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VIRTIS observations of the nucleus of 67P/Churyumov-Gerasimenko at low phase angle

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On 9-10 of April 2016, the Rosetta orbiter completed a close flyby around the nucleus of 67P/Churyumov-Gerasimenko, when the comet was at heliocentric distance of 2.76 AU, along the outbound leg of its orbit around the Sun. This allowed the VIRTIS-M imaging spectrometer to observe the surface of 67P at visible wavelengths (0.2-1 μm) in the 0.93°-89.7° phase angle range with a spatial resolution ranging from 7 to 46 m/pix, resulting in a total of 105 hyperspectral images. Previous observations of the comet at low phase angle were acquired by VIRTIS-M during the approach phase on July 2014 (3.7 AU), with pixel resolution varying from 450 to 3200 m/pix, preventing disk-resolved imaging. The April 2016 observations fill this gap, allowing us to constrain the spectrophotometric properties of the surface at higher spatial resolution in the opposition surge geometry, therefore investigating both the 'shadow hiding' and 'coherent backscattering' opposition effect. Extrapolation to 0° phase angle of the reflectance measured during the flyby at latitude between -10° and 30° indicates a surface normal albedo of 0.06 at 0.55 μm . This result is close to the previous average value derived by Ciarniello et al. (2015) from a full-disk analysis giving 0.062 $\pm$ 0.002 (3.7 AU, inbound orbit). Subsequent measurements by Filacchione et al. (2016) and Ciarniello et al. (submitted), derived from pre-perihelion observations at lower heliocentric distances, revealed a progressive enrichment of water ice abundance on the nucleus, in northern hemisphere regions, with a consequent brightening of the surface. The measured normal albedo derived from the 9-10 April 2016 dataset seems to indicate that during the post-perihelion phase the northern hemisphere has returned to albedo values compatible to the ones measured during the inbound part of the orbit, when the comet was at 3.7 AU from the Sun. This could be an indication that the northern hemisphere has been either covered by dust emitted by the southern hemisphere during the very active perihelion phase, or that dehydration of the upper surface layers has taken place.