Imaging and Spectroscopy Observations of Comet 21P/Giacobini-Zinner

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The study of the physical properties of cometary nuclei and coma are equally important to our understanding of the outer solar system environment during the era of its formation. A basic goal of modern astrophysics is to understand conditions in early protoplanetary disks during the epoch of planetesimal formation. In our own solar system, comets are frozen archives of this early epoch. We would like to focus and present here the optical and IR imaging and spectroscopy observations of comet 21P, which is part of survey comets with the Spitzer Space Telescope. Our comet survey is primarily a mid-IR spectroscopic study of 14 sublimating comets, both Jupiter-family and Oort Cloud members, to characterize the coma and nuclear morphology; study their dust characteristics; search for possible organic (PAH-like) signatures; and look for origin of crystalline silicates in the Solar nebula. Optical and infrared imagery of each comet's coma provides context for the "snapshot" spectra. We will present eight sets of observations of 21P between June 2004 and March 2006 that were made to obtain optical photometry, using the UH2.2m telescope. Optical imaging enabled us to obtain a precise optical photometry and morphology of the comet nucleus and its near-nucleus structures, like jets and coma morphology. They allowed us to map how the activity of the comet is developing with a time and observe the morphological changes. IR imaging of comet 21P was performed with the IRAC camera at 4.5 and 7.9 μm, and the MIPS 24 μm imager. The 4.5 μm image has a different morphology than the 7.9 μm image, likely due to CO$_2$ and CO gaseous emission at 4.3 and 4.7 μm contributing to the 4.5 μm image. The 24 μm image shows a strong dust coma and tail, but no evidence for a dust trail, even though this comet is the parent body of the Draconid meteor stream. The 7-14 μm spectrum of the comet shows a prominent amorphous silicate emission feature. The shape of the feature suggests the existence of crystalline olivine from emission peaks at 10.0, 11.2,
and 11.8 μm. Detailed thermal modelling is underway to confirm the existence of crystalline silicates in this and other comets in our survey.