

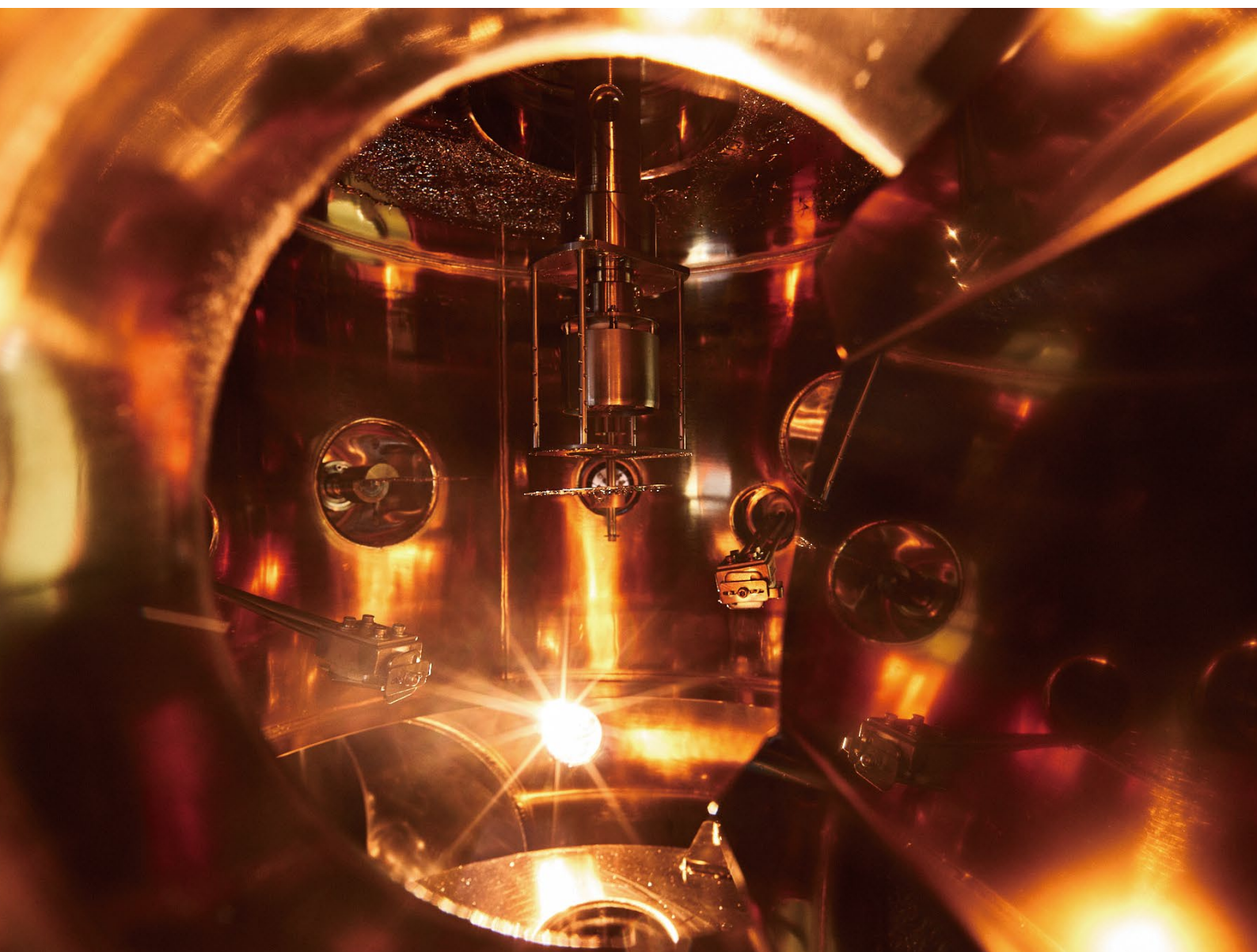
# ICC-IMR

*NEWS*

No. **12**  
Jan. 2022

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**ICC-IMR Director**  
**Hiroyuki**  
**NOJIRI**

## Top Message

In the year of 2021, the world was in the storm of Covid-19, and international exchange including travel has been very restricted. In the second half of this year, Tohoku University students' study abroad and business trips have resumed in part. I myself visited Germany and the United States during the calm period of covid, and was able to restart the three projects that had been partly suspended during last one and half years. Although there were many restrictions, it was an opportunity to recognize the essential importance of continuing on-site international exchange.

