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Sigmund, Peter

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ICACS 25: An Anniversary

Peter Sigmund

Department of Physics, Chemistry and Pharmacy, University of Southern Denmark, 5230 Odense, Denmark

ICACS (International Conference on Atomic Collisions in Solids) is a bi-annual conference that typically attracts some 100-300 researchers active in the field of ion-beam-solid interaction. Although I did not attend all 25 editions, I was the only 'survivor' in Kyoto from ICACS-1. Therefore I thought it appropriate to have a brief look back over the years, to present some statistics and to add a few recollections.

The conference convenes in even years, alternating between Europe and overseas, and the proceedings fill a volume or issue of NIMB (Nuclear Instruments and Methods B). So it has been for several years, but certainly not in the beginning: There has never been a meeting announced as ICACS-1, nor ICACS-2 or ICACS-3. However, a meeting with a very different title was held in Aarhus, Denmark in 1965, an uneven year and at a time when NIMB did not exist. Counting backward, that meeting must be ICACS-1.

The numbering actually makes sense: To the best of my knowledge, the scientific community populating the field of atomic collisions in solids was established at Harwell, UK in 1955 [1], when wartime work on isotope separation had been declassified by president Eisenhower, thereby opening up for a wealth of research with accelerators, including particle-matter interactions over a wide range of energies, and numerous applications. Initial efforts focused on instrumental aspects, ion ranges, sputtering, ion-electron emission and radiation damage. Various groupings interested in one or more items on this list met when somebody called for a meeting, at Bellevue or Orsay, France (1961), Oak Ridge, USA (1962), Chalk River, Canada (1963) and Harwell, UK (1964) to name a few. Only the meeting in Bellevue produced a published proceedings volume [2]. Conversely, the meeting in Aarhus in 1965, chaired by the late K. O. Nielsen and entitled 'Electromagnetic Isotope Separators and their Applications', incorporated all the above topics and a few more, and its proceedings were published in NIM, the predecessor of NIMB (table 1).

There is one more feature that shows that ICACS-1 marked a new beginning: In the Wednesday morning session, Jens Lindhard presented his channeling theory to the international community [3]. Evidence for channeling had emerged gradually, mainly from Oak Ridge and Chalk River, in the early 1960s, but it was Lindhard's work that opened up for a wide perspective of basic research in atomic and nuclear physics as well as materials and surface science. From then on, channeling became the dominating topic at ICACS for a quarter of a century. Lindhard became the leading figure, he was often invited to give the opening lecture, he was honored specifically at ICACS-14 in Salford and ICACS-17 in Beijing, and after his death, from ICACS-18 in Odense on, prominent members of the community have been invited to present the Lindhard lecture.

Going through the proceedings of the past 25 meetings gives an impression of the development not only of the field itself, but also of general trends in science and how to act in science. There were no posters at Aarhus in 1965, no overhead projectors, and although there were 35 mm slides, Lindhard used

Email address: sigmund@sdu.dk (Peter Sigmund)

the blackboard for his lecture. Speaking time was allotted for typically one paper per participant. Authors submitting more than one paper could expect a phone call from the organizer, asking them to withdraw all but one. With the notable exception of ICACS-2, systematic refereeing of proceedings articles was uncommon until NIMB took over from NIM in 1983. Common refereeing standards for conference papers and ordinary papers was the guiding concept for NIMB from the beginning, but converting this concept from an idea to commonly accepted practice turned out to be a major challenge.

For many years, ICACS was alternating with another bi-annual meeting, the Gordon Research Conference on Particle-Solid Interactions, initiated by L. Marton in 1968 and terminated in 1996. While there was little difference in scientific scope, the Gordon Conference had a greater appeal to pertinent industry, while ICACS was more university-oriented and, when held in Europe, had a wider international attendance. There were several delegations from Eastern Europe at Aarhus. A somewhat larger Russian delegation came to ICACS-3 in Norway, and the first Chinese delegation was seen at ICACS-6 in Amsterdam. Japanese science had an unforgettable entrance into the community with F. Fujimoto's talk on electron channeling at ICACS-3.

Participation from countries behind the iron curtain used to be restricted to very few prominent researchers. Moreover, organizers would never know for sure whether somebody would come, nor who would ultimately show up. As a consequence, it was an established rule to place contributions from Eastern Europe in the end of the late-afternoon program. A notable exception was ICACS-7 in Moscow, one of the biggest meetings if not the biggest in the series. The practical problems that had to be overcome by our hosts, headed by Anatoly Tulinov, must have been monumental. No surprise that it took four years to publish the proceedings of that conference, a unique record. Actually, the Russians had two ICACS-type conferences for themselves with only few Western invitees, an All-Union conference on channeling phenomena and ISI, Ion-Surface Interactions, initiated by Vera Yurasova and nowadays a successful partner of ICACS.

