Identification of near-Earth asteroids in astronomical archives. A citizen-science project of the Spanish Virtual Observatory.

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Benoit Carry
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The Virtual Observatory (VO)

- Goal: Effficient access and analysis of the information hosted in astronomical archives and services.

The Spanish Virtual Observatory

Carlos Rodrigo

Enrique Solano

Miriam Aberasturi

Almudena Velasco

Mauro López

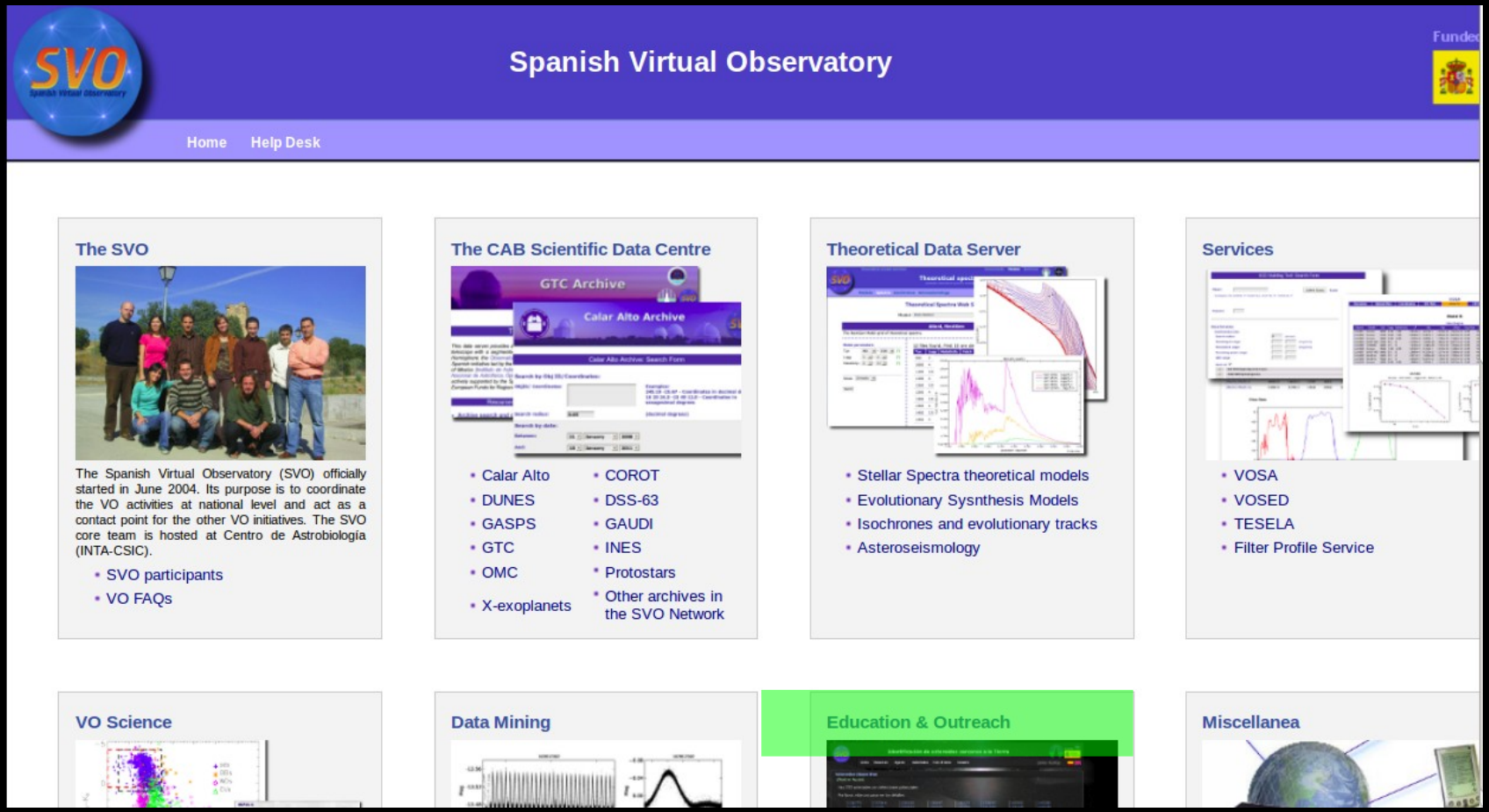
Alba Aller

J. Manuel Alacid

Francisco Jiménez

The Spanish Virtual Observatory

http://svo.cab.inta-csic.es @ObsVirtEsp



VO – CS – NEAs – Precov. - The project

Citizen-science project

- ✓ Scientific research conducted, in whole or in part, by amateur or non- professional scientists.

