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Jovian impact flashes and their implication to small bodies

Jun-ichi Watanabe[1*], Isshi Tabe[2], Seiji Sugita[3], Masahisa Yanagisawa[4], Takashi Ito[1]

[1]National Astronomical Observatory, [2]Libra Co., [3]University of Tokyo, [4]The University of Electro-communications

Optical flashes on the surface of Jupiter were observed by amateur astronomers in June and August 2010. It is thought that these phenomena were bright meteors caused by the collision of small celestial bodies of a few to 10 m, and that they seemed to be more frequent than expected. If the frequency and the scale of these phenomena are investigated, the size distribution down to size of a few m can be decided at around the giant planet region. If the systematic observation is achieved, it will be a unique attempt to use the giant planets as a natural detector of small bodies.

The collision to the giant planets, especially the Jupiter is a phenomenon that often occurs as comet Shoemaker-Levy 9 in 1994. A trace of such impact was discovered by many amateur astronomers including Japan in July, 2009 (T. Mishina, in Astronomical Herald, August 2010). The follow up observation with Hubble Space Telescope etc. was promptly performed. It was presumed that it was a small body of about 500m-1km (A. S?nchez-Lavega et al. 2009, H. Hammel et al. 2010). Because this impact occurred in the opposite side, the impact flash was not observed. In June 2010, a optical flash of about two seconds in June, 2010 was caught by two amateur astronomers in Australia and the Philippines independently during their video observations of Jupiter. It is thought that this was caused by an impact of small body of about 8-13m diameter, without leaving any trace in the atmosphere (Hueso et al. 2010).

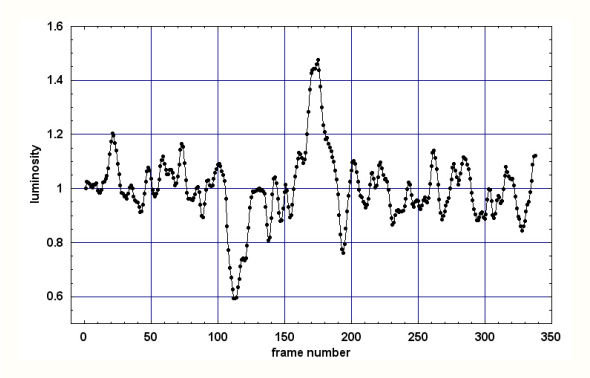
Only two month later, four amateur astronomers in Japan recorded a flash at 3h22m12s on August 21 (UT). The coordinate is 140.4 and +21.1degrees in system II. The duration was about two seconds, and the brightness was 6.2 magnitudes. This data is presumed to be an equivalent or slightly smaller scale than that in June.

In case of Earth, the brightness of meteors depends not only on sizes but also on the entry velocity. However, in the case of Jupiter, the entry velocity becomes almost similar value (60-64km per second) which is almost independent on the direction of the orbits of bodies because of the strong gravity of Jupiter. We do not have any uncertainty for estimating size of impacting bodies from the brightness of the flashes.

On the other hand, we have large uncertainty in the size distribution of small bodies in the giant planet region, because we cannot see directly any bodies of less than 1km. There is an unbridgeable gulf in the size distribution at 1km or less though presumptions from the crater count on the surface of the satellites. Estimation from the satellite of Uranus and Jupiter has one-order difference in 0.1km size. There is two-order or more difference compared to the size distribution extended from the trans-Neptunian objects (Zahnle et al. 2003). If we thinks only two samples observed in 2010, the collision probability of 10m size on the Jupiter becomes about 0.5-10 per year, somewhere between the size distribution presumed by the Crater count of the satellite of Uranus and by the trans-neptunian objects.

However, it should be a lower limit. By a systematic monitoring observation, we may have larger value. Anyway, this is certainly a powerful means that we can derive information on the distribution of the size of small bodies of 1km or less. The result may be a feedback to the Crater chronology. As for craters that remain on the surface of the planet in an internal region in the solar system, the size distribution is relatively consistent, but those in the icy satellites in the giant planets have wide variety, which suggests complicated processes. As for the meaning to make the understanding of the vicinity advance, the meaning of such phenomena is significant.

We try to construct a network of monitoring observations of Jupiter and Saturn together with skilled amateur astronomers, and to detect more small-scale impact flashes with large telescopes in order to investigate frequency and scale of such impact flashes.



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