Under these circumstances, ICC-IMR has provided support to international students, held workshops, and invited visiting professors to take advantage of limited opportunities. We have also supported the international activities of young researchers and students such as participations to international workshops and writings of research articles in English.

In the end of year, the subsequent wave of Omicron-variant has once again set restrictions on

exchanges, but it is hoped that some progress will be made towards 2022.

In 2022, ICC-IMR will start a new program called Covis: Co-visiting Program in collaboration with the GIMRT's international collaboration program. By the Covis, researchers from overseas institutes can combine GIMRT's single visit program supporting a few weeks of international joint research visit and a few months research stay such as guest professor and student fellowship. By the Covis, researchers from overseas institutes could visit IMR as a team. From a timeline perspective, this program aims to cover core period of the collaboration research from implementation to compilation of the project. It would also help to foster the partnerships among different laboratories. We believe that the new program would be helpful to establish a continuous and active international joint research team including both researchers and students. As such, Covis is our new tool to activate international collaborations in post-covid era.

## ❖ Comments from Visitors

Research Activities under the COVID-19 pandemic.



**Timothy Ziman,**  
**Institut Laue Langevin,**  
**France**

It was a great feeling to return to Japan and Sendai at the beginning of this month. When I was last here In March of 2020, for a small workshop, there were storm clouds but it was not yet apparent how serious the pandemic would be. Like many people, I assumed that it would be only a few weeks for normality to return. Little did I suspect that the next time I could come it would be after three doses of a vaccine that was not yet invented, and four, impressively rapid, PCR tests administered during the journey between Grenoble and Sendai. The last year has shown how important international links in science are to society. While questions in physics may not always have the urgency of those of medicine and biology in a pandemic, the rapid interchange of knowledge between different countries has shown its essential value. We need strong trust between individual scientists. As the recent emergence of the omicron variant has shown, even smaller scientific communities in Africa can have a voice as vital as those in Japan,

Europe, China or the Americas. Interdisciplinarity has also been of the essence – interestingly the epidemiologist who initially convinced the British government to act on the modelling, was originally trained in statistical physics. While mRNA vaccines are primarily a triumph of biology and medicine, their development, production and even delivery at low temperatures relied on decades of advances in physics, chemistry and materials.

In France, we have seen how scientific life has been altered, in some respects only temporarily, in some cases in accelerating permanent change that was already beginning. The challenge will be how to find the new balance. The ILL is a user facility relying on outside experimentalists but functioned remarkably well with many fewer visitors, in part because of accelerated development of remotely controlled instruments. There are limits, though, some of the most difficult experiments had to be delayed, demanding too much of in-house scientists to be practical. It is clear that the training and the psychological support of students have suffered. French universities are allowing extra time for theses to be completed, but we cannot yet tell how far video can replace human contact. My own feeling is that video meetings work well to complete work in progress, but are less fertile in really new ideas, and not at all ideal in the apprenticeship of younger researchers and teachers. While this does not detract from the losses the whole world has suffered in this pandemic, and continues to do so, I hope that we can learn the positive lessons from the past two years – future societal challenges will certainly require scientific collaboration across the world.



Milene Yumi Maeda,  
State University of  
Ponta Grossa (Brazil)

The Akiyama laboratory is full of kind, admirable, intelligent and hard worker people, who taught me so much and provided me a great time in Japan. They were always ready to help me not only with my experiments and research, but also to learn and understand more about the Japanese language, culture and lifestyle. I feel very honored, inspired, glad and lucky to have had the opportunity to be part of such an amazing laboratory.

The pandemic situation was really severe all across the world, so the ICC-IMR Fellowship program offered me the chance to continue my research in Japan for six additional months. Although there were some restrictions, I would not be able to accomplish even half of the work I have done in Japan back in Brazil, since all the laboratories and facilities in my university were closed for a long time and once they were opened back again, our experiments were extremely limited.

Despite the pandemics, we were able to achieve great outcomes, shown by the scientific results that have already been presented on international conferences and published in two papers "Hydrogen-assisted damage evolution in nitrogen-doped duplex stainless steel" and "Pre-straining alters hydrogen-assisted cracking site and local hydrogen diffusivity in a nitrogen-doped duplex steel".

