



IEEE MAGNETICS NEWSLETTER

VOLUME 63 | ISSUE 4 | DEC 2023

Editor: Jia Yan Law

In Memoriam

- + **Bruce A. Gurney**
- + **Helmut Kronmüller**

Magnetic Recording

- + **IEEE Milestone Award**
- + **Magnetic Recording & Spintronics**

- + **The Write Stuff**
Subjective and Objective Pronouns

- + **Students in Magnetism**
Reviews
Summer School 2023

Newsletter Editorial Board



Jia Yan Law
(Editor)

Jia Yan currently holds a tenure-track Emergia fellowship at University of Seville, Spain. Her research interests include functional high-entropy alloys, magnetocalorics, magnetic materials, and additive manufacturing. She has been an IEEE Senior Member and Editor of the IEEE Magnetics Society Newsletter since 2022.



Martin Lonsky
(Associate Editor)

Martin currently works as a senior process engineer at Nexperia Germany where he focuses on power semiconductor devices. Previously, he was a research scientist at the University of Illinois at Urbana-Champaign and Goethe University Frankfurt. His interests lie in materials physics, magnetism, and spintronics. Aside from experimental research, he is interested in computational methods and how to incorporate them into undergraduate science and engineering curricula. In addition, he enjoys writing and communicating science. He is a member of the IEEE Magnetics Society since 2020.



On the Cover

The cover of this issue features "Mystical Forest", which represents the endless possibilities of working in magnetics. The image was created by Dr. Liuliu Han (Max-Planck-Institut für Eisenforschung, MPIE, Germany) using electron backscattered diffraction imaging of a soft magnetic high-entropy alloy. Such alloys are designed with multiple principal elements and have the potential to revolutionize multifunctional alloys.

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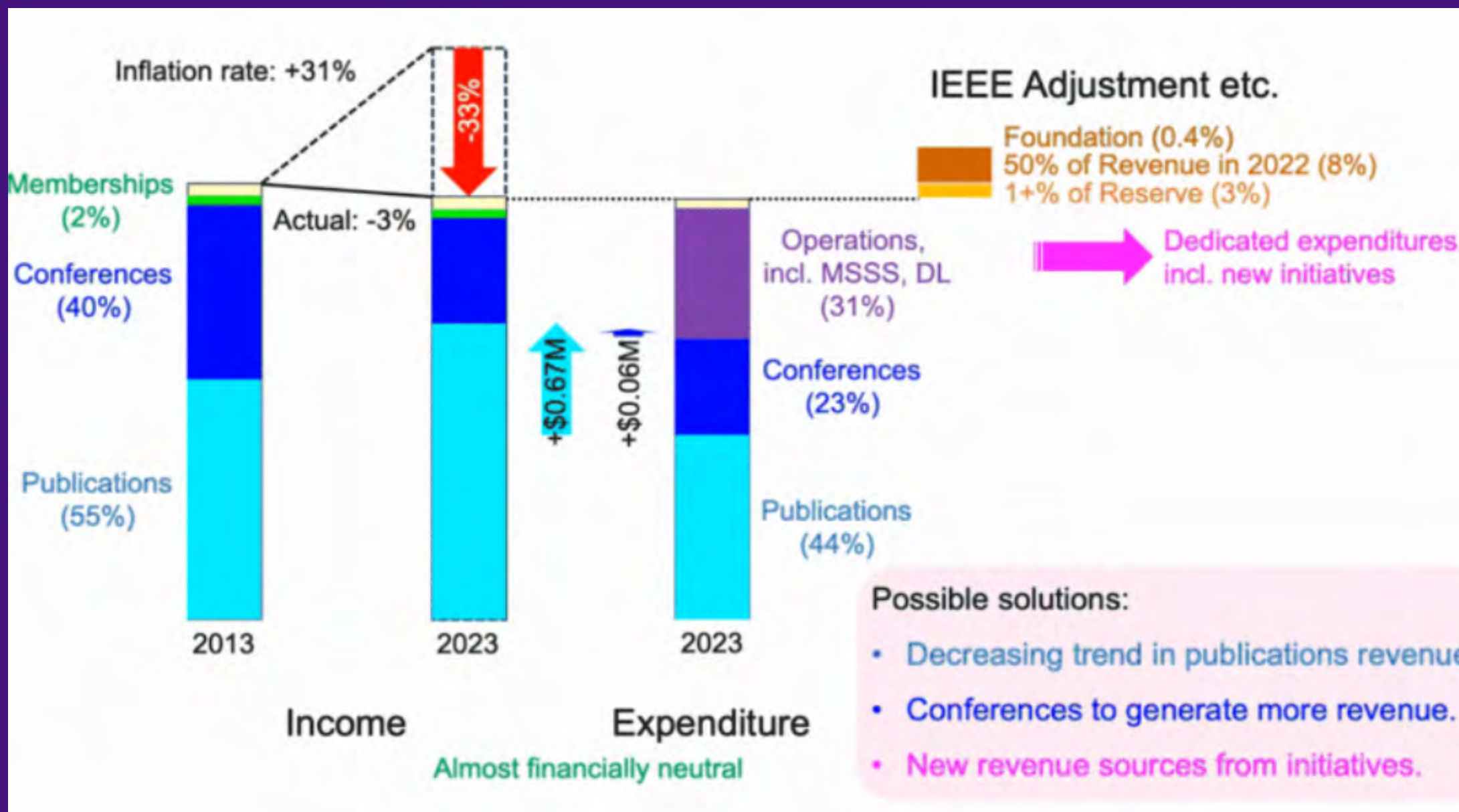
FROM THE PRESIDENT

Welcome to the December issue of our newsletter.

On November 16, 2023, during the IEEE Technical Activities Board (TAB) meeting in Washington, DC, held between November 15 and 18, the president-elect, Ron Goldfarb, and I had our Magnetics Society review, which is organized every five years. Thanks to the continuous efforts by the standing committee chairs and members, the Administration Committee (AdCom) members, and all the Society members, we received very positive comments from the panel. The panel liked our healthy budget, summer school, distinguished lecturer program, "meet the experts/speakers" opportunities at InterMag and MMM (Magnetism and Magnetic Materials) Conferences, Around-the-Clock Around-the-Globe (AtC-AtG) Conference, publication speed, Ukrainian initiative, and activities by the Students in Magnetism and Young Professionals groups. I would like to congratulate those contributors who have taken the lead on these activities.

The panel raised some concerns over some out-of-date/missing information on our web pages, the need to develop a strategic plan to meet the needs of our members, and the promotion of the society at our financially/technically supported conferences. The next step is for the panel to send us their report by January 3, 2024. We will prepare a draft response to their comments and will ask the standing committee chairs and the AdCom members for their review.

During the Society review, a major concern was also raised on the need to stabilize conference participation and to seek new income sources. This is a common topic throughout the IEEE (and beyond), but it needs to be resolved to make our Society sustainable. As summarized in the diagram below, our income is reduced by 3% this year as compared with that ten years ago, while inflation hits us at a rate of 31% (U.S. Federal Reserve Board data), resulting in a 34% effective reduction in our income. Over these years, our expenditures remained almost the same to achieve an approximately financially neutral budget. By comparing these numbers, you can find our major sources of income are publications and conferences.



Considering the recent move to open-access publications, we expect a gradual decrease in publication income in the coming years, forcing us to find new sources of income to support our activities for the benefit of the magnetics community. I would ask you to send your ideas to AdCom members in your region/subject, the corresponding committee chairs and/or me.

We can initially fund

new ideas as "initiatives" that make use of our budget surplus from a prior year or our reserves.

A new initiative can be funded for up to 3 years, during which it should become financially self-sustainable or funded by the operations budget.

While our operations budget is funded by revenue, mostly from publications and conferences, our recently-established Diversity, Talent and Innovation (DTI) Fund also provides about \$12k per year, which we plan to devote to competitively support local activities you may wish to plan. Magnetics Society membership dues contribute only about 2% of our income, which is almost negligible financially, but is important to keep our medium society size (~3,000 members or more) in IEEE to support our activities, such as in the election of IEEE Fellows.

Following the IEEE TAB meeting, the IEEE Board of Directors (BoD) meeting was held on November 19 and 20, during which new IEEE Fellows were approved. This year, the IEEE Magnetics Society nominated five candidates, and all of them were promoted.

Congratulations to



Elke Arenholz
Pacific Northwest
National Laboratory, USA



Victorino Franco
Universidad de Sevilla, Spain



YiMing Huai
Avalanche
Technology, USA



Yoichiro Tanaka
Tohoku University, Japan



Stephen E. Russek
National Institute of
Standards and Technology,
USA

Find out more
about them in the
next Newsletter.

It was great to see many of you at the MMM in Dallas, Texas, USA, at the end of October and the beginning of November. Almost 800 on-site participants and about 100 online registrants attended the MMM. It is clear that the morning coffee and evening beer as well as the middle-session breaks promoted a continuous flow of participants to the poster and exhibit hall. Additional networking events were offered for young professionals (lightning talk competition), Women in Magnetism, Students in Magnetism, and for all attendees to meet the experts/speakers, all of which were filled with enthusiastic attendees. I would like to congratulate and thank the conference chair, Barry Zink, and his team. You can find more details in their report in the next Newsletter.

On Thursday in the week following MMM, our AdCom meeting was held online. We approved



(1) financial support for the Intermag conference in Rio de Janeiro, Brazil, to be held between May 5 and 10, 2024,



(2) additional student travel support for our Summer School in Taipei, Taiwan, between June 9 and 14, 2024, and



(3) renewal of our affiliate membership in the IEEE Brain Community.

For (1), support for the Intermag 2024, we approved support for the following on-site activities: "Spotting the Next Big Idea in Magnetism" event, Sensor Challenge, hardship travel support,

Young Professionals event, Meet the Experts/Speakers, Writing Workshop, Meet the IEEE Transactions on Magnetics/IEEE Magnetics Letters Editors event, Women in Magnetism event, student travel grants, and Students in Magnetism event. These events and support can facilitate another successful Intermag next year. Please save the dates in your diary. Additional support (2) should compensate for the recent increase in travel costs and help to cover about 80% of students' travel expenses. For those who are interested in participating, please watch for our call for applications to the Summer School. (3) The collaboration with IEEE Brain Community has been productive thanks to Ravi Hadimani. Please contact Ravi if you are interested in participating in their meetings and/or organizing one.




Over the past months, the Committee Chairs and I have been meeting online on the first Friday of every month. We informally discuss various issues related to the society and welcome your ideas and/or suggestions. Please do not hesitate to contact us.

In addition to our flagship Intermag conference, our other important conference, The Magnetic Recording Conference (TMRC), was held between July 31 and August 2 in Minneapolis, Minnesota, USA, with 114 participants, including 64 from industry. It is always important (and interesting!) to see the latest research presented by those from industry. I would like to congratulate and thank the Conference Chair, Stephanie Hernandez, and her team. I am also glad to celebrate two winners of our newly created Neil Smith Award. It will be the turn for California to host TMRC next year.

I am also grateful to report the following conferences have been approved to be supported by the society. Please consider attending these events.

I am also grateful to report the following conferences have been approved to be supported by the society. Please consider attending these events.

- Biennial Conference on Electromagnetic Field Computation (CEFC) (June 2–5, 2024, Jeju, Korea) 
- European Magnetic Sensors and Actuators Conference (EMSA) 2024 (June 24–27, 2024, Košice, Slovakia) 
- International Symposium on Integrated Magnetics (iSIM) 2024 (May 4–5, 2024, Rio de Janeiro, Brazil) 
- Magnetic Frontiers 2024 (Darmstadt, Germany)
- New Jersey Offshore Wind Technology Conference and Exhibition 2024

Last, but not least, the society is very excited to welcome three new student chapters established this year. These student chapters were established in Recife in Brazil, Chennai in India, and Torreón in Mexico. Now we have 51 chapters in total and look forward to continuing to work closely with them! In addition, Students in Magnetism ran a sensor competition this year and announced winners at their virtual coffee last month. 

As always, please visit our society’s website to learn more about our activities and to find the contact details for officers, committee chairs, and AdCom members. We welcome any comments and suggestions you may have, especially any new initiatives! Please feel free to circulate this newsletter to your colleagues who are interested in setting up a new chapter and/or filling out a new volunteer form.



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(Please note new email address)

IN MEMORIAM BRUCE A. GURNEY (1957-2023)

by Matt Carey and Jeff Childress
San Jose, California, USA

**Bruce Gurney,
a physicist and
inventor, good friend
and husband, passed
away on October 20,
2023. He is survived
by his loving wife,
Noemi Bolvary.**

Bruce left an indelible mark on the field of magnetic recording. His groundbreaking work contributed to a revolution in data storage technology in the 1990s, and his legacy continues to resonate today throughout the field of spintronics.

Bruce was born in Oregon on July 8, 1957, but grew up in San Diego, California. His father was an electrical engineer, and sparked Bruce's interest in technology and science, physics in particular. He earned his Bachelor of Science degree from the California Institute of Technology in 1979. Remarkably, his letters of recommendation for graduate school were from Hans Bethe and Richard Feynman, who encouraged him to apply to Cornell University in

Ithaca, New York. He earned both a Master's and a Ph.D. from Cornell, where he defended his dissertation, *Kinetics of Structural and Chemical Transformations of Adsorbates Obtained With a Time-Resolved Electron Energy Loss Spectrometer*, in 1987.

After completing his graduate studies, Bruce was recruited by IBM's General Products Division in San Jose, California, with the goal to build a spin-polarized electron source to study interfaces in magnetic devices. Shortly thereafter, in 1988, the phenomenon of giant magnetoresistance (GMR) was discovered and explained by Albert Fert and Peter Grünberg, later 2007 Nobel Prize laureates. Bruce quickly began exploring the physics and properties of GMR in

Fe/Cr multilayers, with an eye toward their application to magnetic recording sensors. By 1990, he was working with Virgil Speriosu and IBM Research on a new practical sensor using the GMR effect: the GMR spin valve. Bruce officially joined Speriosu's team at the IBM Almaden Research Center in 1991 as a research staff member.

Bruce went on to be very successful as a researcher and manager for more than two decades. However, it was his role in the invention and optimization of the GMR spin-valve sensor that truly defined his career.

This work was a collaboration with a number of IBM scientists and engineers including Virgil Speriosu, Bernard Dieny, Stuart Parkin, Daniele Mauri, Steve Lambert, Dennis Wilhoit, David Heim, Ching Tsang, and Bob Fontana, among others, who conceived of the steps required to harness GMR into a practical device. In addition, Bruce championed the spin-valve sensor internally at IBM, shepherding it through its developments in IBM Research and its transfer to manufacturing. Through his particular interest in magnetic interfaces, Bruce added many improvements of his own along the way, which helped boost the sensor's performance, and he quickly recognized the value of the antiparallel pinned (later referred to as the synthetic antiferromagnet) version of the spin valve. While this durable design is now standard in hard-disk drive (HDD) read sensors, it initially met with much skepticism within IBM and was completely ignored by other companies until IBM shipped its first GMR spin-valve HDDs.

This GMR spin-valve sensor became the cornerstone of HDDs, leading to a dramatic increase in storage density over time. The first spin-valve based HDDs were shipped in 1997, only 10 years after the discovery of GMR. Bruce's technical work and product development efforts were pivotal in making IBM first to market with this new sensor device. It stands as one of the great achievements of industrial research, where the right people in the right place at the right time can quickly effect a major change in technology by harnessing fundamental research results. The GMR based HDDs appeared just in time for the explosion of the Internet, helping IBM achieve over \$1 billion in profit from HDDs alone in the year after the spin-valve read heads were introduced. At that time, and for years to come, Bruce could rightly say, "If you are using a computer, you are probably using one of my inventions."

