The spatial distribution of dust in the inner comae of comets: Evidence for and modelling of nightside emission

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Spacecraft imaging of the inner comae of 1P/Halley (Giotto/HMC) and 19P/Borrelly (DS1/MICAS) indicated unexpectedly low ratios for the dust brightness above the dayside hemisphere to that above the nightside. Neither ratio was consistent with dust emission being directly proportional to sublimation loss of H2O using purely insolation-driven models. The near-terminator observations of 67P/Churyumov-Gerasimenko from Rosetta allow very precise separation of the dayside and nightside hemispheres and confirm low dayside to nightside dust brightness ratios. In the case of 67P values of ~3.3:1 were observed and an interesting trend towards increased ratios with decreasing heliocentric distance. Detailed modelling using insolation-driven models do not fit the data by factors of several. Dust from the dayside may contribute to the brightness on the nightside if particles are not escaping and therefore gravitationally bound. However, the radial distribution of brightness on the nightside is inconsistent with this interpretation as can be demonstrated with a simple model. The source is also not in the form of single nightside (e.g. “sunset”) jets. Furthermore, shadowing of emitted dust by the nucleus itself indicates that much of the observed brightness on the nightside is very close to the nucleus and distributed roughly uniformly around in the nightside hemisphere (Gerig et al., submitted).

Gas emission from the nightside has been a consistent element of source distributions (e.g. Bieler et al., 2015) required to model ROSINA/COPS data. However, the composition is frequently not specified. We have been investigating self-consistent, physically generated, numerical models of combined H2O and CO2 emission (see also Herny et al., submitted). Dust emission has been incorporated into the model chain allowing modelling of the observation of the gas composition, the gas density, and the dust brightness distribution in the vicinity of the nucleus for specific times. The results of investigation will be presented.