Hopefully, the partnership between the Akiyama laboratory members and my research group in Brazil will continue in the future, with new projects and knowledge exchange.

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## ❖ Comments from IMR Students

In FY2020, ICC-IMR supported the travel expenses of international students who came to Japan in the midst of the COVID-19 pandemic. This time, we got some comments from international students about their student life in Japan.

### WEN YIFEI, Akiyama Laboratory, IMR

To begin with, I am sincerely thankful to the ICC organization for providing me with the financial assistance of the travel to Sendai.

Certainly, the covid-19 pandemic had a big impact on our school lives. During the period of preparing for the visa and ticket, the Japanese government had issued several travel restrictions and requirements of more files which needed to be submitted. Fortunately, thanks to the help of our lab's secretary and department's staff, I successfully got the entry to Japan.

After arriving in Sendai, I was preparing for the entrance exam for master's course, and I'd like to thank my tutor for his kindly help in preparing for the exam. Finally, I ushered in the beginning of the new term. As a freshman of graduate school, I started to learn how to use the instrument and discuss with professor to establish my own research topics. Although we didn't attend class face to face and some activities had to be canceled, zoom can also be a convenient tool. I think university has tried its best to prevent us to be the victim of covid-19, with our unremitting efforts to protective work, will we beat the virus in the near future.

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### XIATONG YE, Ichitsubo Laboratory, IMR

My name is Xiatong Ye, and I arrived in Japan in November last year. From that time, because of the COVID-19, my research activities are basically in the IMR and my home. What's more, the seminars of laboratory are held on Zoom, and I always wear a mask to communicate with my teachers and seniors by keeping a social distance. In the first three months, I did not devote a lot of time to research because I had to

study for the master's entrance exam. After I was successfully enrolled, I gradually started to review literature, learn experimental operations and try experiments. At the beginning, I followed my senior and teacher to do experiments, and learned how to make batteries and the rules of using various testing instruments. Later, after I became familiar with operations, I can do experiments alone. Recently, I have just finished my interim briefing session, so I need to discuss with teachers and senior about the future research and summarize recent experiment data.

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### YUYANG ZHANG, Ichitsubo Laboratory, IMR

As the coronavirus outbreak roils across the world, the courses and seminars are shifted to online. Most of the online courses have a synchronous component, where I can view live lectures online and participate in discussions through videoconferencing platforms such as Zoom. Although online courses can also take interact with each other, I

may need to be more proactive than on-campus students to develop a strong relationship. Thanks to the professors and students in lab keep the lab safety from the virus, the research activities are not affected fortunately. So I can still perform the tasks and experiments at lab to complete my research. And I believe the difficulties will eventually pass. Hope to be back as soon as is safe for all.



## Tang Bowen, Kato Laboratory, IMR

When my life in Japan just started, I still had some worries. It was soon proved that there was no need to worry at all. Supervisors helped me

with research topic and students in Kato lab taught me how to operating laboratory apparatus. Unfortunately, I did not have the opportunity to participate in offline class. Despite this, I want to say, even under the COVID-19 pandemic, my research life is really enjoyable.

## Zhu Pengfei, Kato laboratory, IMR

The COVID-19 has been rampant since 2020, and it has swept the world in an instant, suspended work and school, and the economy has been shut down. The virus has pressed the pause button on this busy world. People are caught off guard watching everything that happens before them and the spreading epidemic. For myself, I have been in Japan almost one year, under the shadow of virus. It was really hard from

the beginning. Having course online, impossible talk with people face to face, making people who need communication like me feel desperate. However, things all will go well. Thanks to my roommates, they helped me to get through the toughest time. Thanks for my teachers and classmates, they helped my research a lot.

COVID-19 is a disaster, but I believe it will be overcome in future. Now the second spring of my life in Japan is coming, and I believe the spring of the world under pandemic will also come in one day.

