ICPEAC — The Early Days

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ABSTRACT

I present an informal history of how ICPEAC got started. It should be understood that this is a personal view, not intended as an authoritative history. The article by Sheldon Datz in the 1997 ICPEAC book of invited papers [see references] admirably summarizes the vital statistics of ICPEAC as they developed over the years, and I recommend that article highly to the reader who is interested in a fuller presentation.

ICPEAC was conceived in early 1957. It is important to understand the context out of which this idea developed. Atomic collision physics by that time already had a distinguished history. It wasn't long after the development of modern quantum mechanics that its applications to atomic collisions helped in firmly establishing that theory. This was dramatically illustrated by the ability to explain the "Ramsauer effect" as being attributable to diffraction and interference phenomena in the low energy scattering of electrons by rare gas atoms. The seminal volume of Mott and Massey, "The theory of atomic collisions" [1] was the lodestone that was able to deal with the collision problem in a way that was remarkably similar to the earlier analyses of scattering of electromagnetic radiation, with the added richness attributable to the intrinsic many-body nature of atomic interactions, not to mention such complications as the need for proper symmetrization of the final states. This volume was followed by the experimental equivalent, by Massey and Burhop, "Electronic and ionic impact phenomena" [2].

By 1956 increasing numbers of collision groups were appearing, notably in France, the Netherlands and the Soviet Union. But the strong tradition of collision physics in Great Britain and Germany continued to play the major roles in the field. In Great Britain the dominant forces included Sir Harrie Massey, his student David R. Bates at The Queens' University in Belfast, and then by Bates' student P G Burke as well as such notables as Alex Dalgarno (later to move to the US) and M J Seaton., M R C McDowell and many others. Work in Germany, very strong before WWII, took a while to reestablish itself after the war, but it soon began to flourish as strongly as ever. While there were no German representatives at the first ICPEAC this was soon remedied in later ones. Also, by this time the US had become a major contender with groups and laboratories divided approximately evenly between academic and non-academic (including government laboratory) centers. Also, crossed beam experiments were beginning to alter the experimental landscape with their ability to control and observe individual collision events, contributing greatly to the range and the quality of the experimental data, already beginning to reveal itself in ICPEAC I.

At that time the cold war was at its peak, although McCarthyism was beginning to wane in the US and brutal suppression was also declining in the USSR. There was great, mutual suspicion between these two world powers, even though scientists, led by physicists, were doing their best to break down barriers to mutual communication and cooperation. The threat of atomic warfare was on everyone's minds, since both the US and the USSR

possessed both fission and fusion bombs. But the race for development of delivery vehicles, that is, intercontinental missiles, was in its infancy. It would be only slightly more than a year later that the USSR would launch Sputnik, dramatically altering the balance of power, or terror, at least temporarily. Thus space, and especially the upper atmosphere, were high priorities of the military in both major powers. It was not surprising that upper atmospheric reactions, based on collision physics, was of special interest to military support agencies, in the US particularly centered first around the Office of Naval Research and the Air Force Office of Scientific Research and later to include the Army Research Office. These agencies were beginning to support atomic collisions research in the US, as were equivalent agencies, including the Academy of Sciences, in the USSR.

With the support of these military agencies, I had started a crossed beam collisions program at New York University, and at the same time and place Sidney Borowitz, formerly a post doctoral student of Julian Schwinger at Harvard, was beginning to attack such problems as electron scattering by atomic hydrogen. At General Atomics in San Diego, Wade Fite was setting up a major experimental program, studying atomic hydrogen and other relatively simple but important systems. Elsewhere in the US collision activities were burgeoning, for example at the National Bureau of Standards (now NIST) in the atomic physics section under the leadership of Lewis Branscomb. It was within this context of physics activity and practical need that the idea of having a collisions conference was broached. It was the military that made the first suggestion, particularly the Office of Naval Research, through its NYU project monitor Fritz Byrne. Borowitz and I were happy to serve as the principal organizers and hosts.

