



Jovian impact flashes detection with DeTeCt software project

EPSC2013-812
Sep. 12th, 2013, London, UK

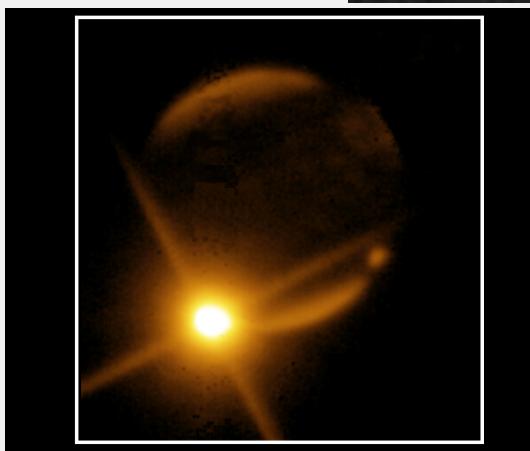
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- Jupiter, the biggest planet, is the planet with the most important gravitational influence on solar system's small bodies
- From **July 16th to 22nd, 1994**, 21 fragments of **P/Shoemaker-Levy 9** comet impacted Jupiter:



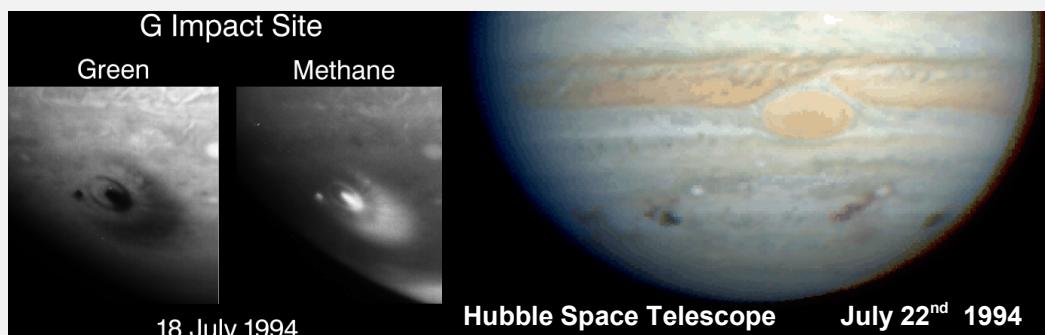
© Pic du Midi, March 20th, 1994 (F.Colas, J.Lecacheux, L.Jorda, JC Le Floch)



Impact of Fragment G of Comet Shoemaker-Levy on Jupiter.
The fireball is seen 12 minutes after impact at 2.34 microns.
The impact A site is seen on the opposite limb of the planet.

Image at 2.34 microns with CASPIR by Peter McGregor
ANU 2.3m telescope at Siding Spring

- All phases could be observed by professionals:
 - **Impactor** bodies before impacts
 - Impacts themselves **forecasted** and **observed** live
 - **Evolutions** of the observed impacts **traces**



- After such a show, jovian observable impacts **frequency** is estimated around **one per century(ies)**, but ...

... amateur discovered :

July 19th, 2009: a dark impact trace visible for weeks (A.Wesley) - 15 years after Shoemaker/Levy 9

