# Impacts/flashes detection on Jupiter (and Saturn)

Juno Ground-based support from Amateurs Europlanet workshop
Nice, May 12-13, 2017

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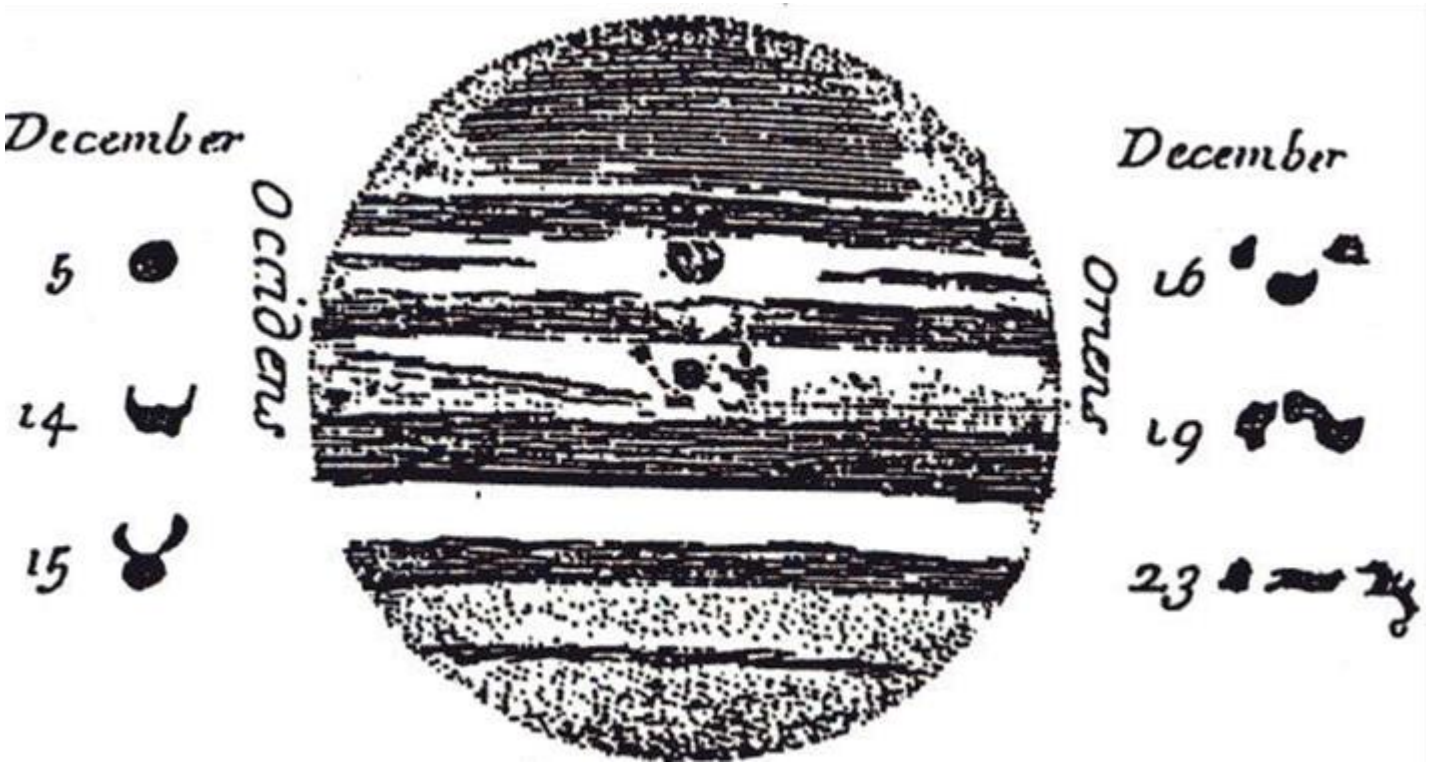
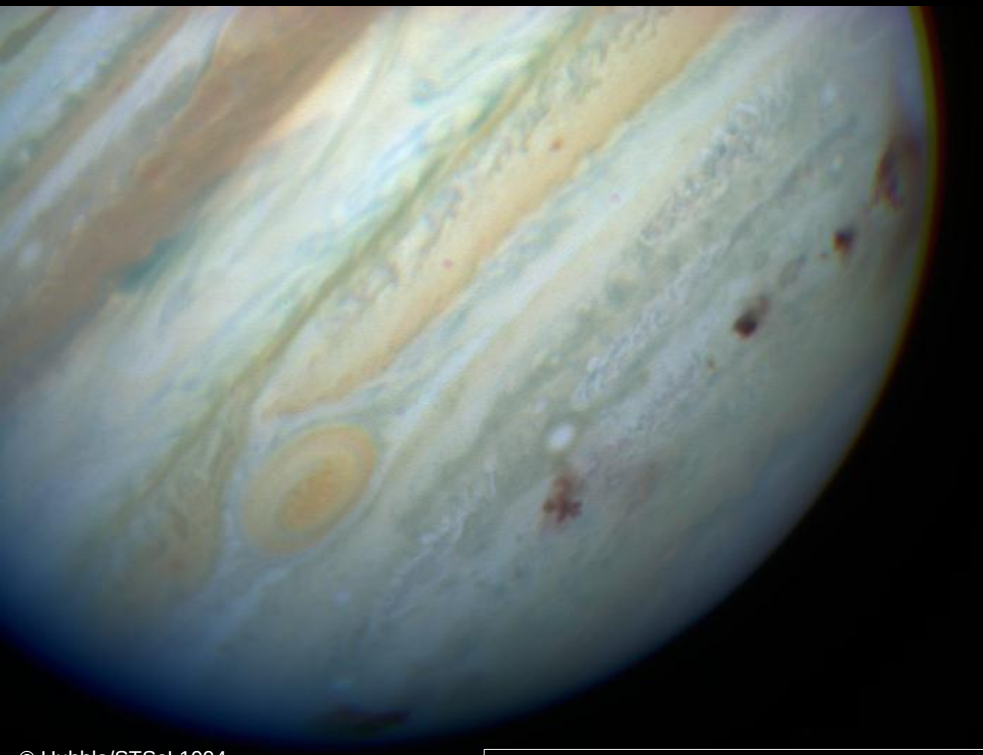
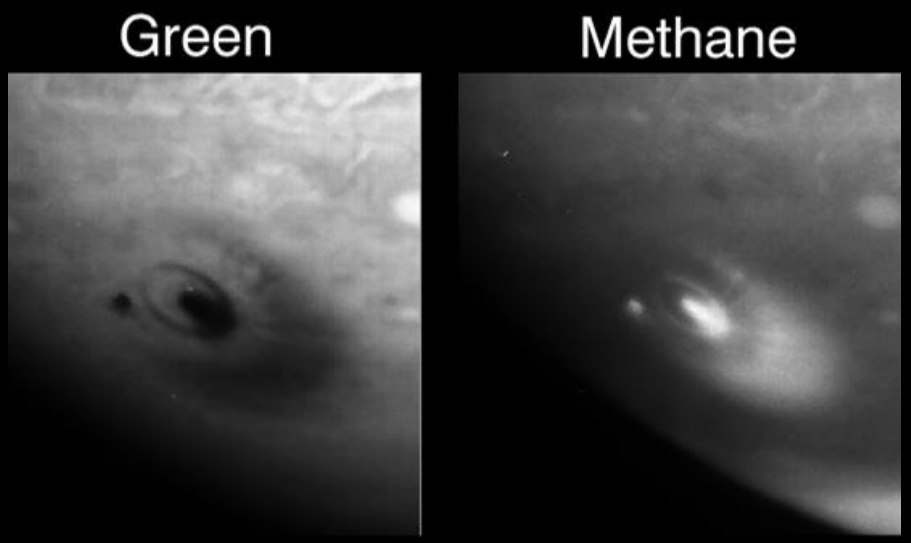



