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Flux of impacts in Jupiter: From superbolides to large-scale meteorites

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ABSTRACT

In July 2009 Jupiter received an impact from a 500-1000 m object that left a large-scale debris feature in its atmosphere observable over months from ground-based observations and firstly discovered by an amateur astronomer (A. Wesley, see report by Sánchez-Lavega et al. 2010). Although smaller than the SL9 comet that impacted Jupiter 15 years earlier, the impact of this object hinted to a larger than expected impact flux in Jupiter. Small impacts of objects of the 10 m size class have also been detected by the short-lived 1-2 seconds long fireball produced in the atmosphere as these objects entered the atmosphere of the planet releasing amounts of energy comparable to the Tunguska event on Earth (Hueso et al. 2010). Three of these jovian superbolides have been found in video observations obtained by amateur astronomers in June 2010, August 2010 and September 2012 at periods of time when Jupiter is relatively close to opposition and many amateurs are observing the

planet. We present the light-curves of the three events as well as the size characterization of the impact objects.

In all cases the impact was detected at least by two different observers with only one of them noticing the impact and others finding the short flash in their video observations after knowing something hit Jupiter at the time they were observing the planet. This leaves open the possibility that some of these objects could have been observed without actually realizing the faint photometric signal of the impacts. We have developed software tools to automatically analyze video observations of Jupiter and find the small-scale impactors producing fireballs in the planet that could pass without notice in video observations of Jupiter. We describe observing campaigns to find these objects and the threshold for detection of small-size objects producing short flashes and large-scale objects resulting in long-standing particulates debris features in the atmosphere. We also discuss the characteristics of a light-flash in Jupiter that should be considered important enough to trigger fast high-resolution observations of the planet in the next few Jupiter rotations to detect the relatively short-term enduring debris fields left by intermediate size objects (50-100 m). Based on this data we present an estimation of the current rate of impacts in Jupiter and our suggestions of the observational campaigns that would be needed to improve the accuracy of the current.

Monitoring and understanding airbursts on Jupiter can better inform our understanding Tunguska-like airbursts on Earth. The significance of the flux at Jupiter is that that it is much higher than the flux rate at Earth offering opportunities for model validation and understanding of Tunguska-like events that happen on Earth on time-scales of a few centuries but happen on Jupiter may be every year.

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