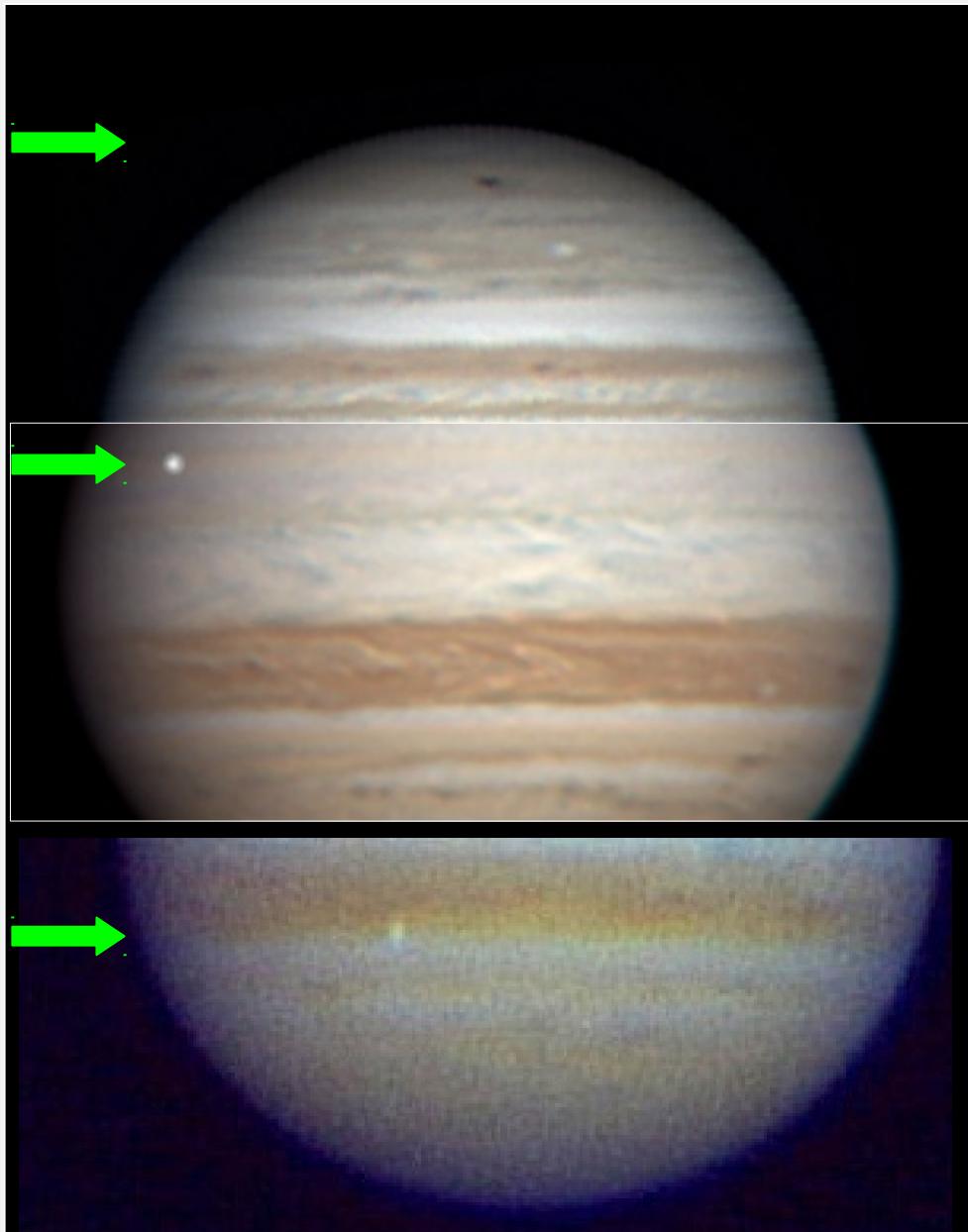
Body ~200/500m

June 4th 2010: impact (a 2s bright flash) observed live (A.Wesley, C. Go)

Body ~10m, no trace

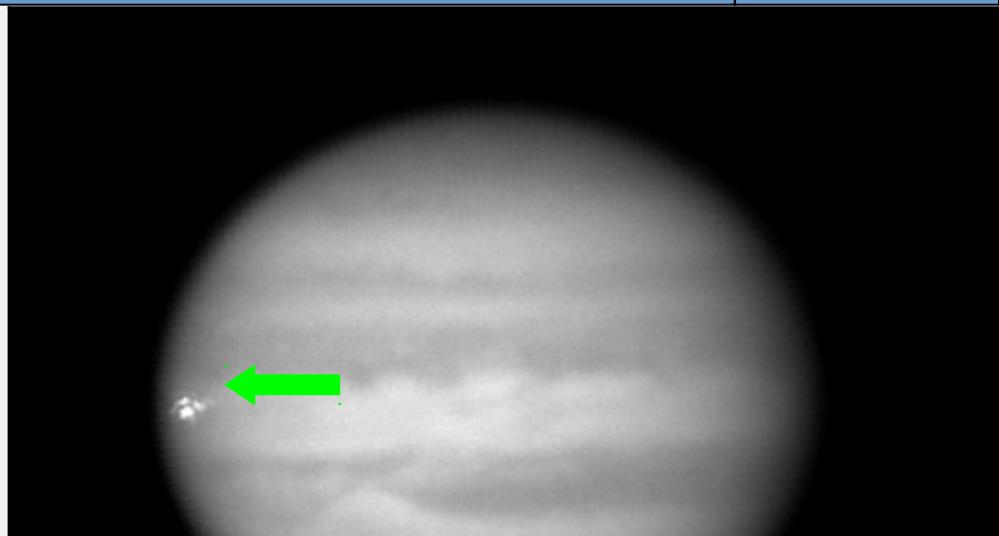
August 20th 2010 : impact a 2s bright flash) observed live (M.Tachikawa, K.Aoki and M. Ichimaru)

Body ~10m, no trace after one rotation (M.Delcroix)