Bruce's impact extended beyond the lab. As a manager, he spearheaded the early development of magnetic tunnel junctions for magnetic recording read heads. These sensors eventually replaced the GMR spin valve, using many of the design traits he and his team developed for spin valves. His relentless pursuit of excellence led to further innovations in nanotechnology and spintronics, including spin-torque oscillators and "extraordinary" magnetoresistance, which his team also explored for their potential in HDD read heads. Bruce's work further encompassed recording media, as he focused on novel nanostructured media toward the end of his career. He was an author on over 80 scientific publications and an inventor on over 80 issued U.S. patents. Bruce inspired and mentored many young scientists as postdocs and interns in his group, and many have gone on to prominence in the field of magnetics and spintronics.

Bruce Gurney's contributions are well recognized in the magnetism community. He was elected Fellow of the American Physical Society in 2000 and Fellow of the Institute of Electrical and Electronics Engineers (IEEE) in 2014 in recognition of his pivotal role in advancing magnetic recording systems.

Together with Virgil Speriosu, Bruce received the prestigious IEEE Reynold B. Johnson Information Storage Technology Field Award in 2004 for their co-invention of the GMR spin valve. Their work, along with that of their colleagues, forever changed the landscape of data storage, making our digital lives possible. He was also widely recognized internally, receiving the IBM Research Division Award, the IBM Outstanding Innovation Award, and the Hitachi Gold Patent Award. Bruce's dedication extended to service on the Administrative Committee and chairing the Honors and Awards committee for the IEEE Magnetics Society. In 2016, he was the General Chair of the highly successful Joint MMM-Intermag Conference in his hometown of San Diego.

On a personal note, Bruce was a mentor and a good friend to many people both inside and outside the magnetism community. He was a highly professional, patient, insightful, and enthusiastic colleague. We join his many friends, and Noemi, in sorrow of the loss of a good and thoughtful man. His firm handshake, strong voice, and sharp wit will be sorely missed.



IN MEMORY OF

PROFESSOR HELMUT KRONMÜLLER (1932-2023)

by Manuel Vázquez
*On Behalf of the
Spanish Chapter of
the IEEE Magnetics
Society and the
Spanish Magnetism
Club (Club Español de
Magnetismo CEMAG)*

Professor
Helmut
Kronmüller
passed away on
June 30, 2023, at
the age of 90.



The scientific magnetism community of Spain, and in particular the Spanish Chapter of the IEEE Magnetism Society and the Spanish Magnetism Club, at their joint annual meeting in San Lorenzo de El Escorial, deeply regret the loss of such a significant figure in the field of metal magnetism.

Prof. Dr. Kronmüller was an exceptional research figure who maintained a special relationship with magnetism in Spain, both for those of us who carried out stays at the Max-Planck-Institut für Metallforschung in Stuttgart, and for his dedication as President of the Advisory Board of the Institute of Applied Magnetism of the *Universidad Complutense de Madrid*.

Helmut Kronmüller was born on November 21, 1932. He earned his doctorate at the Institute of Theoretical and Applied Physics, University of Stuttgart, in 1958. His habilitation thesis in 1966 was on the topic *Nachwirkung in Ferromagnetika* ("Aftereffects in Ferromagnetics"), published as a book by Springer-Verlag, which earned him the Physics Prize of the *Deutsche Physikalische Gemeinschaft* (DPG), the German Society of Physics, in 1968. He was appointed scientific member of the Max-Planck-Institut für Metallforschung (MPI-MF) in 1970, Professor of Physics at the University of Stuttgart in 1974, and Director of MPI-MF in 1987. From 1992 to 1995

he was Director General of MPI-MF and President and Head of the Magnetism Division of the DPG from 1993 to 2001. He was a member of different international committees, participating decisively in several BRITE-EURAM programs on hard magnetic materials of the European Union. In 2000, he served as an IEEE Magnetism Society Distinguished Lecturer.

Prof. Kronmüller was the author of about 1000 publications, particularly reference books such as *Micromagnetism and the Microstructure of Ferromagnetic Solids* (with Manfred Fähnle, 2003) and the edited series, *Handbook of Magnetism and Advanced Magnetic Materials* (with Stuart Parkin, in five volumes, 2007). He supervised more than 120 doctoral theses, and many of his former students and visiting scientists have held prominent positions in industry and academia. Although retired in 1999, he continued to be scientifically active as a scientific member emeritus of MPI-MF's successor institute, the Max-Planck-Institut für Intelligente Systeme.

Renowned for his vibrant energy, Prof. Kronmüller passionately conveyed his dedication to magnetism research to younger scientists. He had a significant impact on the progress of magnetism in Spain through his years of support for research groups.

The Spanish magnetism community extends its heartfelt condolences to his wife Sonja, their four children, and their grandchildren.

- Manuel Vázquez,
at Royal Site of San Lorenzo de El Escorial, Spain, November 24, 2023



IEEE INTERNATIONAL MAGNETICS CONFERENCE

INTERMAG 2024

RIO

5 - 10
MAY
2024

FIRST-TIME

IN LATAM!

 IEEE
MAGNETICS

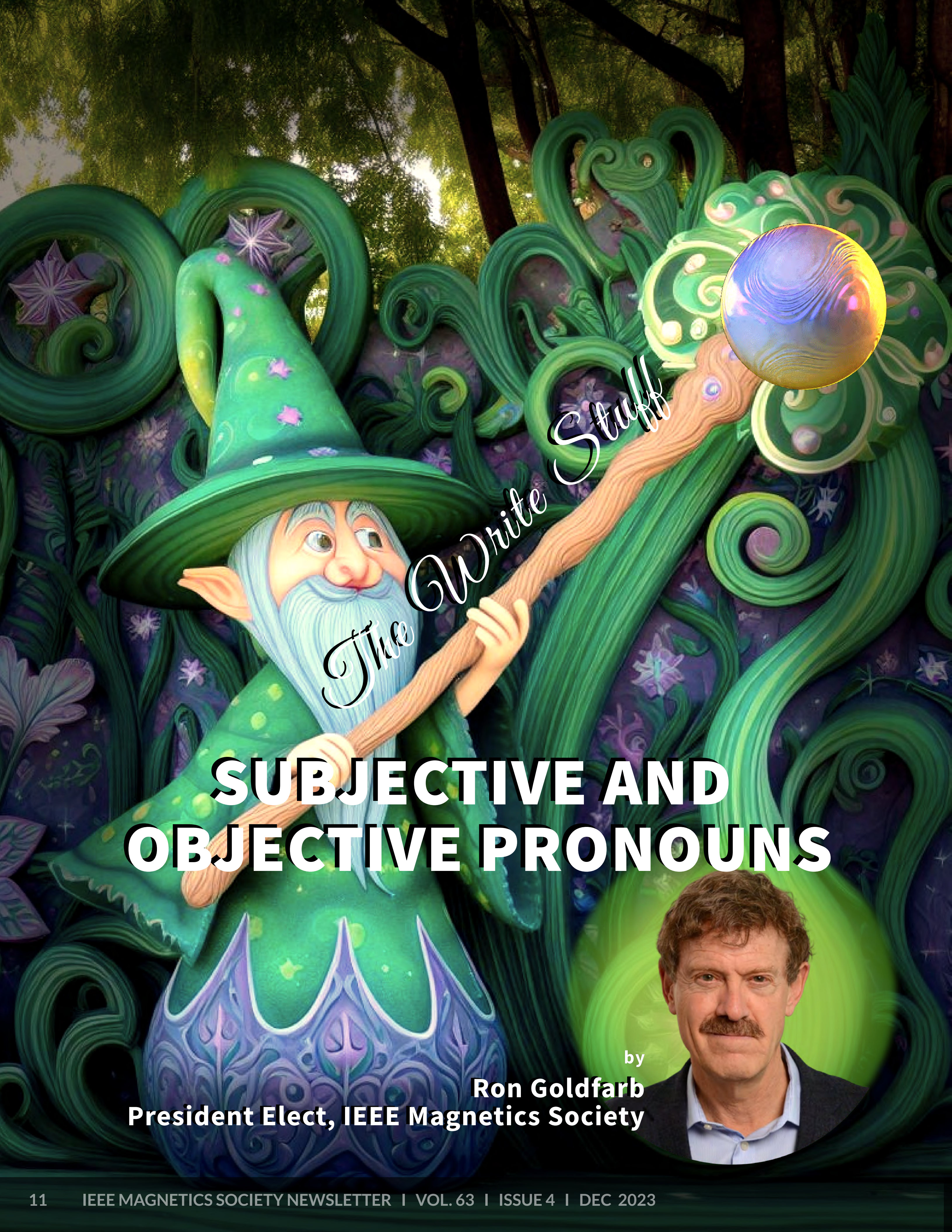
NEW

Prof. Albert Fert, who was awarded the Nobel Prize in Physics in 2007 for the Giant Magnetoresistance discovery, will be given a plenary lecture.



**DIGEST SUBMISSION IS OPEN
UNTIL **JANUARY 08, 2024****

**MORE INFO
WWW.INTERMAG2024.ORG**

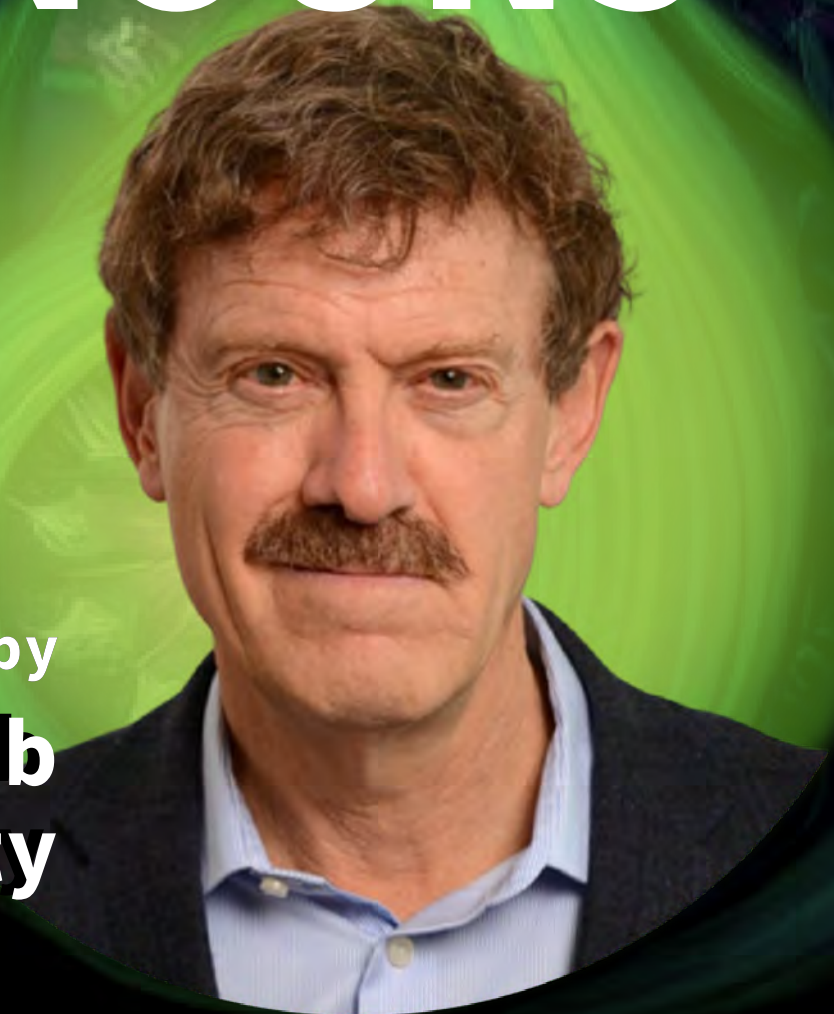


The Write Stuff

SUBJECTIVE AND OBJECTIVE PRONOUNS

by

Ron Goldfarb
President Elect, IEEE Magnetics Society



Some of us have been indoctrinated to deprecate the pronoun *me*.

Ron: "Me and Guido went to the store."

Third Grade Teacher: "No, that's not right."

Ron: "Guido and me went to the store."

Third Grade Teacher: "Guido and I went to the store."

Ron: "Really? Me too!"

Third Grade Teacher: "Sit down, Ron."

I vs. Me

Some of us think the use of *me* is usually wrong, or at least impolite. Here are some lines from emails I received recently:

- Your suggestions are due to Rod and I today.
- You will need to make sure you get the information sent to Hal, Heidi, and I.
- Thanks for all the help you have given Denise and I.

When the pronoun follows a preposition (e.g., *to*, or an implied *to* in the third example), use *me*. Hint: Remove the proper nouns Rod, Hal, Heidi, and Denise and see how it sounds.

What do you think about this email example?

- Between Lynn and I, we answered your questions.

Between is a preposition, so *me* would be correct.

What about this example?

- Feel free to call Don or I if you have any questions.

When the pronoun follows an action verb, also use *me*. In this case, the verb is *call*, so *me* would be correct.



I

me

The general rule is that I is used for the subjects of sentences, me for the objects of sentences. Other subjective pronouns are he, she, they, and we; other objective pronouns are him, her, them, and us. You can serve as either subject or object.

Sometimes we write *myself* when we are not sure whether to use *I* or *me*. From other emails I received recently:

- Alan or myself would be happy to discuss this.
- The other authors and myself are aiming to publish this article.
- Rich and myself provided important consultation.
- Jake and myself are co-authors.

In these examples, *myself* is the subject; *I* can be used safely instead.

How about this email line?

- Please contact myself or Mike with any questions.

This *myself* is the object, following the action verb *contact*; use *me*.

***Myself* is properly used either (1) reflexively, as the object to refer to the subject of a sentence, or (2) intensively, for emphasis:**

- I hit myself with the hammer.
- I myself don't end sentences with prepositions.

How about this?

- Mary is smarter than I.

It seems that most grammarians treat *than* as a conjunction, not a preposition. The implied meaning is *Mary is smarter than I am*. So, *I* it is.

But wait! What if most grammarians are wrong, or at least out of touch? In informal writing and speaking, *than* may be treated as a preposition, in which case: *Mary is smarter than me*.

What would you think of this?

- Woe is me.

Is is a verb, so *me*, right?

*The general rule is that **a linking verb is followed by a subjective pronoun**. Verbs that refer to a state of being (*is, am, are, was, were, has been, are being, might be, becomes, is becoming, became, will become, seems, seeming, will seem, seemed*) are linking verbs, unlike action verbs.*

So, “Woe is I” is correct. But it may sound pretentious. Spoken English is more relaxed than formal writing; there is no need to demonstrate your superiority by correcting others who say, for example, “It was me.”



O, woe is
me!

[Hamlet, Act 3, Scene 1]

My two favorite grammar books are *Woe Is I: The Grammarphobe's Guide to Better English in Plain English* by Patricia T. O'Conner and *The Technical Writer's Handbook: Writing with Style and Clarity* by Matt Young.



"Who you gonna call?"

To demonstrate our social refinement, some of us would like to use *whom* instead of *who* whenever we can. Well, when can we?

- Who/whom ate my lunch?
- To who/whom it may concern.
- Ask not for who/whom the bell tolls.

As with *I* and *me*, *who* is a subjective pronoun and *whom* is an objective pronoun. **To tell if *who/whom* is a subject or an object, ask yourself about *they/them*. If *they*, then *who*; if *them*, then *whom*** (memory aid: both *them* and *whom* end with the letter *m*). For the above examples:

- Who/whom ate my lunch?
They did. → "*Who* ate my lunch?"
- Who/whom does it concern?
It concerns *them*. → "*To whom* it may concern."
- Who/whom does the bell toll for?
The bell tolls for *them*. → "*Ask not for whom* the bell tolls."

What about these?

- Who/whom should I give it to?
- Who/whom you gonna call? Ghostbusters!

