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Dayside to nightside dust column density ratios in the inner comae of comets

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It was recognized in observations of the innermost coma of comet 1P/Halley by the Halley Multicolour Camera onboard Giotto, that the dayside dust coma was, on average, only around a factor 3.2 brighter than the dust coma on the nightside. This was considered surprising because the phase angle of the approach (107.2°) was not substantially different from a terminator viewing direction. The dominance of water sublimation in comets and the assumption that nightside activity should be strongly limited led to the conclusion that lateral (non-radial) flow of dust from the dayside to the nightside must be responsible. This was apparently supported qualitatively by evidence of dust gradients seen against the background of the shadowed nucleus (Keller and Thomas, 1989).

Using observations from the MICAS camera on Deep Space 1, Ho et al. (2003) found for 19P/Borrelly a dayside to nightside coma brightness ratio (DS:NS) of just 1.7 at a phase angle of 88° and r_h= 1.36 AU and subsequently compared this to the results from 1P/Halley (Ho et al., 2007). The brightness ratio was even smaller despite the observation being from almost directly above the terminator. This observation has not been widely promoted, possibly in part because of the quite poor imaging quality of MICAS.

Lateral flow is not the only means of producing low values of DS:NS. Both slow moving particles in orbit about the nucleus and nightside outgassing can influence the observed column density ratio. Gerig et al. (2020) have investigated the observational data at 67P/Churyumov-Gerasimenko and have established both the low DS:NS ratio (as at the other comets) and an increasing DS:NS ratio with reducing heliocentric distance. Furthermore, the brightness distribution with distance in the innermost coma most closely fits radial outflow suggesting that gravitationally bound particles are not the dominant influence on DS:NS. Pinzon-Rodriguez et al. (2021) have modelled H_2O and CO_2 emissions from 67P in a simplified, coupled, thermal system and shown that for reasonable parameters, nightside emission of dust driven by CO2 is a promising explanation for the observations.

The presentation will provide the observational evidence for the DS:NS ratio, describe the modelling work, and demonstrate the results.

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