Faint-meteor survey with a large-format CMOS sensor

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For observing faint meteors, we need a large telescope or similar optics, which always give a restriction of the field of view. It is a kind of trade-off between the high sensitivity by using larger telescope and narrower field of view. Reconciling this contradiction, we need a large-format imaging detector together with fast readout for meteor observations. A high-sensitivity CMOS sensor of the large format was developed by Canon Inc. in 2010[1]. Its size is 202 mm × 205 mm which makes it the largest one-chip CMOS sensor in the world, and approximately 40 times the size of Canon's largest commercial CMOS sensor as shown in the figure. The number of pixel is 1280 × 1248. Because the increased size of the new CMOS sensor allows more light to be gathered, it enables shooting in low-light environments. The sensor makes image capture possible in one-hundredth the amount of light required by a 35 mm full-frame CMOS sensor, facilitating the shooting of 60 frame-per-second video with a mere 0.3 lux of illumination.

We tried to use this large-format CMOS sensor attached to the prime focus of the 1.05-m (F3.1) Schmidt telescope at the Kiso Observatory, University of Tokyo, for surveying faint meteors. The field of view is 3.3 by 3.3 degrees. Test observations including operation check of the system were carried out in January 2011, September 2011,and December 2012. Images were obtained at a time resolution of 60 frames per second. In this system, the limiting magnitude is estimated to be about 11–12. Because of the limitation of the data storage, full-power observations (14-bit data per 1/60 second) were performed for about one or two hours each night. During the first period, we can count a sporadic meteor every 5 seconds. This is about one order higher detection rate of the faint meteors compared with the previous work[2]. Assuming the height of faint meteors at 100 km, the derived flux of the sporadic meteors is about 5×10^{-4} km^{-2} sec^{-1}. The last run was performed during the active period of the Geminid meteor shower. We could take valuable data on December 12 and 13. The result will be given in this presentation, together with the future potential of the large format CMOS sensor.

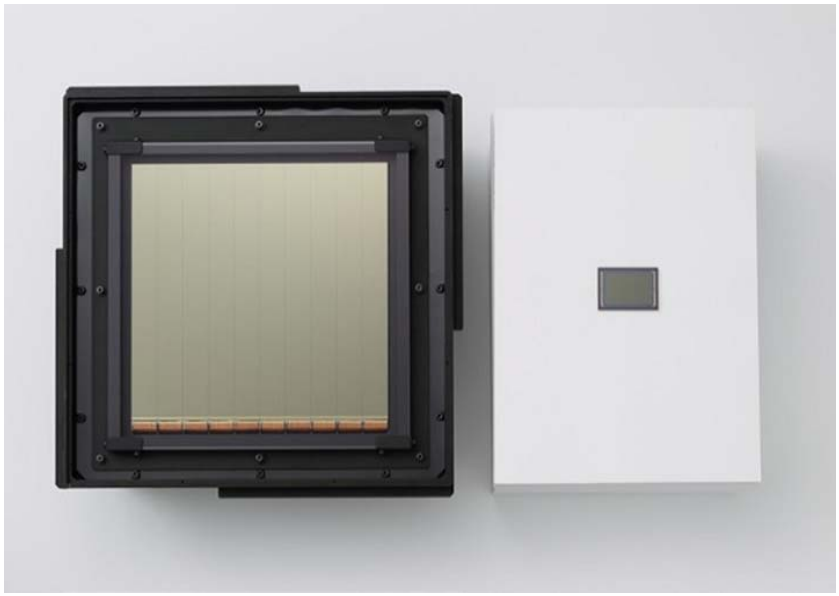

Figure: A new large-format CMOS sensor (left) and a 35-mm full-frame CMOS sensor often used in digital single-lens reflex camera product (right). Image was provided by Canon Inc.

References: [1] http://www.canon.com/news/2010/aug31e.html, 2010. [2] Pawlowski, J. F. et al. 2011 Meteoritics & Planetary Science, vol. 36, no. 11, pp. 1467–1477.