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Rajkumar Hajra (1), Pierre Henri (1), Minna Myllys (1), Kevin L. Heritier (2), Marina Galand (2), Cyril Simon Wedlund (3), Hugo Breuillard (1,4), Etienne Behar (5), Niklas J. T. Edberg (6), Charlotte Goetz (7), Hans Nilsson (5), Anders I. Eriksson (6), Raymond Goldstein (8), Bruce T. Tsurutani (9), Jerome More (1), Xavier Vallieres (1), Gaetan Wattieaux (10)

(1) LPC2E - CNRS, Orleans, France (rajkumarhajra@yahoo.co.in), (2) Department of Physics, Imperial College London, Prince Consort Road, London, SW7 2AZ, UK, (3) Department of Physics, University of Oslo, Box 1048 Blindern, 0316 Oslo, Norway, (4) Laboratoire de Physique des Plasmas, Ecole Polytechnique/CNRS/Sorbonne Universit´e, 4 Place Jussieu, Paris, France, (5) Swedish Institute of Space Physics, P.O. Box 812, 981 28 Kiruna, Sweden, (6) Institutet for rymdfysik, Angstrom Laboratory, Lagerhyddsvagen 1, Uppsala, Sweden, (7) Institut fur Geophysik und extraterrestrische Physik, TU Braunschweig, Mendelssohnstr. 3, 38106 Braunschweig, Germany, (8) Southwest Research Institute, PO Drawer 28510, San Antonio, TX 78228-0510, USA, (9) Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109, USA, (10) LAPLACE, Universite de Toulouse, CNRS, F-31062 Toulouse, France

Abstract

Four interplanetary corotating interaction regions (CIRs) were identified during 2016 June through September by the Rosetta Plasma Consortium (RPC) monitoring in situ the plasma environment of the comet 67P/Churyumov-Gerasimenko (67P) at the heliocentric distances of ∼3 and 3.8 au. The CIRs, formed in the interface region between low- and high-speed solar wind streams with speeds of ∼320-400 km s^{-1} and ∼580-640 km s^{-1} respectively, are characterized by relative increases in solar wind proton density by ∼13-29, in proton temperature by ∼7-29, and in magnetic field by ∼1-4 with respect to the pre-CIR values. The CIR boundaries are well-defined with interplanetary discontinuities. Out of 10 interplanetary discontinuities at the CIR boundaries, 4 are determined to be forward waves and 5 are reverse waves, propagating at ∼5-92% of the magnetosonic speed at angles of ∼19.8°-86.6° relative to ambient magnetic field. Only one is identified to be a quasi-parallel forward shock with magnetosonic Mach number of 1.48 and shock normal angle of 41.0°. The response of the cometary ionosphere was monitored by Rosetta from cometocentric distances of ∼4 to 30 km. A quiet time plasma density map was developed by considering the effects of varying cometary latitude, longitude and cometocentric distance of the Rosetta observations before and after each of the CIR intervals. The CIRs lead to plasma density enhancements of ∼500-1000% with respect to the quiet time reference level. Ionospheric modeling shows that increased ionization rate due to enhanced ionizing suprathermal (>12-200 eV) electron impact is the prime cause of the large cometary plasma density enhancements during the CIRs. Plausible origin mechanisms of the cometary suprathermal electron enhancements are discussed.