Broadband FORS/VLT polarimetry of comet nuclei: 9P/Tempel 1, 19P/Borrelly, 67P/Churyumov-Gerasimenko, 74P/Smirnova-Chernykh, and 152P/Helin-Lawrence

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We present polarimetric observations of five cometary nuclei, 9P/Tempel 1, 19P/Borrelly, 67P/Churyumov-Gerasimenko, 74P/Smirnova-Chernykh, and 152P/Helin-Lawerence obtained with the FORS instrument of the ESO VLT between 2007–2012. All these comets belong to the dynamical group of Jupiter family comets that come from the Kuiper belt. Our observations span the typical phase-angle range of 1–18 degrees and have been obtained with a typical error bar of 0.2 %. The data were collected in service mode to sample in the best possible way the respective phase-angle range during the visibility periods of 9P in 2007, 19P in 2007, 67P in 2010, 74P in 2012, and 152P in 2012. Differential auto-guiding of the telescope with the projected speed of the comets in the sky was applied during the observations. Data were reduced trying to minimize the small contribution to the nucleus polarization due to small coma activity and tail.

Unlike simple photometry and spectroscopy that enable the estimate of global properties like body size and composition, polarimetry offers information on the microscopic scale. Measurements of the photometric and polarimetric phase functions of atmosphereless bodies of our solar system may be modeled to obtain an estimate of their microscopic surface properties like grain albedo, grain size, and constitution. Only recently, the polarimetric phase function of a cometary nucleus, 2P/Encke was determined (Boehnhardt et al. 2008). The results of these measurements showed that the known polarimetric, photometric, and spectroscopic properties of this nucleus do not match those of any of the other small bodies for which similar data exist. It remains to be seen whether this is a population property for cometary nuclei per se or it is just the special flavor of this enigmatic object in the inner solar system. Hence, we have tried to explore the polarimetric — and photometric — properties of cometary nuclei further by measuring many more objects.

From our target list, probably the most interesting is comet 67P/Churyumov-Gerasimenko, the target of the ESA Rosetta rendezvous mission. Measurements with the ROSETTA PHILAE lander will allow us a direct comparison between the actual surface properties of the comet nuclei and those obtained from our remote observations.

References: Boehnhardt, H., Tozzi, G. P., Bagnulo, S., et al. 2008, A&A, 489, 1337.