

Three-Dimensional Multi-Fluid Modeling of Comet 26P/Grigg-Skjellerup: Extrapolation to Comet 67P/Churyumov-Gerasimenko

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In July 10, 1992 the Giotto spacecraft encountered comet 26P/Grigg-Skjellerup at a heliocentric distance of 1.01 AU as part of its extended mission that followed the successful flyby of comet Halley 4 years earlier. This second flyby provided the opportunity to study the inner coma of this Jupiter-family comet and to compare its properties with those observed at comet Halley. Comet 67P/Churyumov-Gerasimenko, also a Jupiter-family comet, is the target of the Rosetta spacecraft and a sustained modeling effort is needed for mission planning and for the interpretation of the collected data. In this paper we use our MHD multi-fluid model CASIM3D to study the environment of comet Grigg-Skjellerup as the Giotto spacecraft saw it. This model will be used to assess the coma structures of comet 67P/Churyumov-Gerasimenko that would be present during its encounter with the Rosetta spacecraft and at its perihelion passage. We also show also that the CASIM3D combined MHD-chemistry approach leads to a more accurate representation of the cometary atmosphere than several previous models since additional details of the interaction between the neutral gas and the plasma and their resulting structures are revealed. In particular, the multi-fluid representation of the ion and neutral populations gives an improved view of the coupling between heavy and light molecules and the resulting coma boundaries at different spatial scales.