Answers:

- I should give it to them.
→ “*Whom* should I give it to?”
- I’m going to call them if I have ghosts.
→ “*Whom* you gonna call?”

But for informal writing and movie theme songs, you might want to go with the colloquial *who* to avoid sounding pompous.

The rule for “*whoever*” and “*whomever*” is the same as that for “*who*” and “*whom*.”

But what would you say about this?

- I want *whoever/whomever* is the bravest to step forward.

Objectively, *whomever*, right? “I want *whomever*.” Actually, *whoever* is the subject of the clause, “*whoever* is the bravest,” so “I want *whoever* is the bravest to step forward” is correct.

The rule for “*whosoever*” and “*whomsoever*” is to never use them.



Adapted from The Write Stuff: Subjective and Objective Pronouns, originally published in April 2022 in For Good Measure, the internal newsletter of the National Institute of Standards and Technology’s Physical Measurement Laboratory.

Perpendicular Magnetic Recording Honored with IEEE Milestone Award

by Yoichiro Tanaka
Research Institute of
Electrical Communication,
Tohoku University, Japan



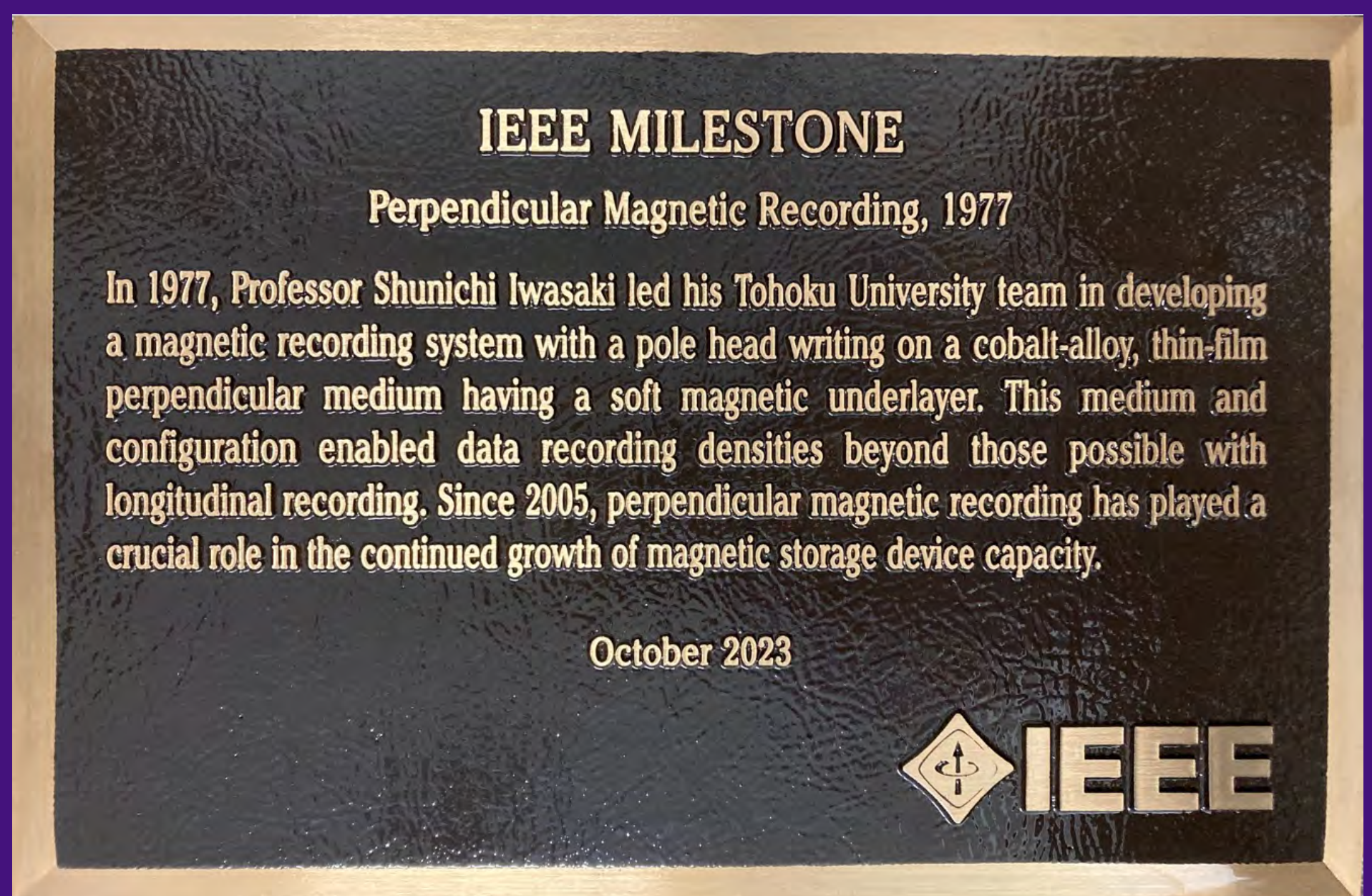
Hideo Ohno and Tom Coughlin with IEEE Milestone plaque



Shunichi Iwasaki and Tom Coughlin

This IEEE Milestone award is dedicated to perpendicular magnetic recording, which was invented by Tohoku University Professor Emeritus Shunichi Iwasaki and his research team at the Research Institute of Electrical Communication in 1977. On October 9, 2023, the IEEE Milestone Dedication Ceremony was held in Sendai, Japan, the birthplace of perpendicular magnetic recording, and the plaque was presented to Tohoku University President Hideo Ohno by Thomas Coughlin, president-elect of IEEE.

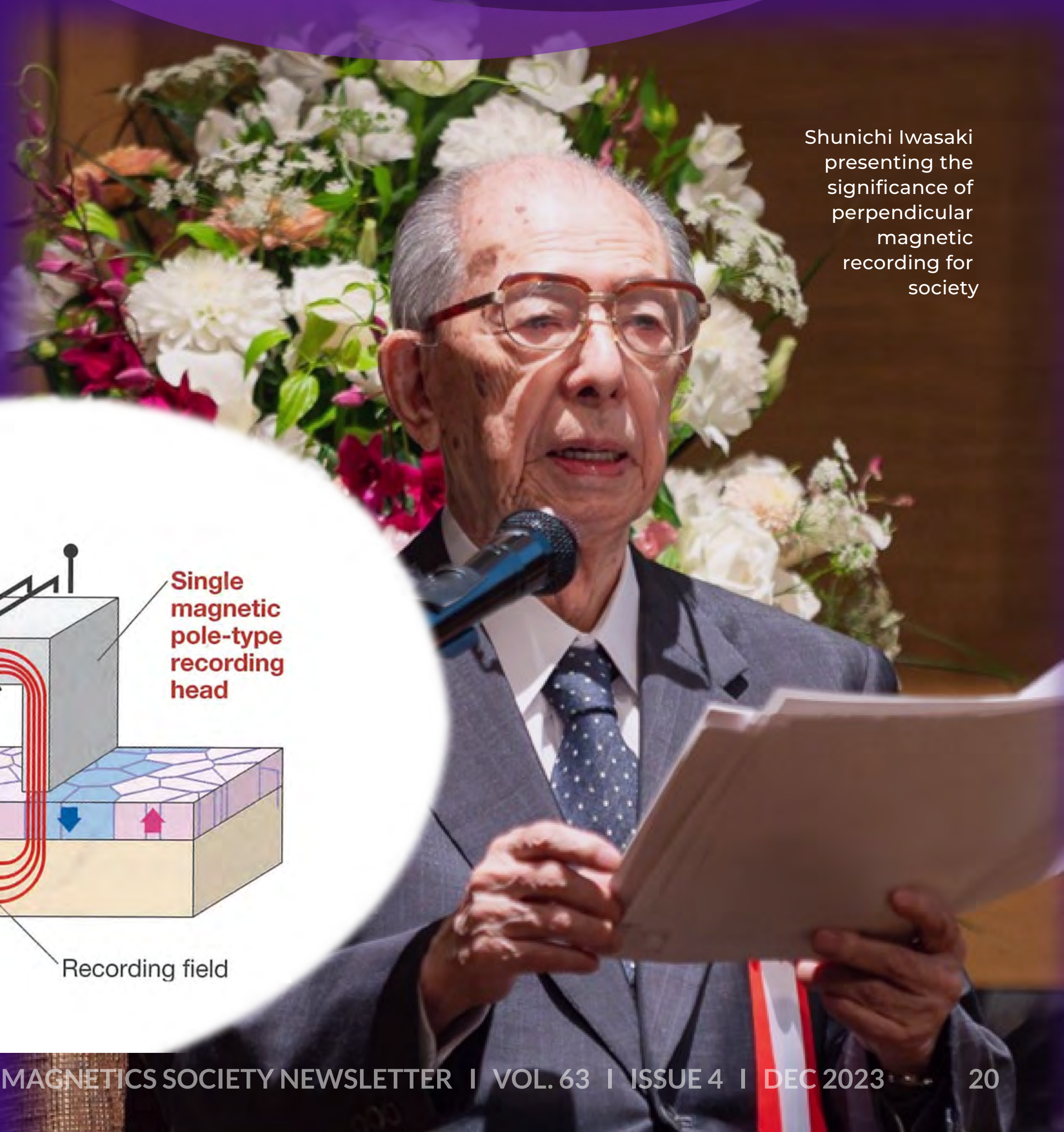
IEEE Milestone plaque dedicated to "Perpendicular Magnetic Recording, 1977"



Iwasaki, Yamaguchi, Hirohata, Tanaka, Coughlin, and Takanashi (from left to right)

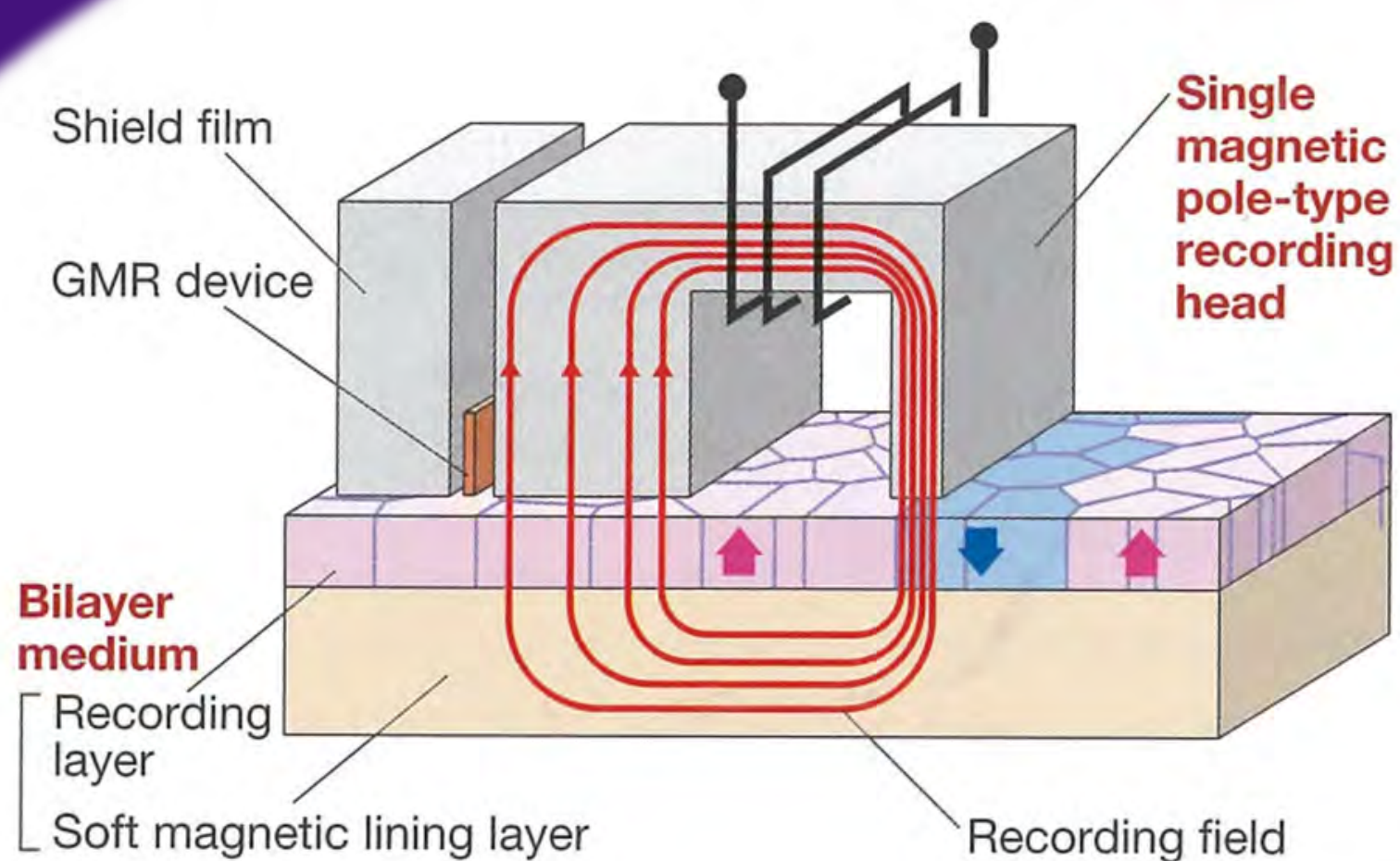


Perpendicular magnetic recording is a technology that can write data bits with a single magnetic pole-type recording head on a magnetic recording layer perpendicular to the plane. A soft magnetic lining layer is placed under the recording layer, enabling excellent high-density recording performance.



Shunichi Iwasaki presenting the significance of perpendicular magnetic recording for society

Invented structure of perpendicular magnetic recording



In 2005, the world's first hard disk drive adopting perpendicular magnetic recording was developed and commercialized by Toshiba (led by Prof. Yoichiro Tanaka), and all hard disk drives used around the world were then quickly transitioned to perpendicular magnetic recording from traditional longitudinal magnetic recording.



Yoichiro Tanaka delivering a lecture on perpendicular magnetic recording development.

The awarded technology is well recognized to have supported modern digital society as a big data infrastructure foundation. The IEEE Milestone dedication recognizes a historical achievement that provides tremendous technical and social contributions to a digital society.

At the dedication ceremony jointly hosted by the IEEE Sendai Section and Tohoku University, commendation speeches were delivered by Tom Coughlin, Hideo Ohno, and Shunichi Iwasaki, followed by special lecturers Isao Shirakawa, chair of the IEEE Japan Council History Committee, Professor Yoichiro Tanaka, Tohoku University, and Hisashi Takano, Western Digital Japan. The ceremony was well attended from academia, the storage industry, and national and local governments.



Commendation speech by Hiroyuki Yoshikawa, former president of University of Tokyo, at the ceremony



Magnetic Recording and Spintronics

by Martin Lonsky

In the article about perpendicular magnetic recording in this issue of the Newsletter, we explored the pivotal role played by Tohoku University Professor Shunichi Iwasaki in driving the development of perpendicular magnetic recording. Only recently, this achievement was recognized as an IEEE Milestone. Here, we aim to provide additional background information on the history behind magnetic recording and discuss both recent as well as potential future developments in the related field of spintronics.



The introduction of magnetic recording into the commercial market can be traced back to the year 1956, when IBM rolled out the first commercial computer equipped with a magnetic hard disk drive (HDD), the IBM 305 RAMAC. Weighing over a ton, it consisted of fifty 24 inch (about 60 cm) disks and offered a storage capacity of about 5 megabytes of data. This implied an areal density of about 1 kilobit per square inch, which would result in a cost of 10 million dollars to store a mere gigabyte of data. In the following decades, magnetic recording underwent remarkable evolution. Presently, state-of-the-art HDDs (e.g., Ironwolf Pro by Seagate and Western Digital WD Gold) boast a capacity of about 20 TB and an areal density of one terabit per square inch, approximately a billion times higher than in 1956. Consequently, the cost of storing a gigabyte has plummeted to only US\$0.02. Considering these substantial improvements, one may wonder what the key developments were that have shaped magnetic recording technology.