## ❖ Highlight of Research Project

### Spin dynamics studied by inelastic neutron scattering experiments in spin-triplet superconductor $UTe_2$

Dai Aoki, IMR

Recently discovered superconductivity in  $UTe_2$  is one of the hottest topics in condensed matter physics. It had been believed that  $UTe_2$  is located at the proximity of ferromagnetic order, thus spin-triplet superconductivity is naturally expected. In fact, the observed huge upper critical field  $H_{c2}$  highly exceeding the Pauli paramagnetic limit support a spin-triplet scenario. Superconductivity with the spin-triplet state is already known in ferromagnetic superconductors, namely  $UGe_2$ ,  $URhGe$  and  $UCoGe$ , which are categorized as weak ferromagnets with the 5f-itinerant nature. Superconductivity microscopically coexists with ferromagnetism. Therefore the ferromagnetic fluctuations are naturally expected as the mechanism of superconducting Cooper pairs, and indeed the ferromagnetic fluctuations are experimentally detected. On the other hand,  $UTe_2$  is a heavy fermion paramagnet, thus the ferromagnetic fluctuations are not trivial, although it is inferred from the  $\mu$ SR experiments.

In order to clarify the magnetic fluctuations, we performed the inelastic neutron scattering experiments at ILL using a large single crystal of high quality  $UTe_2$  [1]. As shown in Fig.1(c) the antiferromagnetic fluctuations with the incommensurate wave vector  $k_1=(0, 0.57, 0)$  was detected. These fluctuations saturate below  $T^* \sim 15K$ , implying the possible relation with the results of NMR, thermal expansion [2] and resistivity measurements. A quasi-elastic signal is detected, indicating that the magnetic moment is parallel to a-axis with a sine-wave modulations with  $k_1$ . These low dimensional fluctuations are probably due to the unique crystal structure with the ladder structure as shown in Fig.1(a).

The ferromagnetic fluctuations were not detected within the energy transfers from 0.6 to 7.5 meV down to 2K. These results constitute constrains for models of magnetically mediated superconductivity in  $UTe_2$ . At lower temperatures below  $T_c \sim 1.7K$ , a modification of the excitation spectrum at  $k_1$  is evidenced, indicating the feedback of superconductivity on the magnetic excitation [3].

This work was done in the framework of international collaboration project of ICC-IMR with CEA-Grenoble and LNCMI.

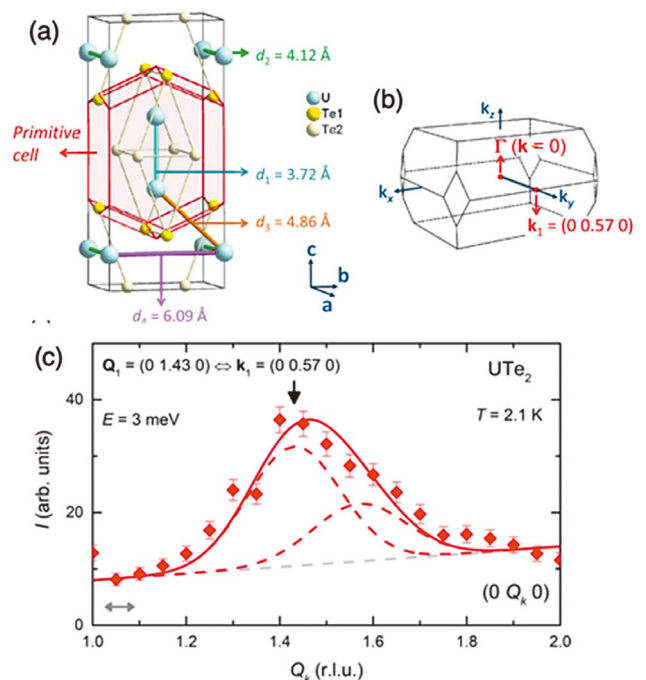


Fig.1 (a)body-centered orthorhombic structure and (b) its Brillouin zone of  $UTe_2$ . (c)  $(0, Q_k, 0)$  scan of  $UTe_2$  at 2.1K above  $T_c$ .

## References

- [1] W. Knafo, G. Knebel, P. Steffens, K. Kaneko, A. Rosuel, J.-P. Brison, J. Flouquet, D. Aoki, G. Lapertot, and S. Raymond, Phys. Rev. B 104, L100409 (2021).
- [2] K. Willa, F. Hardy, D. Aoki, D. Li, P. Wiecki, G. Lapertot, and C. Meingast, Phys. Rev. B 104, 205107 (2021).
- [3] S. Raymond, W. Knafo, G. Knebel, K. Kaneko, J.-P. Brison, J. Flouquet, D. Aoki, and G. Lapertot, J. Phys. Soc. Jpn. 90, 113706 (2021).

