

## **George R. Neil**

**Doctor of Philosophy, University of Wisconsin, Nuclear Engineering, 1977**

**Bachelor of Science, University of Virginia, Engineering Science, 1970**

George Neil recently retired (7/2017) as a Principal Scientist of Jefferson Laboratory. He was formerly Associate Director of the Lab and head of the Free Electron Laser Division. Dr. Neil has 38 years of experience in plasma physics, accelerator technology, optical technology, and Free Electron Lasers (FELs).

His primary responsibility at Jefferson Lab was to advance the technology of particle accelerators and high power laser systems, develop high power FEL technology, and to manage the beam research and user operation of the facility for basic and applied studies in a safe and scientifically productive way. He was responsible for the original proposal of utilizing an energy recovering linac as the source for a high power FEL at Jefferson Lab and guided the technical development of that source from its original design. He was the primary contact point at the lab for funding agencies supporting the FEL including the Office of Naval Research, Air Force Office of Scientific Research, Joint Technology Office and the Department of Energy's Office of Basic Energy Sciences. Before retiring in 2018, Dr. Neil served as Program Manager to Jefferson Laboratories production of superconducting rf cavities for the LCLS-II X-ray Free Electron Laser at SLAC.

While performing this effort he has served as local thesis advisor to two successful Ph. D. students and is past Editor of the Elsevier journal, Infrared Physics and Technology. He served on the Editorial Board of the Springer Scientific Journal of Infrared Millimeter and Terahertz Waves and Board of Directors of the International Society of Infrared Millimeter and Terahertz Technology. He regularly reviews submissions for Physical Review and Physical Review Letters. He led for 5 years the Future Light Sources Committee of the International Committee on Future Accelerators. He was a regular reviewer of major projects for the U.S Department of Energy and the U. S. National Science Foundation including the early efforts for NIF and LCLS and, more recently, and LCLS-II.

Prior to the FEL program at Jefferson Lab (then called CEBAF) he served as Linac Department Manager during construction of CEBAF. This was the world's first large scale application of superconducting rf technology and Dr. Neil had responsibility for designing, installing, commissioning, and maintaining the linear accelerator systems including injector, RF systems, and cryogenics. The responsibility included technical, personnel, and budgetary oversight comprising more than 20% of the national laboratory's construction budget of \$500M with a staff of 120 FTEs. The system exceeded all technical requirements while staying on schedule and budget.

Before coming to CEBAF in 1990 he was employed from 1977 to 1990 by TRW, Defense and Space Systems Group and worked on plasma isotope separation of uranium and high-power lasers. He served for many years as the Program Manager of the Free Electron Laser Program. In his final position there he was Chief Scientist on the Induction Free Electron Laser Program at Lawrence Livermore National Laboratory and Senior Scientist on staff of the Optics and Directed Energy Laboratory.

Dr. Neil's key technical and programmatic accomplishments on FELs and accelerators (together with colleagues from TRW, Stanford University, Jefferson Lab, and elsewhere):

- Led construction and commissioning of CEBAF linac systems: the world's largest (at that time) 2K

helium refrigerator, 438 klystron power sources and controls, and the initial commissioning and operation of the CEBAF injector. This was the first major application of srf technology.

- Established high current energy recovery linac (ERL) technology as a practical concept for a new generation of light sources to supplant 3<sup>rd</sup> generation synchrotron machines. This achievement has resulted in ERL light source design and prototyping efforts at more than 7 other laboratories around the world and two ICFA Workshops on the subject.
- Performed the first measurements of optical beam quality, tapered wiggler oscillation (for efficiency enhancement), and the first visible lasing from a linac-driven FEL, the first demonstration of fifth harmonic and of second harmonic FEL lasing. The systems his team developed produced the highest average power output of any FEL increasing by more than three orders of magnitude than the previous record; and has held the record for more than 24 years.
- Performed the first measurements of and highest power production (by 10,000x) of broadband terahertz pulses from collective synchrotron and edge emission of relativistic electrons.
- Developed key optical technology for high power FEL oscillators including deformable mirrors, harmonic control, optical cavity metrology and cryogenic mirror technology.
- Performed the first demonstration of same cell energy recovery with an FEL and established the principal design approaches being utilized for high power energy recovery for a number of applications in photon science, accelerator science and nuclear physics.