First, we need to understand that a magnetic HDD is a nonvolatile storage device that consists of glass- or aluminum-based circular platters that are coated with a thin layer of a magnetic material. The surface is divided into nanoscale regions, each representing a binary 0 or 1 (bits) encoded by the local magnetic orientation. These disks spin at high speeds, facilitating a read/write head that is mounted on an arm to access and determine the magnetic orientation ("read") or alter the configuration of a magnetic region ("write"). While the fundamental idea has remained the same since the IBM RAMAC era, the areal density has increased dramatically by scaling down the individual HDD components (e.g., by reducing the size of magnetic bits and the spatial extent of the read/write head).

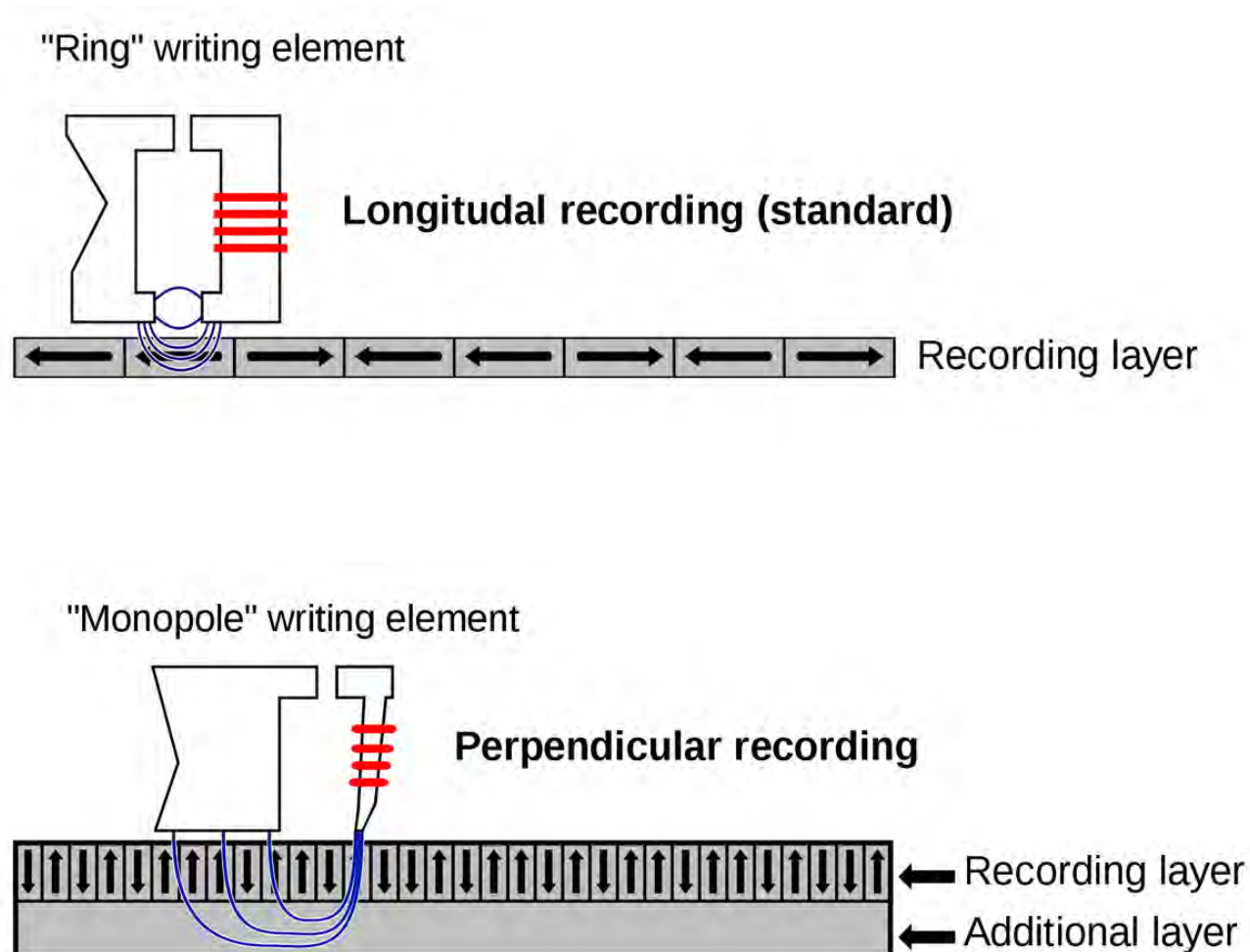


Figure 1. Longitudinal (top) vs. perpendicular (bottom) magnetic recording. Also shown is the inductive write head, which requires a different geometric design for both cases. Reproduced from https://en.wikipedia.org/wiki/Magnetic_storage under a Public Domain license.

This was accompanied by major conceptual improvements such as the transition from purely inductive reading (i.e., using a magnetic coil to pick up the orientation of the individual bits) to magnetoresistive reading, whereby changes in the magnetic field are detected through electrical resistance changes within a thin film that is part of the read head. A more mature version of these sensing devices is based on the so-called Giant Magnetoresistance (GMR) effect, discovered by Albert Fert and Peter Grünberg (Nobel Prize 2007). GMR occurs in multilayer stacks composed of ferromagnetic and nonmagnetic materials, leading to a more sensitive and accurate readout of magnetic bits. Further significant developments include perpendicular writing and more recently heat-assisted magnetic recording (HAMR). Perpendicular recording is a technology that arranges magnetic bits on a storage medium perpendicular to the surface, as opposed to the traditional horizontal orientation. This vertical alignment results in a reduced interference between neighboring bits, thereby allowing for higher storage densities; see Fig. 1. Once again, we would like to recognize Professor Shunichi Iwasaki's essential contributions to this technique.

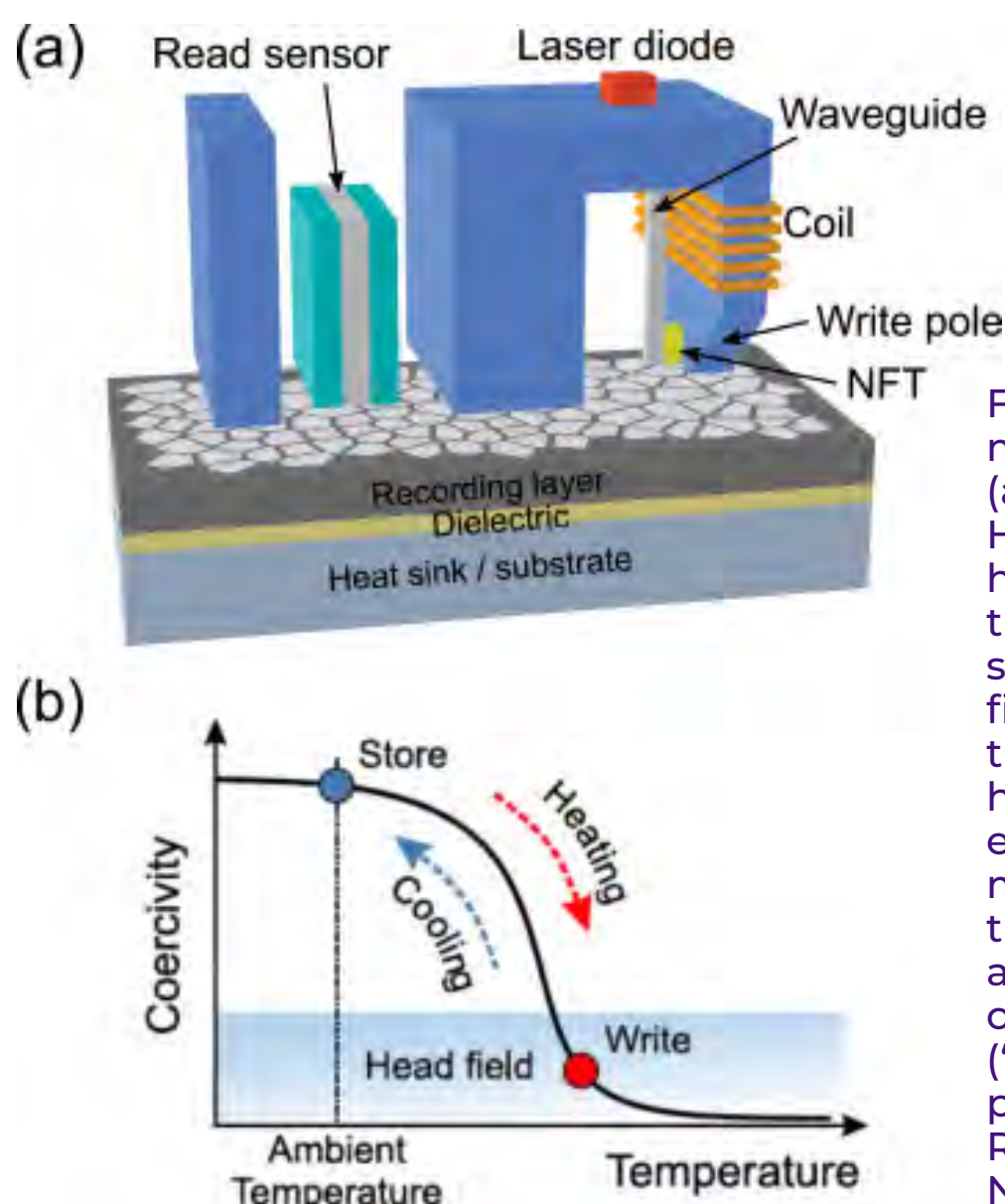


Figure 2. Heat-assisted magnetic recording (HAMR). (a) Fundamental principle of HAMR, whereby a laser locally heats the magnetic medium through the excitation of surface plasmons in a near-field transducer (NFT). Note that the read sensor depicted here is based on the GMR effect. (b) Coercive field of the magnetic material is reduced through heating, which then allows the magnetic orientation to be switched ("write") before the cooling process is completed. Reproduced under a CC BY-NC-ND 4.0 license from: Hsu and Victora, *J. Magn. Magn. Mater.* 563, 169973 (2022).

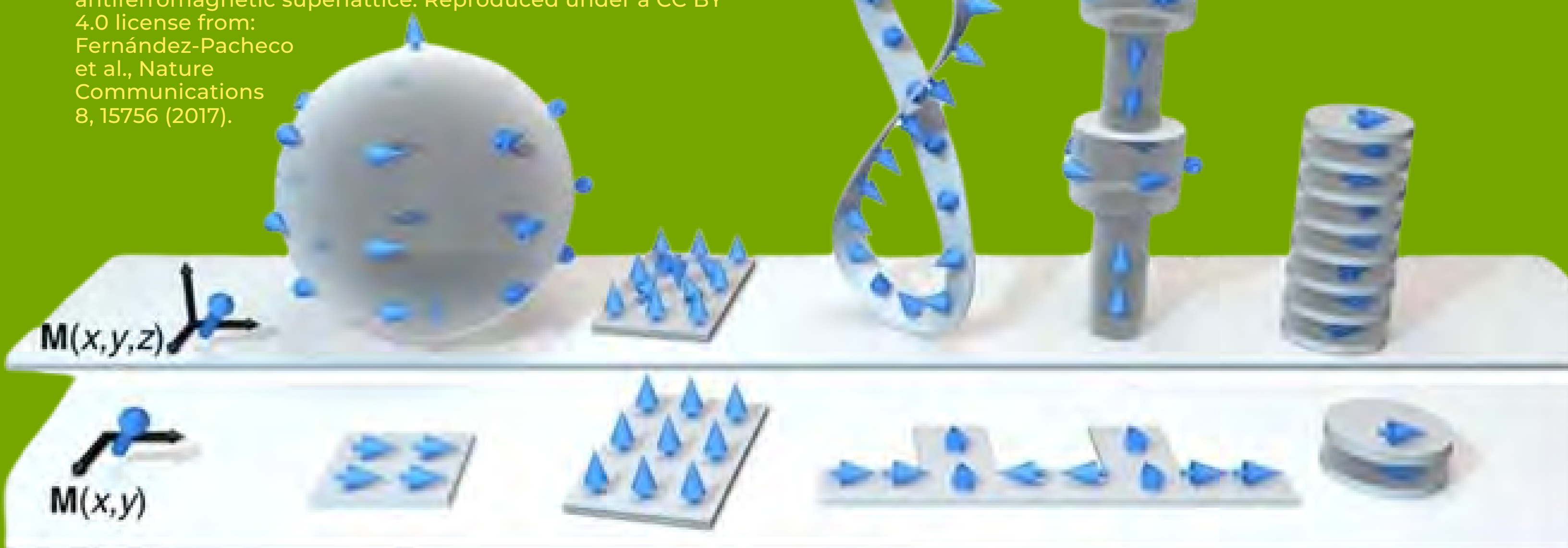
As of December 2023, the above-mentioned HAMR is currently being integrated into HDD mass production by Seagate, Western Digital, and potentially other competitors. The underlying idea is to use a laser that heats a small area of the disk surface prior to changing the magnetic orientation of the corresponding bit; see Fig. 2(a). As shown in Fig. 2(b), this very localized heating makes it easier to switch the magnetization (owing to a reduction of the coercivity) and thereby allows for more closely packed magnetic bits. Once the write head has flipped the magnetic orientation, the heated area cools down quickly, and the material retains the new magnetization state. The design is such that at room temperature no switching can occur. HAMR has been developed in order to counteract the effects of superparamagnetism, which has become increasingly relevant in the past years due

to the shrinking of the magnetic bit size. Below a critical size, thermal fluctuations can cause the magnetization to randomly flip, leading to data loss in the HDD. Therefore, HAMR is making use of materials with magnetic regions that can only be switched at elevated temperatures.

Further intriguing topics include the integration of magnetic recording with artificial intelligence and machine learning, presenting a fascinating landscape for advanced algorithms in data retrieval and processing. The synergy of magnetic storage with neuromorphic (brain-inspired) computing holds the potential to reshape computing architectures. Additionally, the emergence of probabilistic computing introduces new dimensions and may provide an exciting middle ground between conventional and quantum computing. Here, so-called p-bits take on the binary values 0 and 1 with controlled probabilities and can be used for randomized algorithms. It has been proposed, for example, to realize stochastic p-bits by using magnetic tunnel junctions.

Applications beyond traditional hard disk drives, such as three-dimensional magnetic architectures, spin waves-based logic, racetrack memories, and other novel concepts, may play an essential role in the technology's evolving trajectory in the field of data storage and information technology, but also for other applications such as magnetic sensing. Figure 3 contains numerous examples of three-dimensional nanomagnets that can be fabricated using two-photon direct-write optical lithography, chemical synthesis techniques, or focused electron beam induced deposition (FEBID). All of the above-mentioned ideas are pursued in the research field termed "spintronics." In this field, unlike in conventional electronics, which relies solely on electron charge, the spin of an electron presents an additional degree of freedom and offers potential advantages such as increased energy efficiency and novel functionalities in devices.

Figure 3. Different geometries of (a) three-dimensional and (b) two-dimensional nanomagnets, including a magnetic sphere, Möbius strip, cylindrical nanowire, and an antiferromagnetic superlattice. Reproduced under a CC BY 4.0 license from: Fernández-Pacheco et al., Nature Communications 8, 15756 (2017).



In conclusion, our exploration of the development of magnetic recording has unveiled a rich history and transformative advancements in the underlying technology. From the humble beginnings of the IBM RAMAC in 1956 to the present state-of-the-art HDDs with 20 TB capacity, the evolution has been remarkable, significantly reducing the cost of storing a gigabyte to a mere \$0.02. Key technological milestones, including the transition to magnetoresistive reading and the adoption of perpendicular writing and heat-assisted magnetic recording (HAMR), have paved the way for higher storage densities. As HAMR is actively being integrated into mass production, the field continues to evolve. Exploring innovative concepts like probabilistic computing and three-dimensional storage architectures further underscores the dynamic trajectory of data storage and information technology.

