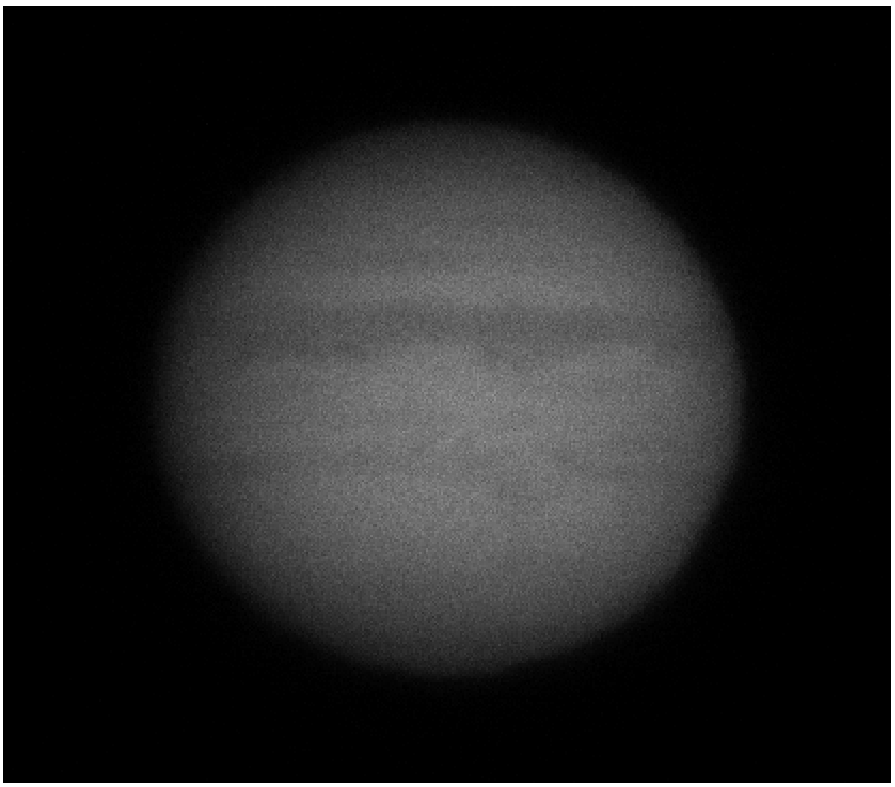
Stony-iron meteor caused August impact flash at Jupiter

September 17 2019



The movie plays at slow motion, but it was captured at a speed of 83 frames per second. The flash lasts about 1.5 seconds and is easily visible as a point of light in the left side of the planet with a ring around in the brightest frames caused by diffraction in the optics of the telescope. The flash has structure, it lightens, decays and brightens again which are signatures of impact fragmentation in the upper atmosphere of the planet. The movie is in black and white but it was captured using a red filter. Credit: E. Chappel

Analysis of a bright flash in Jupiter's atmosphere observed by an amateur astronomer in August 2019 has revealed that the likely cause was a small asteroid with a density typical of stony-iron meteors. The impact is estimated to have released energy equivalent to an explosion of 240 kilotons of TNT—around half the energy released in the 2013 Chelyabinsk event at Earth. The results have been presented today at the EPSC-DPS Joint Meeting 2019 in Geneva.

Ethan Chappel from Cibolo Texas captured a short flash of light at 04:07 UTC on 7th August in video observations of Jupiter using a small telescope in his backyard. The flash lasted for about 1.5 seconds and, at its peak, appeared as bright as Jupiter's moon Io. Chappel continued his observations for the next half hour without knowing he had been the only witness of a planetary collision.

Once inside, Chappel analysed the video data using DeTeCt, an open source software specially designed to identify impacts in Jupiter. On finding a clear image of a flash in one of the videos, he quickly got in touch with the developers of the DeTeCt project, Marc Delcroix and Ricardo Hueso, who in turn contacted their large network of amateurs to see if any other detections had been made.