Figure 1 shows some statistics, based on the published ICACS proceedings. Very big meetings were ICACS-10 in Bad Iburg, Germany and ICACS-12 in Okayama, Japan. Since the 1980s, activity in the field has gradually turned from basic to applied science, and attendance of pertinent conferences such as Ion Beam Analysis and Ion-Beam Modification of Materials has become higher than even the biggest ICACS meetings. The biggest proceedings volumes stem from ICACS-12 in Okayama and ICACS-18 in Odense. Although ICACS-18 was a big meeting with 250 attendees, the proceedings became particularly voluminous because unlike previous organizers we did not impose a page limit on papers.

I am not the right person to talk about the dramatic development in instrumentation over the past half century. Clearly the use of computers in the laboratory was only in its beginning in 1965, as was ultrahigh vacuum in target chambers. Solid-state detectors were under development. A novelty at ICACS-1 was Sheldon Datz' demonstration of the use of tandem accelerators in ion-solid collisions. I also recall several contributions on implantation in semiconductors, a field that expanded at an amazing speed during the subsequent years.

As everywhere else, computers play an increasingly important role also in ICACS-related topics. Simulation of collision processes had made its entrance into the field already in 1960, mainly at Oak Ridge and Brookhaven, but simulational contributions played only a minor role in the ICACS program until much later. Conversely, from around 1980, marked by ICACS-9 in Lyon, simulation became the dominating theoretical tool as far as nuclear motion was concerned. This trend was strengthened by experienced experimentalists who found simulation a more attractive occupation than doing experiments.

I cannot resist the temptation to mention a few highlights that I recall from the early meetings, even though my priorities must be highly subjective. One of them was Fred Eisen's demonstration at ICACS-2 in Chalk River of huge Z_1 oscillations in stopping of ions under channeling conditions, a topic that gave

rise to lively discussions at IVCACS-3 in Brighton. Other topics of intense discussion were the role of classical versus quantum mechanics in channeling of electrons and positrons as well as heavier particles, the origin of spot patterns in sputtering and the mechanism(s) of atomic mixing. The concept of a thermal spike had been the subject of controversy already before ICACS, and long before Hans Henrik Andersen and colleagues had performed pertinent experiments, and it can still get people to raise their voices.

An ongoing theme for about twenty years, starting in the early 1970s, was penetration of molecules. ICACS proceedings show the whole development from initial disbelief over discussion of the role of wake fields and multiple scattering to successful application in the determination of the structure of molecular ions. The study of the penetration of molecules – which, in reality, dealt with the penetration of atomic ions in close vicinity – went parallel with the study of convoy electrons, i.e., electrons that are emitted from a foil in the forward direction. The overlap was not only timewise, but also with regard to the groups involved.

In the 1980s, interest in the channeling community turned into high-energy phenomena such as channeling radiation and other crystal-assisted processes. At the same time, surface scattering of swift ions at grazing incidence, pioneered by Mike Thompson in the late 1960s, became a fashionable field. There has actually been a clear trend from bulk to surface processes, despite the existence of separate ion-surface meetings such as ISI mentioned above and ISSC (Inelastic Ion-Surface Collisions) initiated by Norman Tolk in 1976. Adding to this the SHIM conference (Swift Heavy Ions in Matter) one may ask whether there is enough progress to justify such a number of major bi-annual conferences. The organizers of ICACS-SHIM 2012 deserve applause for their initiative of a joint meeting.