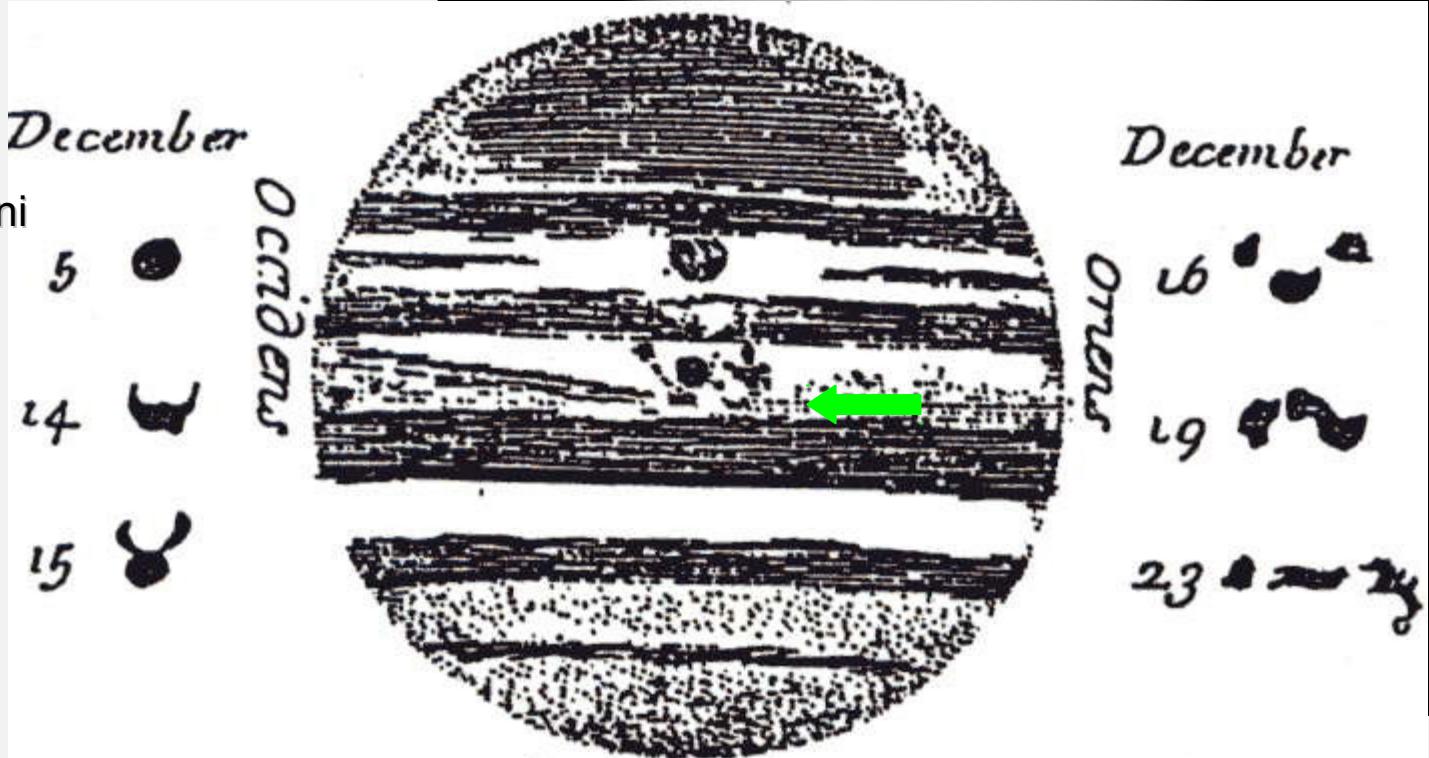


September 10th, 2012: a 2s bright flash observed live visually (D.Petersen) and found a posteriori on a video (G.Hall)

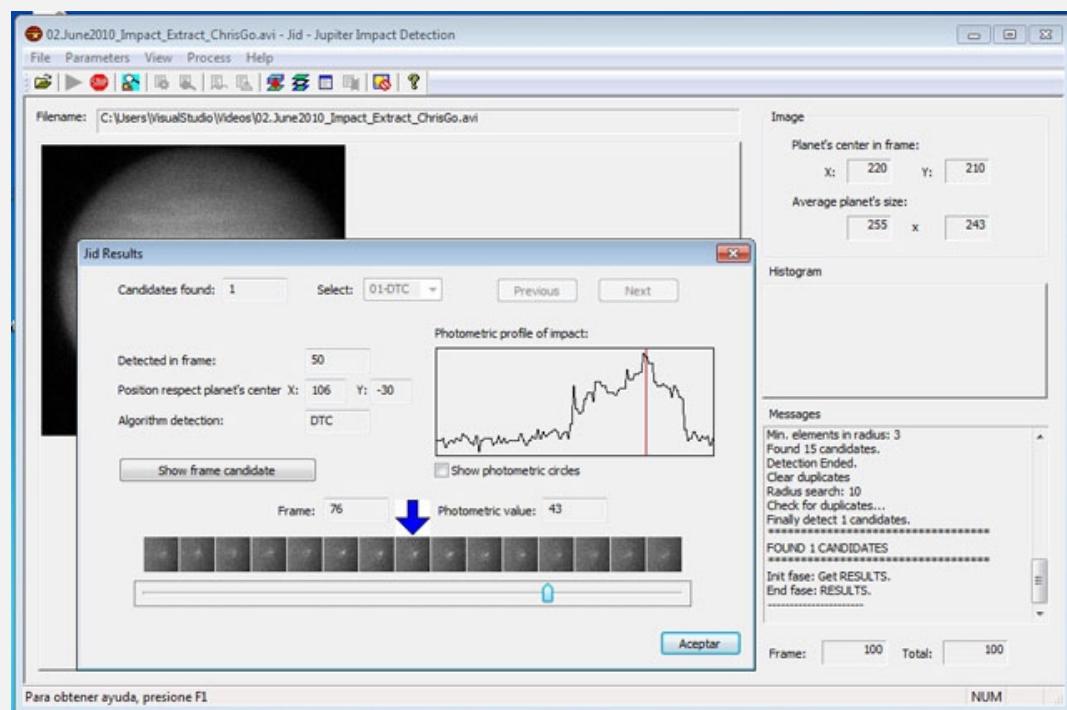
Body>10m, no trace



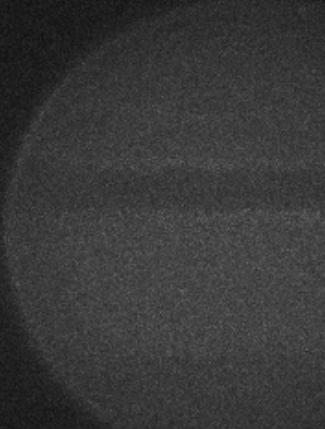
And before,
Jean-Dominique Cassini
in 1690 ?