# ICC-IMR Activities in FY 2020

## Visiting Professors Online



**Amar Prasad Yadav**  
Central Department of Chemistry,  
Tribhuvan University, Nepal  
January 4, 2021- February 26, 2021  
"Effective Electropolymerization of Aniline onto  
Mild Steel for Corrosion Protection and Inhibition  
of Hydrogen Uptake"  
(Host: E. Akiyama, IMR)



**Thierry Duffar**  
Grenoble Institute of Technology,  
France  
January 4, 2021- February 26, 2021  
"Growth kinetics at crystal/melt interface"  
(Host: K. Fujiwara, IMR)

## Research Project

Quantum Matter Research under  
Extreme Conditions-Networking of  
Advanced Multiple Tools (2018-2020)

PI: J. Chang, Univ. of Zürich and H. Nojiri, IMR

Novel Spin Triplet  
Superconductivity in  $UTe_2$   
(2019-2020)

PI: J.-P. Brison, Univ. Grenoble Alpes &  
CEA-Grenoble and D. Aoki, IMR

Synthesis and Investigation of  
Biocompatible and Biodegradable  
Materials (2019-2021)

PI: J. Eckert, Erich Schmid Institute of Materials Science of  
the Austrian Academy of Sciences and H. Kato, IMR

## International Workshop

GIMRT Workshop: International Workshop on  
Joint-Use at IRCNMS, Online, Sep. 30-Oct. 3, 2020

Organizer: Y. Nagai, IMR

GIMRT Workshop: The 4th Symposium for The  
Core Research Cluster for Materials Science and  
the 3rd Symposium on International Joint  
Graduate Program in Materials Science, Online,  
Nov. 16-18, 2020

Organizer: T. Sasaki, IMR

GIMRT Workshop: ARHMF2020 & KINKEN  
Materials Science School 2020 for Young  
Scientists, Online, Dec. 1-3, 2020

Organizer: H. Nojiri, IMR

GIMRT Workshop: Round Table for Condensed  
Matter Physics in Asia-Pacific, Online, Dec. 4-5, 2020

Organizer: H. Nojiri, IMR

GIMRT Workshop: 15th International Workshop  
on Biomaterials in Interface Science, Online,  
Dec. 14-15, 2020

Organizer: H. Kato, IMR

## Young Fellowship

**M. Y. Maeda**

State University of Ponta Grossa, Brazil  
September 1, 2020 - February 28, 2021

"Understanding Hydrogen Embrittlement Mechanisms of Ferrite/austenite Duplex Steels"  
(Host: E. Akiyama, IMR)

## Major Publications

O. Prokhnenko, G. Marmorini, S.E. Nikitin, D. Yamamoto,  
A. Gazizulina, M. Bartkowiak, A.N. Ponomaryov,  
S.A. Zvyagin, H. Nojiri, I. F. Díaz-Ortega, L.M. Anovitz,  
A.I. Kolesnikov, and A. Podlesnyak