*Jean-Dominique Cassini, 1690*
Impact trace not confirmed
Discovered more than 3 centuries after

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

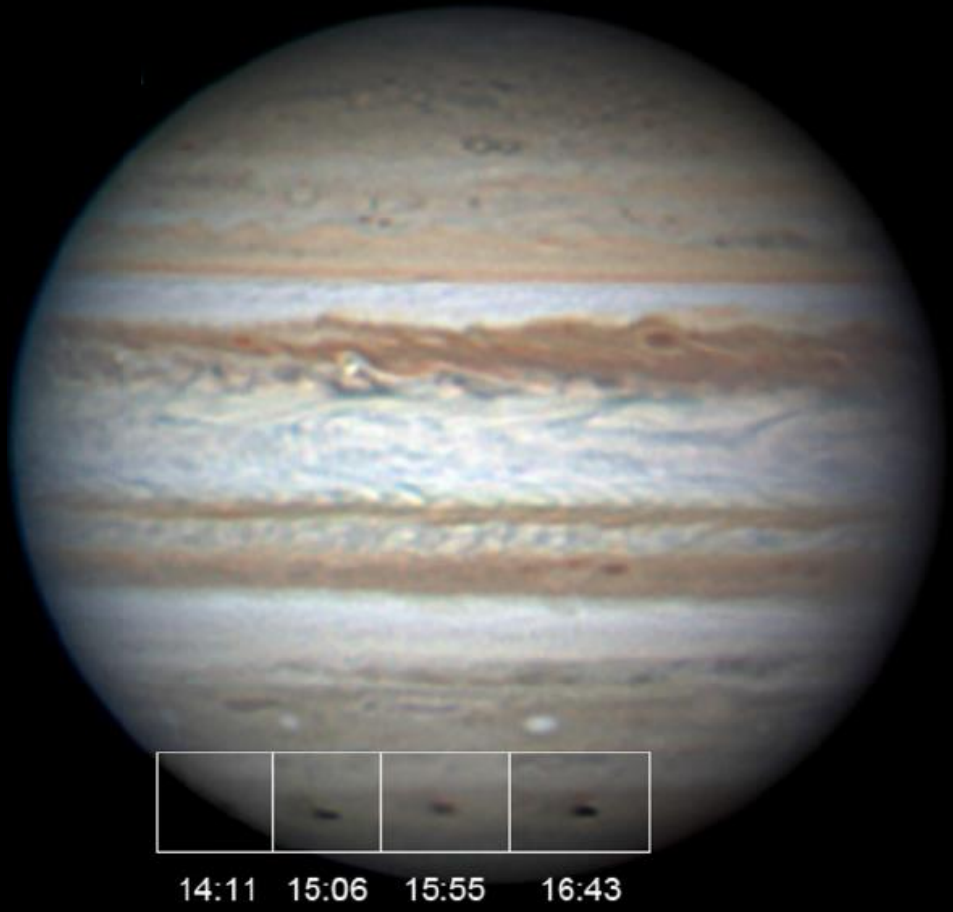


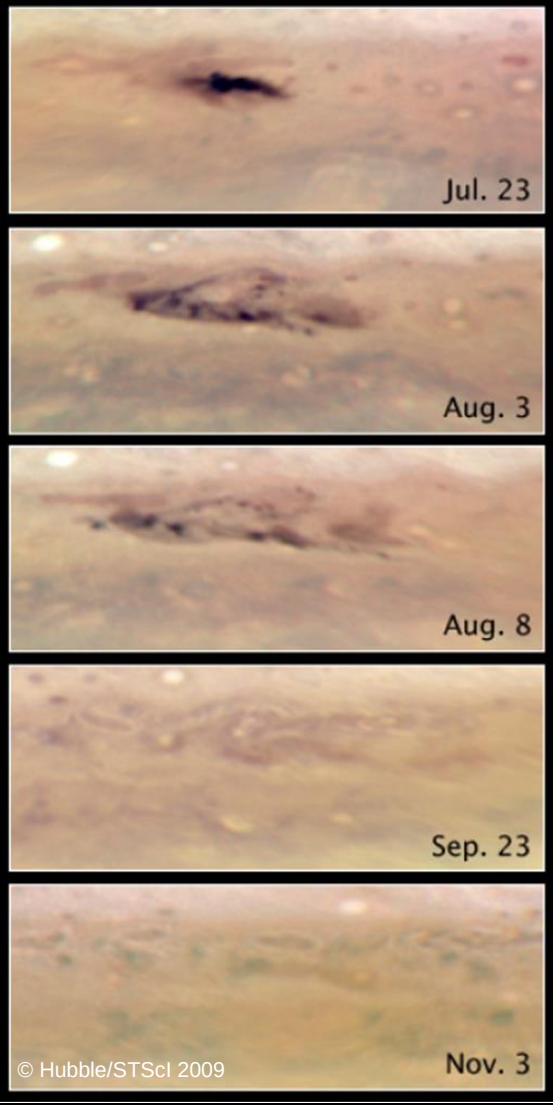
© Hubble/STScI 1994




© Hubble/STScI 1994/07/18

Jul. 16-22, 1994: 21 bodies from P/Shoemaker-Levy 9 impacted Jupiter
Forecasted impacts observed live and traces afterwards by both pros and ams




Jul. 19, 2009: Impact trace discovered by am. A. Wesley
~500m body, impact not seen live



