ALLEN H. BOOZER

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PERSONAL:

Born July 28, 1944 in Orangeburg, South Carolina.

Married to Carol N. Boozer (D.Sc., Harvard School of Public Health, 1976).

EDUCATION:

Ph.D. in physics, Cornell University, 1970 (Woodrow Wilson Fellow, National Science Foundation Fellow). Thesis under E. E. Salpeter on "Late Stages of Stellar Evolution."

B.A. in physics, University of Virginia with High Distinction 1966 (Echols Scholar, Dupont Regional Scholar, Phi Beta Kappa).

PROFESSIONAL:

1994-present: Full professor, Department of Applied Physics and Applied Mathematics, Columbia University.

1986-1994: Full professor, Department of Physics, College of William and Mary.

1974-1986: Research physicist, Plasma Physics Laboratory, Princeton University. Held ranks up to the most senior, principal research physicist; member of the theoretical division steering committee and the laboratory program committee; acting head of the theoretical division from June 1985 to May 1986.

1970-1974: Officer in the U.S. Air Force, (1970-1971) at the Air Force Armaments Laboratory, Eglin AFB, FL and (1971-1974) at the Air Force Cambridge Research Laboratories, Hanscom Field, MA. Received Commendation Medal.

Awarded the Alfvén Prize by the Division of Plasma Physics of the European Physical Society (2010). Elected to scientific membership in the German Max Planck Society (Auswärtiges Wissenschafliches Mitglied der Max-Planck-Gesellschaft) (1989). Awarded the Kaul prize (2014), the highest scientific award of the Princeton Plasma Physics Laboratory.

Fellow American Physical Society (elected 1982); Secretary/Treasurer APS Division of Plasma Physics 1989-1990; Elected to three year chair sequence of the APS Division of Plasma Physics (1998-2001). Member of the Plasma Science Committee of the National Research Council (2001-2004).

Held first U.S.-Japan fusion theory visiting professorship at Nagoya University (1982). Associate Editor of Physics of Plasmas (1992-94); Editorial Board for Plasma Physics and Controlled Fusion (1992-95); president of the University Fusion Association (1992).

Asked by the Reviews of Modern Physics to write the most general article that they have published on plasma physics, “Physics of Magnetically Confined Plasmas,” Reviews of Modern Physics 76, 1071-1141 (2004).

RESEARCH CONTRIBUTIONS:

Demonstrated, Phys. Fluids 24, 1999 (1981), the existence of coordinates in which the magnetic field has simple covariant and contravariant forms. These magnetic coordinates simplify calculations of plasma equilibrium and transport and are usually called Boozer coordinates. Found the first general method for determining magnetic coordinates, Phys. Fluids 25, 520 (1982), showed the poloidal flux is a one and a half degree of freedom Hamiltonian for the lines of a magnetic field, or more generally for any divergence-free field, Phys. Fluids 26, 1288 (1983), and was a co-developer of a technique for determining the field-line Hamiltonian in canonical variables for a given magnetic field, J. Comp. Phys. 73, 107 (1987).

Showed that the standard equations for the guiding center motion of particles are inconsistent with Hamiltonian mechanics and Liouville's equation, and gave a form for the guiding center motion that is consistent with Hamiltonian mechanics, Phys. Fluids 23, 904 (1980). Developed a general time dependent Hamiltonian in canonical form for the guiding center motion of particles for the non-relativistic, Phys. Fluids 27, 2110 (1984), and later for the relativistic, Phys. Plasmas 3, 3297 (1996), case. Was a co-developer of many of the major techniques for carrying out Monte Carlo calculations of transport in asymmetric devices such as stellarators, Phys. Fluids 24, 851 (1981). Was an author of the first paper on the stochastic loss of alpha particles, Phys. Rev. Lett. 47, 647 (1981). This loss determines the maximum ripple, due to the finite number of toroidal field coils, that can be tolerated in an ignited tokamak plasma.

Was the co-inventor of electron cyclotron current drive and more generally the method of driving current by selectively heating high energy particles, Phys. Rev. Lett. 45, 720 (1980) and U.S. patent number 4,425,295, which was issued in 1984. Determined the minimum power required to drive a current that is carried by high energy (tail) electrons, Phys. Fluids 31, 591 (1988). This paper demonstrated a steady-state tokamak was possible only with a strong bootstrap current.