- **Thousands of amateurs** image worldwide Jupiter each apparition.
Their acquisitions could contain **jovian impact flashes not yet detected**
- **video detection softwares** developed (<http://www.pvol.ehu.es/software>):
coordination R. Hueso/A. Sanchez-Lavega/J. Maria-Gomez (Grupo de Ciencias
Planetarias, UPV-EHU, Spain)
with **algorithms proposed by amateurs** (E. Kraaijkamp & M. Delcroix)
- Graphical software **JID**
amateur author JC Moreno



« batch » software ***DeTeCt*** (**amateur author** Luis Calderon) modified by M. Delcroix for a project collecting amateur detection attempts on their own acquisitions, aiming at constraining the jovian impact rate

- analysis of all old acquisitions (wherever they are stored) in a row without user interaction
 - focused on a **simple, fast and efficient** algorithm minimizing **false positives** by visual inspection of a single « detection image » per acquisition
 - Generating a **single log file** for all videos analyzed, with **datation** and acquisition **information** (using acquisition softwares logs when available – Lucam Recorder, Genika, Firecapture, PlxCapture, Avi felopaul, Genicap, ...)
 - **Participation to the project is simple:** just send your log files to delcroix.marc@free.fr, informing of course of any possible detection!

```
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Dt\Work\Impact\dto\dev\exe\Jupiter_20120804\ch4\Jupiter_2012_08_04_061411_Clear.ser
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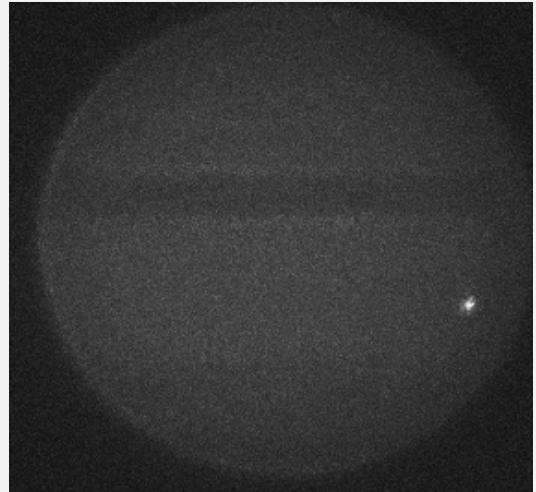
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Dt\Work\Impact\dto\dev\exe\Jupiter_dark_2012_08_04_062314_Clear.ser
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```



- Impacts last ~2s out of amateur acquisition movies usually > 30s
- Impacts are bright compared to all of the surrounding
- Work on the whole movie (not on successive frames) to detect pixels brighter than the average

Method

- **alignment** of all frames
- addition of all aligned frames to calculate an « **average image** » (each pixel is the average value for all n frames of the acquisition)

$$\text{ADU}_{\text{average}} = \sum_{i=1..n} \text{ADU}_i / n$$

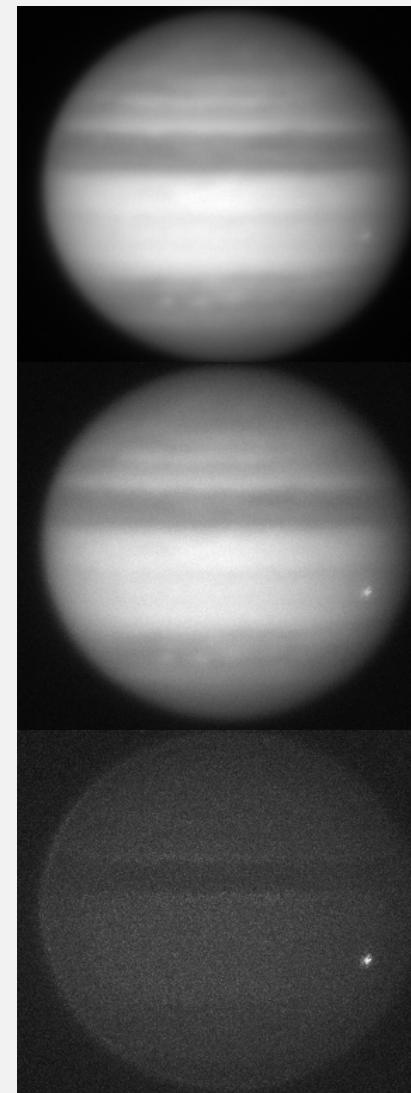
- construction of a « **maximum image** » composed for each pixel of maximum for all n frames of the acquisition :

$$\text{ADU}_{\text{max}} = \max_{i=1..n} (\text{ADU}_i)$$

- construction of a final « **detection image** » subtracting maximum and average values :

$$\text{ADU}_{\text{detection}} = \text{ADU}_{\text{max}} - \text{ADU}_{\text{average}}$$

- **normalisation of the final detection image** for easing the visual inspection of the « **detection image** » where a candidate impact should « pop-up » out of the rest of the image



DeTeCt Base of impact estimation : http://www.astrosurf.com/planetessaf/doc/project_detect.shtml

**Planetary impact flashes detection with DeTeCt software project/
Projet de détection de flash d'impacts planétaires avec le logiciel DeTeCt**

by/par [Marc Delcroix](#)



Currently 0 impact detection out of

=====
Total 20 observers for a total observing duration of 6d 13h 7m 28,525s (8285 videos) from 2006/04/14 to 2013/09/05
=====

Observer Trevor Barry (Australia) : duration of 1d 14h 43m 54,053s (2424 videos) from 2009/07/07 to 2012/12/30
Observer Marc Delcroix (France) : duration of 1d 9h 33m 20,851s (1409 videos) from 2006/04/14 to 2013/09/03
Observer Paul Rolet (France) : duration of 0d 17h 15m 4,999s (605 videos) from 2012/09/07 to 2013/09/05
Observer Pascal Bayle (France) : duration of 0d 16h 47m 53,999s (1006 videos) from 2012/11/30 to 2013/03/03
Observer Pascal Lemaire (France) : duration of 0d 10h 46m 55,768s (573 videos) from 2012/08/01 to 2013/02/16
Observer Manos Kardassis (Greece) : duration of 0d 10h 11m 48,248s (524 videos) from 2010/06/09 to 2013/05/15
