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Five-moment Two-Electron Plasma Simulation for Comet 67P/Churyumov-Gerasimenko

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One of the key investigations of the Rosetta mission is to understand the interactions between the solar wind and the cometary magnetosphere of comet 67P/Churyumov-Gerasimenko (CG). Extensive numerical modeling work based on fluid, hybrid and fully kinetic models have been carried out and provided valuable context for interpreting various features of the cometary environment observed by different instruments. Fluid-type models have proven to be a useful tool for investigating how the solar wind interacts with comets on a global scale. However, in previous fluid models (e.g., MHD models), electrons are either treated as part of the plasma fluid or simulated with an additional electron pressure equation, without having their own the continuity and momentum equations. Such an approach cannot represent any of the electron kinetic features properly. Besides, previous MHD models could not simulate multiple electron fluids. In this study, we present the first five-moment two-electron plasma simulation of a comet, by introducing the continuity and momentum equations respectively for the solar wind and cometary electrons, in which case the Hall effect is included automatically and the electron dynamics and resulting electric field are simulated self-consistently. As will be shown in this presentation, our five-moment two-electron simulation captures the separate bulk motions of the solar wind electrons and the cometary electrons, which is consistent with the results of the Particle-In-Cell (PIC) simulation performed by Deca et al. (2017).