Marc Delcroix, a French amateur astronomer, said: "I was thrilled when Ethan contacted me. This is the first impact flash at Jupiter found using the DeTeCt software. These detections are extremely rare because the impact flashes are faint, short and can be easily missed while observing the planets for hours. However, once a flash is found in a video recording it can be analyzed to quantify the energy required to make it visible at a distance of 700 million kilometers."

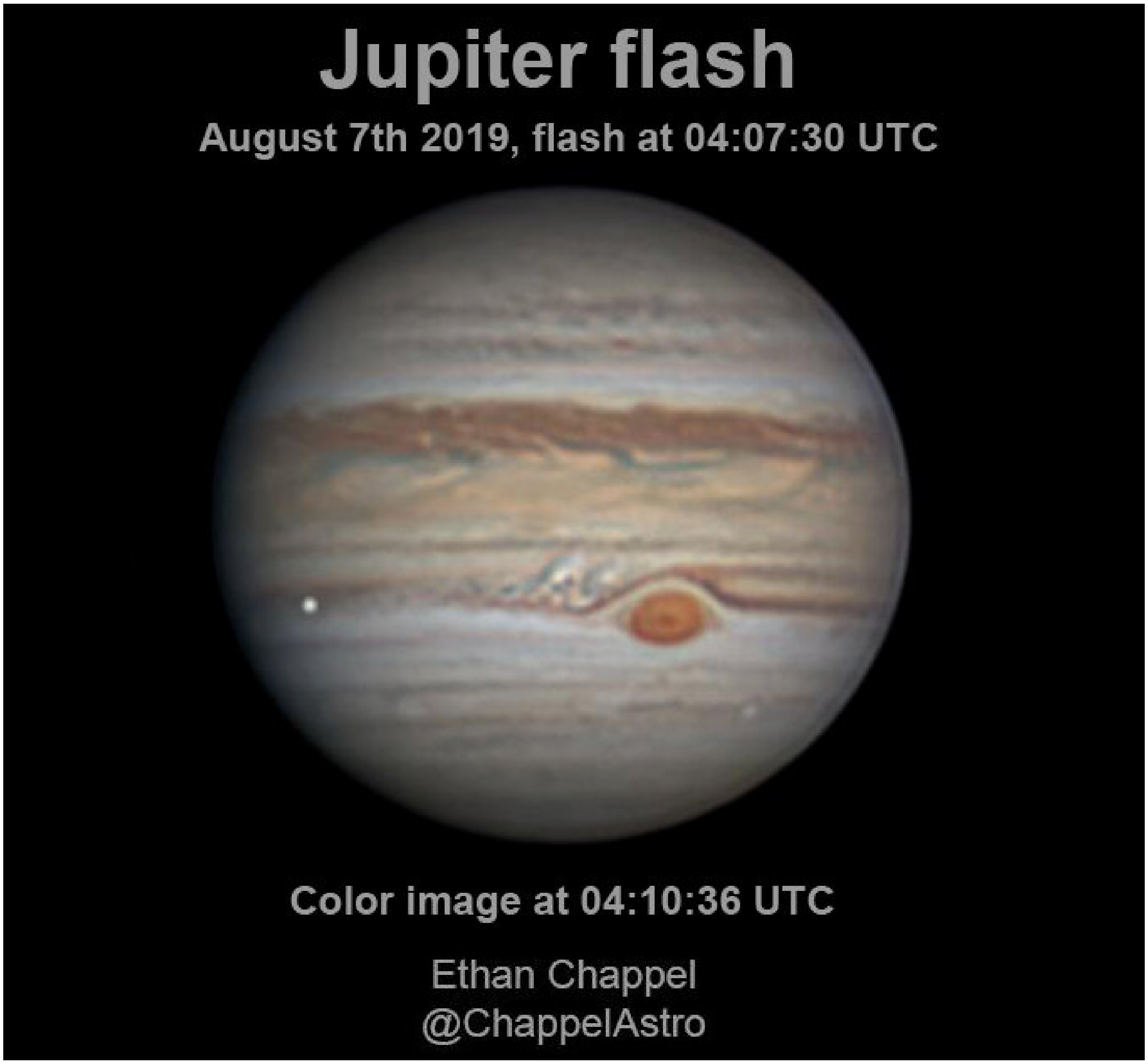
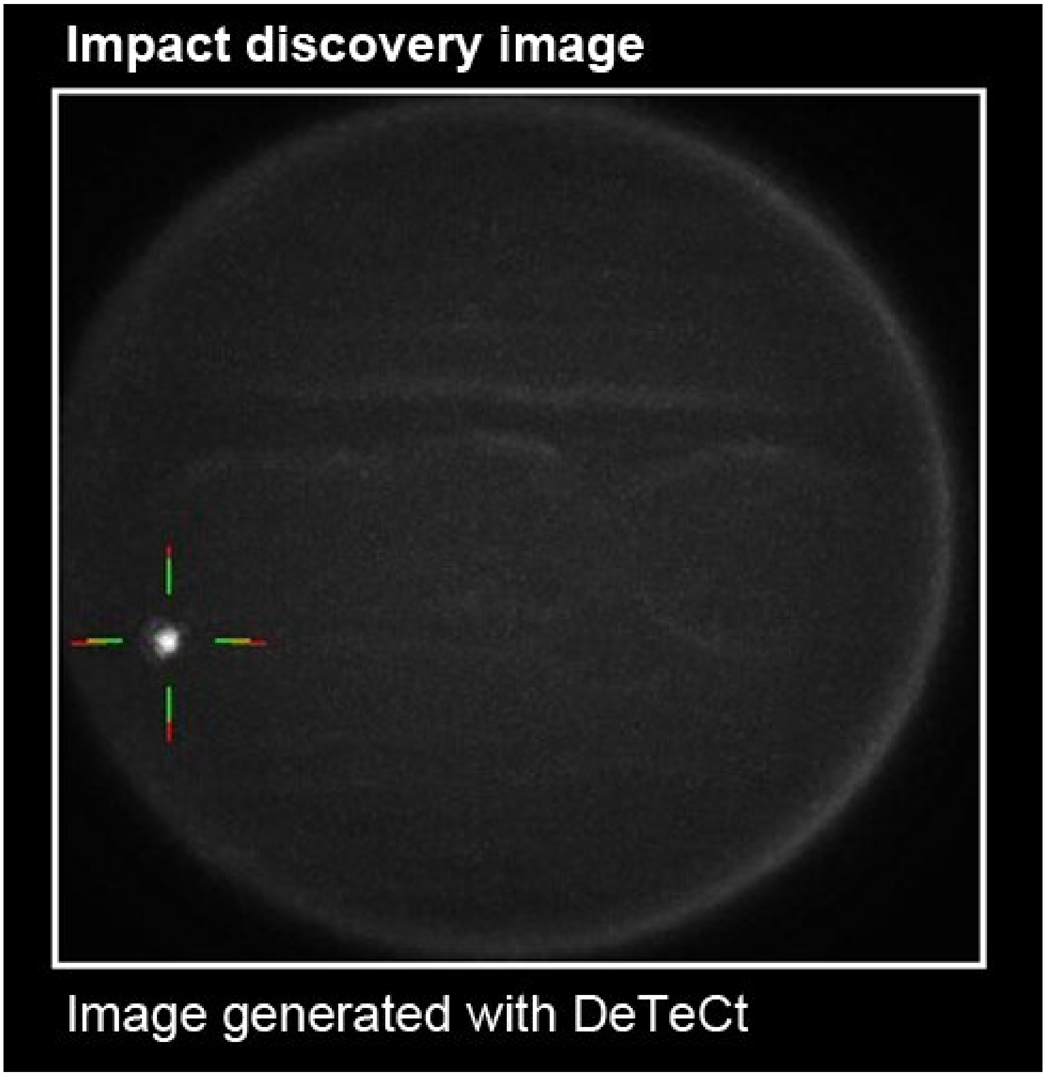


