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IMS in 1985 and 37 years later

1976 - 1980　B.S. in Chemistry, Massachusetts Institute of Technology
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1985 – 1987　Postdoctoral Fellow, Institute for Molecular Science
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2024 – 2034　International Fellow of the Japan Society of Vacuum and Surface Science
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I have participated as a Postdoctoral Fellow from 1985 and as a Research Associate from 1987 to 1993 in Prof. Keitaro Yoshihara's group as my first experience in IMS, and as a Senior Scientific Advisor to the Director General (Prof. Maki Kawai) from 2017 to 2022. So as I grew as a scientist, I could observe IMS evolve as an institution from first hand experience. I was invited to contribute to IMS Letters, and here are my thoughts.

I first heard about IMS from my PhD advisor Prof. Bradley Moore at the University of California at Berkeley, who spent his sabbatical in Okazaki during its formative years. From the stories that I heard, IMS sounded like a beacon on a hill of physical chemistry sciences, and it caught my attention with a transformative effect. During my PhD research I had the opportunity to meet two Japanese scientists, who would later have transformative effect on my career, though when I met them, they were also struggling to establish their careers in Japan. One was Prof. Yoshiyasu Matsumoto (Yoshi), who spent several months in Berkeley working with me on magnetic rotation transient spectroscopy of CH_2, and in doing that established a lifelong relationship. The other was Prof. Maki Kawai (Maki), who one day appeared in my lab, where she borrowed a desk and was quietly working on her PhD research for about two weeks, while visiting her husband who was a postdoc in our group. I do not recall much interaction with Maki, but she had a lifelong impact.

As I was heading towards graduation, I considered going for a postdoctoral study abroad, either in Germany or Japan. The Japan's economy was booming, and we were hearing every day how Japan is overcoming America in this and that, how Japanese were buying American landmarks, and that IMS had become internationally one of the most appealing places to do research. I visited Japan in March of 1985 with Yoshi's help and was introduced to the science and culture. With Yoshi, we discovered that in March, Chuzenjiko is covered in 1 m of snow, but never mind, the onsen was welcoming. That spring, I also met Prof. Yoshihara in Berkeley, who made it possible for me to stay as a postdoc in his group. I came with an ambitious research plan, which was never realized, but I expanded on my laser expertise that started as an undergraduate student at MIT, continued at Berkeley, and at IMS, I had the opportunity to master ultrafast laser operation and spectroscopy. After two years I applied for academic positions in the USA and had an offer from the University of California at Santa Barbara, but Japan had a stronger pull. I had enjoyed life outside of IMS, such as bike riding in Okumikawa before work, meeting friends at their homes and in izakaya, going to Hakusan with the Yoshihara family, etc.,

so I decided to stay a year longer with unforeseen consequences. The USA economy crashed, the academic jobs disappeared, and my only possibility was to stay at IMS as a Research Associate in Yoshihara group. This was certainly a life changing transformation, which ultimately had a good ending. I shared an office with Kazuhito Hashimoto, who was interesting to talk to (if you ever want some stories from his youth, I heard a few), whose presence at IMS was always announced by his red Fairlady Z parked in a prominent place. He was very helpful in my first kakenhi application, which I somehow put together in kanji. In subsequent years I made minor revisions to the original with a 100% success rate. Okazaki became a part of my life, with annual events like hanabi organized by Sugou Jinja, friends in all aspects of life, and finally marriage to my wife, Takako. An important change was the arrival of Yoshi as an Associate Professor in the division led by Yoshihara. What impressed and impacted me about Yoshi, is that he came out of high-resolution molecular spectroscopy field (that reminds me we first met the Ohio State Spectroscopy conference, when he came to talk to me after my presentation), but at IMS he decided to move into surface science focusing on surface molecular photochemistry. It was a mystery to me why he changed, but his proximity and communication showed me that this is ok, and in his case, it was premonition, because high resolution molecular spectroscopy soon ran out of interesting molecules to study. Exposure to his science was important to everything I did since then.

But good things must come to an end. IMS expects anybody below the professor position to move out, but more on that later. With Prof. Yoshihara's help, I got an offer from Hitachi Advanced Research Laboratory, which was striving to become the next Bell Labs, but now, I see, has disappeared from internet. At the time, it was in a truly lovely location to do research in the countryside of Saitama Prefecture. Its location was chosen to enable Akira Tonomura's electron microscopy research with minimum electrical and mechanical interference. As it happened, I was put in charge of a surface science group, and based what I learned from Yoshi, I combined my laser spectroscopy skills with surface science to establish research on ultrafast nonlinear photoelectron spectroscopy. I was fortunate to have contacts with Toshiaki Munakata at RIKEN who advised me on photoelectron spectroscopy, and a capable surface science collaborators, with whom we could very soon do research that was at an international top level. We were pushed by then Director Shojiro Asai to publish in good journals, resulting in 6 PRL publications from my group, but I never reached his norma of 3 per year. These achievements, in part, helped me to get a NEDO International project funding on surface femtochemistry with Yoshi, Nobel Laurate John Polanyi (University of Toronto), Hai-lung Dai (University of Pennsylvania) and Hajo Freund (Fritz-Haber Institute).