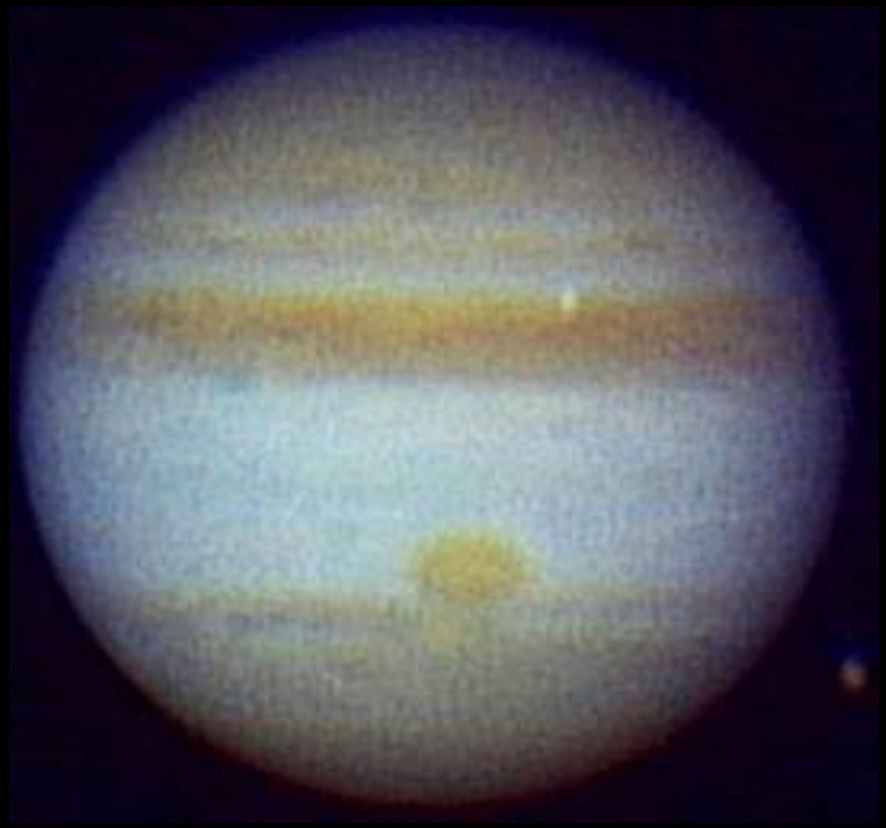
Jun. 4, 2010: 2s flash discovered by am. A. Wesley
confirmed by C. Go
~10m body, no trace left

Dec. **1690**

Jul. **1994**

Jul. **2009**

Jun. **2010**



Aug. 20, 2010: 2s flash discovered by am. M. Tachikawa
confirmed by K. Aoki and M. Ichimaru
~10m body, no trace left



Sep. 10, 2012: 2s flash discovered *visually* by am. D. Petersen
confirmed by G. Hall
~20m body, no trace left

Dec. **1690**

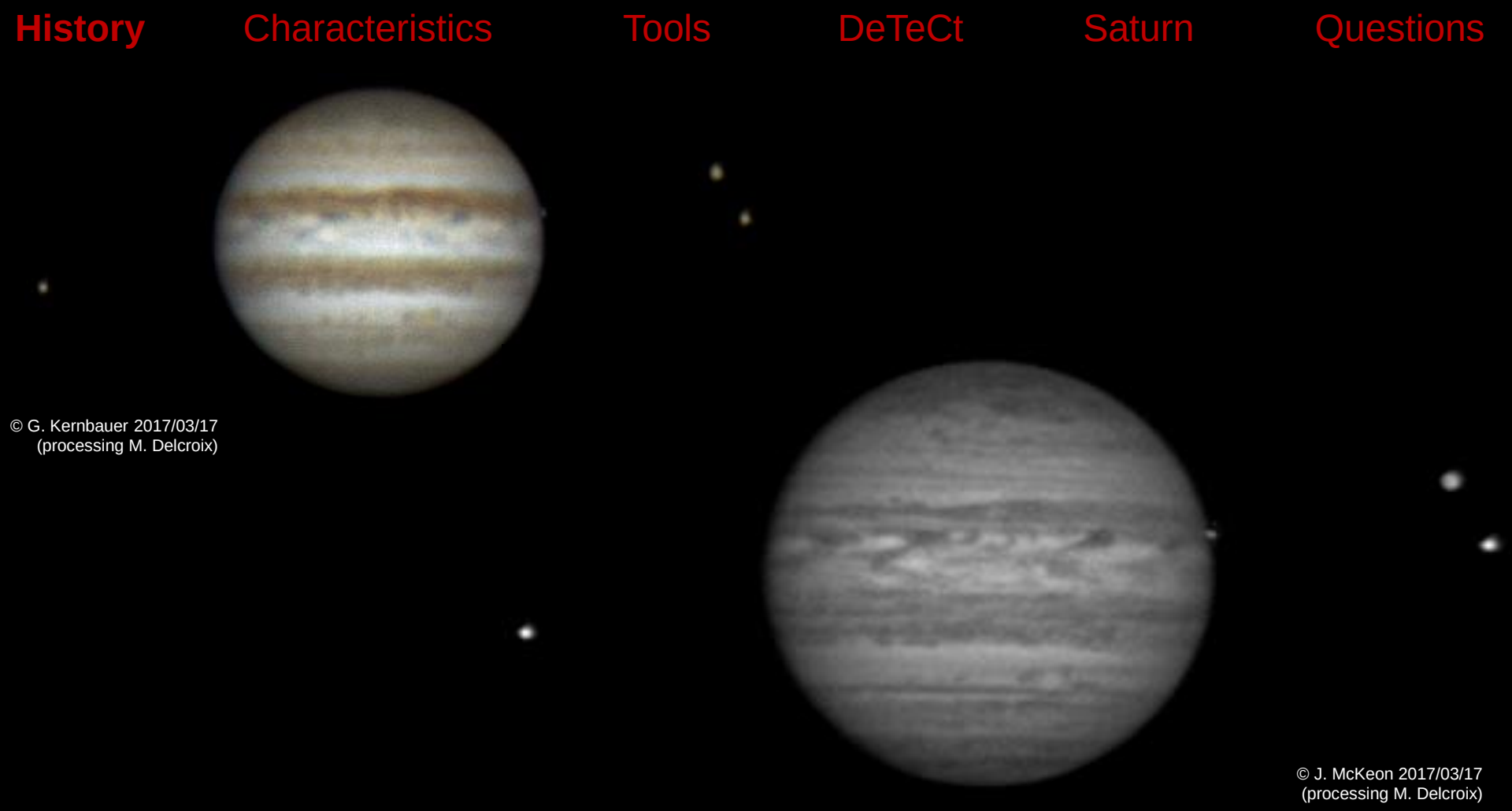
Jul. 1994

Jun. **2010**

Jul. **2009**

Aug. **2010**

Sep. **2012**



© G. Kernbauer 2017/03/17
(processing M. Delcroix)

