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Will Allis Prize for the Study of Ionized Gases talk: Solving the Boltzmann equation for electrons in weakly ionized gases

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Technologies based on low-temperature plasmas (LTPs) are ubiquitous in today's society, and modeling has played an essential role in their development and optimization. LTPs are generated most simply by applying a voltage across two electrodes separated by a gas gap. Because of their light mass, the electrons are rapidly accelerated and energy is transferred to the gas in collisions. The electron "effective temperature" is much higher than that of the ions or the neutrals, and the electron energy distribution function (eedf) is often non-Maxwellian. Data needed for fluid models of LPTs include transport and rate coefficients which are various energy moments of the eedf. The eedf itself is determined by solving the Boltzmann equation using a complete set of electron-neutral scattering cross sections as input, the availability and quality of which are factors determining the accuracy of the solution. Additional determining factors are the assumptions used in solving the Boltzmann equation, an integro-differential equation in space, velocity, and time. A classic assumption is the "2-term" approximation - a 2-term Legendre expansion of the angular dependence of the velocity with respect to the applied electric field, as detailed by WP Allis in 1956 in Handbuch des Physik. This talk will briefly review the 2-term and other approximations before concluding with a description of the LXCat project, a community-wide project aimed at making quality data for modeling LTPs available on-line.