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Kinetic modeling of electronically enhanced reaction pathways in Plasma Assisted Combustion[1] GUY PARSEY, YAMAN GÜÇLÜ, JOHN VERBONCOEUR, ANDREW CHRISTLIEB, Michigan State University — The use of plasma energy to enhance and control the chemical reactions during combustion, a technology referred to as "plasma assisted combustion" (PAC), can result in a variety of beneficial effects: e.g. stable lean operation, pollution reduction, and wider range of p-T operating conditions. While experimental evidence abounds, theoretical understanding of PAC is at best incomplete, and numerical tools still lack in reliable predictive capabilities. In the context of a joint experimental-numerical effort at Michigan State University, we present here a modular Python framework dedicated to the dynamic optimization of non-equilibrium PAC systems. We first describe a novel kinetic global model, which aims at exploring scaling laws in parameter space, as well as the effect of a non-Maxwellian electron energy distribution function (EEDF). With such a model, we reproduce literature results and we critically review the effect of data uncertainty and limiting assumptions. Then, we explore means of measuring a non-Maxwellian EEDF through the use of a detailed collisional-radiative model, coupled to optical emission spectroscopy. Finally, we investigate the effect of different numerical integrators, as well as customized routines specifically designed to solve stiff sparse ODE systems.

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