© J. McKeon 2017/03/17
(processing M. Delcroix)

Mar. 17, 2017: 1s flash discovered by am. G. Kernbauer
confirmed by J. Mc Keon
~10m body (tbc), no trace left

Jul. **2009** Aug. **2010** Mar. **2017**

Dec. **1690** Jul. 1994 Jun. **2010** Sep. **2012**

Various sizes for the impactors
more small than big

2009/07

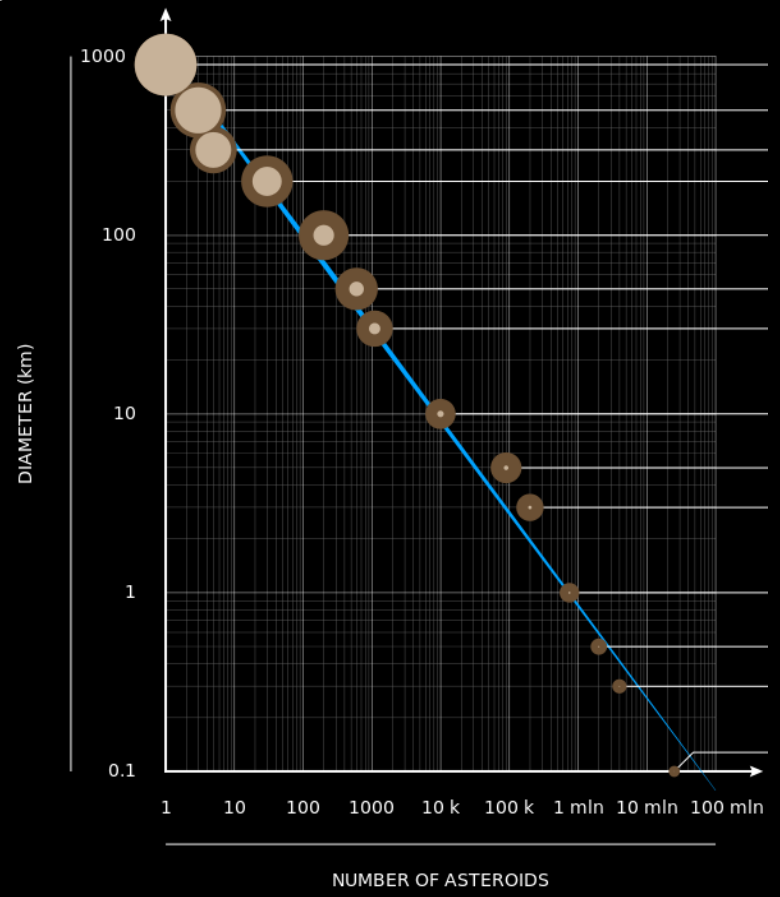
2012/09

2017/03

2010/08

2010/06

P/Shoemaker-Mevy 9
1994/07



| Date | Type | Date from opposition |
|---|---|---|
| 1994/07 | Flashes / Traces | |
| **2009/07** | **Trace** | -26d |
| **2010/06** | **Flash** | -110d |
| **2010/08** | **Flash** | -33d |
| **2012/09** | **Flash** | -83d |
| **2017/03** | **Flash** | -22d |

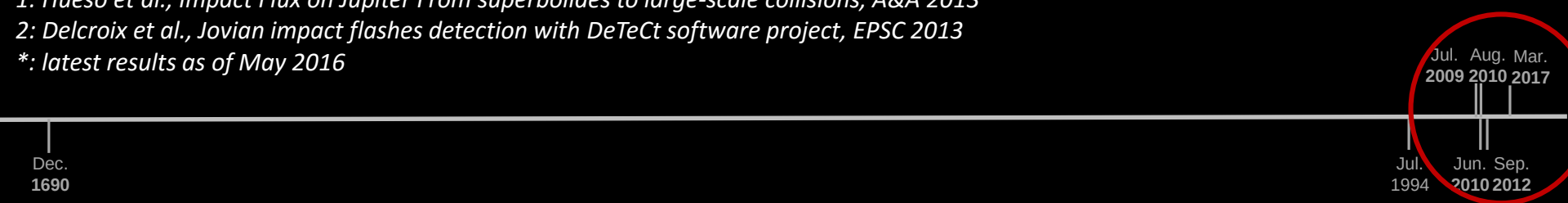
Impact frequency ?

Directly from recent discoveries: **min. 0.6/y**

From scientific study[1]: **12 to 45/y**

From detection project[2]: **~6.5/y***

*1: Hueso et al., Impact Flux on Jupiter From superbolides to large-scale collisions, A&A 2013*
*2: Delcroix et al., Jovian impact flashes detection with DeTeCt software project, EPSC 2013*
**: latest results as of May 2016*

