Robert F. Welton

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EDUCATION

Ph.D. in Physics, Georgia Institute of Technology, 1994
Dissertation: *The Formation of Metastable and Multicharged Ions,*
Minor: Electrical Engineering

M.S. in Theoretical Physics, Georgia Institute of Technology

B.S. in Applied Physics (Optics), Georgia Institute of Technology

EXPERIENCE

Senior Physicist – Spallation Neutron Source

Oak Ridge National Laboratory, Oak Ridge, TN

- Currently, provide daily hands-on, co-leadership for the ion source team insuring our operational and R&D goals are met. I conduct weekly meetings defining and tracking work and provide ion source and FE presentations at various internal and external SNS reviews and meetings: AAC, ACCC, MSA, RR's, operator training classes, etc.

- Currently, I am also serving on several international review committees guiding the development of new machines and upgrades such as IsoDAR, DAEdALUS; LHC, LINAC-4, and the ORNL stable isotope program. I also regularly serve on ion source conference and symposium program committees.

- Led the ORNL effort in the LANL neutral beam collaboration that is responsible for the design and development of the ion source systems for the proposed accelerator. Design and plans were reviewed, accepted and given high marks but overall project was suspended at the congressional level.

- Led the design / construction / commissioning effort for the ion source systems of Beam Test Facility (BTF) with the new RFQ.

- Coordinated the Front End (FE) ion source reconfiguration and commissioning to support the new RFQ and the implementation of numerous FE ion source upgrades. This work served as the basis for my 2019 promotion.

- Previously, I conducted R&D efforts to develop SNS ion sources and related systems including the development an improved internal RF antenna and LEBT configuration now critical to daily high-availability SNS operation. These accomplishments greatly contributed to the attainment of the 2018 Brightness Award, the highest international award given in the field of ion sources.

- I participate in the continuing development of the ORNL external antenna ion source based on an AlN plasma chamber to serve as a backup for the current LBNL-designed internal antenna source. This approach diversifies the risk

associated with the internal antenna source which depends critically on a propriety coating technology from a single source vender. Similar external antenna sources are now being developed at CSNS, CERN, ISIS and elsewhere based on this work.

- Other developments include hollow anode plasma guns, various Cs delivery systems, electron and ion beam targets and emittance analysis software which has been used by in other accelerator facilities.

- I have served as principal investigator for the helicon SNS LDRD project: conceived of project, developed collaboration with Fusion Energy Division (FED), secured funding, and facilitated transition to the now successful ORNL fusion material irradiation facility.

- Served on the SEED/LDRD committee determining future research directions for ORNL.

- Worked extensively at Berkeley National Laboratory with the Ion Beam Technology group on the SNS front end system prior to delivery to ORNL

- Held consultancy positions related to injector and ion source design: International Isotopes, Trace Life Sciences, Trace Radiochemical, Kimball Physics, Group 3 LLC and Diversified Consulting LLC.

- Active leader in the ion source community: organized H^- workshops given, invited and contributed talks at major conferences (PAC, LINAC, CARRI, ICIS, PNNIB, NIBs, CTIFR), given review and tutorial lectures summarizing the field (LINAC, ICIS), also served on program committees and chaired sessions at these conferences. Received multiple awards for R&D excellence both international and within ORNL including the 2018 Brightness Award.

- Active journal reviewer: Review of Scientific Instruments, Physical Review, Plasma Science and Technology, Nuclear Instruments and Methods A & B, IEEE Transactions in Nuclear Science and other journals.

- Currently I hold a Q-security clearance which has been useful in managing externally funded projects involving high power ion sources

- Mentored 6 students who have found successful careers in the science, industry, finance and teaching.

1997-2001 **Staff Member – Holifield Radioactive Ion Beam Facility**
Oak Ridge National Laboratory, Oak Ridge, TN

- Developed the target/ion source used in the production of world record beam intensities of ^{17}F, the first significant beam produced at the HRIBF. This work was internationally recognized as one, if not the most significant R&D development in the field of radioactive nuclear beams during the last three years by DOE program manager. I received an international R&D award for this work at RNB 2000.

- Originated the use of HfO_2 target material which is now routinely used for the production ^{17}F and ^{18}F beams. I later received ORNL technical achievement award for this work.

- Developed a general process to form UC_2 targets from arbitrary C matrices. I produced a variety of UC_2 targets for neutron rich radioactive species of Rb, Y, As, Sr, Sn, Sb, Se, Br, Ag, As, Ge, In, Te and Ga

1994-1997 **Post Doctoral Fellow – Holifield Radioactive Ion Beam Facility**
Oak Ridge National Laboratory, Oak Ridge, TN.

- I ran the off-line ion source test facility at the HRIBF from 1994-1998, and developed new techniques to test many ion sources: compact RF multicusp ion sources, Cs sputter sources, negative surface ionization sources and electron beam plasma sources. These sources were characterized in terms of beam intensity, emittance and ionization efficiency. Numerous source design improvements were conceived of and implemented.