Soon an organizing committee was formed, from among the people we (and the military) personally knew were active in the field. Of course we did not include all major figures. Showing our bias we were probably neglectful of the physical chemists (but we did include I. Amdur of the MIT Chemistry Department) who were working primarily in heavy particle collisions and reactions. The committee held its first meeting during the Washington meeting of the American Physical Society, on April 26, 1957. Attending were Borowitz and myself from NYU, Branscomb, Sydney Geltman, Felix S. Smith, and Earl Beaty all from NBS, Fite from General Atomics and Manfred Biondi from Westinghouse Research Laboratories. It was at this meeting that the general tone of the ICPEAC, as it would eventually be called, was set, although at first the title did not include the word "International". The minutes of this meeting survive in my files, and I reproduce here part of these.

The following decisions were reached at this preliminary meeting: The name of the conference would be "Physics of Electronic and Atomic Collisions." The subject matter would include the elastic and inelastic collisions of electrons plus and minus with atomic and simple molecular systems, photodetachment, charge exchange processes etc. It would exclude multiple processes, solid state problems and exclusively bound state problems. The time of the meeting was set for the Monday and Tuesday preceding the New York meeting of the American Physical Society in 1958. The place will be New York University.

It was decided to invite foreign visitors to this conference."

Thus, two crucial decisions were made which have set the tone for ICPEAC for almost half a century: the limited subject matter (although in later years the above criteria were no longer rigidly enforced) and the international nature of the conference, despite its rather parochial origins. Fig. 1 is a photo of the cover of the program of the first ICPEAC. It contained Abstracts for exactly 47 papers. About 85 people attended, including such notables as Philip Morse, Willis Lamb, S. K. Allison, Mike Seaton, T. Yamanouchi, S.C.

Brown and Vernon Hughes. Great Britain was well represented, with five talks including an invited paper by M J Seaton on electron-hydrogen scattering, although there were none from the rest of Western Europe and only one from all of Asia, by Professor Yamanouchi. As for subject matter, there were essentially four major categories represented. The largest by far was various aspects of electron atom collisions, with 18 talks, with the remaining being approximately equally divided between atom-atom collisions, atom-photon interactions, and charge exchange.

Partly because of the encouragement of the supporting agencies we made a concerted effort to invite physicists from the USSR. Very few conferences at that time included Soviet participants, and with the cold war at full strength we knew that accomplishing this goal would not be easy. We identified four such scientists, including two from the Physico-Technical Institute in Leningrad. In the end these two-N. V. Fedorenko and V. M. Dukelsky--managed to obtain approval from both involved governments. This established a precedent of strong Soviet participation in ICPEAC, that eventually led to its hosting ICPEAC VII in Leningrad.

At the time no one as far as I know envisaged that this conference would develop into the continuing, biennial establishment, with its many satellites, that it now is. It was the success of the first conference that encouraged us to go for a second, and it was really the second one which institutionalized the conference and set it on its continuing course. It took a while to set up number two, and it wasn't until three years later, in 1961, that it took place, in Boulder-the first and only exception to the present ongoing two-year cycle. For this meeting we had the considerable resources of the National Bureau of Standards, both in Washington and Boulder, at our disposal. These were forthcoming mainly because of the efforts of Lewis Branscomb, who was at that time Chief of the Atomic Physics Division of NBS, on his way towards founding JILA. Branscomb was of enormous help with the increasing complexity of the logistics for the conference, which was to have maybe three times as many attendees as the first ICPEAC and nearly twice as many papers. Notably, the conference became truly international, with Great Britain leading the pack as always, followed by Germany and with France, Japan, Poland, New Zealand and Canada and of course the USSR also represented.