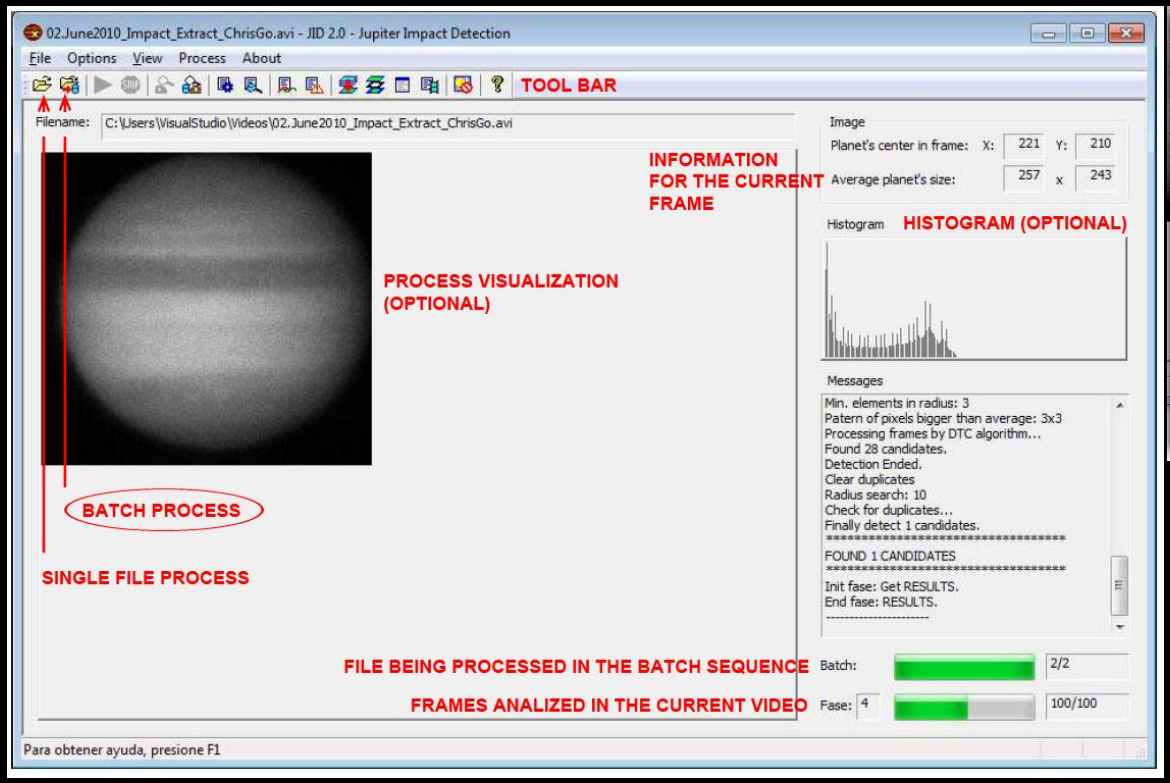


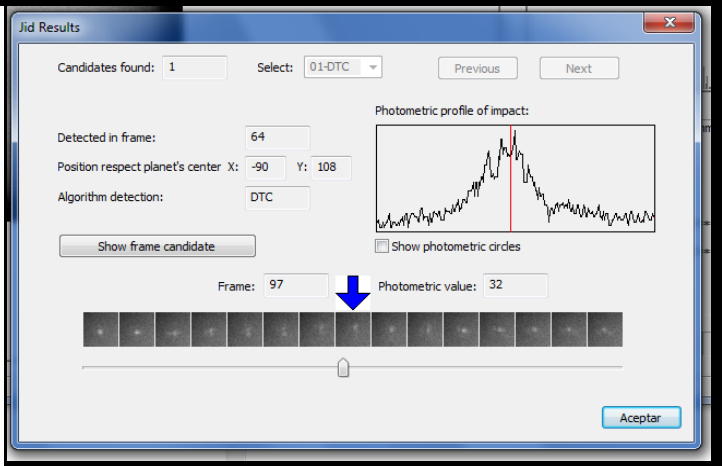
| Date | Type | Diameter (cm) | Filters | Camera |
|---|---|---|---|---|
| 1994/07 | Flashes Traces | All | All | All |
| 2009/07 | Trace | All | All | All |
| 2010/06 | Flash | 37, 28 | R, B | PG Flea3 |
| 2010/08 | Flash | 15, 23, 12 | Color | ToUCam |
| 2012/09 | Flash | 30 | Visual, R | Visual, PG Flea3 |
| 2017/03 | Flash | 20, 28 | Color, IR | QHY5LII, ASI120MM |

*© Pic du Midi, July 25, 2009 (F.Colas)*

Detection of flashes with as small as 12cm scope
Visual detection of flashes possible
The darker Jupiter is (ie in blue), the easier a flash could be detected

Traces visible as black elongated features, bright in methane absorption band

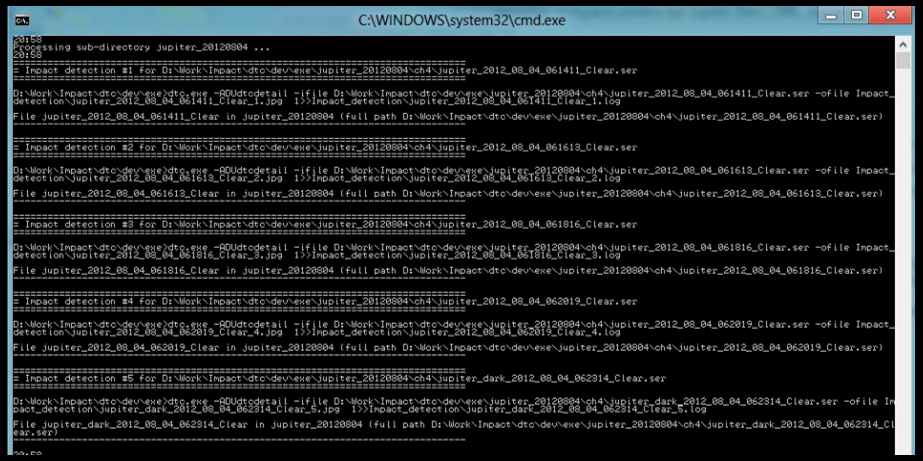



**JID**: UPV/EHU software developed by amateur J.Moreno

Pros: open source, multiplatform, batch mode
automatic detection and light-curve extraction

Cons: focused only on detection, not widely used, some bugs
user interaction necessary




© C. Go 2010/06 – processing M. Delcroix

**DeTeCt**: software developed by amateur M. Delcroix based on UPV/EHU software

Pros: focused on statistics (dated detections and non-detections)
open source, batch mode
amateur oriented: simple, non interactive, complete tutorial
Support of all acquisitions softwares: FireCapture, Genika, Lucam Recorder, …

Cons: not so user friendly

*Delcroix et al., Jovian impact flashes detection with DeTeCt software project, EPSC 2013*

