COMPARING THE DUST EMISSION IN THE CLOSE VICINITY OF COMETS 1P/HALLEY, 19P/BORRELLY, 81P/WILD2 AND 9P/TEMPEL1.

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Introduction: Until now there have been four comets imaged by spacecrafts: 19P/Halley in March 14, 1986, by HMC onboard Giotto; 19P/Borrelly in September 22, 2001, by MICAS onboard DS1; 81P/Wild 2 by the navigation camera onboard Stardust; and 9P/Tempel 1 by the MIR & HIR onboard Deep Impact. This paper presents a comparative studies of the dust emission within the first 30 – 40 km away from the nuclei of all four comets.

Observations and data sets: In March 14, 1986, Giotto encountered comet 1P/Halley's nucleus to a closest distance of 596km carrying the Halley Multicolour Camera (HMC) onboard [1]. Over 5 years later, Deep Space 1 was redirected to obtain images of the nucleus of comet 19P/Borrelly with the Miniature Integrated Camera and Spectrometer (MICAS), reaching a closest distance of 2174km [2]. The next cometary rendezvous was performed by Stardust approaching comet 81P/Wild 2 at 236km on January 2, 2004, tracking its nucleus with its optical navigation camera (NavCam) [3]. The latest close encounter of a spacecraft and a comet happened in July 4, 2005, when Deep Impact flew by 9P/Tempel 1 at 500km distance [4] carrying the Medium Resolution Instrument (MIR). Since the nuclei of 1P/Halley, 19P/Borrelly, 81P/Wild 2 and 9P/Tempel 1 have been observed under similar phase angles, 108º, 88º, 73º, and 63º respectively, we are able to do comparative analyses of the inner dust environment with the HMC, MICAS, NavCam, and MIR data sets.

Dust emission close to the nucleus: The inner dust coma morphology, in particular the dust emissions in terms of jets and broader fans, have been investigated by several authors for the four comets [5]-[8]. In this paper, we concentrate on the comparative studies of the dust emission of the four comets. The outflow of dust particles is force-free at large radial distance from the comet nucleus. Thus, integrating the intensity $\int I\, ds$ [9] around a comet should result in constant $\int I\, ds$. However, the integrated intensities of comets 1P/Halley and 19P/Borrelly indicate deviation from the expected behavior within the first 50 km from their nuclei [10]. 1P/Halley's $\int I\, ds$ decreases near the nucleus surface whereas comet 19P/Borrelly's $\int I\, ds$ increases (see Figure 1). But at large distances, they both converge to constant values. These reverse effects in the first 30km indicate that different mechanisms dominate the inner intensity distribution around the nuclei. At comet 1P/Halley, dust fragmentation into optically larger particles is most likely the dominant process giving the rise of the intensity. The inner intensity distribution around 19P/Borrelly's nucleus shows in turn the effect of dust acceleration and fragmentation into optically smaller particles. By investigating the integrated intensity around comets 81P/Wild 2 and 9P/Tempel 1 (see Figure 1), we obtained the same characteristics as found at 19P/Borrelly indicating that their inner intensity distribution is most likely dominated by the same processes.

We will present further comparative analyses of the dust emission morphology and dynamics for the four comets with the objectives to constrain possible mechanisms creating the observed features.

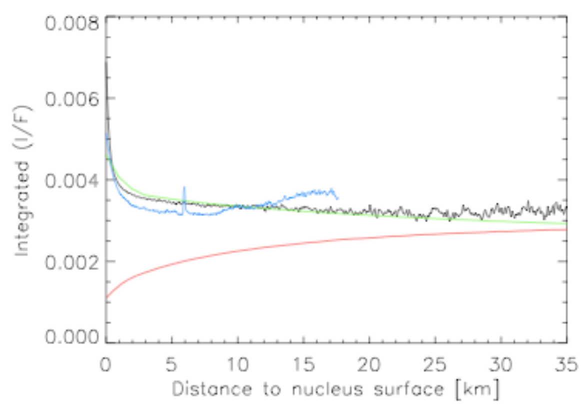

Figure 1: Integrated intensity of comets 1P/Halley (red line), 19P/Borrelly (black line), 81P/Wild 2 (blue line) and 9P/Tempel 1 (green line)

References:

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