Should you have any comments, questions, or suggestions, please reach out to us by writing an email to lonskymartin@gmail.com. If you are interested in learning more about some of the above-mentioned topics, we provide a list of recommended articles in the following.

Recommended reading

- HAMR: Hsu and Vitoria, J. Magn. Magn. Mater. 563, 169973 (2022)
- 3D nanomagnetism: Fernández-Pacheco et al., Nature Communications 8, 15756 (2017)
- Spintronics: Hirohata et al., J. Magn. Magn. Mater. 509, 166711 (2020)
- Probabilistic computing: Chowdhury et al., IEEE Journal on Exploratory Solid-State Computational Devices and Circuits 9, 1 (2023)
- Spin waves-based logic: Mahmoud et al., J. Appl. Phys. 128, 161101 (2020)
- Neuromorphic computing: Grollier et al., Nature Electronics 3, 360 (2020)



LIST OF 2024 IEEE MAGNETICS SOCIETY DISTINGUISHED LECTURERS

Submitted by Hendrik Ohldag,
Distinguished Lecturer Chair

Kerem Camsari
(UC Santa Barbara, USA)

Alina Deac
(Helmholtz Zentrum Dresden, Germany)

Prem Piramanayagam
(Nanyang Technological University, Singapore)

Satoru Emori
(Virginia Tech, USA)

NEW SENIOR MEMBERS

The following members of the
IEEE Magnetics Society were
recently elevated to the grade of
Senior Member:

August 2023:

Kurinjimalar L.
Myung-Seop Lim
Teruo Ono
Byong-Guk Park
Riccardo Tomasello

November 2023:

Subhankar Bedanta
Jonathan Bird
Jian Feng
Adam Larson
Abhronil Sengupta
Yayoi Takamura
George Tsekouras

September 2023:

Alexei Filatov
Alexander Sutor
Kai Wu



For more
information on
elevation to Senior
Member, visit the
IEEE Senior Member
Grade webpage



Meet a MagSoc AdCom Member: International Relations Coordinator

My name is Min-Fu. I am a distinguished professor in the Department of Electrical Engineering at National Cheng Kung University (NCKU) in Taiwan. Concurrently, I hold the position of associate vice president for research and development at the university. My primary focus lies in enhancing our faculty's research capabilities, particularly nurturing the development of young talents, who are the future pillars of our institution. Understanding their needs, whether it is funding, resources, administrative support, or simply encouragement, underscores the importance of a well-designed strategy in guiding and nurturing their journey towards a successful career.

Looking back at my professional trajectory, my academic endeavors actually centered on mechanical engineering from my undergraduate studies through to my Ph.D. My exploration into the realm of electric motors commenced during my postdoctoral tenure.

Transitioning to an assistant professor in the Department of Systems and Naval Mechatronic Engineering at NCKU marked the inception of my research team. Over time, my research expanded into electromagnetics and electronics, leading me to my current role in the Department of Electrical Engineering.

A portrait of Min-Fu Hsieh, a man with short dark hair and glasses, wearing a dark blue suit, white shirt, and a striped tie. He is standing against a teal background.

Min-Fu
Hsieh

These experiences have molded me into a researcher unafraid of cross-disciplinary challenges, fostering an ease in collaborative work. I often share my journey with young minds, not due to its uniqueness, but to inspire breaking barriers across disciplines for innovative collaboration in today's context.

My research primarily focuses on electric machine design, drives, control, and applications, particularly in electric vehicle propulsion. In the IEEE Magnetics Society, electric motor-related research seems to be a distinctive, application-oriented domain. Though some may consider electric motor research to be less advanced, the rapid development in materials, semiconductors, and sustainable applications demands continuous work. Driven by advancements in renewable energy and green transportation, electric machines hold increased significance. My involvement in collaborative industry-academia projects with companies such as Delta Electronics, Taiwan Space Agency, and manufacturers of propulsion or powertrain systems has garnered domestic recognition and honors.



My engagement with IEEE commenced in 2001 when I began researching electric motors. Intermag 2005, sponsored by the IEEE Magnetics Society, marked my inaugural conference attendance. By Intermag 2011, held in Taipei, I served as editor for the IEEE Transactions on Magnetics special issue dedicated to the event. Since 2013, I have been a consistent editor for the IEEE Transactions on Magnetics. I have also contributed as a guest editor and occasionally as a program committee member for various Intermag conferences. Dr. Cindi Dennis, the general chair for Intermag 2020, invited me as the publication chair. Despite the conference's cancellation due to COVID-19, we successfully collected and reviewed full paper submissions and ultimately published them in IEEE Transactions on Magnetics. I have continued as publication co-chair for Intermag 2022 and 2023 and am honored to hold the same role for the upcoming 2025 Joint Magnetism and Magnetic Materials (MMM)–Intermag conference. An ongoing challenge as publication cochair is securing reliable reviewers for full paper reviews within a short time frame, a task requiring close collaboration with the Program Committee.

I currently serve as the International Relations Coordinator and Technical Committee member for the IEEE Magnetics Society. The coordinator role has allowed me to engage in insightful discussions with global societies, fostering deeper connections and understanding of their operations. I liken this experience to making friends, making the task particularly enjoyable, despite not always receiving responses.

Sister Societies:

- **Chinese Institute of Electronics Magnetics Society (CIEMS)**
 - European Magnetism Association
- **International Compumag Society (ICS)**
 - Korean Magnetics Society
- **Spanish Club of Magnetism (CEMAG)**
- **Taiwan Association for Magnetic Technology**



Women in Magnetism (WiM) Event at InterMag 2023 Conference

Submitted by Montserrat Rivas and Yuko Ichiyanagi, Women in Magnetism Committee

The Women in Magnetism Event at InterMag2023 was successfully held on Tuesday, May 16, 2023, from 5:00 p.m. to 6:30 p.m. in the Sakura 2 room at Sendai International Center, Sendai, Japan, cosponsored by the IEEE Magnetics Society.



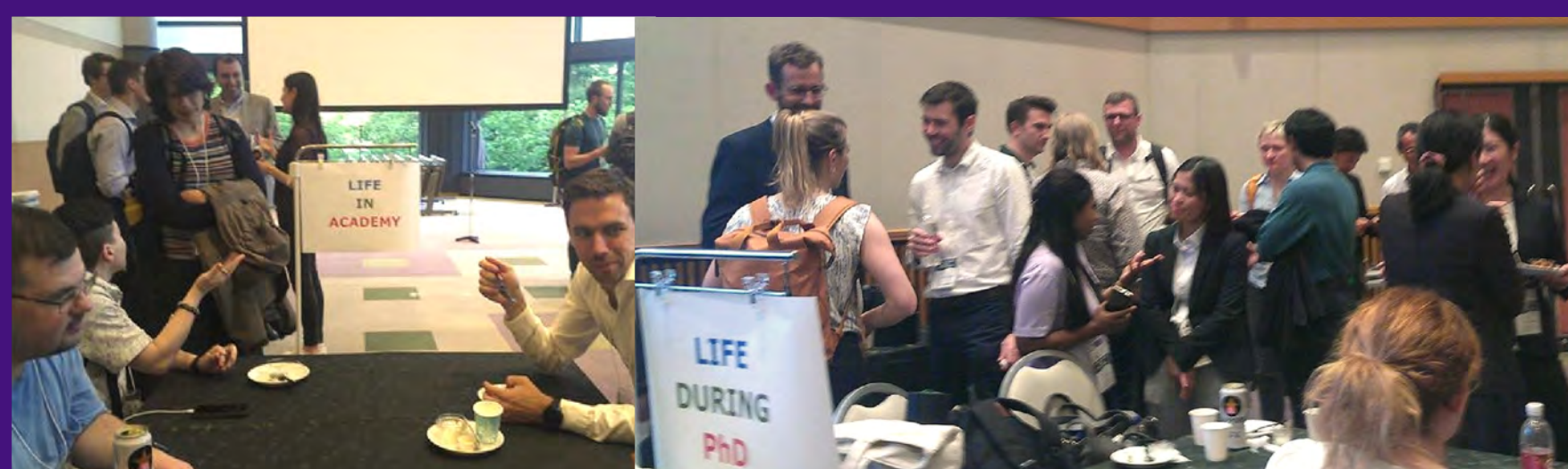
Prof. Rivas, WiM Chair and other volunteer members preparing the topics and proceedings prior to the event



In this event, we aimed to network with other female researchers, discuss our specific challenges in conducting science, and talk about mentoring, leadership, nomination, and job opportunities. Most importantly, we mingled, connected junior with senior attendees, and chatted to share concerns and experiences. This Women's Networking Event was chaired by Prof. Rivas, chair of Women in Magnetism in IEEE Magnetics Society, and Prof. Ichiyanagi, chair of Women in Magnetism for InterMag 2023 Conference. We had about 120 attendees from various countries, including the current president and former president of IEEE Magnetics Society.



Our WiM event at InterMag 2023 Conference starts!



Various topics of interest for information exchange



Prof. Hirohata, current president of IEEE Magnetics Society, with the WiM participants at InterMag 2023 Conference

The event began with opening remarks by Prof. Ichiyanagi and then brief remarks by Prof. Hirohata, the current president of IEEE Magnetics, Prof. Yamaguchi, the former president of IEEE Magnetics, and Prof. Rivas; announcements were made freely by those who had information to offer about positions and other information.

Next, "Leadership," "Life During PhD," "Life After PhD," "Life in Academia," "Volunteering in the IEEE Magnetics Society," and "Mentoring" topics were posted on the tables, and the participants separated into groups by topic of interest to exchange information. At the "Life During PhD" table, they expressed their request directly to the president, and he immediately planned to set up a bulletin board where everyone could view open positions. There were all kinds of other exchanges of ideas in every corner of the room, regardless of the theme.

Female and male researchers exchanged opinions and deepened mutual recognition and understanding of the differences in the situations in each country. They enjoyed the green forest scenery and the Japanese snacks and were full of smiles. By the end of the event, everyone was talking about how glad they were to have participated.



MAGSOC SiM



Submitted by
May Inn Sim,
Students in
Magnetism
(SiM) Chair

(IEEE MAGNETICS SUMMER SCHOOL 2023)

5.0 ★★★★★ (94) · Educational event

Located in: [Carovigno-Bari, Italy](#)

Address: [Via della Pineta, 72012 Specchiolla BR, Italy](#)

Hours: [Open 24 Hours](#) ▼

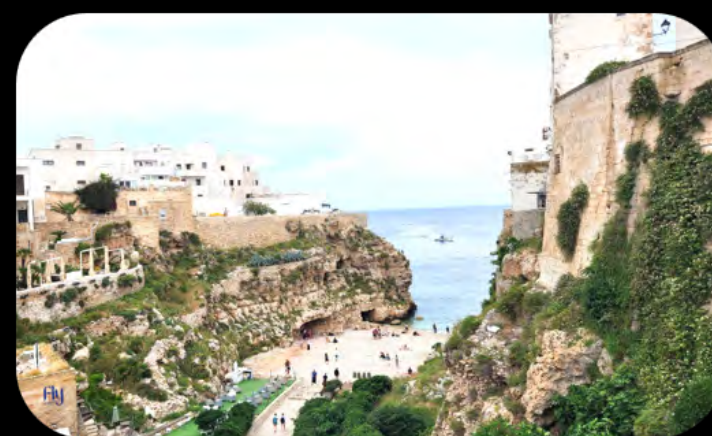
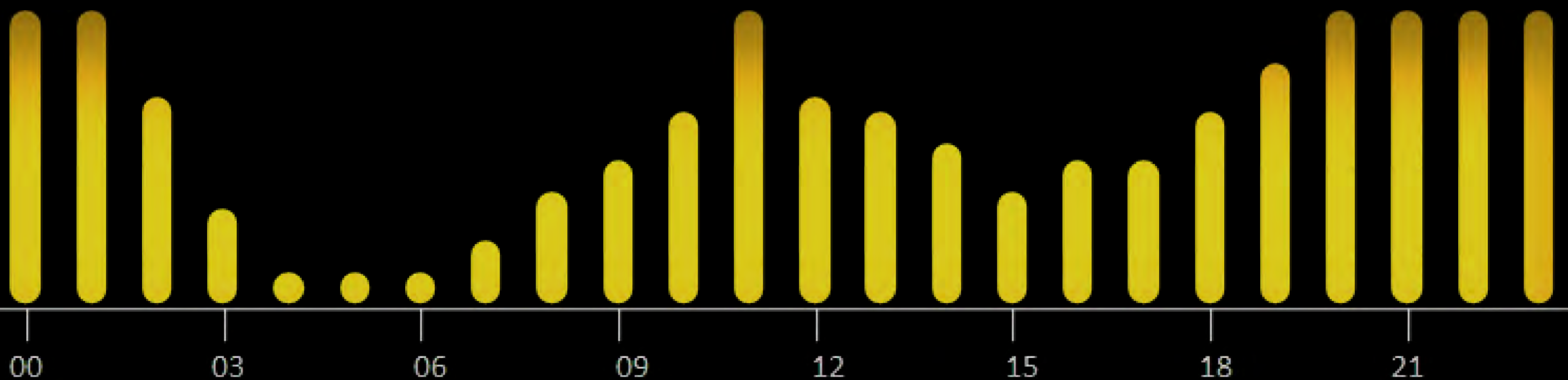


Photo credits: Anthony Duong, Virginia Commonwealth University, Virginia, USA

Popular times:





Daniel Arranz Lopez

Instituto de Magnetismo Aplicado, Madrid, Spain



IEEE Magnetics Society summer school is one of the best experiences I have ever had as a young researcher. My Ph.D. student journey began in June 2020, when the COVID pandemic was at its highest. Not having the opportunity to meet other colleagues in person annoyed me. In return, IEEE summer school allowed me to get to know each other and become friends with people around the globe. I spent two weeks in Bari, Italy, receiving knowledge from top-performance researchers, helping me improve my career, and opening my mind to other research lines I had never thought about. In my resume, I do highly recommend attending the IEEE Magnetics Society for its academic, and personal development value.



Maxwell Robbins

University of Notre Dame, Indiana, USA



Coming into an event titled "IEEE Magnetics Summer School," I must admit my expectations were around the level of a typical academic conference. Combined with travel difficulties, the outlook was looking bleaker as I arrived at the event.

All anxieties were forgotten the instant I left my final flight and smelled the sea breeze. The coastal, relaxed feel carried throughout the event and did much to balance the rich depth of technical content. The organizers of the event did a wonderful job of planning events and excursions, with the trips to Bari and Carovigno as particular highlights.

The technical content included talks from renowned experts with an astounding diversity and depth of content in the field of magnetism.

The poster sessions were another great way to learn about a wide range of topics in magnetism.

Above all else, all of these opportunities contributed to help establish many, many contacts and friends for the future. I would recommend to any student in magnetism 👍



Anthony Duong

Virginia Commonwealth University, Virginia, USA



Met people I never would have met and had experience I never would've had without the summer school. Amazing speakers and amazing people. Arrived in Italy a grad student and left a scientist.