MAX AVERAGE DETECTION IMAGE

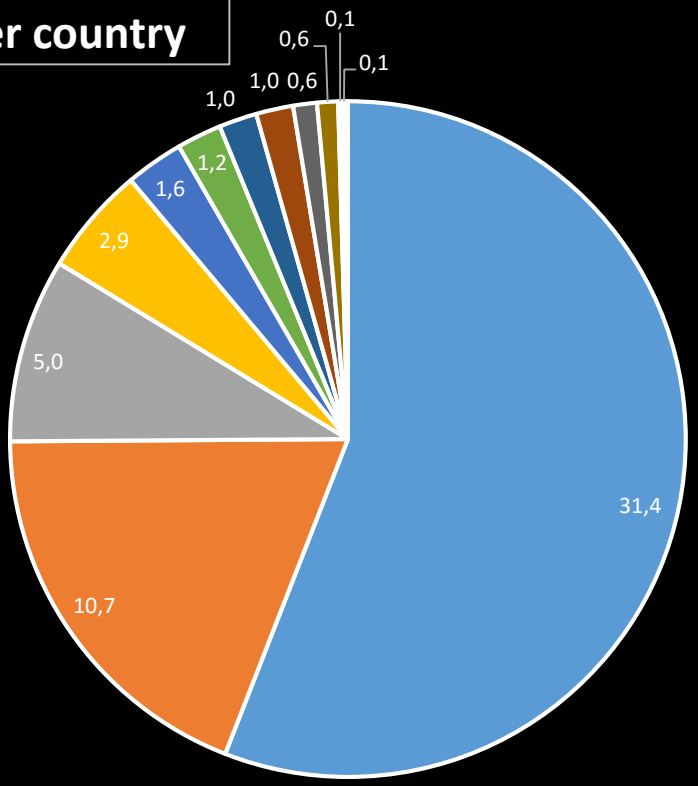


**DeTeCt** Principle

Classic detection algorithm results in log files
(impacts are so rare and false positive not so!)
+
user friendly visual rapid inspection of detection image for faster/better detection
possibly fainter impacts and impacts close to the edge more easily detected

*Delcroix et al., Jovian impact flashes detection with DeTeCt software project, EPSC 2013*

## DeTeCt videos duration (days) per country




France, USA, Greece, Australia, Germany, Spain, Cyprus, Ireland, UK, Slovenia, Malta, Netherlands, Belgium, Finland, Brazil

## **DeTeCt** results

>60 observers
> 53 000 videos
> 56 days of videos
~6.5 impacts/year

Impact flashes detection with DeTeCt
*Projet de détection de flash d'impacts av*
by/*par* Marc Delcroix

Presentation of the project (EPSC201

14/03/2015: NEW SOFTWARE VERSION 2.0.4 / *NOUVEL*

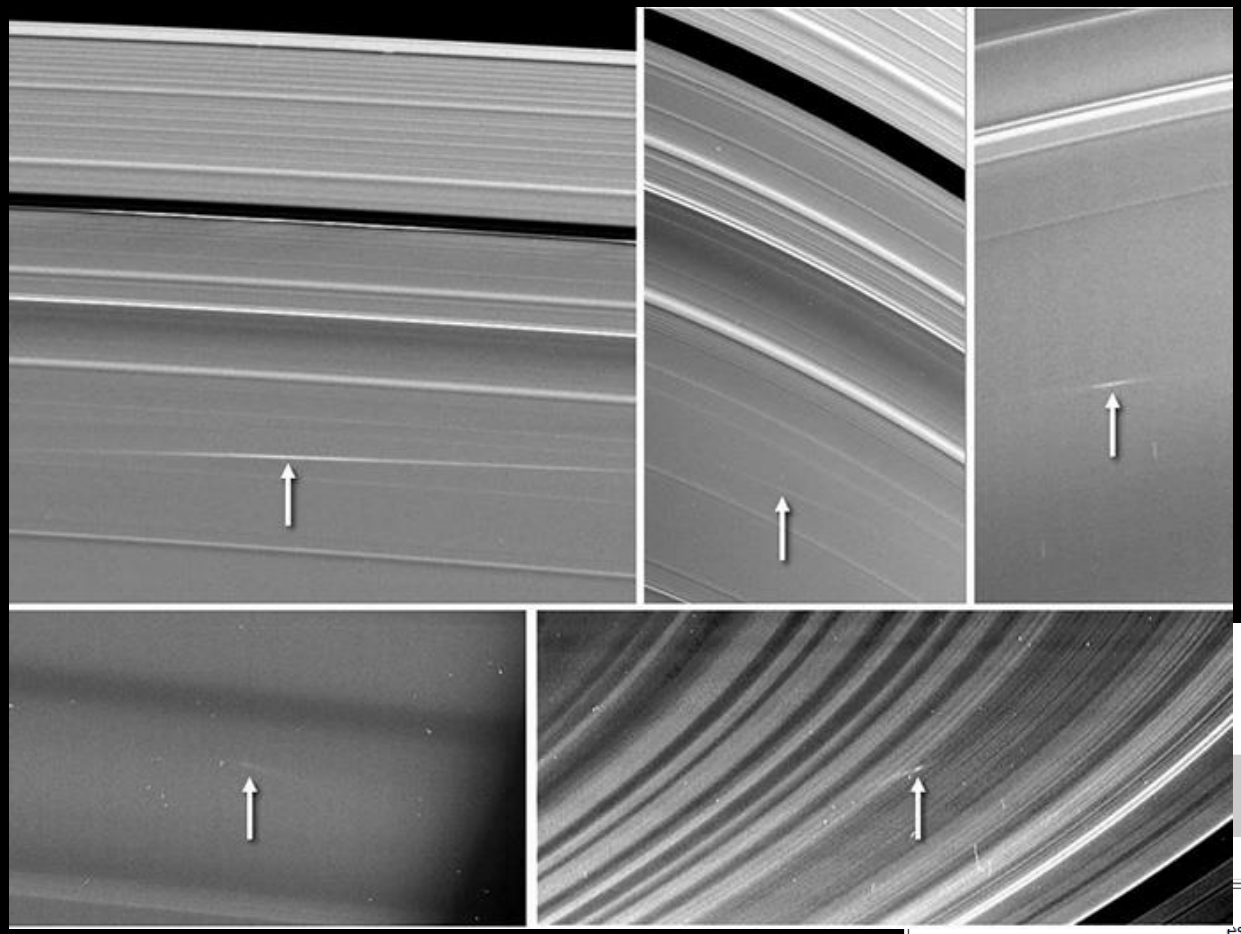
Software download and tutorial for partic
*Téléchargement du logiciel et tutoriel pou*

### Jupiter

estimation of 6,5 impacts per year (0,5 per month)

