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The Splintering of Comet 17P/Holmes During a Mega-Outburst

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Abstract

Jupiter Family comet 17P/Holmes underwent a spectacular outburst in late October 2007, brightening by a factor of almost a million and ejecting a spherical dust coma that grew larger than the Sun in under two weeks. We obtained wide-field images of the comet in the months following the outburst and, using a Lorentzian filter, have detected a plethora of small-scale structures within the coma (see Figure 1) including dust streaks, dust shells and small fragments.
Close to the nucleus, multiple fragments were observed to migrate radially outwards at speeds of $\sim$100 m s^{-1} as projected onto the plane of the sky. Their motions are consistent with isotropic ejection from the nucleus on UT 2007 October 24.3$\pm$1.2. Photometric analysis confirmed that they were brighter than the surrounding background in unfiltered images. Aperture photometry on the sources yields magnitudes between 17.6 and 20.4 on UT 2007 November 6. These magnitudes prove that the fragments cannot be bare nuclei, as they convert to radii greater than that of the parent nucleus, assuming geometric albedos between 0.04 and 0.15. Thus, we conclude that each fragment is likely to be an active cometesimal with its own dust coma. This idea is supported by the observed fading of the fragments over the duration of our observations as the fragments lose mass, and break up further. A much larger dust cloud was observed to separate from the nucleus at a speed of $\sim$130 m s^{-1} shortly after the outburst. We propose that a fragment broke off from the nucleus during the outburst and quickly broke up due to sublimation of volatiles.

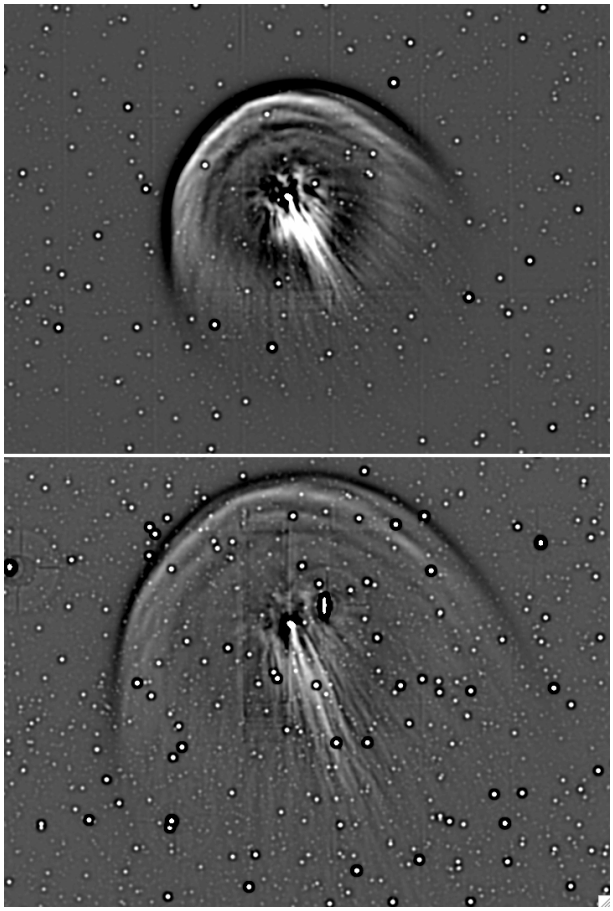

Figure 1: Spatially-filtered images of Comet 17P/Holmes obtained with MegaCam on the 3.6m Canada-France-Hawaii Telescope atop Mauna Kea on UT 2007 November 6 (top) and 15 (bottom). Dust streaks, shells and discrete fragments can be seen in the aftermath of the outburst.

Additional Information

This work is based on observations obtained with MegaPrime/MegaCam, a joint project of CFHT and CEA/DAPNIA, at the Canada-France-Hawaii Telescope (CFHT) which is operated by the National Research Council (NRC) of Canada, the Institut National des Science de l'Univers of the Centre National de la Recherche Scientifique (CNRS) of France, and the University of Hawaii.