We did have one problem with Soviet visitors that did not exist at the first meeting. It turned out that Boulder was off limits for USSR citizens! This was a quid pro quo set up by the State Department to balance off limit cities in the USSR (cities with some particular military or scientific activities). Happily the State Department, with some strong encouragement by Branscomb and others, waived this proscription, so a delegation from the USSR did indeed show up, although as frequently happened we did not know until the last moment precisely who would, and would not, come. In any case ICPEAC II was a smashing success, and from then on the conference took on a life of its own, which shows no signs of waning.

The first several ICPEACs reflected the state of experimental and theoretical physics in the late 1950s and early 1960s, naturally enough. This was a time when new experimental and theoretical techniques were just beginning to be developed, the latter already heavily exploiting rapidly developing computing capabilities, after the long hiatus resulting from WWII. Experimentally, it was a time when war surplus material-for example, microwave oscillators-helped collision experiments acquire a sophistication not hitherto possible. There were no experimental electron-atom collision resonance papers in the first two ICPEACs, although some early calculations and suggestions (C Schwartz , P. G. Burke et al., E. Gerjuoy), had already hinted at their existence (although of course resonances were well known in nuclear reactions). It was a somewhat different story with molecular resonances. The first invited paper at the first ICPEAC was titled "Resonance electron

scattering by molecules", by T. Yamanouchi of the University of Tokyo, although unfortunately I have no record (or Abstract) of that paper.

It wasn't until 1963 that George Schulz reported on his famous electron-helium resonance, in time for ICPEAC III. Schulz's work, apart from its importance in developing a fuller understanding of atomic collision physics, had an equally important impact because of his pioneering efforts in the production of controlled beams of "monoenergetic" electrons, a now ubiquitous feature of electron collision work.. The first ICPEAC had only two papers on what we would now characterize as alignment phenomena in atomic collisions, by B B Aubrey and L C Bradley III, and by W Lichten and S Schultz. By the time of the second ICPEAC this rapidly developing area already was represented by four papers. This very important field had experienced a hiatus after the work of Skinner and Appleyard in 1928, lasting thirty years! By ICPEAC III observations of spin exchange were being reported at NYU, and work was intensifying to produce usable beams of polarized electrons (J Kessler, V W Hughes). Hughes was also represented by his continuing work on the atomic physics of exotic atoms, muonium and positron for example). One of his co-authors in ICPEAC I was Leon Lederman.

New and revolutionary beams techniques were being exploited in heavy particle collisions, with such notable contributors as D Herschbach, I Amdur, J P Toennies, P Toschek, J Ross, and many others. Reactive, elastic, inelastic, charge transfer, ionization, capture interactions, you name it — all these appeared already in the first several ICPEACs.

Theorists were equally productive. Variational techniques, minimum principles and effective range theories, used in earlier years in nuclear physics, now were being heavily exploited by such atomic theorists (some of these themselves converted from nuclear theory) as my NYU colleagues Spruch, O'Malley and Rosenberg, B Lippmann and S Borowitz. Already computational techniques were being mastered; people were learning how to solve complex integro-differential equations hitherto not susceptible to analytic solutions. To put the computational revolution into a proper perspective, I will quote here from a paper by P A Fraser, University of Western Ontario, appearing at the first ICPEAC — over 40 years ago! — on a numerical method of solution of some equations of scattering theory: "With the general availability of high-speed and large capacity electronic computers, the arithmetic problem is no great difficulty, as is neither the computation of the coefficient matrix."