1990-1994 **Doctoral Student – Departments of Physics, Chemistry and Electrical Engineering**
Georgia Institute of Technology, Atlanta, GA.

- Designed, developed, modeled and characterized an all-permanent magnet ECR ion source/trap which has been employed in numerous atomic and molecular physics experiments. Multiply charged species of up to Ar^{8+} have been extracted under low pressure operating conditions while singly charged ion currents of up to 0.5 A/cm^2 have been achieved at higher operating pressures.

- Received student teacher of the year award ~1990 for best student lecturer on campus

COMMUNITY SERVICE

- Served as president of the Camera Club of Oak Ridge 2013-2016 (~100 members), Children's Museum of Oak Ridge board member 2018-2020. Volunteer work includes: Photography for Explore Oak Ridge, Emory Valley Center, Museum of Science and Energy, CASA, United Way, Oak Ridge Rotary Clubs, Children's Museum of Oak Ridge, Dogwood Arts, Linden Elementary School, Boy Scouts of America, and the Secret City Festival.

REFERENCES

- Kevin Jones, former SNS RAD division director now at ESS
- Jose Alonso, LBNL, MIT, Director of SURF (retired)
- Rod Keller, SNS Front End Systems Group leader at LBNL (retired)
- Ursel Fantz, IPP Garching, Division head: ITER Technology & Diagnostics
- Richard Scrivens, CERN - HSL Team Leader
- Dan Faircloth, ISIS Low Energy Beams Group Leader
- John Thomason, ISIS Accelerator Division Head
- Yuri Belchenko, Chief Scientist, Budker Institute of Nuclear Physics
- Sasha Alexsandrov, ORNL-SNS, Beam Instrumentation / BTF Team Leader
- Robert Saethre, ORNL-SNS, Electrical Group Leader
- Martin Stockli, ORNL-SNS, Ion Source Team Leader
- Robert Garnett, LANL Deputy Director of the Accelerator Operations and Technology Division (retired)

SELECTED PEER-REVIEWED PUBLICATIONS

(Complete list available upon request)

5. R.F. Welton, T.F. Moran, R.K. Feeney and E.W. Thomas, *A Simple Electron Cyclotron Resonance Ion Source,* Rev. Sci. Instrum, 67 (1996) 1634

34. R.F. Welton, *The development of the ^{17}F beam at the Holifield radioactive ion beam facility,* Nuclear Physics A, A701 (2002) 452

41. R.F. Welton, *An Overview of High Brightness H^- Ion Sources*, Proceedings of the Linear Accelerator Conference 2002, Gyeongju, Korea.

43. R. F. Welton, et al, *Ion source antenna development for the Spallation Neutron Source*, Rev. Sci. Instrum. 73, 1008 (2002)

54. R.F. Welton, et al, *The Design of High Power External Antennas for RF Multicusp Ion Sources*, Rev. Sci. Instrum 75 (2004) 1789

66. R.F. Welton, M. P. Stockli, S.N. Murray, T. R. Pennisi, B. Han, Y. Kang, R.H. Goulding, D.W. Crisp, D. O. Sparks, N.P. Luciano, J. R. Carmichael and J. Carr, *Ion Source Development at the SNS*, Rev. Sci. Instrum. 79 02C721 (2007)

70. R.F. Welton, M.P. Stockli, S.N. Murray, D. Crisp, J. Carmichael, R.H. Goulding, B. Han, O. Tarvainen, T. Pennisi, *Next Generation H^- Ion Sources for the SNS*, accepted, Negative Ion Beams and Sources 2008 AIP Conference Proceedings.

81. R.F. Welton, et al., *The Continued Development of the SNS External Antenna H- Ion Source*, Rev. Sci. Instrum. 81 02A727 (2010)

112. R.F. Welton, et al, *A Look Ahead: Status of the SNS External Antenna Ion Source and New RFQ Test Facility,* Negative Ions, Beams and Sources 2015 AIP Conference Proceedings.

116. R.F. Welton, et al, *The status of the SNS external antenna ion source and spare RFQ test facility*, Rev. of Sci. Instrum., 87 (2016) 02B146

120. R.F. Welton, et al, A new 2.5 MeV injector and beam test facility for the spallation neutron source, AIP Conf. Proc. 1869 (2017) 060002 1-8

122. M.P. Stockli, R.F. Welton, Record productions establish RF-driven sources as the standard for generating high-duty-factor, high-current H− beams for accelerators, Rev. of Sci. Instum. 89 (2018) 052202

123. R.F. Welton, Status of the new SNS Injector and external antenna ion source, AIP Conf. Proc. 2011 (2018) 050003

126. R.F. Welton, et al, Installation and Commissioning of the Ion Source Systems for the New Spallation Neutron Source 2.5 MeV Injector, Rev. of Sci. Instum. 91 (2020) 013334