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Plasma Environment around Comet 67P/ Churyumov-Gerasimenko at its Perihelion Observed by the Rosetta RPC-IES Sensors

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Near the perihelion of comet 67P/Churyumov-Gerasimenko (67P/CG) the Rosetta Plasma Consortium (RPC) instruments detected signatures of a diamagnetic cavity at about 170 km from the nucleus. The MAGnetometer (MAG) instrument observed crossing events into a magnetic field-free region, where at each crossing, the magnetic field magnitude dropped by more than 20 nT to near zero. The Ion and Electron Sensor (IES) observed lower (by a factor of 2) electron fluxes for energies between about 40 and 200 eV. This drop in suprathermal electron fluxes is perhaps due to the absence of the solar wind electrons inside the diamagnetic cavity. Colder electrons (E<40 eV) are abundant inside and outside the cavity and show no decrease in flux. Note that suprathermal electrons with energies greater than $\sim$250 eV have gyroradii large enough that they might be affected less by the magnetic field. In this study, we show IES electron differential flux energy spectra both inside and outside the cavity crossing points and compare the observations with model results. The model cases are for (1) pure photoelectron spectra inside a diamagnetic cavity, (2) photoelectrons with a reflecting (trapping) boundary condition at 150 km from the nucleus, (3) photoelectrons plus entry of a weak solar wind electron spectrum as a boundary condition. The model case (2) best resembles the IES electron spectra inside the cavity while case (3) resembles the electron spectra seen just outside of the cavity. We also studied the correlation between observed count rates of electrons of different energies with the magnitude of the magnetic field. We found no apparent linear correlation; however, for all energies, the highest electron counts are recorded at the highest magnetic field magnitudes.