

Editorial: Steve Buckman – 40 years of pushing leptons uphill*

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Professor Stephen Buckman has had a lasting impact on the field of low energy electron and positron collisions, having made a career of high precision measurement of scattering cross sections, and developing many different experimental techniques to do so. Graduating from his PhD under the supervision of Professor Peter Teubner at Flinders University in 1979, Steve went on to work as a postdoctoral fellow at the University of Manchester and then JILA, at the University of Colorado, before moving to the Australian National University where he worked for the majority of his scientific career. His time in Adelaide, Manchester and Boulder gave him a grounding in the techniques of measuring single electron scattering processes, as distinct from the swarm measurements which were used to measure bulk properties of electron transport and infer the scattering cross sections from that information. He was recruited to the Australian National University by Professors Bob Crompton and Malcolm Elford, who were giants in the field of swarm measurements, to start an experimental program of low energy electron scattering. This in itself revealed remarkable foresight, not only in recruiting such an eminently suitable candidate, but also in recognizing that it was time to move the Department into a new direction, which would prove to be an area of great scientific fertility.

The first of many experiments that Steve developed at the ANU was an electron time-of-flight spectrometer, for the measurement of very low energy total scattering cross sections. What followed reads like a history of the development of experimental techniques for measuring low energy scattering processes. During his time at ANU, Steve designed, built or had significant input into at least 7 major individual experiments, addressing a variety of problems in low energy electron scattering. These ranged through measurements of low energy electron total cross sections,

differential cross sections, excitation processes, metastable helium guiding and trapping, and low energy positron scattering. Many (most) of these experiments had a significant scientific lifetime and resulted in an impressive publication record that has firmly established Steve as a world leader within the field. Perhaps the most significant of these was the first crossed beam experiment (CBA1) that Steve designed and built at ANU, for the measurement of low energy absolute differential electron scattering cross sections from atomic and molecular targets. Data from this experiment was first published in 1990, with the final article appearing in 2013. This is a remarkable operational lifespan for any experimental apparatus, and there was a huge range of measurements and targets covered, providing an impressive database of accurate, high precision work. In addition, Steve has been responsible for co-authoring several significant review articles, on topics such as negative ion resonances, electron-molecule cross sections and low energy positron scattering.

The raw numbers of almost 200 scientific papers with over 4000 citations and an h-index of 35 are impressive enough, but only tell a small part of the story of Steve's career. In addition to research output, Steve has contributed strongly to the leadership of research within his chosen field, supervising a large number of PhD students, many of whom have gone on to successful scientific careers themselves, as well as mentoring many postdoctoral fellows who have passed through the labs at ANU during his tenure there. The group at ANU has always been a lively place to work, not only because of the excellent research environment and culture set by Steve, but also because of his tendency towards wide ranging collaborations throughout Australia and the world. This has resulted in a large number of visitors, from amongst the top researchers in the field, finding their way to Canberra for visits of varying lengths, from a year to just a few days. Regardless of the length of visit, the interactions with a range of theorists and experimentalists from related areas of research has enhanced both the educational opportunities of students and younger academics, as well as the research of the Department. One only has to attend a conference with Steve

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to observe the large number of connections he has made, and the personal regard with which he is held throughout the fields of electron and positron scattering.

After spending decades establishing himself as a leader in low energy electron scattering, Steve took the opportunity in 2000/2001 to take a years' sabbatical, partly funded through the award of a Fulbright Fellowship, at the University of California, San Diego, with the group of Professor Cliff Surko which included a recent graduate from Steve's group at the ANU, James Sullivan. Cliff's lab was an acknowledged world leader in low energy positron physics, and had recently developed techniques that revolutionized the measurement of low energy positron scattering. This time at UCSD defined the later part of Steve's career, as the ideas developed at San Diego provided the basis for establishing a significant effort in low energy positron scattering at the ANU, which commenced at the start of 2004. This work was the focus of an Australia wide collaboration to build two new positron-based experiments. The collaboration evolved into the Centre for Antimatter-Matter Studies (CAMS), with Steve as the Research Director of a significant organization bringing together a wide range of experimental and theoretical groups from around the country into a collective push to develop the experimental and theoretical side of positron and electron scattering. In keeping with his collaborative philosophy, CAMS had a significant international presence, hosting international conferences

and bringing a flood of international scientists to Australia for short term visits and longer collaborations – many of which continue today, long after the funding for CAMS has finished.

Steve's scientific leadership has not been limited to Australia, or to his field of low energy atomic and molecular physics. Steve has served as the Head of the Atomic and Molecular Physics Laboratories, Deputy Director and Director within the Research School of Physical Sciences and Engineering, as well as on an uncountable number of international conference advisory committees, journal editorial boards, grant and research review panels. To all these roles, he has brought the same sense of endeavor and collegiality that has made his research record so remarkable. In recognition of his service and achievement, he has been made a Fellow of the Australian Institute of Physics, the American Physical Society and the Institute of Physics (UK). He was awarded the ANU Vice Chancellor's Award for Distinguished Service to the University in 2008, and in 2012 he received the Flinders University Convocation Medal. In 2014 he was awarded Membership of the Order of Australia (AM), in recognition of his contributions as a researcher and leader within the field.

On the occasion of his retirement, in July 2015, it is fitting that this special journal issue be dedicated to marking the remarkable achievements and leadership of Stephen Buckman within the field of low energy positron and electron scattering.