Citizen-science project

Near-Earth asteroids

ASTRONOMÍA | 2012 DA14 fue descubierto en La Sagra (Granada)

El asteroide que más se ha aproximado a la Tierra sin colisionar

VÍDEO FOTO

RUSIA | Por la rotura de cristales provocada por el impacto

Más de 900 heridos tras la caída de un meteorito en los Urales

VÍDEO FOTO

Near-Earth asteroids

Barringer

2008 TC3

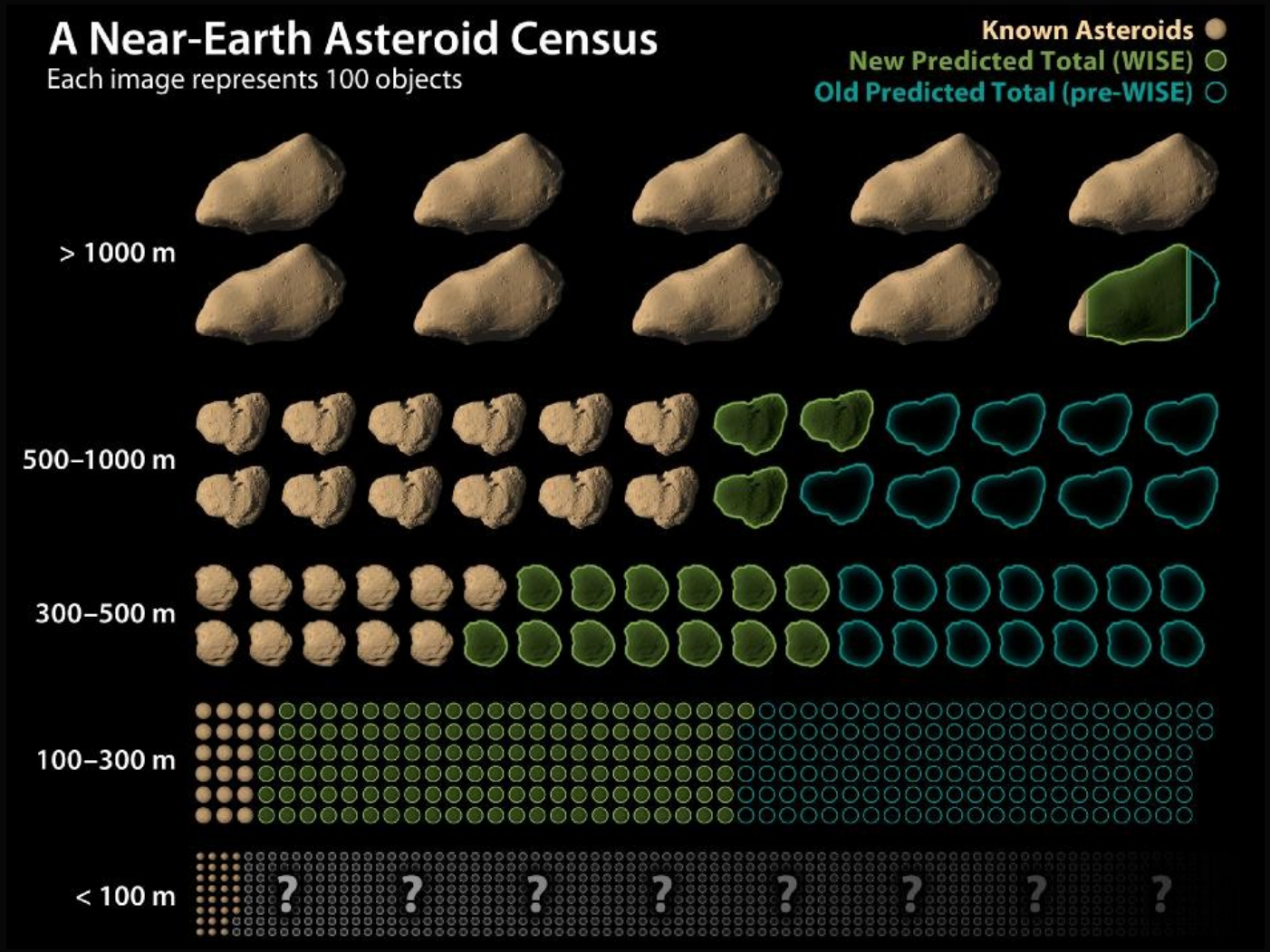
Near-Earth asteroids

UPCOMING CLOSE APPROACHES TO EARTH

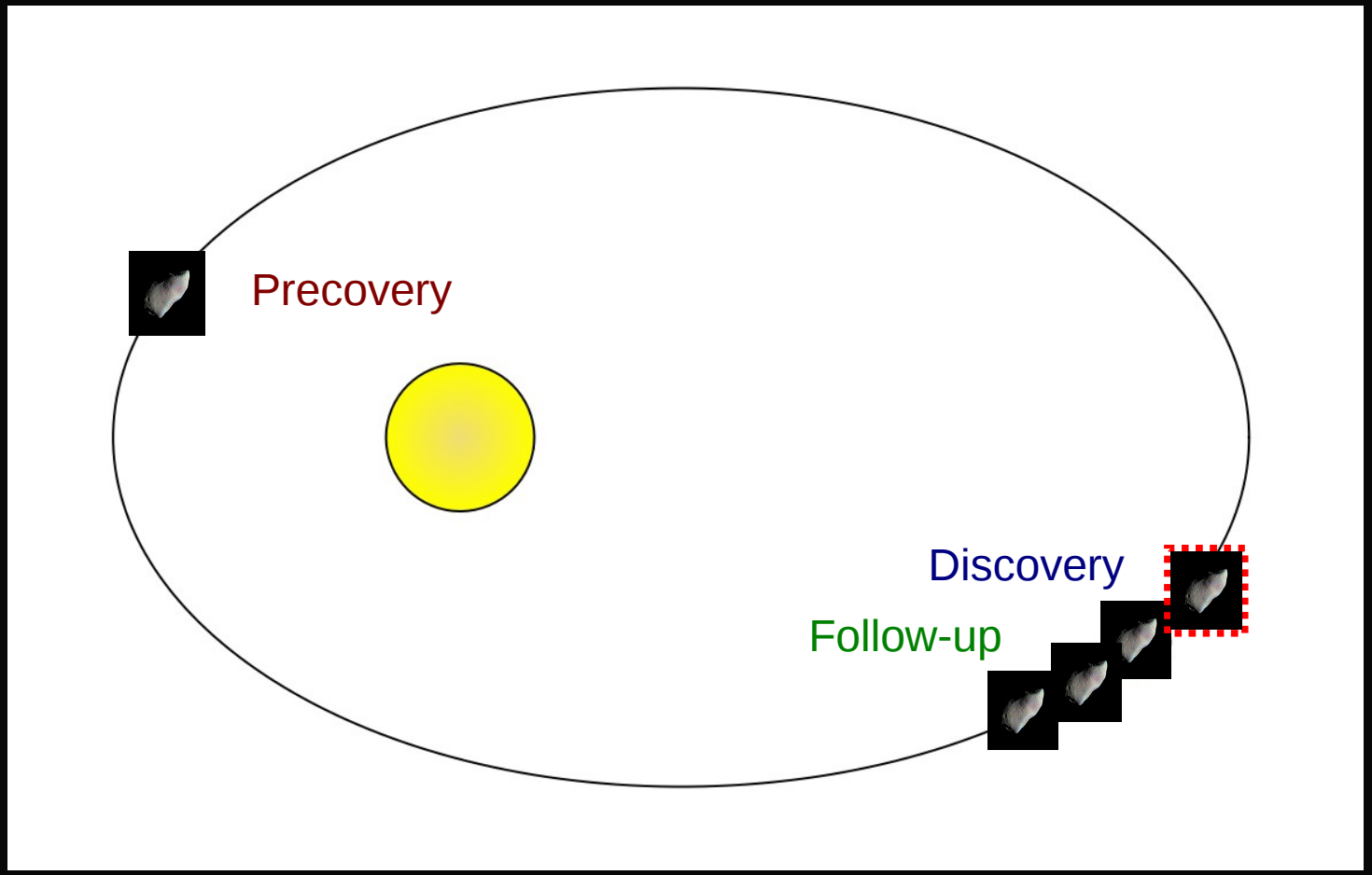
1 AU = ~150 million kilometers
1 LD = Lunar Distance = ~384,000 kilometers

Object Name	Close Approach Date	CA Distance* (AU)	CA Distance* (LD)	Estimated Diameter**	H (mag)	Relative Velocity (km/s)
(2013 LC7)	2013-Jun-16	0.1271	49.4	350 m - 790 m	19.4	35.66
(2013 JR28)	2013-Jun-18	0.0349	13.6	130 m - 290 m	21.6	16.99
(2011 KR12)	2013-Jun-18	0.1670	65.0	140 m - 310 m	21.4	8.46
340666 (2006 RO36)	2013-Jun-18	0.1823	70.9	740 m - 1.7 km	17.8	12.76
(2013 KL6)	2013-Jun-20	0.0346	13.5	38 m - 85 m	24.2	10.57
(2010 LL68)	2013-Jun-21	0.1826	71.1	77 m - 170 m	22.7	8.09
(2013 LC2)	2013-Jun-21	0.0970	37.7	97 m - 220 m	22.2	8.26
164202 (2004 EW)	2013-Jun-23	0.1840	71.6	190 m - 420 m	20.8	5.09
354952 (2006 FJ9)	2013-Jun-24	0.1992	77.5	370 m - 840 m	19.3	4.63
(2011 DL19)	2013-Jun-25	0.1828	71.1	430 m - 960 m	18.9	19.82
(2013 LE1)	2013-Jun-25	0.1287	50.1	80 m - 180 m	22.6	11.26