"High-Field Spin-Flop State in Green Dioptase", Phys. Rev. B, 103(2021) 014427

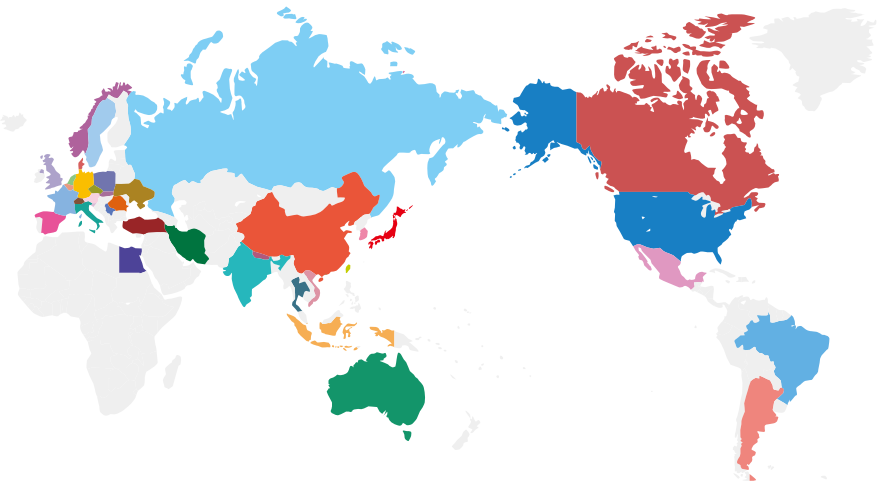
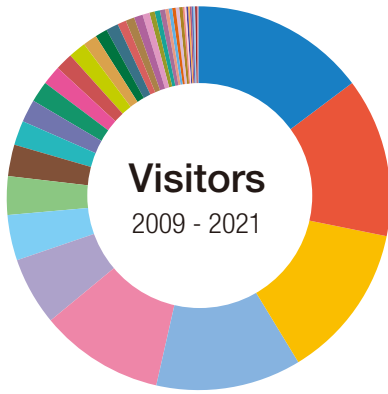
**M.Y. Maeda, M. Koyama, H. Nishimura, O.M. Cintho,  
E. Akiyama**

"Hydrogen-Assisted Damage Evolution in Nitrogen-Doped Duplex Stainless Steel", Int. J. Hydrog. Energy 46 (2021), 2716-2728

**I.V. Okulov, J. Wilmers, S.H. Joo, S. Bargmann,  
H.S. Kim, H. Kato**

"Anomalous Compliance of Interpenetrating-Phase Composite of Ti and Mg Synthesized by Liquid Metal Dealloying", Scr. Mater, 194(2021) 113660

## 🌐 Visitors supported by ICC-Programs



USA ..... 100	Switzerland ..... 18	Iran ..... 7	Slovakia ..... 3	Egypt ..... 1
China ..... 91	India ..... 14	Thailand ..... 7	Belgium ..... 2	Indonesia ..... 1
Germany ..... 89	Poland ..... 13	Denmark ..... 5	Brazil ..... 2	Nepal ..... 1
France ..... 83	Australia ..... 12	Hong-Kong ..... 5	Rumania ..... 2	Serbia ..... 1
Korea ..... 71	Spain ..... 11	Norway ..... 5	Slovenia ..... 2	Sweden ..... 1
UK ..... 39	Canada ..... 10	Mexico ..... 4	Ukraine ..... 2	Turkey ..... 1
Russia ..... 26	Taiwan ..... 10	Czech Republic ..... 3	Argentina ..... 1	Vietnam ..... 1
Netherlands ..... 22	Singapore ..... 8	Italy ..... 3	Austria ..... 1	

## 🌐 ICC-IMR Programs

ICC-IMR was founded in April 2008 as the center for international collaboration of the Institute for Materials Research (IMR). As one of the centers of excellence in materials science, IMR holds 27 research groups and five research centers. ICC-IMR works as a gateway of diverse collaborations between international researchers and IMR members. ICC-IMR has invited 67 visiting professors and conducted 23 international research projects since the start-up. The applications are open for foreign researchers and the projects are evaluated by a peer-review process involving international reviewers. Currently, ICC-IMR coordinates five different programs:

- 1 International Integrated Project Research
- 2 Visiting Professorships
- 3 International Workshops
- 4 Fellowships for Young Researchers and PhD Students
- 5 Material Transfer Program

We welcome applicants from around the globe to participate in these international programs.

## 🌐 Invitation to Covis-GIMRT's long stay type research program

GIMRT aims to form an international research team that will continue for a long time beyond single, short-term research visits. A new GIMRT program Covis, Co-research visit is to combine the short term research visit (Type S) and guest professorship (Type G) of International Collaboration center (ICC-IMR). By using this scheme, the overseas teams can stay for a longer period and a few members consist of senior and young researchers including students could come together even in the tight border control under covid-19.

We wish to resume the active international collaborations, which have been suspended for more than a year under pandemic.

Please visit our website for more information.

<http://gimrt.www.imr.tohoku.ac.jp/>



### Contact Information

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### On the Cover

Inside of Ultrahigh Vacuum-Compatible  
 Molecular Beam Epitaxy Chamber  
 Photo Credit: Takanashi Laboratory, IMR

