INTRODUCTION TO THE SESSION IN MEMORY OF

WILLIAM P. ALLIS

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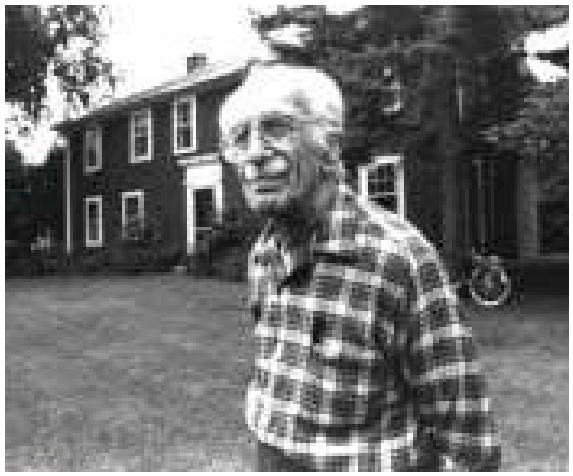
WILL ALLIS
HONORARY CHAIR AND CO-FOUNDER OF THE GEC

November 15, 1901 - March 5, 1999

University of Illinois
Optical and Discharge Physics

WILL ALLIS: THE RESEARCHER



"My first successful work in [gaseous electronics] was with Phil Morse....The problem involved a hollow cathode.... [Karl] Compton said the hollow cathode didn't have a Maxwell distribution of electron velocity, and he wanted to know why. So, that put both of us on the project. Phil used the Boltzmann equation, which I hadn't used before. In 1935, Phil, Edward Lamar, and I published a paper, "Velocity Distributions for Elastically Colliding Electrons," in The Physical Review....Our paper on non-Maxwellian distributions is considered by some to be the beginnings of the modern theory of plasmas and gas discharges."

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WILL ALLIS: CO-FOUNDER OF THE GEC

"The Gaseous Electronics Conference had its foundation in 1948 when Julius Molnar and Leon Fisher met over coffee at the Physical Electronics Conference...where they discussed the desirability of having a more strictly *gaseous* electronics conference....Will Allis joined the group, Leon Fisher was drafted to be the first chairman and Brookhaven National Laboratory had already agreed to house such a conference....And by the way, the first conference was entitled 'Gas Discharge Conference....

Underneath the diversity of laboratories and people, a solid and persistent nucleus prevailed over the years, MIT, under the leadership of Will Allis and the University of California under the leadership of Leonard Loeb."

Robert Varney

Allis was chosen to be chairman of the second meeting...Allis continued to be chairman year after year until he went to work for NATO in 1962.

Leon Fisher

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WILL ALLIS: THE RESEARCHER

- **Introduced energy dependent collision cross sections and spatially homogeneous and inhomogeneous electron energy distributions Previous work had used constant mean-free-time.**

  P. M. Morse, W. P. Allis, and E. S. Lamar, "Velocity Distributions for Elastically Colliding Electrons", Phys. Rev. 48, 412 (1935).

- **Solved the ambipolar diffusion transition from the free diffusion limit to the Shottky limit.**

The Transition from Free to Ambipolar Diffusion*

W. P. ALLIS, *Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts*

AND

D. J. ROSE, *Bell Telephone Laboratories, Murray Hill, New Jersey*

(Received September 30, 1953)

In gas discharge plasmas with very low charge densities, the charged particles diffuse freely in directions perpendicular to the applied electric field because the space-charge field is negligible. At high charge densities, the space-charge field saturates and gives rise to a combination of diffusive and mobility flow termed ambipolar. The transition between these limits is examined theoretically for the case of plasmas maintained through ionization by electron impact. The ionization frequency per electron, one of the principal parameters of the transition, can be re-expressed in terms of an effective diffusion coefficient; it falls from a high value at the free diffusion limit to a low value at the ambipolar limit as the electron density increases over many orders of magnitude. The transition is accompanied by changes in the charge distributions and by the development of a positive ion sheath. The current equations determining the process are examined, and approximate solutions are obtained. Second approximations are obtained for the case where the ratio of electron to ion energies is much greater than unity. Machine solutions are presented both for the above case and for an isothermal plasma in which this ratio equals unity. An application to the afterglow is shown.

W. P. Allis and D. J. Rose, "The Transition from Free to Ambipolar Diffusion" Phys. Rev. 93, 84 (1954)

WILL ALLIS: THE RESEARCHER

- **Authored the standard reference on the electron Boltzmann equation and its solutions, especially at microwave frequencies.**

  W. P. Allis, "Motions of Ions and Electrons" in Handbuch der Physik, ed. S. Flugge, (Springer-Verlag, 1956, Berlin) p. 383: W. P. Allis and S. C. Brown, Phys. Rev. 87, 419 (1952).

- **Pioneered the "upflux" approach to the solution of the electron Boltzmann equation.**

  W. P. Allis and H. A. Haus, "Electron Distributions in Gas Lasers", J. Appl. Phys. 45, 781 (1974).

WILL ALLIS: THE RESEARCHER

- **Introduced the scattering-out-only approximation to the solution of the electron Boltzmann equation at high energies where the conventional spherical harmonic solution fails.**

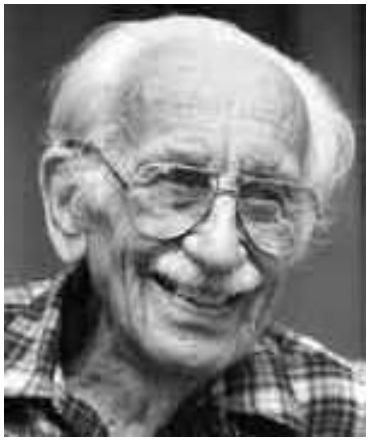
Semidivergence of the Legendre expansion of the Boltzmann equation

William P. Allis*
Joint Institute for Laboratory Astrophysics, Boulder, Colorado
and Laboratoire de Physique des Gaz et des Plasmas,
Université de Paris-Sud, Orsay, France
(Received 1 February 1982)

The Boltzmann equation for a uniform gas in an electric field is immediately soluble if we neglect the scattering in, and these solutions will be termed SOO functions (for scattering out only). They are complementary functions to the conventional P_1 approximation, and for isotropic scattering they satisfy all the Legendre component equations except the zero-order equation. With the taking of the Legendre components of the complete Boltzmann equation, the zero-order equation determines the ratio f_1/f_0 and no more, and shows this to be an increasing function of the energy u so that f_1 crosses f_0 at u_1. Above u_1, the behavior of the Legendre expansion is defined as semidivergent. The first-order equation relates f_2, f_1, f_0, and as $f_2/f_1 \rightarrow 0$ at low energies the P_1 approximation is valid there, whereas when $f_0/f_1 \rightarrow 0$ at high energies a SOO function is valid there. This is illustrated by an analytical solution of a simple model in the integral-equation form of the Boltzmann equation.

W. P. Allis, "Semidivergence of the Legandre expansion of the Boltzmann equation", Phys. Rev. A 26, 1704 (1982).

WILL ALLIS: THE TEACHER



What is your most significant achievement?

"It's the students I've educated! Whenever I am traveling in some distant, crowded airport, someone inevitably comes up to me and says, 'Professor Allis, I worked with you!' That is my principal contribution, and it's something that's remembered rather than written. That has been the most rewarding aspect of being a teacher."

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