Near-Earth asteroids



Precovery



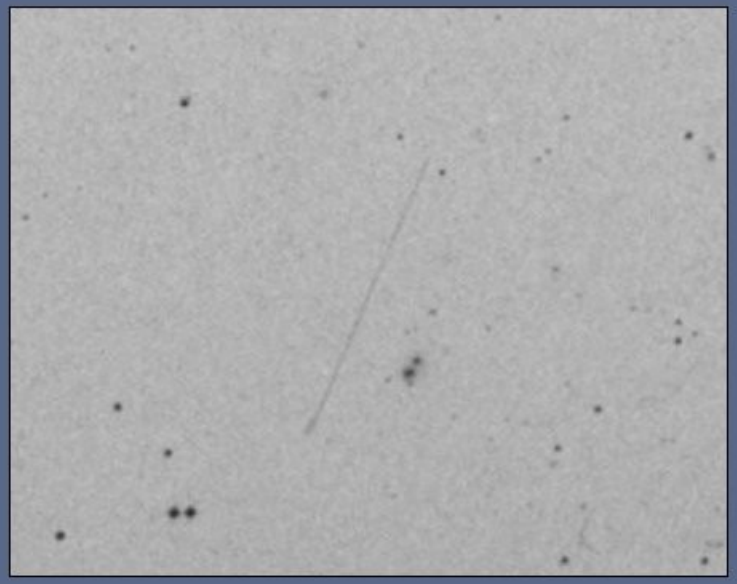
Precovery


(99942) ApophisE
Distance: 14,008 km
Radius: 420,00 m
Apparent diameter: 3° 20' 10,3"
2029 04 14 09:37:31 UTC
Time stopped
Speed: 0,00000 m/s
Follow (99942),ApophisE
FOV: 7° 15' 3,5" (3,56×)