Observer Flavius Isac (France) : duration of 0d 7h 47m 23,231s (546 videos) from 2011/08/12 to 2013/02/17
Observer Christophe PELLIER (France) : duration of 0d 7h 38m 53,628s (311 videos) from 2012/02/20 to 2013/01/16
Observer Xavier Dupont (France) : duration of 0d 6h 4m 57,283s (299 videos) from 2012/08/16 to 2013/08/23
Observer Laurent Labruyere (France) : duration of 0d 1h 37m 29,48s (42 videos) from 2012/11/13 to 2012/12/02
Observer Jean-Luc Dauvergne (France) : duration of 0d 1h 37m 10,19s (176 videos) from 2011/10/13 to 2011/10/16
Observer Olivier Dechambre(France) : duration of 0d 1h 20m 46,569s (82 videos) from 2012/11/29 to 2013/02/18
Observer Freddy Willems (USA) : duration of 0d 1h 19m 35,055s (53 videos) from 2012/12/29 to 2012/12/30
Observer Jean-Jacques Poupeau (France) : duration of 0d 1h 0m 0,038s (85 videos) from 2013/02/05 to 2013/03/14
Observer Yann Le Gall (France) : duration of 0d 0h 35m 10,639s (50 videos) from 2011/08/20 to 2012/10/01
Observer Marc Patry (France) : duration of 0d 0h 22m 1,477s (67 videos) from 2012/10/02 to 2012/11/15
Observer Société Astronomique de Touraine (France) : duration of 0d 0h 16m 23,285s (15 videos) from 2012/12/12 to 2013/04/02
Observer Giuseppe Monachino (Belgique) : duration of 0d 0h 6m 4,232s (10 videos) from 2012/09/23 to 2012/09/23
Observer Agustin Sanchez-Lavega (Spain) : duration of 0d 0h 1m 35,299s (5 videos) from 2012/12/09 to 2012/12/09
Observer Bernard Bayle (France) : duration of 0d 0h 1m 0,19s (3 videos) from 2012/11/21 to 2012/11/21

English tutorial for participating to the project: [Planetary impact flashes detection with DeTeCt software](#)

Tutoriel français pour participer au projet: [Détection de flash d'impacts planétaires avec le logiciel DeTeCt](#)

Current results :

- no impact detected
- 6,54 days of acquisitions
- 20 observers (France, Australia, Greece, US)
- 8285 acquisitions
- from 2006 to now

We need more amateur data to estimate jovian impact frequency
(including detections, and enough time coverage to be significant)

It's up to you to contribute to science!

Send us our detection logs, they are useful and will be used!
GO TO
[**http://www.astrosurf.com/planetessaf/doc/project_detect.shtml**](http://www.astrosurf.com/planetessaf/doc/project_detect.shtml)
(download, tutorial, results)

Questions ?

Presentation will be downloadable one week after the lecture at :
[***http://astrosurf.com/delcroix***](http://astrosurf.com/delcroix)
(as well as all of my other publications/presentations)



Jupiter impacts detection project: a pro-am collaboration

BAA Workshop
Sep. 13th, 2013, London, UK

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Commission des observations planétaires, Société Astronomique de France

Astronomy & Astrophysics manuscript no. Jovian_Impacts_aa_2013_09_02
September 3, 2013

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Impact Flux on Jupiter: From superbolides to large-scale collisions

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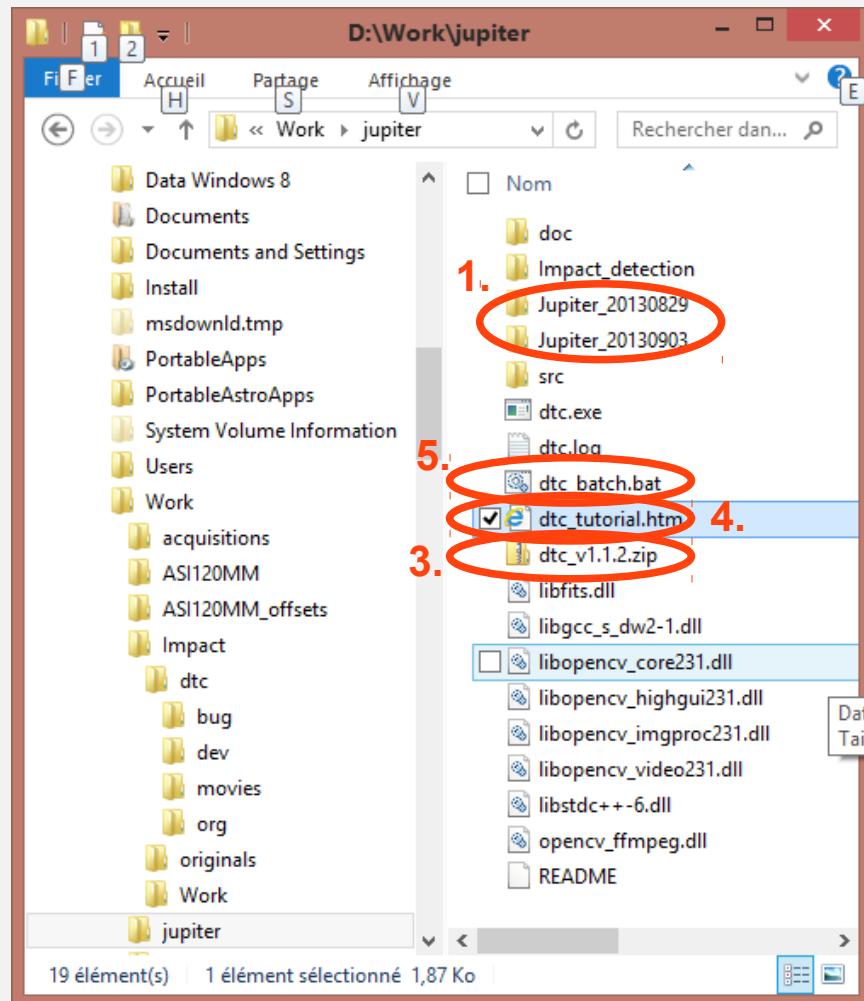
¹⁵ Agrupación astronómica de Sabadell, Sabadell, Spain

Amateurs having
discovered :
- impact **flashes**
- **traces** of impacts

Amateurs having:
- **developped**
impact detection
softwares
- **coordinated a**
impact detection
project

Detailed STEP by STEP

1. Gather your acquisitions (files + acquisition logs) directories in a work directory
2. Download latest DeTeCt software in a zip file from
http://www.astrosurf.com/planetessaf/doc/project_detect.shtml
3. Save the zip file in your work directory, and
unzip it here
4. Use the “dtc_tutorial” for any help
5. Double click on « dtc_batch »



A command window opens, processing start for each found acquisition,

Process is done when you see "Please press a key to continue"

Here it is, everything is done, the only thing left for you is to inspect each generated image for each movie, easy, isn't it ?