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Table 1: ICACS Chronology

No.	Year	Location	Chairman	Proceedings
1	1965	Aarhus, Denmark	K. O. Nielsen	NIM 38 (1965) 1-325
2	1967	Chalk River, Canada	J. A. Davies	[4]
3	1969	Brighton, UK	M. W. Thompson	[5]
4	1971	Gausdal, Norway	I. Bergström	[6]
5	1973	Gatlinburg, USA	S. Datz	[7]
6	1975	Amsterdam, NL	F. W. Saris	NIM 132 (1976) 1-713
7	1977	Moscow, USSR	A. F. Tulinov	[8]
8	1979	Hamilton, Canada	D. O. Thompson	NIM 170 (1980) 1-604
9	1981	Lyon, France	J. Remillieux	NIM 194 (1982) 1-693
10	1983	Bad Iburg, Germany	W. Heiland	NIMB 02 (1984) 1-831
11	1985	Washington, USA	T. M. Buck et al.	NIMB 13 (1986)1-831
12	1987	Okayama, Japan	F. Fujimoto	NIMB 33 (1988) 1-942
13	1989	Aarhus, Denmark	J. U. Andersen	NIMB 48 (1990) 1-654
14	1991	Salford, UK	G. Carter	NIMB 67 (1992) 1-675
15	1993	London, Canada	W. N. Lennard	NIMB 90 (1994) 1-621
16	1995	Linz, Austria	H. Paul	NIMB 115 (1996) 1-608
17	1997	Beijing, China	Z. L. Wang	NIMB 135 (1998)1-585
18	1999	Odense, Denmark	P. Sigmund	NIMB 164 (2000) 1-1029
19	2001	Paris, France	V. M. Esaulov	NIMB 193 (2002) 1-905
20	2003	Puri, India	A. P. Pathak	NIMB 212 (2003) 1-662
21	2004	Genova, Italy	M. Canepa	NIMB 230 (2005)1-635
22	2006	Berlin, Germany	G. Schiwietz	NIMB 256 (2007) 1-580
23	2008	Palaborwa, S. Africa	J. M. Malherbe	NIMB 267 (2008) 2563-2787
24	2010	Krakow, Poland	M. Szymonski	NIMB 269 (2010) 795-1040
25	2012	Kyoto, Japan	T. Azuma, K. Kimura	NIMB ??

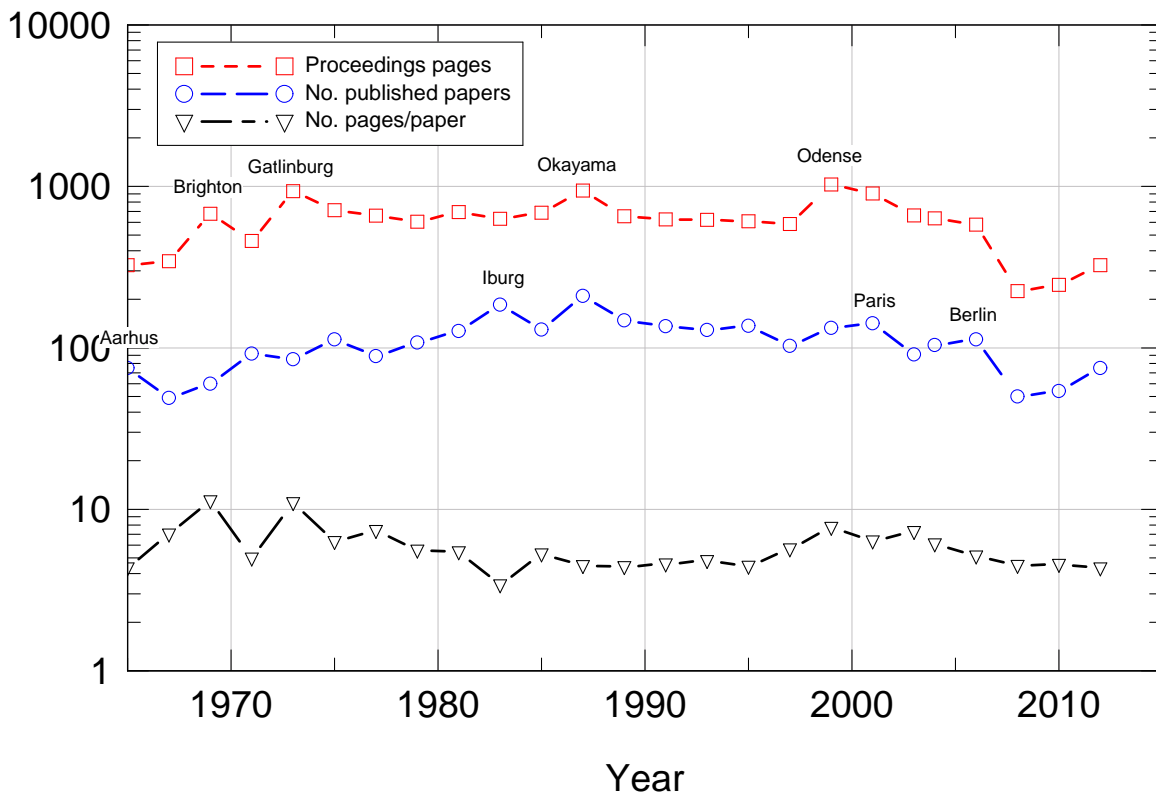


Figure 1: Statistics of ICACS proceedings