Precovery

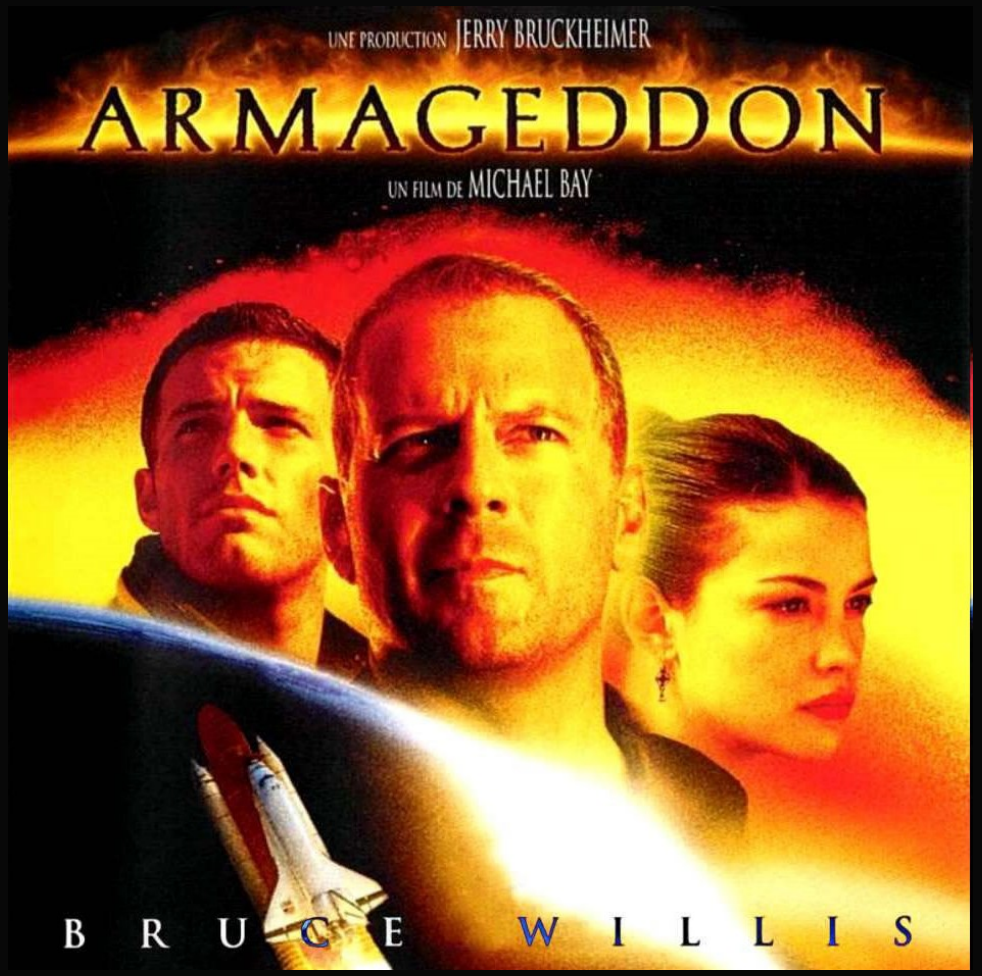
Siding Spring Survey

AANEAS



(6318) Cronkite precovery image, 1982 Dec 5
On original 90min exposure, trail was 3.5mm long.
(c) SERC 1982

The citizen-science project



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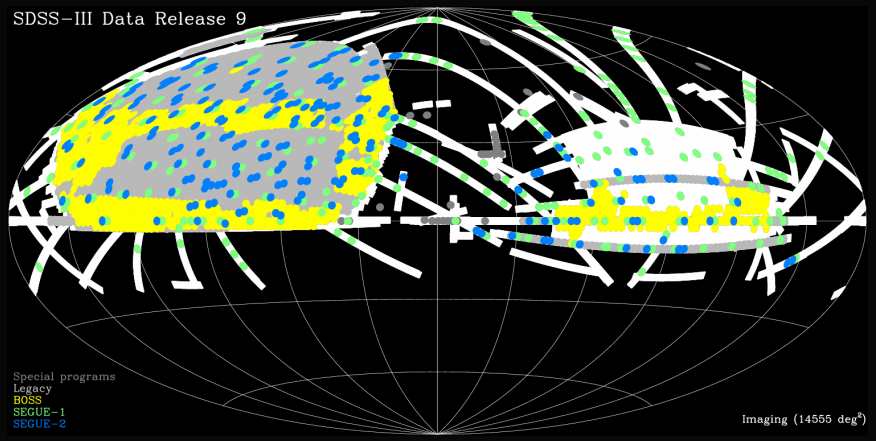
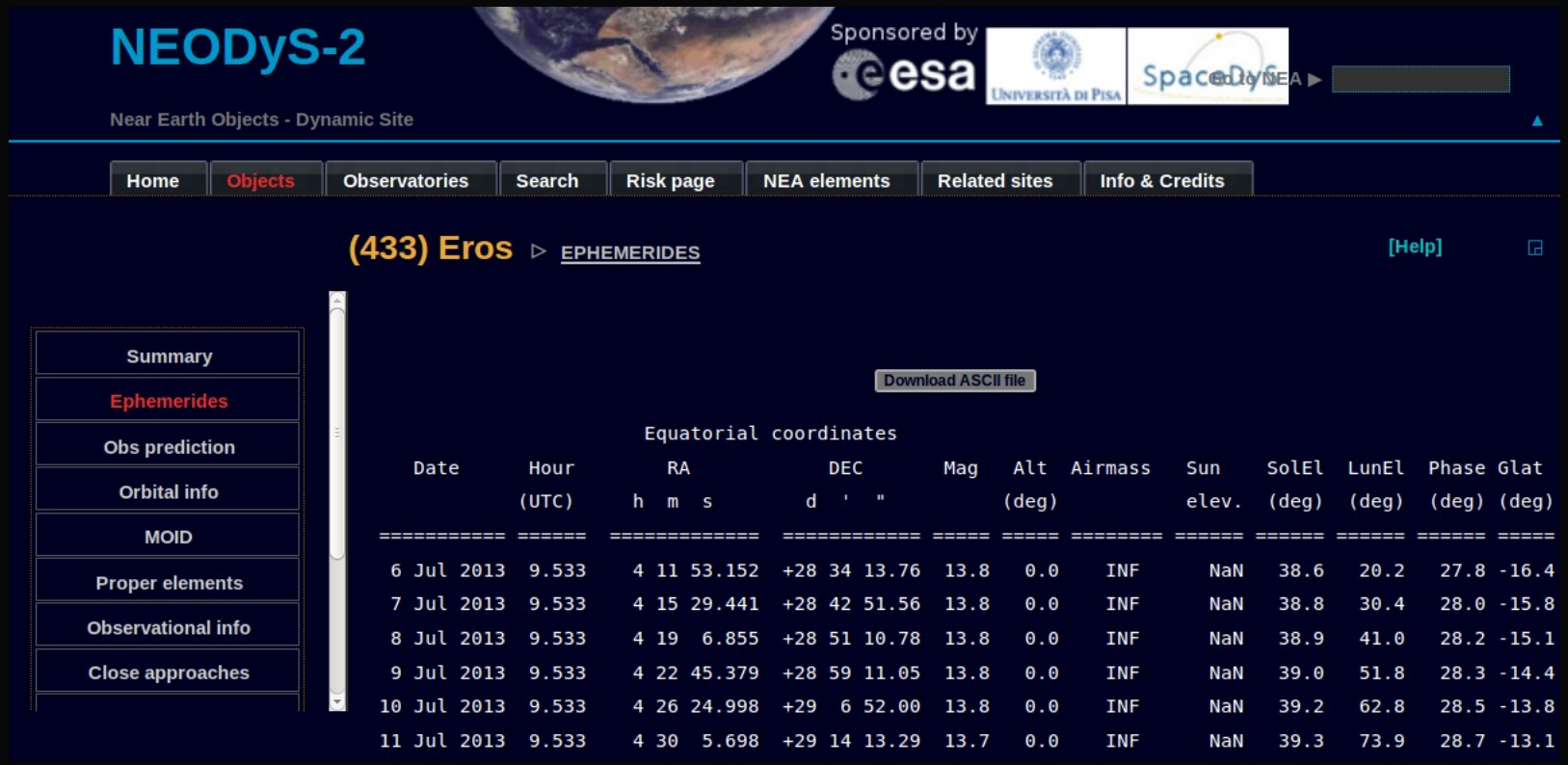
Prov. Des.	q	Q	EMoid	H	Epoch	M	P
2013 NG6	1.275	2.938	0.25905	22.3	20130418	340.7	
2013 NU	1.289	3.367	0.27284	21.3	20130418	330.2	
2013 NK	1.273	3.530	0.26889	21.4	20130418	324.4	
2013 MP11	1.251	3.142	0.24031	21.8	20130418	341.4	
2013 MV10	1.137	2.817	0.14263	21.8	20130418	350.0	
2013 MR6	1.226	4.186	0.28077	18.8	20130418	324.6	
2013 MZ5	1.278	1.826	0.46072	20.2	20130418	258.9	
2013 MX5	1.252	3.292	0.25652	18.9	20130418	336.1	