Was an author on the papers that first defined the two known methods for obtaining confined particle orbits in stellarators: (i) having all minima of the field strength on a magnetic surface have the same value, Phys. Rev. Lett. 48, 322 (1982) and (ii) quasisymmetry, Phys. Fluids 26, 496 (1983). Was a co-author of the first paper showing the limitation on the plasma pressure in a stellarator due to the breakup of the magnetic surfaces, Phys. Fluids 27, 2446 (1984). Working with a doctoral student, gave the general form for the magnetic field strength in toroidal plasma equilibria and the minimal breaking of quasisymmetry that is mathematically required, Phys. Fluids B 3, 2805 and 2822 (1991).

Gave the general form of Ohm's law for a spatially-averaged magnetic field that incorporates the helicity conserving properties of resistive MHD, J. Plasma Phys. 35, 133 (1986). Derived the constraints of magnetic helicity conservation on natural dynamos, Phys. Fluids B 5, 2271 (1993), and gave implications for the solar corona in *Magnetic Helicity in Space and Laboratory Plasmas* edited by M. R. Brown and R. C. Canfield (American Geophysical Union, Washington, DC, 1999) p. 11-16.

Developed the electrical circuit representation for the kink stability of tokamak plasmas, Phys. Plasmas 5, 3350 (1998) and Phys. Plasmas 6, 3180 (1999). This representation is the basis of the design and interpretation of resistive wall mode experiments. It has also been used to explain the slowing of the rotation of tokamak plasmas approaching marginal stability to kinks by magnetic field errors, Phys. Rev. Lett. 86, 5059-5061 (2001). Experimental demonstration of this theory considered major advance of magnetic fusion program of the year, Physics Today, Sept. 2001, p. 18-20.

A developer of the theory of perturbed plasma equilibria, Phys. Plasmas 10, 2840-2851 (2003), Phys Plasmas 13, 102501 (2006), Physics of Plasmas 14, 052110 (2007), and its application to error field control, Phys. Rev. Lett. 99, 195003 (2007).

Has shown that magnetic reconnection in three dimensions is dominated by the exponentially increasing separation of neighboring magnetic field lines, Physics of Plasmas **19**, 092902 (2012); **19**, 112901 (2012); **20**, 032903 (2013). He recently submitted an article on why current sheets appear in simulations of three-dimensional reconnection although they are not required for the reconnection itself.

PUBLICATIONS:

For citation numbers see http://scholar.google.com/citations?user=gppbmsQAAAAJ&hl=en

1. Particle loss in a toroidally symmetric cusp
M. A. Levine, A. H. Boozer, G. Kalman, and P. Bakshi
Phys. Rev. Lett. 28, 1323-1326 (1972).

2. Models for initially homogeneous carbon rich stars
A. H. Boozer, P. C. Joss, and E. E. Salpeter
Astrophys. J. 181, 393-407 (1973).

3. Particle trapping in magnetic line cusps
A. H. Boozer and M. A. Levine
Phys. Rev. Lett. 31, 1287-1291 (1973).

4. Ion heating in a train of orthogonal magnetoacoustic shocks
A. H. Boozer
Phys. Fluids 18, 919 (1975).

5. The orthogonal conductivity of a toroidal plasma
A. H. Boozer
Phys. Fluids 19, 149-154 (1976).

6. Two fluid theory of divertors without viscosity
A. H. Boozer
Phys. Fluids 19, 1210-1216 (1976).

7. Effect of magnetic perturbations on divertor scrape-off width
A. H. Boozer and A. B. Rechester
Phys. Fluids 21, 682-689 (1978).

8. Magnetic surfaces in the reversed field geometry
A. H. Boozer
Nucl. Fusion 18, 1663-1669 (1978).

9. Reduction of electron parallel thermal conductivity using waves
A. H. Boozer
Comments Plasma Phys. Cont. Fusion 4, 31-35 (1978).

10. Tormac confinement, theory and experiment
M. A. Levine, H. L. Berk, I. G. Brown, J. Coonrod, B. Feinberg, M. Greenwald, J. Hammer, W. B. Kunkel, B. R. Myers, R. A. Niland, A. Sessler, W. Sharp, R. Shaw, L. Soroka, M. Vella, A. H. Boozer, M. A. Mostrom, and N. T. Gladd
Proceedings of the Seventh International Conference on Plasma Physics and Controlled Nuclear Fusion Research (International Atomic Energy Agency, Vienna, 1979) Vol. II, p. 81-92.