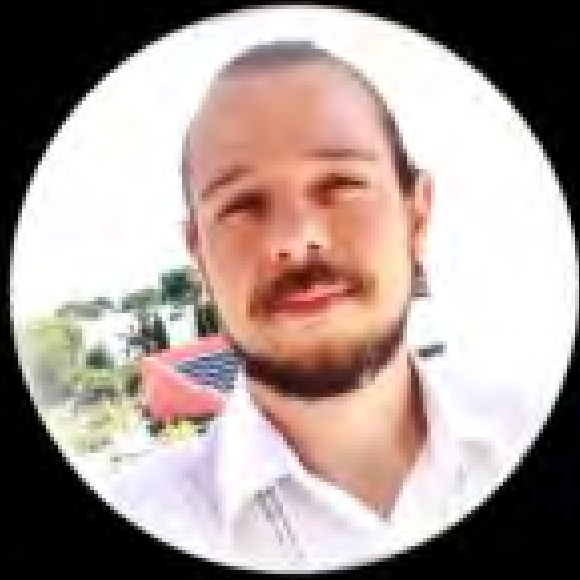
Yuxuan Yao

Beihang University, Beijing, China

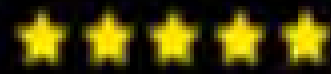


I had no idea before the summer school that it was such an amazing journey. I've learnt a lot, made so many amazing friends, and enjoyed the beautiful scenery. Feel great to have friends to have dinner with from all over the world!



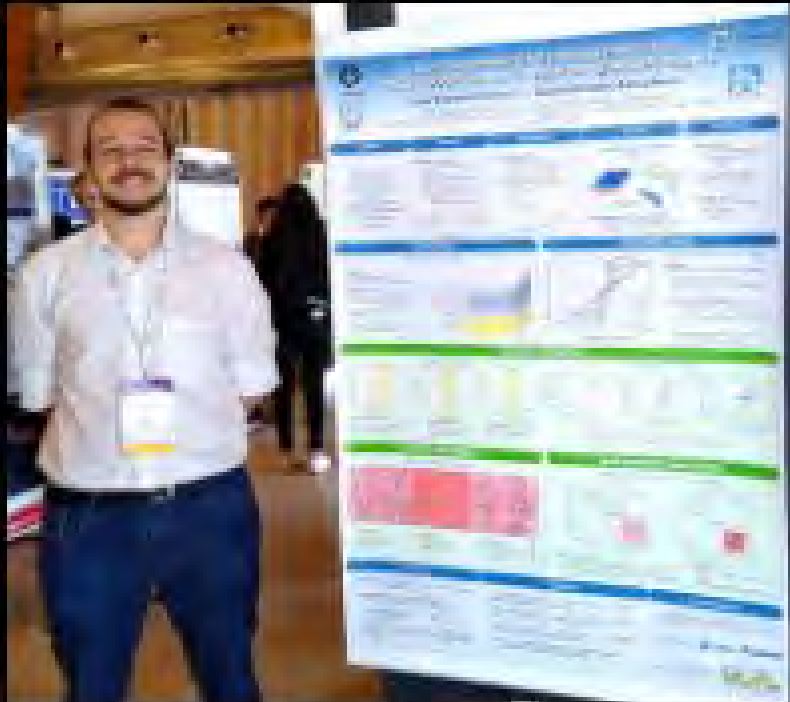


Lucas Scaranari Palhares
University of Campinas, Brazil

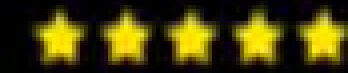


I think the IEEEEMSSS stands out for its worldwide reach to students and early-career researchers, providing a space where young researchers from all over the world can interact among themselves and with distinguished experts, who share invaluable information about

research and the researcher's life. I am beyond grateful for the time I had in Italy with my peers and masters. I'm also sure that I came home with a much bigger understanding of my research field and my role within it.



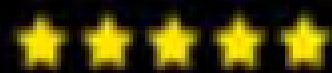
Daniela Abigail López Mireles
IPICYT, San Luis Potosí, Mexico



I found the lectures very interesting, inspiring and novel; maybe a talk about survival to the PhD would have been nice *jejeeje*. Bari was beautiful, and meeting people who work on the same theme Magnetism and with the same passion than me was amazing and [I left with] the vision of future collaborations without a doubt. I came back to my lab wanting to investigate more on many new topics that I learned about in summer school.



Aditya Kumar
JGU Mainz, Germany



One of the best combinations of lectures to give a thorough introduction to the world of magnetism. A picturesque holiday resort to still give you a fun and relaxing time. Get to know your peers and make friends for rest of your career.

10/10 would recommend.



Carlos Iglesias Fernández-Cuevas
IMDEA Nanociencia, Madrid, Spain



What to say about our Summer School... It was a great experience in both scientific and social ways. We had the opportunity to meet other students working on magnetism and exchange many stories and experiences. And we can't forget about the nice people we share our days in Bari.

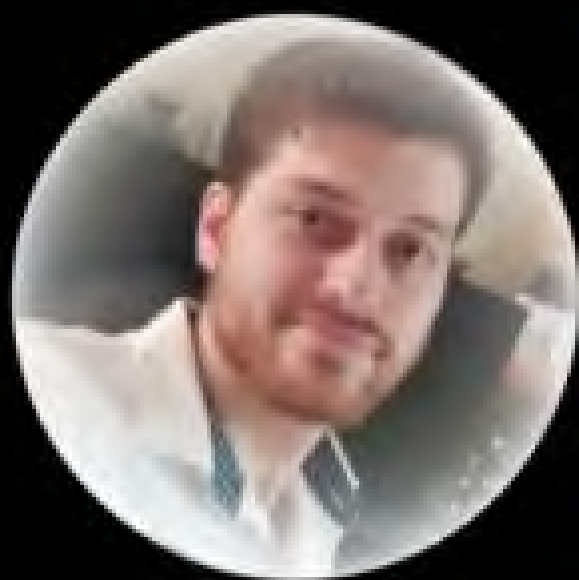
The venue was a perfect choice for the school. A big classroom for lectures, swimming pool, great food and nice weather.

Talking about lectures, we also get to know many important figures from several fields in magnetism and learn from them and their work. Combining all of this let us to understand how experimental, simulation and theoretical works can come together

developing new research results and how magnetism and magnetic phenomena can be understood from different points of view.

But why I gave 4.9 stars? Well, because one week was an extremely short period of time to share with all my new friends and to learn about magnetism.





Jorge Vergara Ortega

*IMDEA Nanociencia,
Madrid, Spain*



The summer school was placed in an amazing place for meeting people, interacting with them and forging friendship.

Lectures were conducted by exponents of magnetism in the world, but the class was a bit too large.

The organization was impeccable, and the organizers were very approachable.



Kayna Lee Mendoza Trujillo

*Argonne National Laboratory,
Chicago, Illinois, USA*



The IEEE Magnetics Society Summer School 2023 in Bari, Italy, was a wonderful opportunity for rising students in the field to come together from across the globe and interact in a way that broadens perspectives, professionally network, and socially gather.

Overall, the lectures given by expert scientists were insightful, spanning from fundamental science to innovative and inspiring applications such as targeted drug delivery. My knowledge on the topic of magnetism was certainly broadened and further enhanced by the daily poster sessions given by the attending students. Much of this time was spent engaging in discussions, likely out of your niche area of expertise, to challenge both speaker and listener to ask questions and spark a new "train of thought" or level of understanding.

Leisure during the summer school was limited! While we had access to most of the amenities provided by the all-inclusive beach resort, we didn't have much time to actually go to the beach since most of the time was allotted to lectures and poster-sessions. However, the excursions held by the school to Polignano a Mare and Bari were absolutely fantastic! Tasty food, lovely company with new friends, and breathtaking views, what more can we ask for? From the science to the social, the program was a beautiful experience. Thank you for bringing us altogether to learn from each other.



**Ricardo Moura
Costa Pinto**

*University of Porto,
Portugal*



The IEEE Magnetics Society summer school in Bari was nothing short of perfection. Whether from a more academic point of view, with the lectures that ranged from the most varied areas, from the foundations of magnetism to spintronics, magnetic textures and various other applications, to the poster presentation where we had the opportunity to present our scientific work as well as get to know the work of colleagues from all over the world in a didactic environment of scientific discussion. Whether in a more networking or leisurely



environment, in which we were able to enjoy the best that the Italian south has to offer, from the fantastic gastronomy, music and dance to the more historical component of Bari, which we also had the opportunity to visit. Even for the good fortune that our visit to Polignano a Mare coincided with the start of the San Vito Martire festivities and to the fact that the weather forecast was for rain for the whole week and we were simply presented with beautiful sunny days, it would be simply impossible to ask for anything better.

So, I'd like to thank IEEE Magnetics Society once again and the team organizing the event, especially Vito Puliafito and Giovanni Finocchio.

Grazie Mille





Amil Ducevic
*University of Vienna,
 Austria*
 ★★★★★

The Lectures: Great diversity of topics within magnetism, from people with years of experience.
 Poster Session: Great opportunity to discuss different work with peers, whether you are already invested in the specific topic or come in completely fresh, doesn't matter. You always come out knowing more than before.
 Location: The venue had amazing food and was overall great. Although it wasn't in the city of Bari, we made excursions to the Politecnico di Bari and Polignano, which were personal highlights for me.
 The people: Truly magnetic 🇪🇺



Supun B. Attanayake
*University of South
 Florida, USA*
 ★★★★★

A wholesome week. Really loved the interactions with and beyond the summer school. Beautiful memories and unique bonds made my experience a truly everlasting one. Would do it again if possible 😊
 A must get experience!



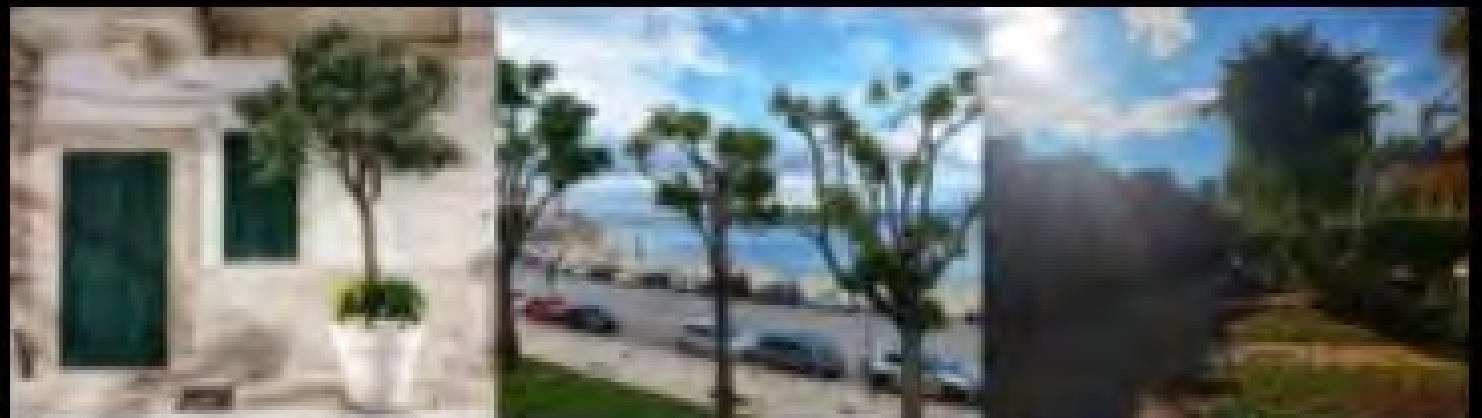
May Inn Sim
*National University of
 Singapore, Singapore*
 ★★★★★
 Yes. 👍



Swarnali Hait
*S. N. Bose National Centre for
 Basic Sciences, Kolkata, India*
 ★★★★★

When we finally arrived at the Riva Marina resort in the evening of June 11, 2023, after a 13-hour flight from Delhi to Milan and a whole night on a bus from North Italy (Milan) to South Italy (Bari), we were welcomed to the school with a very wonderful lecture by Prof. Atsufumi Hirohata and a lively cocktail party. Within a blink of an eye, the six days of the school were over, jam-packed with engaging lectures from renowned scientists, thought-provoking quizzes by the end of the lectures, pool hopping during lunch breaks, a gala dinner filled with dancing until everyone was completely exhausted, late night truth and dare party by the pool with some lovely and very welcoming friends, interactive dancing, singing, and quiz sessions organized by the resort, and, last but not least, sight seeings at Polignano, Politecnico di Bari, and the city of Bari. The warmth in the welcoming smile of people around, the diversity of the cuisines, and the breathtaking views of the surroundings have secured the school a permanent happy place in my memory.

Thanks a lot to the organizers, who put in a lot of time and effort to ensure that the school became a memorable experience to us.



Dedicated to the ones who made it possible,

Co-Directors

Vito Puliafito
Giovanni Finnochio

IEEE Magnetics Society Educational Committee

Hyunsoo Yang
Andrii Chumak
Amal El-Ghazaly
Ravi Hadimani
Tae Hee Kim
Peng Li
Leszek Malkinski
Montserrat Rivas
Laura Steren
Dan Wei

IEEE Magnetics Society President

Atsufumi Hirohata

Local Organizing Team

Mario Carpentieri
Anna Giordano
Christian Rinaldi
Silvia Tacchi
Paola Tiberto
Riccardo Tomasello
Emily Darwin
Francesca Garesci

Lecturers

Atsufumi Hirohata
Olivier Fruchart
Ester Palmero
Cindi Dennis
Kyung-Jin Lee
Manuel Vázquez
Denys Makarov
Andrii Chumak
Yoichiro Tanaka
Hyunsoo Yang
Sara Majetich
Susana Cardoso de Freitas
Giovanni Finocchio
Vito Puliafito

Class of 2023

Abdullatif Durgun
Adam Whitney
Aditya Kumar
Alexandra Christina Carter
Alison Hailey Roxburgh
Allison Harpel
Amil Ducevic
Andrea Grimaldi
Anirban Mukhopadhyay
Anthony Duong
Anton Lutsenko
Anupam Gorai
Ao Du
AshishKumar Moharana
Asma Mouhoub
Bala Priyadarshini Shanmugam
Byron Fritsch
Carenza Elizabeth Cronshaw
Carlos Iglesias Fernandez-Cuevas
Christian Duffee
Christin Schmitt
Cody Trevillian
Daniel Arranz Lopez
Daniela Abigail Lopez Mireles
David Fehr
David Raftrey
Dinesh Wagle
Do Thi Nga
Eleonora Raimondo
Florian Millo
George Mathew
Gregory Andrews
Hannah Bradley
Hauke Lars Heyen
Hong En Fu
Ishmam Nihai
Jan Maskill
Jennifer DeMell
Jiaqi Lu
Jorge Revuelta Losada
Jorge Vergara
Jose Alejandro Ruiz Torres
Julie Soho Shim
Justin Dickovich
K. Mudiyansele Tharindu
Supun Bandara Attanayake
Kayna Lee Mendoza Trujillo

Khanitta Yuanmae
Krishna Priya Hazarika
Krzysztof Sobucki
Libor Vojacek
Lorenzo Gallo
Lucas Scaranari Palhares
Luciano Mazza
Manoj Talluri
Marc Rovirola Metcalfe
Martin Tkac
Maxwell Robbins
May Inn Sim
Megan Smith
Misbah Yaqoob
Mohamed Ben Chroud
Mohannad Tashli
Muhammed Bilal Khan
Nica Jane B. Ferrer
Nikolai Kuznetsov
Nivarthana W. Y. A. Yapa Mudiyansele
Omar Bishop
Pankaj Pathak
Peter Fischer
Pratap Kumar Pal
Priyanka Babu
Raisa Fabiha
Rebecca Sack
Rhea Hoyer
Ricardo Moura Costa Pinto
Rungtawan Khamtavi
Saikat Maji
Sali Salama
Samuel Liu
Shu Hui Lee
Sinead Annie Ryan
Swarnali Hait
Tzu-Hsiang Lo
Ulysse Rocabert
Vaishnavi Kateel
Vismaya Rajeevan
Ward Janssens
Wasan Pantasri
Weixiang Li
Wen-jie Wan
Wociecz Jacek Klich
Xinran Wang
Yuki Yoshihara
Yuxuan Yao





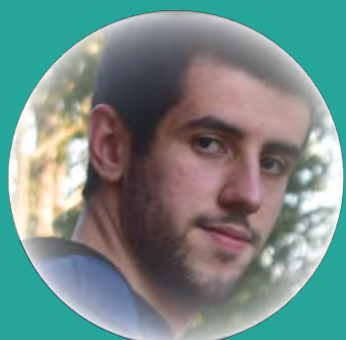
MAKE SENSE OF YOUR SENSORS

By Students in Magnetism (SiM)
of IEEE Magnetics Society

MagnetSiM is the annual outreach series introduced by Students in Magnetism (SiM) in 2022. Each year, we launch a different theme, providing graduate students with a platform to participate in outreach activities and younger students with the opportunity to learn the fundamentals of magnetism through interactive and hands-on activities. More information related to MagnetSiM series are available on our website: <https://www.studentsinmagnetism.org/events>. We encourage you to explore our past activity *MagnetSiM 2022*, where students around the world learned about Earth's magnetic field and phone magnetometers. All learning materials and activities are available to the public, and we welcome educators to bring forth our activities to your classrooms!

