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Interplanetary journey of a coronal mass ejection to Mars and to Comet 67P/Churyumov-Gerasimenko

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We discuss observations of a large coronal mass ejection (CME) ejected on 14 October 2014, which hit Mars on 17 October 2014, 1.5 days before the Mars close encounter with the Siding Spring comet. Clear disturbances of the Mars' upper atmosphere are identified in the Mars Express and MAVEN data sets. Interestingly, comet 67P/Churyumov-Gerasimenko was perfectly aligned with the Sun and Mars at 1.7 AU behind Mars, with the Rosetta spacecraft orbiting at 10 km above the cometary surface. The Rosetta plasma package and the radiation monitor detected the event on 22 October 2014. We describe the propagation of this CME from the Sun to Rosetta and show comparison with dedicated WSA-ENLIL (large-scale, physics-based prediction model of the heliosphere) simulations. CME effects on the Mars and comet 67P environments are reported. In particular, large and similar Forbush effects – a transient decrease followed by a gradual recovery in the observed galactic cosmic ray intensity- were observed at both places, as recorded by the MSL RAD instrument aboard the Curiosity rover at the surface of Mars and by the Radiation Environment Monitor aboard Rosetta.

Fortuitously, the New Horizons spacecraft was also along the propagation direction of the CME, which can take 3-5 months to reach the distance of 31.7 AU. By the time the solar wind travels that far from the Sun, the fast solar wind parcels have interacted with slower wind parcels emitted at an earlier time along the same radial line. We investigate if the CME observed at Mars and Rosetta has a unique signature at New Horizons. This presents a challenge since many solar structures can either be worn down as they propagate, or they can merge into larger ones. We present also preliminary 3D WSA-ENLIL simulations out to 40 AU showing the evolution of the CME, including other CMEs during this period.