Thermal emission from large solid particles in the coma of comet C/2012 S1 (ISON) around perihelion

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We report submillimeter dust-continuum observations for comet C/2012 S1 (ISON) obtained during the time period immediately before perihelion on 2013 November 28 ($r = 0.0125$ au). The variability and time resolution obtained in these images has revealed significant dust outbursts and have likely captured the onset of the final disruption event of comet ISON. The measured 450-µm and 850-µm submillimeter continuua are the strongest yet detected from a comet.

Data were obtained with the SCUBA-2 submillimetre camera on the James Clerk Maxwell Telescope (JCMT) located at the 4000-m level of Mauna Kea, Hawaii during a week of scheduled day-time observing. Imaging is achieved simultaneously at wavelengths of 850 µm and 450 µm. Conditions necessary to obtain valuable results at 450 µm occur relatively infrequently, and while atmospheric zenith opacities on the days involved were good (low), ranging between 0.08 (nepers at 225 GHz on the first day) and 0.05 (on the day of perihelion), the relatively low elevations of the observations (30–45 degrees), and consequent high line-of-sight opacities, limit the impact of the 450-µm data. Each of the focal planes of SCUBA-2 is populated with 5000 bolometers, and provides an instantaneous Field of View of almost 10 arc minutes. In order to account effectively for the rapidly varying sky transmissions, the observational strategies adopted at JCMT involve scanning the telescope rapidly around the target in a daisy pattern, which produces fairly uniform coverage in exposure time of an area of diameter 3 arc minutes around the target centre.

When comet ISON was first detected at 850 µm, the 1-mm-sized dust particles were tightly bound to the comet nucleus until at least November 23. Three days later the dust was less tightly bound and became elongated and diffuse, spread out over as much as 120 arc seconds (80,000 km) in the anti-solar direction. Preliminary analyses of these observations suggest the detection of either a large-scale fragmentation event and/or the comet's disruption. The ratio of fluxes at 450 µm and 850 µm is 3.5 ± 0.4, which compares well with the expected value of 3.7 if both data come from the Rayleigh-Jeans tail of a black-body spectrum of these temperatures. We discuss both the significance and limitations of our findings and compare them to other investigations obtained simultaneously at complementary wavelengths (such as SOHO and STEREO).

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