Image of Jupiter processed from images obtained by Ethan Chappel shortly after the impact. An image of the flash produced by the impact has been included at its right location over the colour image. Credit: E. Chappel

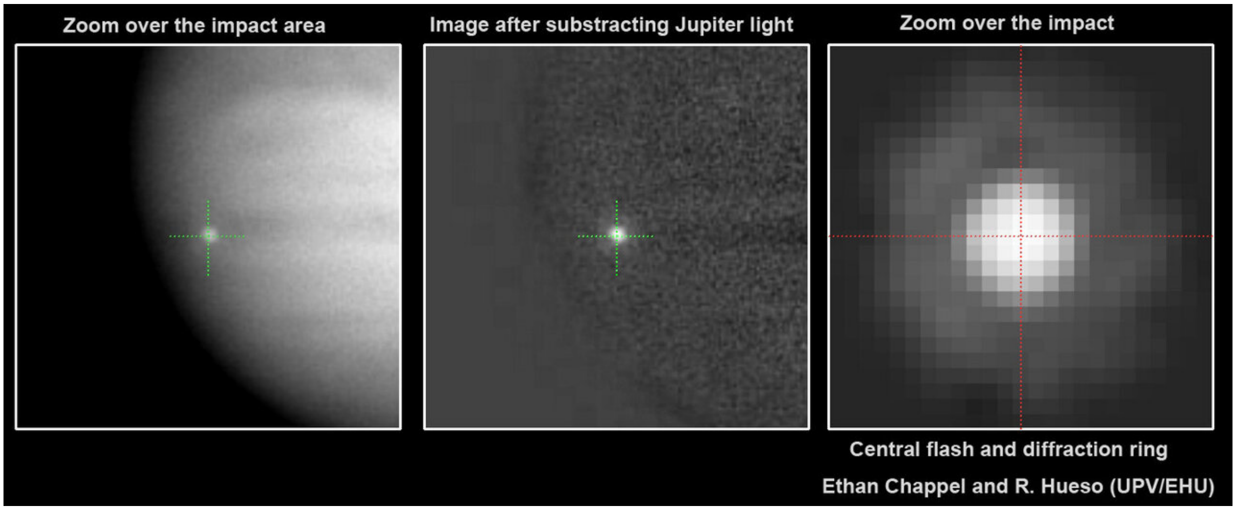
Over the past month, Ramanakumar Sankar and Csaba Palotai of the Florida Institute of Technology (FIT), have made an in-depth analysis of the data. They estimate from the energy released by the flash that the impactor could have been an object around 12-16 meters in diameter and with a mass of about 450 tons that disintegrated in the upper atmosphere at an altitude of about 80 kilometers above Jupiter's clouds. Sankar and Palotai's models of the light-curve for the flash suggest the impactor had a density typical of stony-iron meteors, indicating that it was a small asteroid rather than a comet.

Hueso, of UPV/EHU in Spain, has made a very similar estimate for the size and mass of the impactor through comparisons with the previous impact flashes detected. The flash appears to have been the second brightest of the six observed so far at Jupiter and offers the greatest potential for detailed data analysis.