In July 2023, the SiM team launched their outreach theme of the year for the *MagnetSiM* series: *Make SENSE of your SENSORS*. This initiative invites high school and college students to explore the wide applications of Hall sensors. Students learned about the various types of Hall sensors and discovered different creative ways to incorporate Hall sensors into applications in daily life. In *MagnetSiM 2023*, high school and college students were invited to participate in a competition where they unleash their creativity by designing and constructing innovative projects utilizing Hall sensors!

In the competition process, graduate student members of SiM served as project buddies to provide mentorship to the participants. The graduate students guided the participants through their projects with meaningful feedback and discussions via forums hosted on our [website](#).



Ricardo Pinto
(IFIMUP/University of
Porto, Portugal)



Maxwell Robbins
(University of Notre
Dame, USA)



Yuxuan Yao
(Beihang
University, China)



Swarnali Hait
(S.N. Bose National
Centre for Basic
Sciences, India)



Andrea Esquivel
(Universidad de los
Andes, Colombia)



Daniela Abigail
López Mireles
(IPICYT, Mexico)



Kayna Lee
Mendoza Trujillo
(Argonne National
Laboratory, USA)

On November 11, 2023, SiM successfully hosted our first ever Virtual Science Fair, inviting high school and college student participants to showcase their projects at the SiM gathertown headquarters. Attendees enjoyed a virtual tour of our collaborative work and recreational space and interacted with the SiM members. The Virtual Science Fair culminated with the highly anticipated awards ceremony, recognizing the outstanding efforts of both projects and project buddies with well-deserved prizes. It is worth noting that all submissions received from participants showcased excellent ideas and creativity. With this, we concluded the competition segment for *MagnetSiM 2023*.

If you missed the Virtual Science Fair, fret not! You can still check out the [projects here](#), where video demonstrations and project reports from participants are available!

SiM would like to take this opportunity to thank everyone who was involved in making the competition a success. Firstly, we have the participants **Brittany Tan, Jerick Seng, Leroy Hong, Febio George, Prisha Ghosh, Chuang Jun Han, Su Ying Da, Nahilus Ng, Mallari Kimberly** (all hailing from Singapore Polytechnic, Singapore), and **Hayden Lee Hyong Shin** (Ngee Ann Polytechnic, Singapore). We have our graduate student buddies (**with their profile pictures listed above**). Last, we have our SiM Virtual Coffee Hours team—the Virtual Baristas who coordinated the Virtual Science Fair—**Carlos Iglesias** (IMDEA, Spain) and **Jorge Vergara-Ortega** (IMDEA, Spain). We would also like to thank **IEEE Magnetics Society** and **Atsufumi Hirohata** (Tohoku University, Japan) for their support towards *MagnetSiM*!

by Chuang Jun Han & Su Ying Da
(Singapore Polytechnic,
Singapore)



by Jerick Seng & Leroy Hong
(Singapore Polytechnic,
Singapore)



by Brittany Tan
(Singapore Polytechnic,
Singapore)



If you have any enquiries or wish to collaborate with us, please feel free to contact us at SiM@ieeemagnetics.org. Don't forget to follow us on Twitter/X @SiM_IEEEMagSoc for updates about our ongoing activities!



5TH JOINT ANNUAL MEETING OF THE IEEE MAGNETICS SOCIETY AND IEEE NANOTECHNOLOGY COUNCIL CHICAGO CHAPTERS

Submitted by Yi Li
Vice Chair of Chicago Chapter



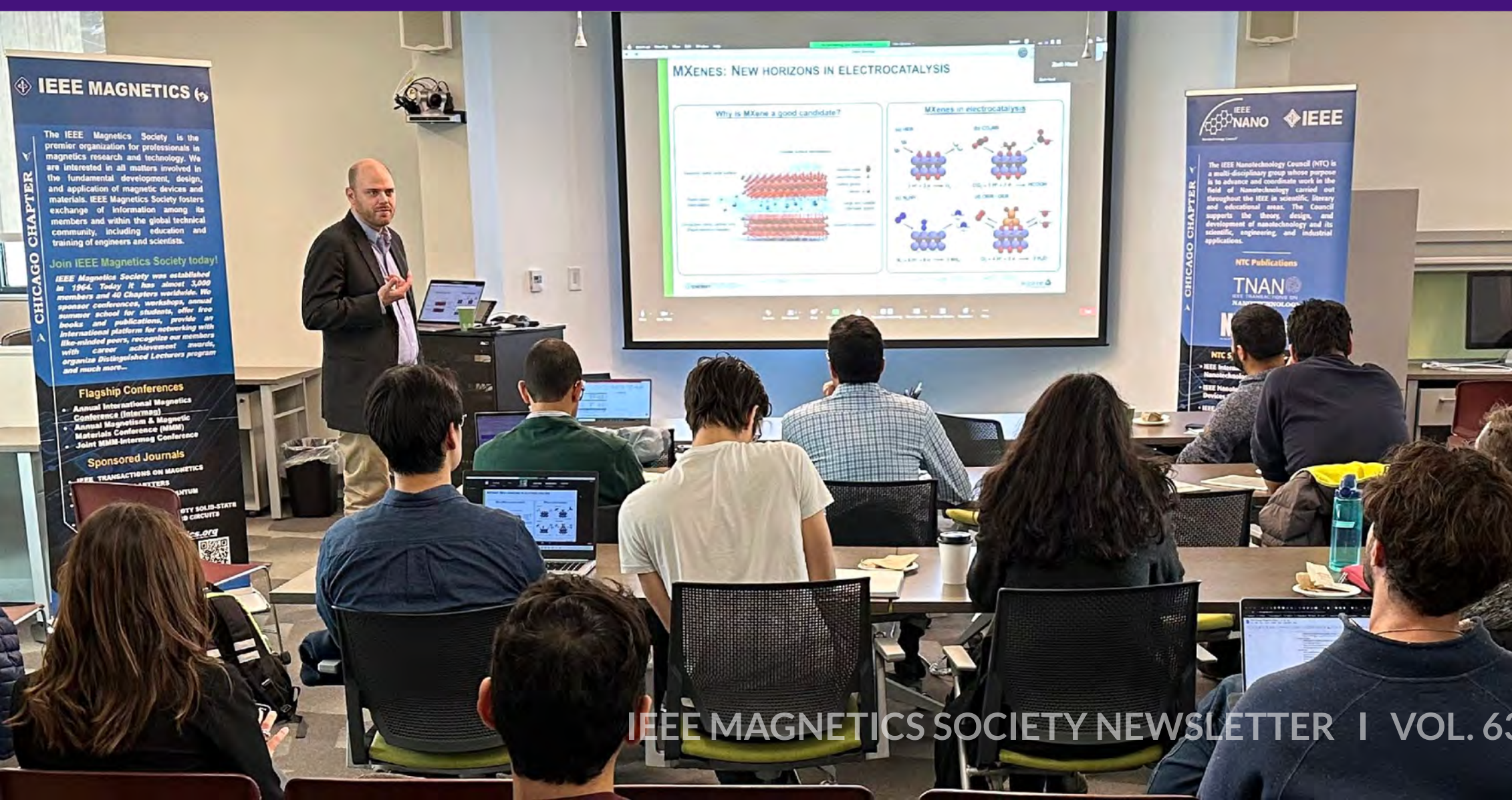
On November 17, 2023, the Chicago Chapters of the IEEE Magnetism Society and IEEE Nanotechnology Council organized their fifth Joint Annual Meeting. The meeting was held at Northwestern University, with virtual attendance available via Zoom. The meeting featured 11 invited talks by experts in the areas of magnetism and nanotechnology, with seven speakers from local Chicago institutes, two speakers from neighborhood cities, and two virtual speakers as IEEE Distinguished Lecturers (DLs), one in magnetism and one in nanotechnology. The meeting covered seven different institutes under the Chicago Chapter. The purpose of the meeting was to advance science, foster networking and collaborations, and promote junior scholars in the Greater Chicago academic community.

This year, the Joint Annual Meeting featured four discussion topics: Spintronics, 2D Materials, Nanomaterials and Orders, and Quantum and Internet Systems. The Spintronics session focused on three frontier topics in magnetism: magnetic sensors, artificial spin ices, and antiferromagnets. One IEEE DL in magnetism, Dr. Susana Cardoso Freitas from INESC-Microsistemas and Nanotecnologias, delivered a talk titled "Magnetic Sensors: From Ultrathin Film Growth to Sensor Integration in Unexpected Systems." Professor Susan Kempinger from North Central College presented a talk about "Perpendicular Artificial Spin Ice," and Mr. Ankit Shukla from the University of Illinois Urbana-Champaign gave a talk about "Understanding SOT-driven Order Dynamics in Noncollinear Antiferromagnets for Next Generation Energy-Efficient Memory and Computing Devices."

The 2D Materials session covered three different angles: new materials, new characterization approaches, and new applications. For new materials, Dr. Zach David Hood from Argonne National Laboratory delivered a talk titled "Two-Dimensional Transition Metal Carbide (MXene) Electrocatalysts for Carbon Dioxide Reduction."

For characterization, Dr. Youngjun Ahn from the University of Michigan presented a talk titled "Shedding Nonlinear Light on Noncollinear Spins." For device applications, Prof. Xianfeng Duan from the University of California Los Angeles, also the IEEE DL in nanotechnology, gave a talk about "2D Transistors: Promises, Problems, and Prospects."

In the afternoon, the Nanomaterials and Orders session covered two different approaches to explore nanomaterials: X-ray and TEM. Dr. Yue Cao (from Argonne National Laboratory) gave a talk about "Watching Microelectronics in Action: A View from Coherent X-Rays." Professor Robert Kile from the University of Illinois at Chicago (UIC) delivered a talk titled "Atomic-Resolution Characterization of Low-Dimensional Materials Using In-Situ Approaches." In addition, in late 2024 or early 2025, UIC will set up the world's first magnetic-field-free, atomic-resolution, monochromated scanning transmission electron microscope at the University of Illinois at Chicago's Research Resources Center (RRC) Electron Microscopy Core facility.



The new instrument will bring unprecedented capabilities to the Chicago-land area, as well as new opportunities for collaborative research in the areas of nanomagnetism, high-temperature superconductivity, quantum materials, and topological systems.

The Quantum and Internet System session covered interesting topics in quantum optics and Internet of Things. Professor Mahdi Hosseini from Northwestern University delivered a talk titled “Quantum Optical Material Synthesis via Top-Down Atomistic Integration.” Dr. Silvia Zorzetti from Fermi National Accelerator Laboratory gave a talk titled “Superconducting Quantum and Internet Systems.” In addition, Prof. Nivedita Arora from Northwestern University presented a talk titled “Sustainable IoT: Rethinking Materials to Applications” for building sustainable computational materials.

A Women In Science (WIS) session was also organized during the lunch break for discussions on life and challenges in academic careers. Hosted by the WIS chair of the chapter, Dr. Yuepeng Zhang (F) from Argonne National Laboratory, a warm discussion took place among the panelists Susan Kempinger (F), Nivedita Arora (F), Silvia Zorzetti (F), and Zach David Hood (M). The WIS session has greatly boosted experience sharing and network building among local Chicago women scientists.

The Joint Annual Meeting announced two awardees for the inaugural IEEE Chicago Early Career Awards in Magnetics and Nanotechnology, Dr. Youngjun Ahn from the University of Michigan and Dr. Peter Smith from Northwestern University. Congratulations to these scientists for their achievements! The chapter made it possible for Youngjun to travel to Chicago, meet with the Chicago researchers, and deliver an excellent talk about his work. This year, the speakers also included two US Department of Energy Early Career awardees from national laboratories, Dr. Yue Cao from Argonne National Laboratory and Dr. Silvia Zorzetti from Fermilab.

The meeting has become a featuring and influential event for building connections in the Chicago academic community, not limited to magnetics and nanotechnology, but covering broad research topics and diverse local institutes. Over the five years, the Joint Annual Meeting has invited 60 different academic speakers, attracted more than 150 IEEE member attendees, and promoted numerous junior postdoctoral researchers, faculty members, and scientists for the benefit of their future academic career. The two Chicago Chapters plan to continue organizing these events on an annual basis in future years.



LEBANESE ELECTROMAGNETICS DAY IN BYBLOS, LEBANON

by Carol Azar



On June 16, 2023, the Lebanon IEEE AP/MTT/MAG joint chapter held the Lebanese Electromagnetics Day in Byblos, Lebanon. The event was attended by professors, researchers and students from various universities and research institutions in Lebanon. It featured three main activities: a talk by a key note speaker, a student competition and a forum about the high-school magnetism project. All this took place in a culturally inspiring environment with the venue in the middle of a Byblos 4000 years old archaeological site on the Mediterranean Sea.

The guest speaker, Dr. Mohammad Awad, is a research director at the National Council for Scientific Research (CNRS). His talk entitled “Remote sensing and Google Cloud Computing Platforms – An overview of some applications in Lebanon” captivated the attention of the audience as he was presenting the various platforms and sensing equipment involved and was elaborating about the data collection, data processing and analysis using the Google Earth Engine (GEE) and the Google Co-Laboratory (Colab). Dr. Awad developed examples of projects related to environment, forestry and archaeology, thus shedding the light on the wide scope of applications and future research trends in the area of remote sensing.

As for the student competition, it featured topics ranging from 3D modeling of motors to microstrip patch antenna for 5G/LTE design to reconfigurable filters for medical equipment. Apart from showing dedication and genuine interest in magnetism and antenna design, the event was a chance for students from various universities to exchange ideas and discuss research plans.

Next, a forum opened the debate about the importance of creativity in introducing the concept of magnetism at the high-school level. The on-going project of offering training in magnetism is leading to an increased interest in the area among high-school students and represents an initiative to be disseminated to a larger number of educational institutions in the future.



Finally, the group gathered for lunch by the port area and awards were distributed for the best student presentations.



IEEE MAGSOC THAILAND CHAPTER HOSTS SUCCESSFUL THAILAND MAGNETECH SCHOOL

by Naratip Vittayakorn



[Bangkok, Thailand] The IEEE Magnetics Society Thailand Chapter successfully hosted the Thailand MagneTech School from October 17 to 20, 2023, at King Mongkut's Institute of Technology Ladkrabang (KMITL) in Bangkok, Thailand. The four-day workshop successfully drew 100 participants from both academic and industry sectors.



The Thailand MagneTech School provided participants with a comprehensive understanding of the latest advancements in magnetic materials and their potential applications across various industries, including energy, electronics, healthcare, and data storage. Renowned professors and industrial researchers from eight leading universities in Thailand delivered insightful lectures covering a wide range of topics, from the fundamentals of magnetism to cutting-edge research.