| Observer | Duration | Number of videos | Date range |
|---|---|---|---|
| **Total : 62 observers** | **56.227 days** | **53628 videos** | **2004/02/29 - 2016/05/09** |
| Michel Jacquesson (France) | 8.307 days | 6012 | 2014/03/12 - 2016/04/24 |
| Paul Rolet (France) | 7.583 days | 6243 | 2012/09/07 - 2016/05/06 |
| Manos Kardasis (Greece) | 4.635 days | 3656 | 2004/02/29 - 2016/04/11 |
| Thomas Ashcraft (USA) | 4.239 days | 5139 | 2013/10/09 - 2016/01/22 |
| Marc Delcroix (France) | 3.085 days | 2130 | 2006/04/14 - 2016/05/04 |
| Alan Coffelt (USA) | 2.513 days | 1827 | 2013/10/04 - 2016/04/26 |
| Xavier Dupont (France) | 2.060 days | 1877 | 2012/08/16 - 2015/04/25 |
| Grant Blair (USA) | 1.995 day | 2132 | 2013/08/20 - 2016/04/21 |
| Trevor Barry (Australia) | 1.613 day | 2424 | 2009/07/07 - 2012/12/30 |
| Christophe Pellier (France) | 1.523 day | 796 | 2012/02/20 - 2015/02/12 |
| Pascal Bayle (France) | 1.389 day | 1802 | 2012/11/30 - 2015/05/10 |
| Lammertus de Vries (Spain) | 1.168 day | 700 | 2009/08/03 - 2015/05/08 |
| Agapios Elia (Cyprus) | 1.021 day | 950 | 2013/11/10 - 2016/04/20 |
| Stéphane Gonzales (France) | 1.006 day | 1196 | 2013/12/20 - 2015/04/14 |
| Zac Pujic (Australia) | 0.992 day | 325 | 2012/10/06 - 2016/05/09 |
| David Dominé (France) | 0.922 day | 583 | 2016/02/25 - 2016/04/19 |
| Paul Jones (USA) | 0.828 day | 757 | 2011/08/29 - 2015/04/05 |
| Jocelyn Serot (France) | 0.777 day | 599 | 2014/01/10 - 2016/04/19 |
| Pascal Lemaire (France) | 0.733 day | 834 | 2012/08/01 - 2016/02/10 |
| Arnaud Claisse (France) | 0.715 day | 633 | 2014/01/19 - 2016/04/02 |
| Jean-Jacques Poupeau (France) | 0.702 day | 1293 | 2013/02/05 - 2016/03/23 |
| Steve Hill (United Kingdom) | 0.639 day | 841 | 2005/03/26 - 2014/03/10 |
| Bernd Gährken (Germany) | 0.618 day | 1210 | 2016/03/07 - 2016/04/12 |
| John McKeon (Ireland) | 0.595 day | 874 | 2012/12/03 - 2016/04/04 |
| Matic Smrekar (Slovenia) | 0.562 day | 859 | 2009/07/29 - 2015/06/05 |
| Pic du Midi observatory (Delcroix/Dauvergne) (France) | 0.562 day | 1243 | 2010/09/29 - 2016/03/13 |
| Torsten Mellenthin (Germany) | 0.450 day | 230 | 2016/01/28 - 2016/04/11 |

http://www.astrosurf.com/planetessaf/doc/project_detect.shtml



© Cassini/NASA/ESA 2009-2012

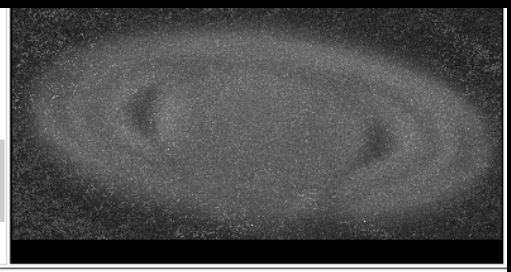
**DeTeCt** results

...

and on **Saturn** ?

Traces on the ring in 2005, 2009, 2012

1cm – meters size



**Saturn**

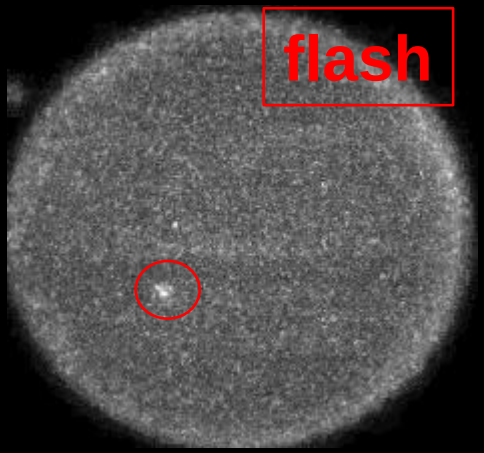
estimation of less than 89 impacts per year

| Observer | Duration | Number of videos | Date range |
|---|---|---|---|
| **Total : 11 observers** | **4.108 days** | **2088 videos** | **2007/01/20 - 2016/04/24** |
| Marc Delcroix (France) | 1.816 day | 890 | 2007/01/20 - 2015/07/15 |
| Manos Kardasis (Greece) | 0.645 day | 293 | 2008/03/10 - 2015/08/20 |
| Grant Blair (USA) | 0.446 day | 255 | 2014/03/14 - 2016/04/24 |
| Paul Rolet (France) | 0.433 day | 144 | 2015/05/12 - 2015/06/12 |
| Société Astronomique de Touraine (France) | 0.212 day | 83 | 2014/03/14 - 2015/08/29 |
| Arnaud Claisse (France) | 0.166 day | 44 | 2015/05/21 - 2015/06/19 |
| Pic du Midi observatory (Delcroix/Dauvergne) (France) | 0.111 day | 202 | 2012/08/06 - 2016/03/13 |
| Stéphane Gonzales (France) | 0.105 day | 60 | 2015/05/23 - 2015/05/25 |
| Charles Galdies (Malta) | 0.077 day | 81 | 2014/06/08 - 2015/07/17 |
| Alan Coffelt (USA) | 0.073 day | 28 | 2015/05/03 - 2015/05/07 |
| Matic Smrekar (Slovenia) | 0.020 day | 8 | 2011/06/27 - 2011/08/05 |

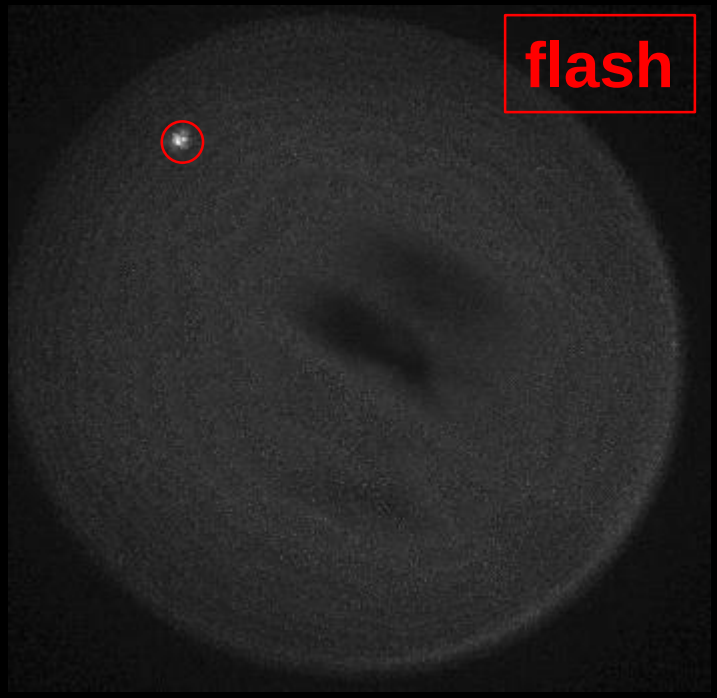
*Tiscareno et al., Observations of Ejecta Clouds Produced by Impacts onto Saturn's Rings, Science 013*


**DeTeCt** detection images

Flash or no flash ?