```
20:58 Processing sub-directory Jupiter_20120804 ...
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File Jupiter_2012_08_04_061411_Clear in jupiter_20120804 (full path D:\Work\Impact\dto\dev\exe\Jupiter_20120804\ch4\jupiter_2012_08_04_061411_Clear.ser)

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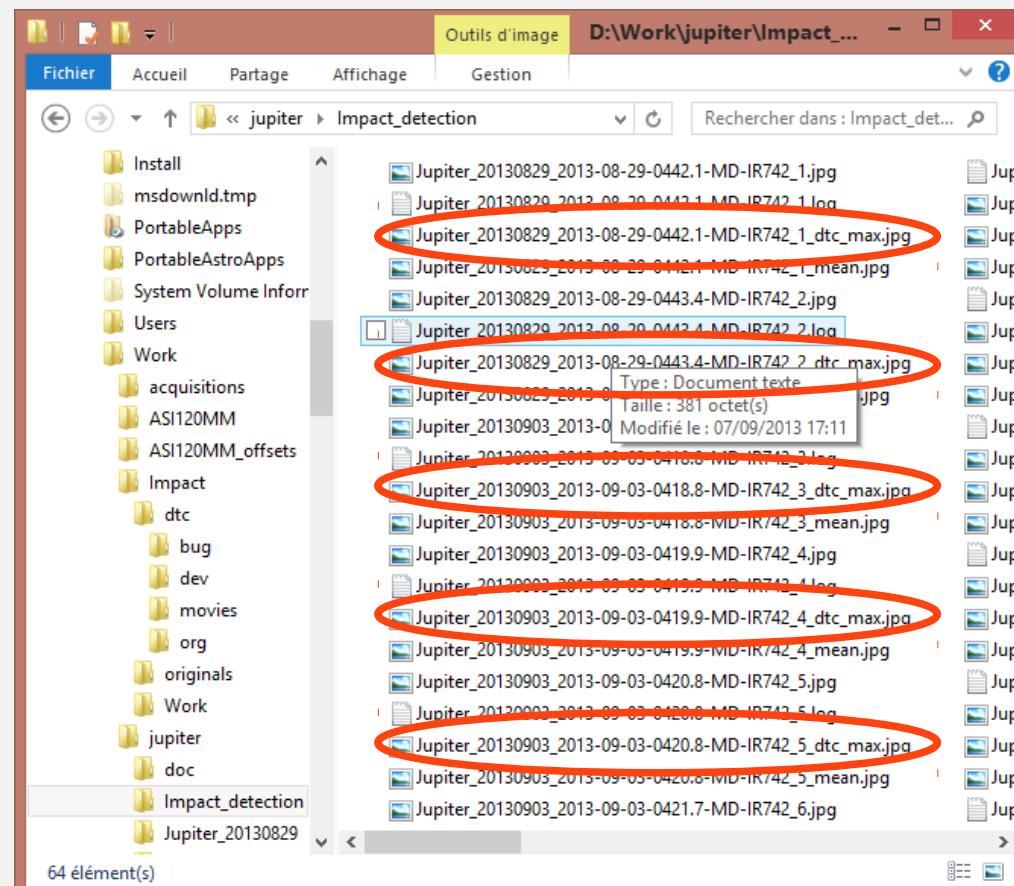
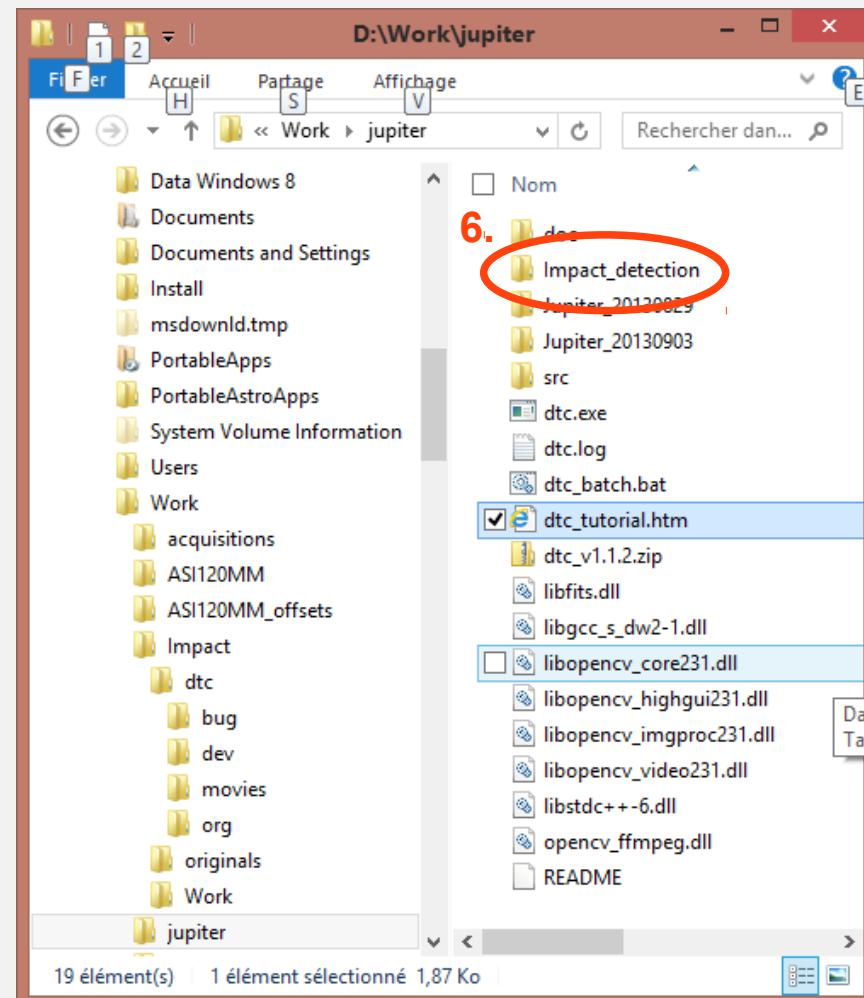
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File Jupiter_dark_2012_08_04_062314_Clear in jupiter_20120804 (full path D:\Work\Impact\dto\dev\exe\Jupiter_20120804\ch4\jupiter_dark_2012_08_04_062314_Clear.ser)