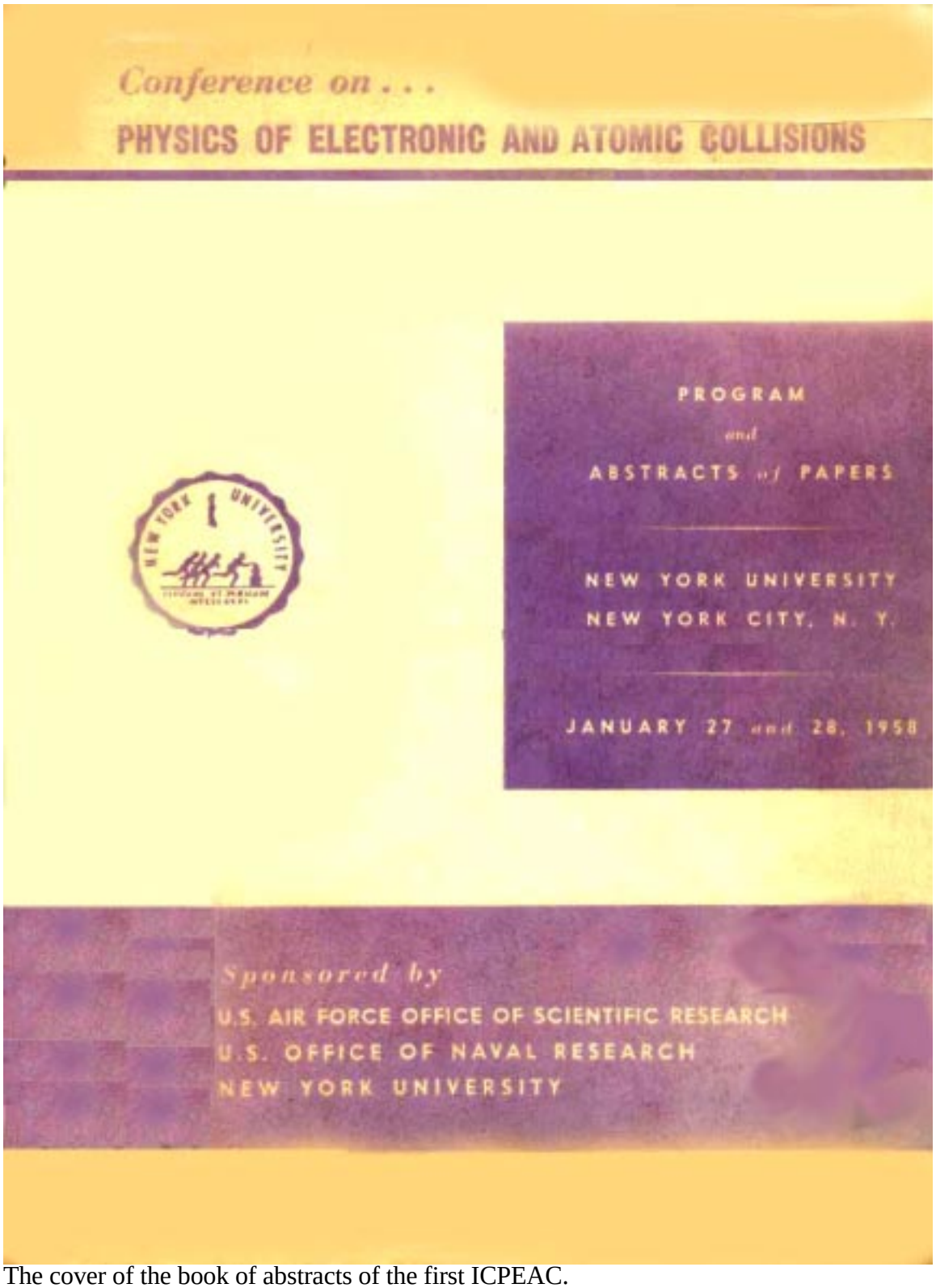
It is fair to say that we had no idea of how dramatically the field would grow in later years. To get a better picture of what happened later, see Datz [3].

References

1. N F Mott and H S W Massey, *The theory of atomic collisions*, 1965 (Clarendon, Oxford)

2. H S W Massey and E H S Burhop, *Electronic and ionic impact phenomena*, 2nd edition, 1969 (Oxford)

3. S Datz, ICPEAC XX: *A retro-and pro-spective analysis* (Book of invited papers, XX International conference on the physics of electronic and atomic collisions, Vienna, Austria, July 23-29, 1997)



The cover of the book of abstracts of the first ICPEAC.