- RA/DEC min/max
- Obs. Time

VO – CS – NEAs – Precov. - The project

The citizen-science project



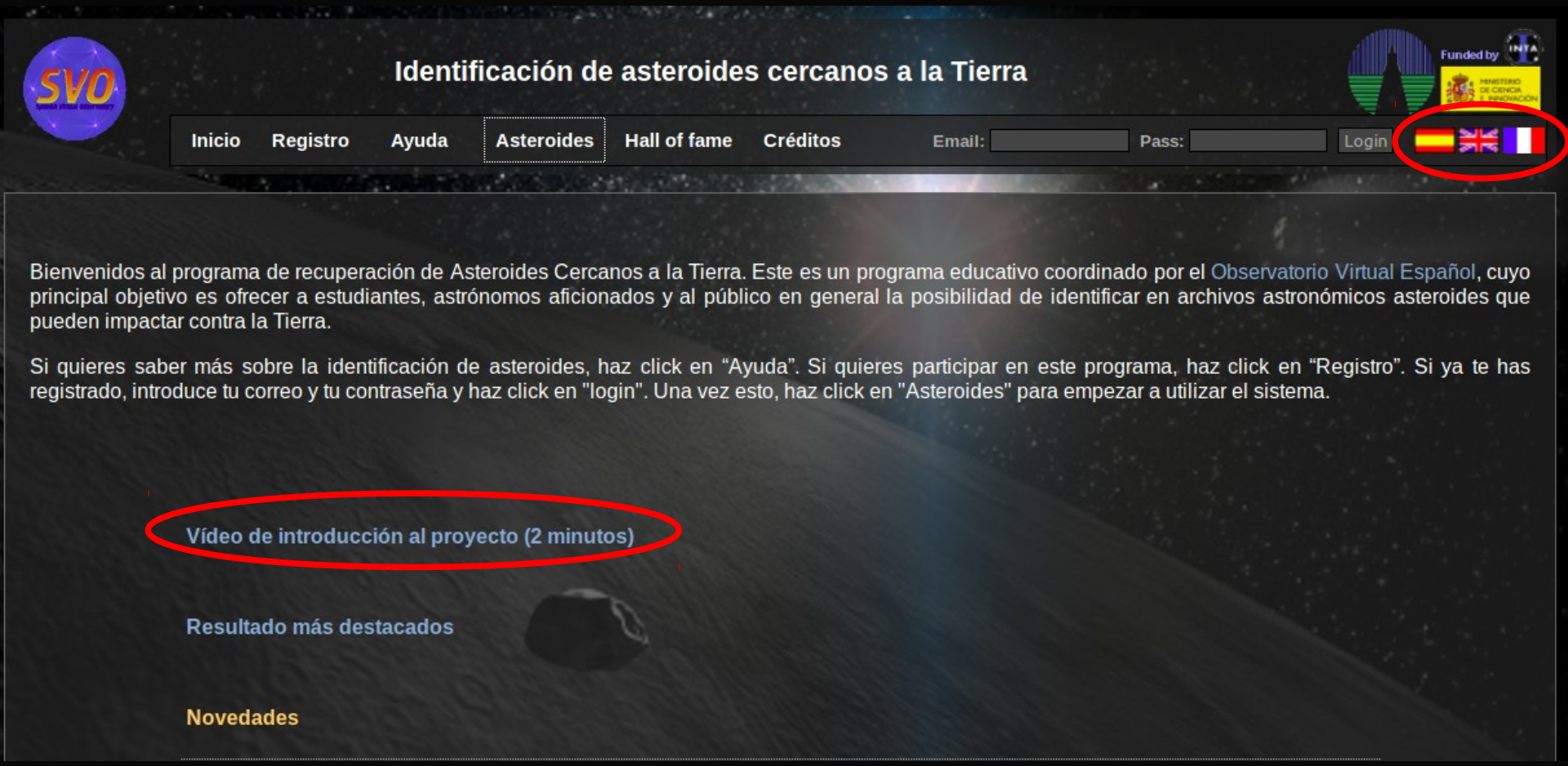
Equatorial coordinates

Date	Hour (UTC)	RA h m s	DEC d ' "	Mag	Alt (deg)	Airmass	Sun elev.	SolEl (deg)	LunEl (deg)	Phase (deg)	Glat (deg)
6 Jul 2013	9.533	4 11 53.152	+28 34 13.76	13.8	0.0	INF	NaN	38.6	20.2	27.8	-16.4
7 Jul 2013	9.533	4 15 29.441	+28 42 51.56	13.8	0.0	INF	NaN	38.8	30.4	28.0	-15.8
8 Jul 2013	9.533	4 19 6.855	+28 51 10.78	13.8	0.0	INF	NaN	38.9	41.0	28.2	-15.1
9 Jul 2013	9.533	4 22 45.379	+28 59 11.05	13.8	0.0	INF	NaN	39.0	51.8	28.3	-14.4
10 Jul 2013	9.533	4 26 24.998	+29 6 52.00	13.8	0.0	INF	NaN	39.2	62.8	28.5	-13.8
11 Jul 2013	9.533	4 30 5.698	+29 14 13.29	13.7	0.0	INF	NaN	39.3	73.9	28.7	-13.1

- ✓ Out of image
- ✓ Too faint
- ✓ Candidate

The citizen-science project

http://www.laeff.cab.inta-csic.es/projects/near/



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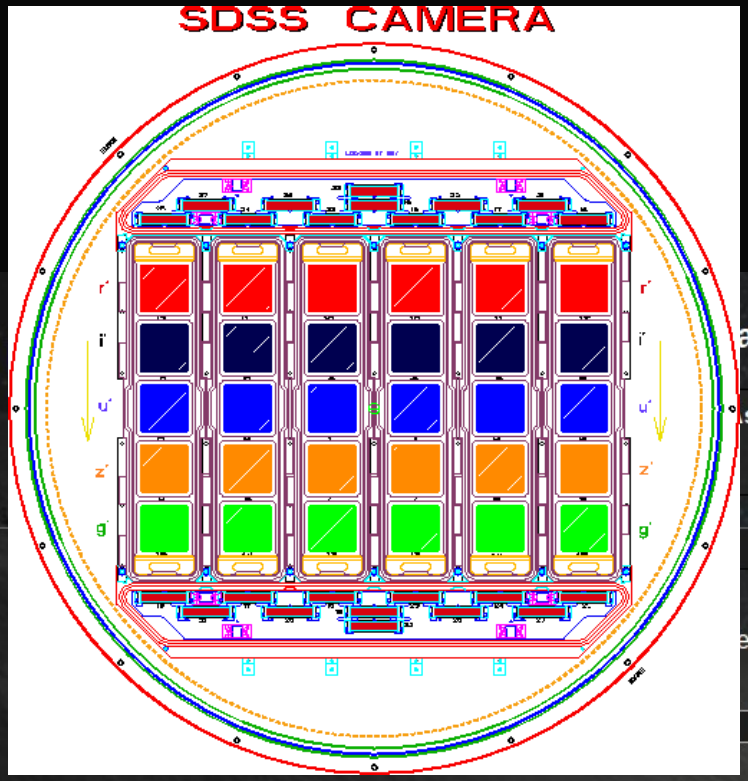
The citizen-science project