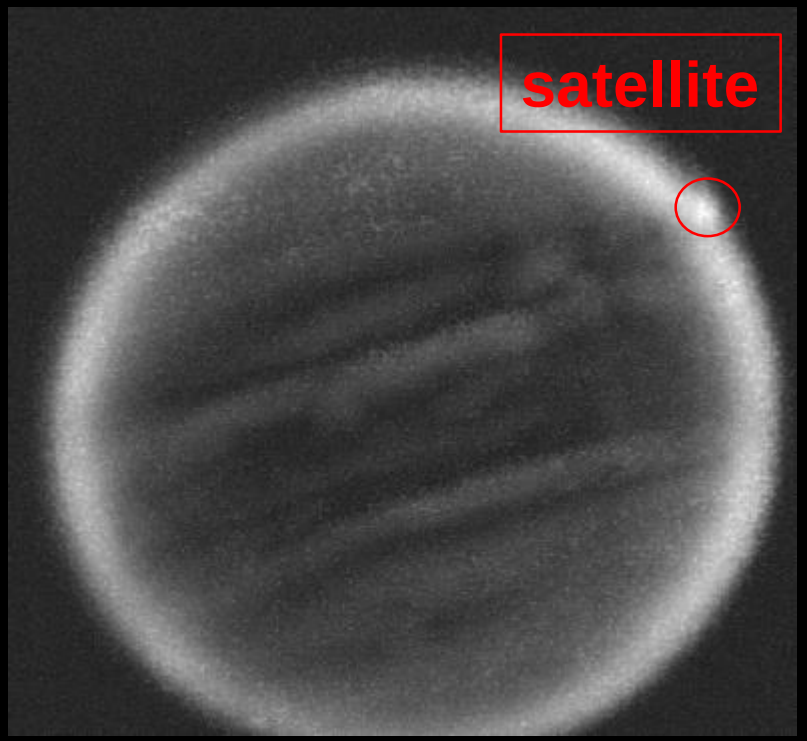



http://www.astrosurf.com/planetessaf/doc/project_detect.shtml




**DeTeCt** detection images

Flash or no flash ?

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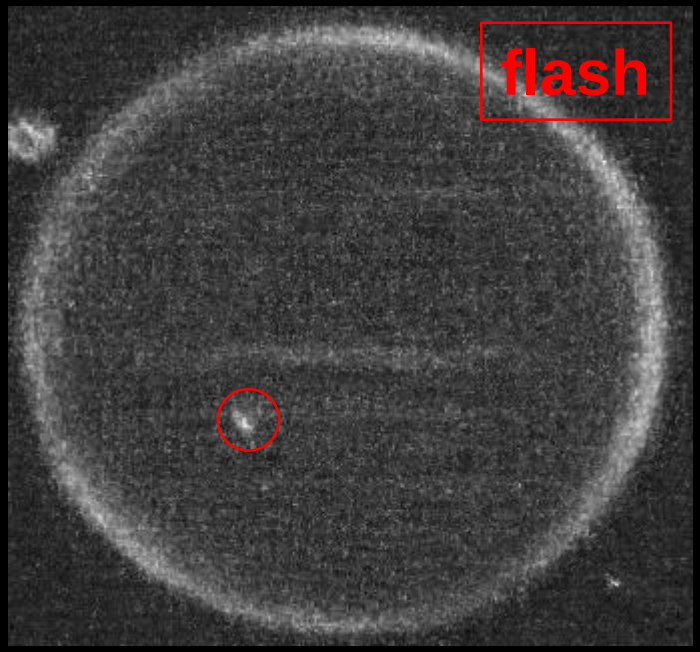
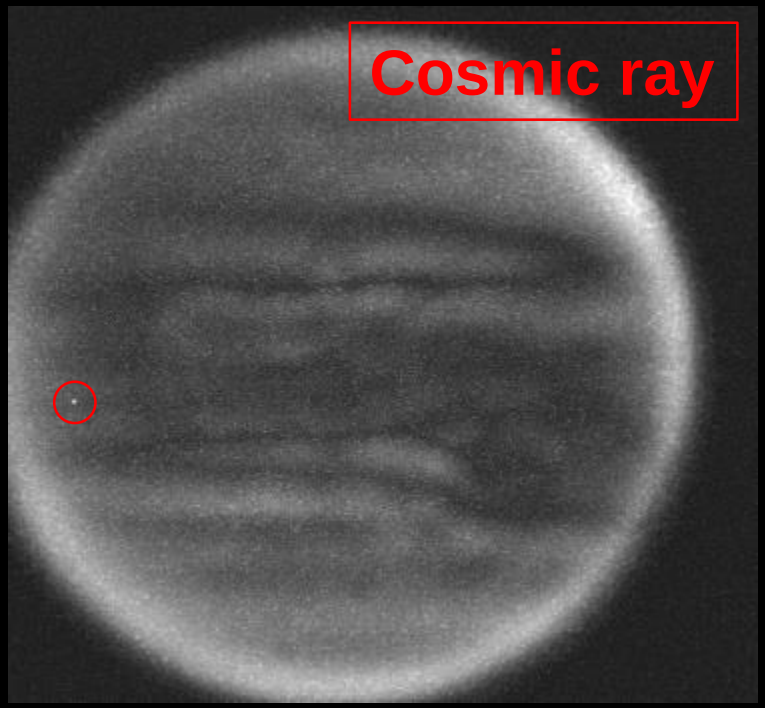



**DeTeCt** detection images

Flash or no flash ?




http://www.astrosurf.com/planetessaf/doc/project_detect.shtml


**DeTeCt** detection images

Flash or no flash ?


http://www.astrosurf.com/planetessaf/doc/project_detect.shtml

# Take away

**5 traces or live impact discovered since 2009 ...**
**... only by amateurs either visually or on videos, even with small scopes!**

**Impact frequency estimations but not known precisely**

**Every impact and their frequency have scientific value**

**Tool available for amateurs helping detection and participating to frequency estimation**

**DeTeCt** users …

Feedback ?

What to improve ?




**DeTeCt** non-users …

Why ?

What are you waiting for contributing to impact science, and take your chance ? ☺