## HONORS and AWARDS

Co-recipient, R&D Magazine R&D 100 Award for “The Tunable Energy Recovered High Power Infrared Free-Electron Laser” as one of the 100 most technologically significant new products of 2005.

Fellow, American Physical Society, Division of Beams (2003)

Co-Winner International FEL Prize (2000)

Fellow, Directed Energy Professional Society (2006)

Senior Member, IEEE (2012)

## PROFESSIONAL ACTIVITIES

### Springer Science

May 2009 – 2018

*Editorial Board, Journal of Infrared Millimeter and Terahertz Waves*

### International Society for Infrared Millimeter and Terahertz Waves

August 2008- 2019

Executive Board

### Elsevier Journals, North Holland Publishing

May 2003 – January 2007

*Editor,  
Infrared Physics and Technology*

### Conference Chair or Co-chair:

Conference Co-Chair, ICFA Workshop on Future Light Sources 2012 Newport News March 2012

Conference Chair, 25<sup>th</sup> International Conference on Infrared and Millimeter Waves and 13<sup>th</sup> International Conference on Terahertz Electronics, Williamsburg, September 2005.

Conference Chair 20<sup>th</sup> International Free Electron Laser Conference, Williamsburg, August 1998

**Laboratory or program review committees:**

Chair, International Advisory Committee, Daresbury Laboratory, UK. (2003-2007)

Reviewer for DOE Basic Energy Sciences, LCLS Construction Project at Stanford Linear Accelerator Center (Linac and Injector Systems Chair) (7+ years leading to the operation of the world's first hard x-ray laser. 2 years for LCLS-II Upgrade effort presently underway). (2003-2017)

Reviewer for DOE Basic Energy Sciences, NSLS-II Construction Project at Brookhaven National Laboratory

Reviewer for National Nuclear Security Agency and DOE, the National Ignition Facility at LLNL (Large Optics and Line Replaceable Chair) (3 years, leading to the operation of the highest peak power laser in the world)

**PATENTS**

1. Electrode Structures for High Energy High Temperature Plasmas, G. A. Navratil and G. R. Neil, U. S. Patent No. 4,129,772.
2. Free-Electron Laser with Diffraction Grating Resonator, George R. Neil, U.S. Patent No. 4,933,942
3. Method for Decelerating Electron Beams, George R. Neil, U. S. Patent No. 4,763,079
4. Free Electron Laser, George R. Neil and John A. Edighoffer, U.S. Patent No. 4,809,281
5. Free Electron Laser with Phase Conjugate Resonator, C. C. Shih and George R. Neil, U. S. Patent No. 4,742,522
6. Apparatus and Method for Compensating for Electron Beam Emittance in Synchronizing Light Sources, George R. Neil, U. S. Patent No. 5,541,994
7. Method for Compensating for Electron Beam Emittance in Synchronizing Light Sources, Hong Xiu Liu and George R. Neil, U. S. Patent No. 5,805,620
8. Radius of Curvature Controlled Mirror, George R. Neil, Michelle, Shinn, et al., U. S. Patent No. 6,986,565
9. Multi-watt THz generator, Gwyn P. Williams and George R. Neil, U. S. Patent No. 6,844,688
10. Method and apparatus for THz radiation power enhancement, George R. Neil and Gwyn P. Williams. U. S. Patent No. 6,714,346
11. Achromatic recirculated chicane with fixed geometry and independently variable path length and momentum compaction, Dave Douglas and George R. Neil, U. S. Patent No. 6,885,008
12. Improved Process for Laser Machining and Surface Treatment, Michelle Shinn and George R. Neil, U. S. Patent No. 6,809,291
13. Protective laser viewing device, George R. Neil and Kevin Jordan, U.S. Patent No. 8,334,899
14. Mirror with Thermally Controlled Radius of Curvature George R. Neil and Michelle D. Shinn, U.S. Patent No. 7,740,362
15. Method for large and rapid terahertz imaging, Gwyn P. Williams and George R. Neil, U.S. Patent No. 8,362,430