In addition to theoretical knowledge, participants gained hands-on experience through practical training sessions in advanced materials analysis tools. They also had the opportunity to visit Thailand's first graphene oxide pilot plant, gaining firsthand exposure to the production and potential applications of this promising material.

The workshop also featured a panel discussion on the crucial role and leadership of women in science and technology. This session highlighted the importance of promoting gender diversity in STEM fields and encouraging young women to pursue careers in these areas.



To conclude the workshop, a session focused on the industry's perspective on employment and the demand for STEM professionals. Participants received valuable insights into the job market for these in-demand fields and gained a better understanding of the skills and qualifications required for success in STEM careers.



The Thailand MagneTech School served as a valuable platform for students, researchers, and industry professionals to learn about the field, connect with other interested parties, and explore the exciting world of magnetic materials. The workshop provided participants with the knowledge, skills, and networking opportunities to contribute to the advancement of magnetic materials research and development in Thailand and beyond.

We would like to extend our heartfelt appreciation to all the participants, speakers, and sponsors who made this event a success. The IEEE MagSoc Thailand Chapter is dedicated to nurturing the future generation of innovators in the field of magnetic materials and is committed to continuing this initiative. Sincere thanks go to everyone involved for their valuable contributions.



CHILEAN SECTION ORGANIZES FIVE DAYS OF MEETINGS DURING AN INTERNATIONAL CONGRESS IN SOUTHERN CHILIE

by Juan Luis Palma Solorza
Chile Chapter Chair

The IEEE Magnetics Society Chile Section celebrates every year a member meeting focused on magnetism and magnetic materials topics; this year it was conducted as a networking event at the Latin American Workshop on Magnetism and Magnetic Materials.

In 2019, we celebrated our meeting in the beautiful city of Pucón, in southern Chile, in the framework of an international encounter organized by Chilean and Mexican scientists, where we received researchers from the Latin American (LATAM) community. In 2021, due to the pandemic situation, a virtual encounter was celebrated by the Spain, Brazil, and Chile sections of the IEEE Magnetics Society.

This encounter was called IEEE Collaboration Days and is documented at [this link](#). 2022 was a year of re-encounter, and we celebrated two meetings of the IEEE Magnetics Society Chile Section, one in southern Chile at La Frontera University (SIMAFE 2022) and one hosted by the Chilean Physics Society (SOCHIFI 2022) at University Santa María in Valparaíso, where we received for the first time a visit by Distinguished Lecturer Michael E. Flatté.

This year, 2023, the Chilean members of the IEEE Magnetics Society restored the series during the international congress called the Latin American Workshop on Magnetism and Magnetic Materials (LAW3M), which is an international congress that has been celebrated since 2005, but the last edition was in Mexico in 2016. LAW3M is an important congress for the Latin American scientific community and our students. This event promotes the magnetic community and generates new opportunities for collaborations between close countries in Latin American, giving more opportunities to our students and postdoctoral researchers to visit other laboratories throughout the IEEE R9 region.

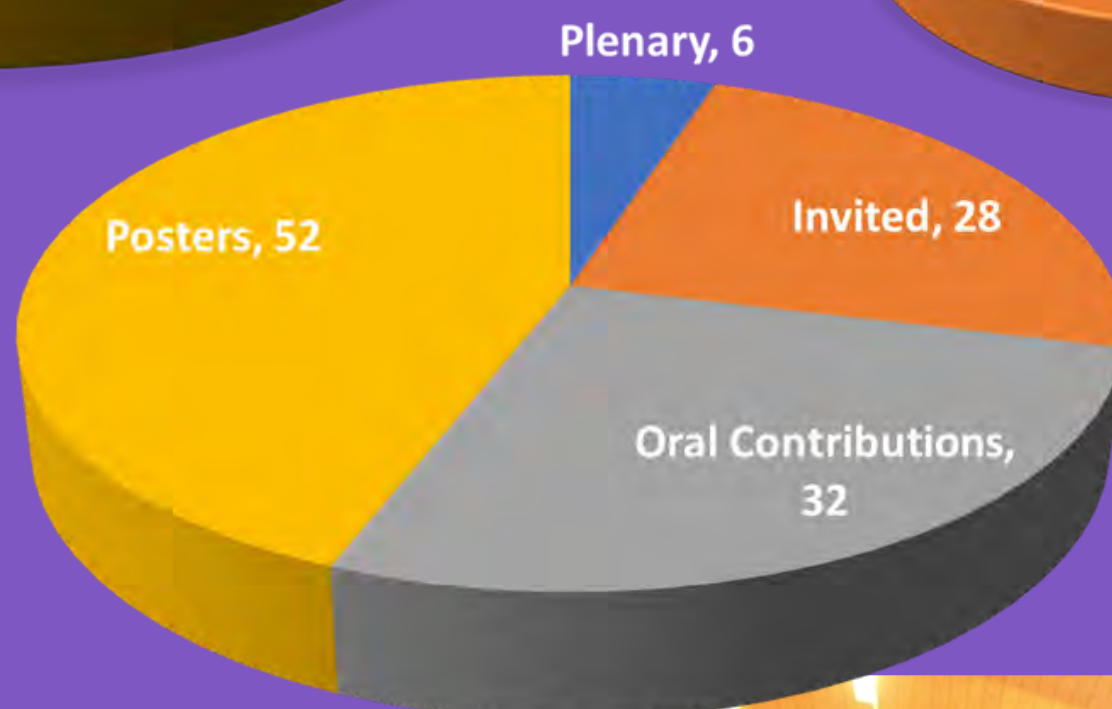
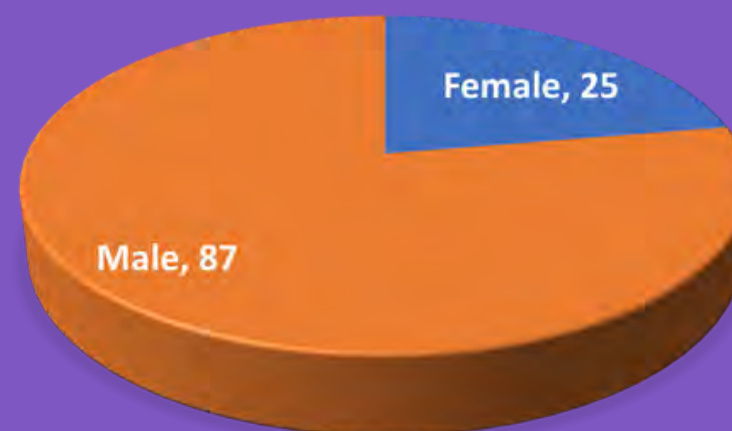
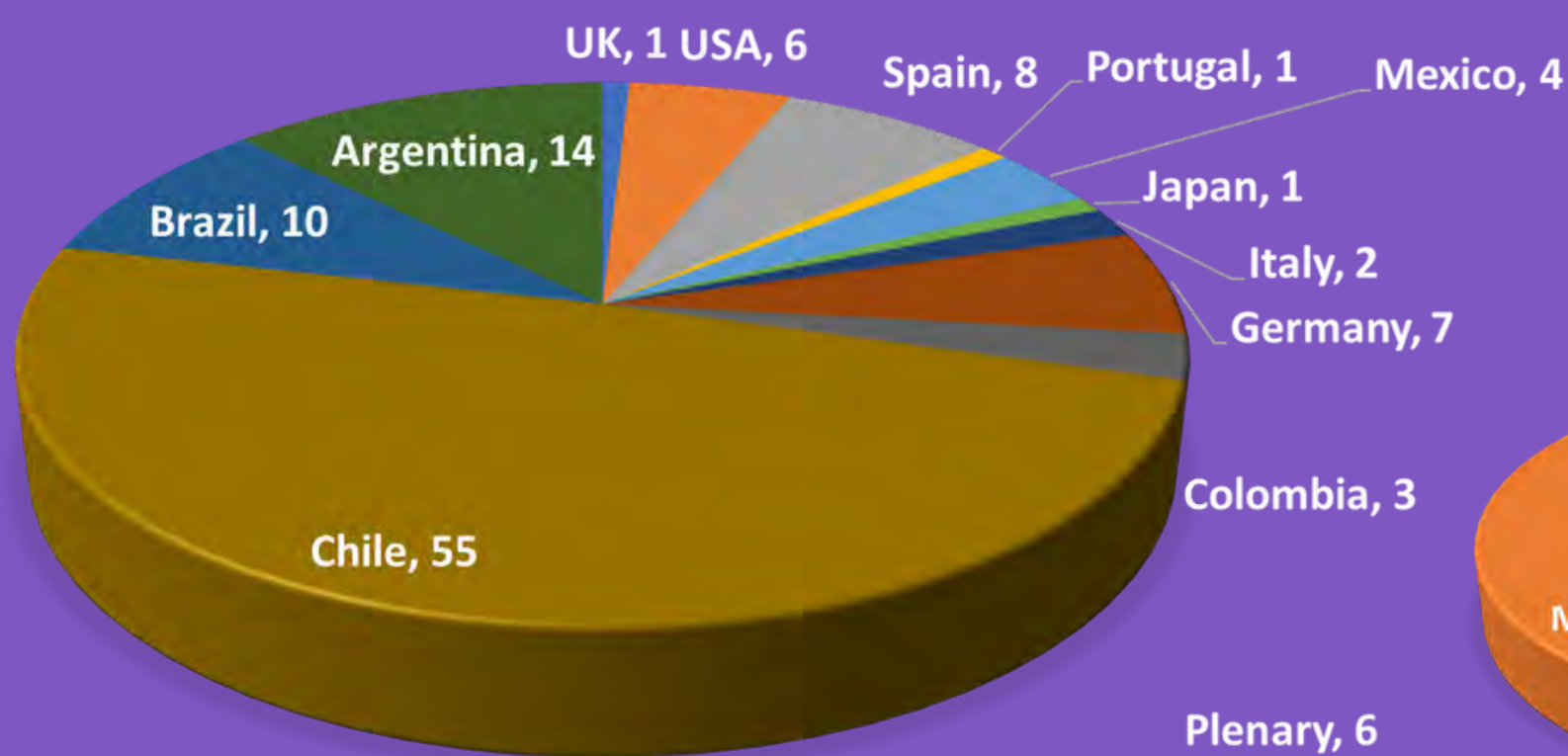


Organizers of LAW3M 2023, from left to right: Nicolás Vidal (UFRO), Sebastian Allende (USACH), Pedro Landeros (UTFSM), Juan Luis Palma (UCEN and IEEE Chile Section chairman), and Rodolfo Gallardo (UTFSM).

In this opportunity, four universities and one research center organized the conference. The Universidad Técnica Federico Santa María, Universidad Central de Chile, Universidad de la Frontera, and Universidad de Santiago de Chile got together for the event organization. Also, the Center for the Development of Nanoscience and Nanotechnology, the most important center of nanotechnology in Chile, also participated.

Official photograph of the LAW3M 2023 conference





The Latin American Workshop on Magnetism and Magnetic Materials was sponsored by six institutions, the IEEE Magnetics Society, ALMA (Asociación Latinoamericana de Magnetismo), Quantum Design, VSA Lab, the Journal of Magnetism and Magnetic Materials, and Thor Labs. We want to thank all the sponsors, but especially the IEEE Magnetics Society, which provided a notable budget for the event that was used for scholarships for students and sponsored the Women in Magnetism reception. Thanks are also extended to the IEEE Magnetics Society for the economic funding that supported the attendance of 18 students from Chile and Argentina.

The event included the participation of 112 scientists from three continents: America, Europe, and Asia. Eighty-six participants came from Latin America, 20 came from Europe, 6 came from North America, and 1 came from Asia, specifically Japan. There were 25 female participants and 87 males. Sixty-six talks were presented at the conference, of which 32 talks corresponded to oral contributions, 28 were invited talks, and 6 talks were given by plenary speakers.



Patricio Vargas and Eugenio Vogel, members of the IEEE Magnetics Society at the Women in Magnetism reception, LAW3M 2023.



Afternoon trip to "Lago de todos los Santos" (All Saints Lake), southern Chile

Thanks go to the IEEE Magnetics Society Distinguished Lecturer Program: LAW3M hosted all four 2023 distinguished lecturers, who were Susana Isabel Cardoso de Freitas, J. Ping Liu, Yoichiro Tanaka, and Manuel Vázquez, as well as Burkard Hillebrands and Antonio Azevedo, who each delivered plenary talks at the conference.



AWARDS & NOMINATIONS CALENDAR



2024 NOMINATIONS DUE

+ + +



+ + +



CONFERENCE & SCHOOL CALENDAR

To list your conference/events in the Newsletter in a future edition, please contact the [Editor](#).

HFM 2024
International
Conference on
Highly Frustrated
Magnetism 2024
Jan 8 -13, 2024
Chennai, India

International
Symposium on
Integrated Magnetics
(iSIM) 2024

May 4-5, 2024
Rio de Janerio, Brazil

**Intermag 2024 -
IEEE International
Magnetics
Conference 2024**

May 5-10, 2024
Rio de Janerio, Brazil

**Symposium @
TMS20204 - Advanced
Soft Magnets and
Magnetocaloric
Materials: An FMD
Symposium in Honor of
Victorino Franco**

Mar 3-7, 2024
Orlando, FL, USA

**Spin
Caloritronics
XIII 2024**

May 20-24, 2024
Beijing, China

**IOP Magnetism 2024 -
UK and RoI conference
welcoming international
and industry participation**
Mar 25-26, 2024
Loughborough, UK

**ICSM2024 - International
Conference on Superconductivity
and Magnetism; together with
Quantum Materials and
Technologies**

Apr 27 - May 4, 2024
Fethiye, Turkey

**CEFC 2024 - 21st
Biennial Conference
on Electromagnetic
Field Computation**
Jun 2-5, 2024
Jeju, Korea

**IEEE MagSoc
Summer
School 2024**

Jun 9-14, 2024
Taipei, Taiwan

**EMSA2024 -
European
Magnetic Sensors
and Actuators
Conference**
Jun 24-27, 2024
Košice, Slovakia

**Summer School of
the Spanish
Magnetism Club -
"Current Research in
Magnetism and
Magnetic Materials:
from fundamentals to
applications"**

Jun 24-28, 2024
Seville, Spain

MMM 2025
Oct 27-31, 2024
Palm Beach, FL, USA

**Joint MMM-
Intermag 2025**
Jan 13-17, 2025
New Orleans, USA

**ICM 2024 -
22nd International
Conference on
Magnetism**
Jun 30 - Jul 5, 2024
Bologna, Italy

**ICMFS2024 - 25th
International
Colloquium on
Magnetic Films
and Surfaces**

Jul 7-12, 2024
Perugia, Italy

THERMAG 2024
Aug 21 - 24, 2024
Baotou, China

**NANO 2024 - 2024
IEEE International
Conference on
Nanotechnology**

Jul 8-11, 2024
Gijón, Spain

**ESM2024 - The
European School
on Magnetism
2024: Magnetism
for energy-efficient**
Aug 27 - Sep 6, 2024
York, UK



IEEE MAGNETICS NEWSLETTER

VOLUME 63 | ISSUE 4 | DEC 2023

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The purpose of the Newsletter of the IEEE Magnetics Society is to publicize activities, conferences, workshops and other information of interest to Society members, sister societies and other people in the area of applied magnetics.

Contributions are solicited from Society and sister society members, Officers & other volunteers, conference organizers, local chapters, and other individuals with relevant material. The Newsletter is published quarterly on the Society website at: <http://www.ieeemagnetics.org>.

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In Memoriam

- + Bruce A. Gurney
- + Helmut Kronmüller

Magnetic Recording

- + IEEE Milestone Award
- + Magnetic Recording & Spintronics

- + The Write Stuff
- + Subjective and Objective Pronouns

- + Students in Magnetism
- + Reviews
- + Summer School 2023

