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Predictability in Low Temperature Plasmas: From Laboratory to Technology

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Low temperature plasmas (LTPs) have a rich history of quickly transitioning advances in science to augmenting and enhancing technology development. These activities often and ideally occur in parallel - researchers developing theories, models and diagnostics to improve our understanding of basic processes while developing plasma devices in real time. This parallel nature of advancing the science and technology of LTPs has placed extreme value on predictability. How can fundamental processes be captured in theory, models and scaling laws, predict the performance of plasma based devices and speed their development? This emphasis on predictability transcends the history of LTPs; and particularly so in the past 50 years as the ability to apply computations and advanced diagnostics to predictability have improved. For example, early theories of Langmuir probes and positive column discharges were intended to improve lamps. The development of multi-term expansions of Boltzmann's equation for electron energy distributions was intended to enhance development of gas discharge lasers. Quantifying stochastic heating in radio frequency discharges was motivated by and applied to optimizing plasma etching. In this talk the path towards predictability in LTPs and its leveraging in technology development over the past 50 years will be highlighted with emphasis on the development of models and diagnostics. Examples will be drawn from plasma lighting, lasers and materials processing.