11. Field reversal in mirror machines
L. D. Pearlstein, D. V. Anderson, D. E. Baldwin, J. A. Byers, B. I. Cohen, R. H. Cohen, W. C. Condit, T. K. Fowler, R. P. Freis, T. B. Kaiser, R. F. Post, M. E. Rensink, G. R. Smith, and A. H. Boozer
Proceedings of the Seventh International Conference on Plasma Physics and Controlled Nuclear Fusion Research (International Atomic Energy Agency, Vienna, 1979) Vol. II, p. 457-466.

12. Guiding center drift equations
A. H. Boozer

Phys. Fluids 23, 904-908 (1980).

13. Creating an anisotropic plasma resistivity with waves
N. J. Fisch and A. H. Boozer
Phys. Rev. Lett. 45, 720-722 (1980).

14. Enhanced transport in tokamaks due to toroidal ripple
A. H. Boozer
Phys. Fluids 23, 2283-2290 (1980).

15. Classical diffusion in the presence of an X point
S. P. Auerbach and A. H. Boozer
Phys. Fluids 23, 2396-2412 (1980).

16. Neoclassical transport in helically symmetric systems
A. Pytte and A. H. Boozer
Phys. Fluids 24, 88-92 (1981).

17. Monte Carlo evaluation of transport coefficients
A. H. Boozer and G. Kuo-Petravic
Phys. Fluids 24, 851-859 (1981).

18. Tokamak microturbulence and the second law of thermodynamics
A. H. Boozer
Phys. Fluids 24, 1382-1387 (1981).

19. Force on a moving plasma by a finite conductivity wall
A. H. Boozer
Phys. Fluids 24, 1387-1389 (1981).

20. Confinement of high energy trapped particles in tokamaks
R. J. Goldston, R. B. White, and A. H. Boozer
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21. Plasma equilibrium with rational magnetic surfaces
A. H. Boozer
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22. Plasma transport and impurity behavior in the edge and divertor regions of a tokamak
J. D. Callen, G. A. Emmert, A. M. Bailey, M. E. Benchikh-Lehocine, J. N. Davidson, R. Hulse, A. Boozer, L. Foote, R. Hawryluk, D. Heifetz, W. Hsu, D. Mikkelsen, J. Ogden, K. Owens, M. Petravic, D. Post, P. H. Rutherford, J. Schmidt, F. Seidl, C. Singer, S. Suckewer, J. Weisheit, and M. Yamada
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R. Linsker and A. H. Boozer
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Phys. Rev. Lett. 48, 322-326 (1982).

25. Establishment of magnetic coordinates for a given magnetic field
A. H. Boozer

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26. Drift Hamiltonian in magnetic coordinates
R. B. White, A. H. Boozer, and R. Hay
Phys. Fluids 25, 575-576 (1982).

27. Particle diffusion in tokamaks with partially destroyed magnetic surfaces
A. H. Boozer and R. B. White
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Phys. Fluids 26, 496-499 (1983).

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Phys. Fluids 26, 1288-1291 (1983).

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G. Kuo-Petravic, A. H. Boozer, J. A. Rome, and R. H. Fowler
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32. Theory of mode-induced beam particle loss in tokamaks
R. B. White, R. J. Goldston, K. McGuire, A. H. Boozer, D. A. Monticello, and W. Park
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33. Helical axis stellarators with noninterlocking planar coils
A. H. Reiman and A. H. Boozer
Phys. Fluids 26, 3167-3169 (1983).

34. Two high-beta toroidal configurations: a stellarator and a tokamak-torsatron hybrid
A. H. Boozer, T. K. Chu, R. L. Dewer, H. P. Furth, J. A. Goree, J. L. Johnson, R. M. Kulsrud, D. A. Monticello, G. Kuo-Petravic, G. V. Sheffield, and S. Yoshikawa
Proceedings of the Ninth International Conference on Plasma Physics and Controlled Nuclear Fusion Research (International Atomic Energy Agency, Vienna, 1983) Vol. III p. 129-139.

35. Confinement in toroidal systems with partially destroyed magnetic surfaces
R. B. White, A. H. Boozer, R. Goldston, R. Hay, J. Albert, and C. F. F. Karney
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A. H. Boozer
Phys. Fluids 27, 2055-2062 (1984).

37. Three-dimensional stellarator equilibria by iteration
A. H. Boozer
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38. Time-dependent drift Hamiltonian
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39. Island formation and destruction of flux surfaces in three-dimensional MHD equilibria
A. H. Reiman and A. H. Boozer
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40. Evolution of twisted magnetic fields
E. G. Zweibel and A. H. Boozer
Astrophys. J. 295, 642-647 (1985).