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20:58
=====
Impact detection #6 for D:\Work\Impact\dto\dev\exe\Jupiter_20121003\ir1\Jupiter_2012_10_03_062744_L.ser
D:\Work\Impact\dto\dev\exe> dto.exe -RQdtdetail -iFile D:\Work\Impact\dto\dev\exe\Jupiter_20121003\ir1\Jupiter_2012_10_03_062744_L.ser -oFile Impact_detection_Jupiter_2012_10_03_062744_L_6.jpg >Impact_detection_Jupiter_2012_10_03_062744_L_6.log
File Jupiter_2012_10_03_062744_L in jupiter_20121003 (full path D:\Work\Impact\dto\dev\exe\Jupiter_20121003\ir1\jupiter_2012_10_03_062744_L.ser)

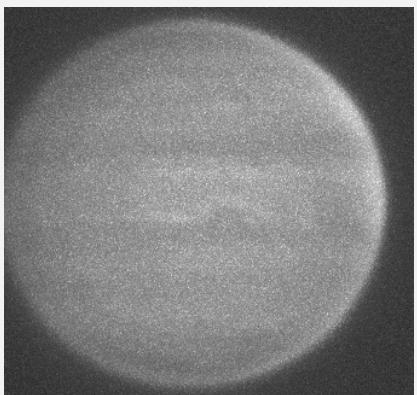
=====
Impact detection #7 for D:\Work\Impact\dto\dev\exe\Jupiter_20121003\ir1\Jupiter_2012_10_03_062947_L.ser
D:\Work\Impact\dto\dev\exe> dto.exe -RQdtdetail -iFile D:\Work\Impact\dto\dev\exe\Jupiter_20121003\ir1\Jupiter_2012_10_03_062947_L.ser -oFile Impact_detection_Jupiter_2012_10_03_062947_L_7.jpg >Impact_detection_Jupiter_2012_10_03_062947_L_7.log
File Jupiter_2012_10_03_062947_L in jupiter_20121003 (full path D:\Work\Impact\dto\dev\exe\Jupiter_20121003\ir1\jupiter_2012_10_03_062947_L.ser)