16. Magnetic chicane for terahertz management Stephen Benson, George Herman Biallas, David Douglas, Kevin Carl Jordan, George R. Neil, Michele D. Shinn, Gwyn P. Williams, U.S. Patent No. 7,859,199.
17. Insertion Device and Method for Accurate and Repeatable Target Insertion Joseph F. Gubeli, III, Michelle D. Shinn, Michael E. Bevins, Lawrence Dillon-Townes, George R. Neil, U.S. Patent No. 9696517
18. FEL System with Homogenous Average Output, Dave Douglas, Robert Legg, R. Roy Whitney, George Neil, Thomas Joseph Powers, U.S. Patent No. 9871337
19. Method for Energy Dither of a Particle Beam, Thomas Joseph Powers, David R. Douglas, Pavel Evtushenko, Stephen V. Benson, George Neil, U.S. Patent No. 10,367, 326
20. Light source for high power coherent light, imaging system, and method of using relativistic electrons for imaging and treatment, Gwyn P. Williams and George R. Neil U.S. Patent No. 11,700,684
21. Free Electron Laser Orbital Debris Removal System, David R. Douglas, Henry P. Freund, George R. Neil, Roy Whitney U.S. Patent No. 11,799,262
22. (others in disclosure)

#### SELECTED KEY PUBLICATIONS:

1. John H. Booske, Richard Dobbs, Carol L. Cory. George R. Neil, Gunsik Park, Jaehun Park and Richard Temkin, “Vacuum Electronic Sources for High Power Terahertz-Regime Radiation”, **IEEE Transactions on Terahertz Science and Technology** (2011). INVITED REVIEW
2. G.L. Carr, M.C. Martin, W.R. McKinney, K. Jordan, G.R. Neil and G.P. Williams, “High Power Terahertz Radiation from Relativistic Electrons”, **Nature** **420**, 153-156 (2002).
3. G. R. Neil, C.L.Bohn, S. V. Benson, G. Biallas, D. Douglas, H. F. Dylla, R. Evans, J. Fugitt, A. Grippo, J. Gubeli, R. Hill, K. Jordan, R. Li, L. Merminga, P. Piot, J. Preble, M. Shinn, T. Siggins, R. Walker, and B. Yunn, “Sustained Kilowatt Lasing in a Free-Electron Laser with Same-Cell Energy Recovery” **Phys. Rev. Lett.** **84**, 662-665(2000).
4. H. P. Freund and G. R. Neil “Free Electron Generators of Microwave Radiation” in *Electron Beam Generators of Microwave Radiation* **Proc. IEEE Vol. 87**, No. 5, 782-803 (May, 1999). (INVITED REVIEW).
5. George Neil, “High Power Free Electron Lasers”, a chapter in **High Power Laser Handbook**, H. Injeyan, Editor, McGraw-Hill, (2010).
6. George Neil, “Ultrafast X-ray Sources”, **McGraw-Hill 2010 Yearbook of Science and Technology**.
7. George Neil, “Advancing the Laser - FEL Transformation”, **SPIE Professional** October 2009, p. 21.
8. Michael J. Kelley, George R. Neil, “Free Electron Lasers”, Chapter 6.1; **Landolt-Bornstein New Series VIII/1B2**, 189-201 (2008).
9. George R. Neil and Lia Merminga, “Technical Approaches for High Average Power FELs, **Reviews of Modern Physics** **74**, 685 (2002) (INVITED).

10. George R. Neil, S. V. Benson, G. Biallas, J. Gubeli, K. Jordan, S. Myers, and M. D. Shinn, "Second Harmonic FEL Oscillation, **Phys. Rev. Lett.** **87**, 084801 (2001).
11. George R. Neil, "Novel Ideas for New Light Sources", Guest Editorial, **Synchrotron Radiation News**, **V. 25, No. 1** (2012).

**HOBBIES and PERSONAL INFORMATION:** Running (over 48 marathons completed including at least one on each of the 7 continents, 2:58 personal best, 13 time qualifier for the Boston Marathon). Developed kinetic sculpture presentations for Burning Man, the Toronto Art Festival, and others; see <https://www.doublehelixart.com/>. Married to Doreen Osowski Neil, a retired Senior Scientist at NASA Langley Research Center in Atmospheric Sciences. They have two children, Rebecca Neil, Masters in Art Administration from NYU, who manages site development at Meow Wolf in Santa Fe, NM; and Daniel Neil, Ph.D., Chief Data Officer of Tessera Therapeutics in Somerville, MA.