In any case, the Japanese economy was getting worse, and having such outside finding appeared to be a wise, so I applied to CREST for a project on ultrafast photoelectron microscopy. The idea was to use nonlinear laser excitation to emit photoelectrons from a nanostructured field distribution and electron optics to image photoemission sources and fields with nanometer spatial and femtosecond temporal resolution. This ended up in a failure for Japan. I was not funded, because the wise men (and it is almost always men) who evaluated the proposal considered it too risky because nobody outside of Japan was doing such research. Such thinking defeats doing original research in Japan.

Considering the situation, after spending 15 formative years as a scientist in Japan, I decided to leave for a Physics Professorship at the University of Pittsburgh. While Japan gave me the opportunity to develop as a scientist, it did not enable me to continue doing world leading science.

At the University of Pittsburgh, I was able to chart my own course. But while my laboratories were being renovated, I was fortunate to have received the Alexander von Humboldt Award to perform research at the Fritz-Haber Institute in Berlin, with Hajo Freund, and at Halle, with Jurgen Kirschner. It was a wonderful opportunity to take my family, with now daughters Rina and Anna to a completely different environment, where we were now all foreigners and had difficulty to communicate with the locals. An important outcome of this opportunity was that in Berlin we could demonstrate

the first ultrafast photoemission electron microscopy research, for which I had left Japan. On returning to Pittsburgh, I started up my new laboratory with two capable Japanese Postdocs, Ken Onda and Atsushi Kubo, also involving visits from Muneaki Hase and Kunie Ishioka from the National Institute for Materials Science. Unfortunately, Japanese young scientists have stopped going abroad, though those who are more adventurous do perform high level research, are noticed, and their broad experience enables them to get the best positions.

Now, to come to 37 years later. While I had a chance to visit IMS on several occasions after leaving, such as Okazaki Conferences, I became personally engaged in IMS administration in 2017 as the Senior Scientific Advisor to Maki Kawai until 2022. I appreciate her choice to seek advice from international experts that can provide a different perspective. What I saw is the IMS had lost much vitality that it used to have on account of its unique facilities and the ability to invite top international scientists. Together with young Japanese scientists not going abroad to do research, top international scientists have stopped coming for collaborative research, because IMS had become less attractive in providing attractive collaborators and facilities. By becoming disengaged from international science, IMS has not been able to follow trends and build on ideas at the forefront of science. While the policy of not promoting young scientists has positive aspects, it also means that the most capable young scientists perform competitive research at IMS with support that would be difficult to get elsewhere, and then they move outside where they continue doing outstanding research. At the professor level, however, there is less motivation or resources to perform outstanding research that will elevate the stature of IMS. Each Director General may have some vision about what science to promote, but while hiring can have impact on the research direction, the research topics become frozen until senior faculty retire. While early retirement age in Japanese research organizations can have positive outcomes by opening positions to younger scientists, the fixed retirement age does not encourage professor to expand their research as they approach that age. I believe that the early strength of IMS was that the professors could attract an outstanding cohort of international scientists, everybody who is anybody, that could make an impact with their presence. Personally, I still have connections with international scientists who were visiting in the early time at IMS, as well as I have had the opportunity to know all the Directors starting with Profs. Nagakura and Inokuchi. While, I may have been of some help to Maki when she was the Director, unfortunately my term ended during COVID. This prevented travel to Okazaki requiring me to listen to faculty presentations in Pittsburgh by Zoom, all night until 6 AM in the morning.

Looking at the Japanese politics these days, it appears that there will be a generational change that may bring some energy to the country that was lost during the past decades. Similarly, IMS needs energetic leadership that will make it an internationally significant institution of science once again. Particularly, engaging female and international scientists may introduce some valuable heterogeneity in thinking.

To young scientists I advise to make relationships with colleagues that may grow in value over time. While I met Matsumoto, Kawai, and Hashimoto as young scientists struggling to establish their careers, their efforts paid off, and they have had significant impacts on my own career.

Personally, I am not facing a retirement ceiling, and can think about what to study next. It turns out that my ultrafast microscopy work, where we measure optical fields evolving on 15 nanometer spatial scale with 50 attosecond time resolution, i.e. at the speed of light, led to imaging of its spin-orbit interaction, where the structured electric and magnetic fields become parallel to each other, and circulate in place at a 0.5 PHz frequency. Such E·B fields can drive magnetoelectric responses in matter and excite axion quasiparticles in topological materials. This may enable developing methods to detect cosmological axion particles of dark matter. Because there is six times more dark than light matter, there is still much more spectroscopy that can be performed on composition of our universe.