21:01
Appuyez sur une touche pour continuer...
```

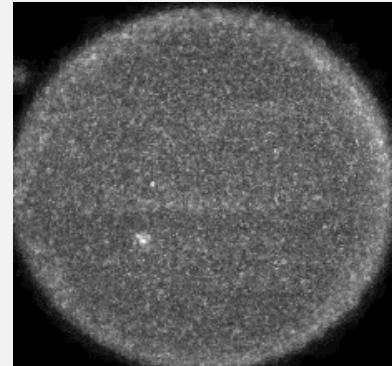
5. Look in the Impact_detection directory (automatically created) for the « xxxx_dtc_max » images



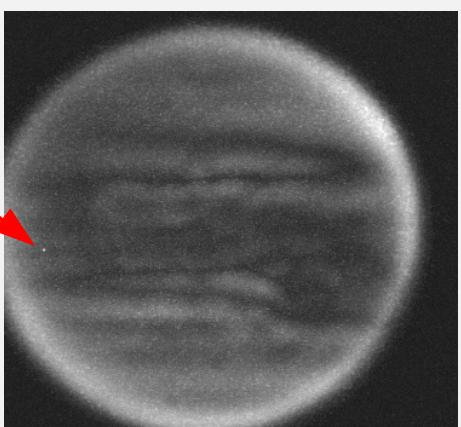
6. Analyze visually in any editor these « xxxx_dtc_max » images for impact detection (using the tutorial “dtc_tutorial” stored in the above directory if needed)



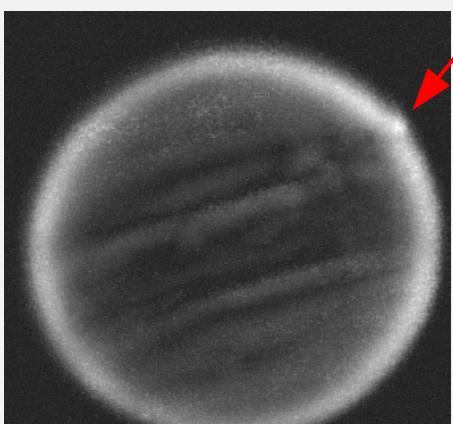
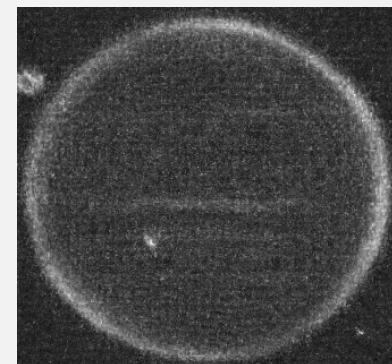
Negative results



**Positive results
(impacts!)**

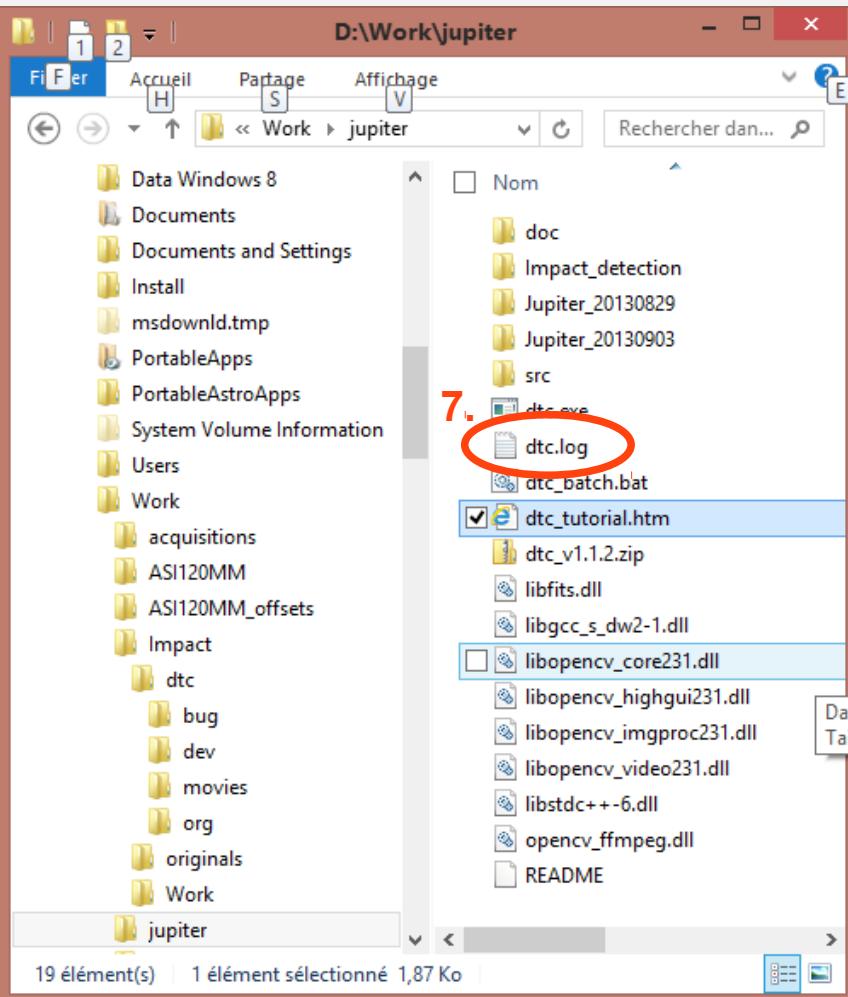


Single hot pixel



Satellite transiting

A **single log file** for all acquisitions analyzed was generated, with **datation** and acquisition **information** (using acquisition softwares logs when available – Lucam Recorder, Genika, Firecapture, PlxCapture, Avi felopaul, Genicap, ...)



7. Participation to the project is simple:
just send your log files to delcroix.marc@free.fr,
informing of course of any possible detection!

We need more amateur data to estimate jovian impact frequency
(including detections, and enough time coverage to be significant)

It's up to you to contribute to science!

Send us our detection logs, they are useful and will be used!
GO TO

[\(download, tutorial, results\)](http://www.astrosurf.com/planetessaf/doc/project_detect.shtml)

Questions ?

Presentation will be downloadable one week after the lecture at :
[*http://astrosurf.com/delcroix*](http://astrosurf.com/delcroix)
(as well as all of my other publications/presentations)