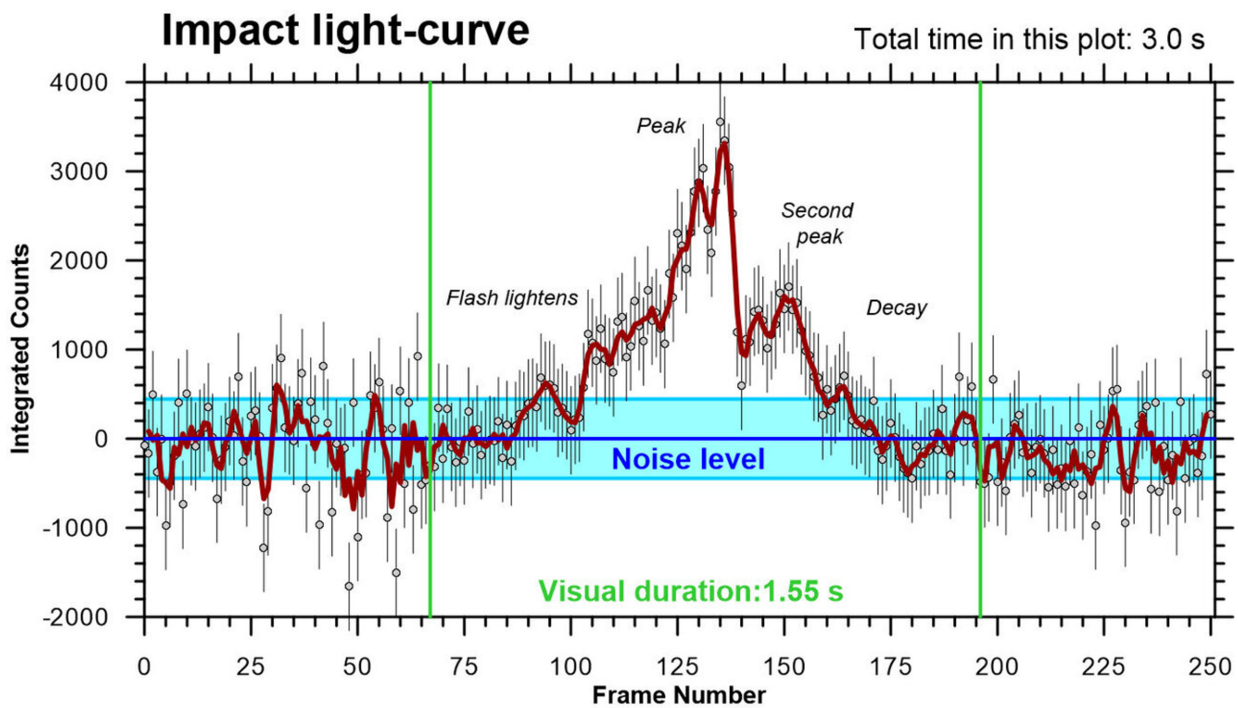
"With six impact flashes observed in ten years since the first flash was discovered in 2010, scientists are becoming more confident in their estimates of the impact rate of these objects in Jupiter. Most of these objects hit Jupiter without being spotted by observers on Earth. However, we now estimate 20-60 similar objects impact with Jupiter each year. Because of Jupiter's large size and gravitational field this impact rate is ten thousand times larger than the impact rate of similar objects on Earth," said Hueso.



This image was produced by the software DeTeCt when analyzing one of the several video observations obtained by Ethan Chappel. The software identified and highlighted the location of the impact flash. DeTeCts performs differential images of a video while it corrects the position of each frame from distortions caused by atmospheric turbulence. E. Chappel/R. Hueso/M. Delcroix/DeTeCt



Detailed analysis of the flash from software written at UPV/EHU. The left image shows a clear image of the flash and Jupiter from adding several images of the video near the peak brightness of the flash. The image in the centre subtracts a reference image of the planet showing only the contribution from the impact flash. The right image shows a zoom of the flash at the peak of its brightness. The structure of the central flash and bright ring around are produced by optic effects in the telescope known as diffraction. Even at the scale of thie zoom the flash is a punctual source ligtening Jupiter's atmosphere over a very small region. Credit: E. Chappel/R. Hueso/M. Delcroix/DeTeCt



Light curve of the impact flash showing the time structure of the fireball in Jupiter's atmosphere. E. Chappel/R. Sankar/C. Palotai

Hueso and Delcroix hope that more amateur astronomers will routinely use DeTeCt to analyze video observations of Jupiter and Saturn so that more of these impacts can be found and studied.

Marc Delcroix said: "The amateur community has been galvanized by this event and the number of observers and the volume of data being processed is increasing rapidly. DeTeCtis a fantastic showcase for pro-am collaboration."

More information: Jupiter and Saturn impact detection project. meetingorganizer.copernicus.or … SC-DPS2019-970-2.pdf

Provided by EuroPlanet