41. Study of stellarator devices by expansion techniques
J. L. Johnson, A. H. Boozer, A. E. Koniges, G. Kuo-Petravic, J. Manikam, D. A. Monticello, H. Mynick, W. Park, A. Reiman, and G. Rewoldt
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A. Bhattacharjee, C. K. Chu, Y. -C. Kwok, E. Hameiri, H. Strauss, and A. H. Boozer
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G. Kuo-Petravic and A. H. Boozer
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A. H. Boozer
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J. M. Albert and A. H. Boozer
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51. Discrete mappings and resonant ripple transport in a tokamak
J. M. Albert and A. H. Boozer
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A. H. Boozer
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53. Three-dimesional plasma equilibrium near a separatrix
A. H. Reiman, N. Pomphrey, and A. H. Boozer
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54. Time dependent drift Hamiltonian
A. H. Boozer
Nagoya Lectures in Plasma Physics and Controlled Fusion (Y. H. Ichikawa and T. Kamimura editors, Tokai Univ. Press, Tokyo, 1989) p. 147-154.

55. A generalized discrete mapping treatment of nonresonant ripple transport in tokamaks
J. M. Albert and A. H. Boozer
Phys. Fluids B 1, 1335-1336 (1989).

56. A selfconsistent kinetic quasiparticle model of wave/plasma interactions
E. R. Tracy and A. H. Boozer
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57. Book review, "Theory of fusion plasmas" by Vaclavik, Troyon, and Sindoni
A. H. Boozer
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58. The evolution of magnetic fields and plasmas in open field line configurations
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59. The bootstrap current in stellarators
A. H. Boozer and H. J. Gardner
Phys. Fluids B 2, 2408-2421 (1990).

60. Alternate transport
A. H. Boozer, D. E. Baldwin, R. R. Dominguez, A. H. Glasser, C. W. Horton, J. A . Krommes, G. H. Neilson, W. L Sadowski, K-C. Shaing, and H. Weitzner
Phys. Fluids B 2, 2871-2878 (1990).

61. Monte Carlo calculations for transport due to MHD modes
A. Punjabi, A. H. Boozer, M. Lam, M. -H. Kim, and K. Burke.
J. Plasma Phys. 44, 405-430 (1990).

62. The drift Hamiltonian in a magnetic field with a separatrix
Allen H. Boozer
Phys. Fluids B 3, 875-879 (1991).

63. Magnetic field strength of toroidal plasma equilibria
D. A. Garren and A. H. Boozer
Phys. Fluids B 3, 2805-2821 (1991).

64. Existence of quasihelically symmetric stellarators
D. A. Garren and A. H. Boozer
Phys. Fluids B 3, 2822-2834 (1991).

65. Electron transport in stochastic fields of RFP ZT-40M
A. Punjabi, A. Verma, M. Kim, and A. H. Boozer

Proc. XX Int. Conf. on Phenomena in Ionized Gases, Barga, Italy, July 8-12, 1991 (V. Palleschi and M. Vaselli ed., Institue of Atomic and Molecular Physics-CNR, Pisa, Italy, 1991) p. 424-425.

66. Completely bootstrapped tokamak
R. H. Weening and A. H. Boozer
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A. H. Boozer
Astrophys. J. 394, 357-362 (1992).

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Q. Yao and A. H. Boozer
Phys. Fluids B 4, 2429-2440 (1992).

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A. Punjabi, A. Verma, and A. H. Boozer
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R. E. Waltz and A. H. Boozer
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D. A. Garren and A. H. Boozer
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R. B. White and A. H. Boozer
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X. Z. Tang and A. H. Boozer
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91. The relation of edge confinement to global confinement ASDEX Upgrade (axially symmetric divertor experiment)
C. S. Pitcher, A. H. Boozer, H. Murmann, J. Sohweinzer, W. Suttrop, and H. Salzmann
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A. H. Boozer
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94. A delta-f Monte Carlo method to calculate plasma parameters
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104. Feedback equations for the wall modes of a rotating plasma
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105. Implications of magnetic Helicity conservation

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"Magnetic helicity in space and laboratory plasmas," edited by M. R. Brown and R. C. Canfield (American Geophysical Union, Washington, DC, 1999) p.11-16.

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Physics of Plasmas 7, 629-634 (2000).

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A.H. Boozer
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C. Cates, M. Shilov, M. E. Maue, G. A. Navratil, D. Maurer, S. Mukherjee, D. Nadle, J. Bialek, and A. Boozer
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A. H. Boozer, J. Bialek, and G. A. Navratil.
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