2024	Yahoo! News, Phys.org, myScience Network, Courrier international, Elite News, myScience, NewsGram, Engineers Online, Ca M'interesse, IFLScience, AlphaGalileo (11 online articles)	Highlights about a Nature Communications paper by PI Dr. Marjolein Dijkstra (A colloidal viewpoint on the sausage catastrophe and the finite sphere packing problem)
4	Dec. 21, Dec. 22, Dec. 24, Dec. 25, Dec. 27, Dec. 29, Dec. 30, 2023; Jan. 2, Jan. 3, Jan. 8, Jan. 31, Feb. 4, 2024	EurekAlert!, Phys.org, Yahoo! News, Frankfurter Allegemeine, The Science Times, Scienmag, ScienceDaily, myScience, Earth.com, Nanowerk, Mirage.News, COSMOS, Space Daily, Today Headline, Devdiscourse, Reston Communications, IFLScience, Swift Telecast, Sci.News, SciTechDaily, Espanol News, salon, Germanic.News, Tech Explorist, Teller Report, Cordoba, elPeriodico, elPeriodico Mediterraneo, La Provincia, La Opinion, La Opinion Demurcia, La Opinion Demalaga, Faro de Vigo, elCorreoGallego, Levante, El Dia, Diario de Ibiza, Diario de Mallorca, La Nueva Espana, Informacion, Muy Interesante, Lenta.ru, Naked Science, Cikavosti, sorae, TNN Online	Highlights about a Science paper by PI Dr. Hikaru Yabuta (Polycyclic aromatic hydrocarbons in samples of Ryugu formed in the interstellar medium)

5	Feb. 23, Feb. 24, Feb. 25, Feb. 27, Feb. 28, Mar. 2, Mar. 3, Mar. 4, 2024	Yahoo! life, Livedoor News, The Science Times, IFLScience, Interesting Engineering, science alert, Futurism, Nouvelles du monde, fanpage.it, hvg.hu, Mynavi TECH+, ASCII.jp (12 online articles)	Highlights about a Science paper by PI Dr. Hikaru Yabuta (Macromolecular organic matter in samples of the asteroid (162173) Ryugu)
6	Mar. 19, 2024	HIROSHIMA UNIVERSITY UPDATE (magazine)	A highlight about the establishment of SKCM2 "SKCM2's mission to knot and knit a sustainable world HU's World Premier International Research Center Initiative Institute"
7	Mar. 28, 2024	nature portfolio (online article)	A feature article of SKCM2 "Untangling pressing global problems using knots"