asteroides cercanos a la Tierra

Funded by

steroides Astero-Dance Hall of fame Créditos SVO

Enrique Solano

e 2012MP

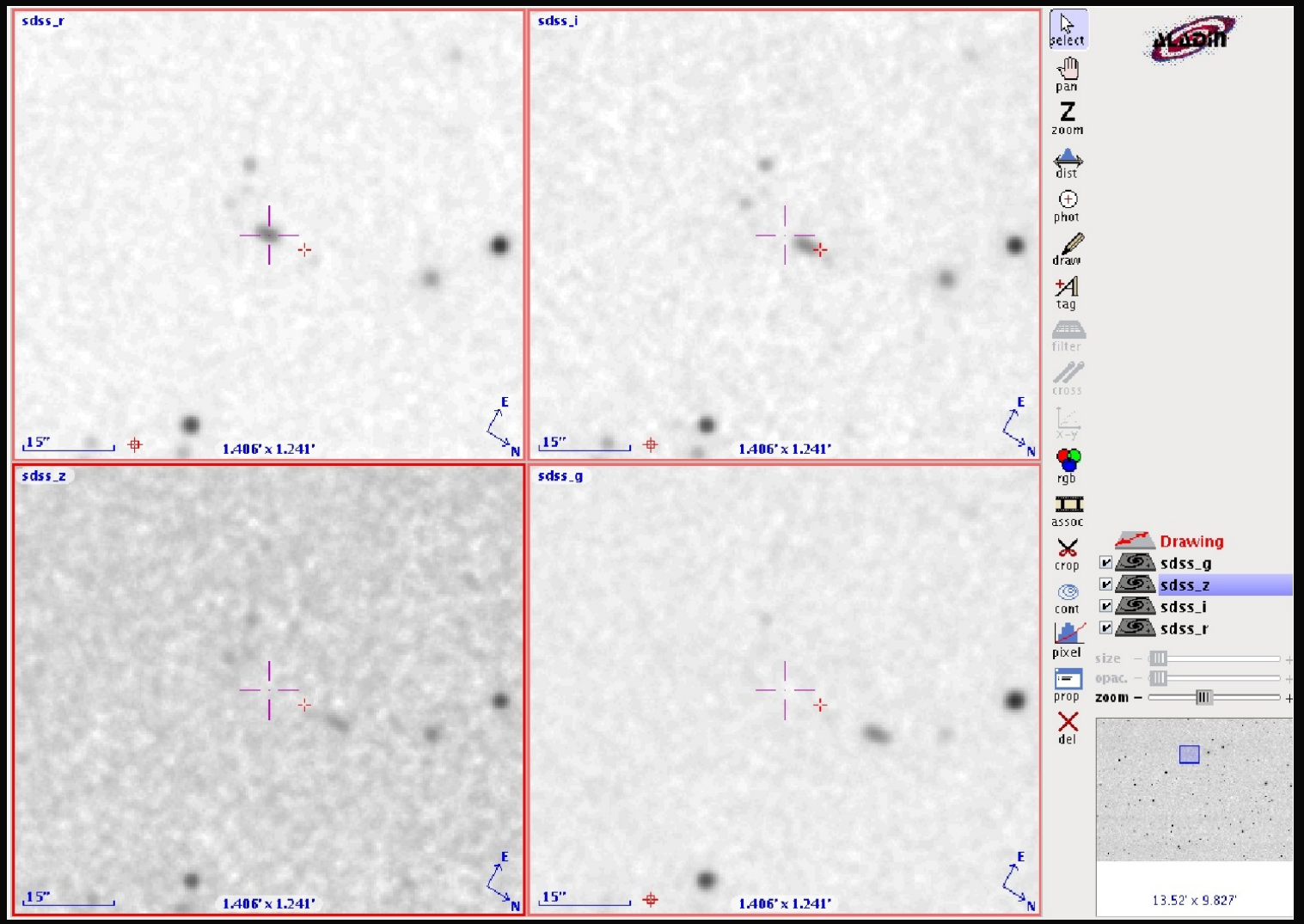
Comprobación visual

		mag	RA/DEC	Estatus	Com
sdss_r	55153.15539669	355.61941	30.41233	21.75	----- +
sdss_i	55153.15622596	355.61971	30.41202	21.75	----- +
sdss_u	55153.15705522	355.62031	30.41139	21.75	----- +
sdss_z	55153.1578844901	355.62061	30.41108	21.75	----- +
sdss_g	55153.15871375	355.62091	30.41077	21.75	----- +

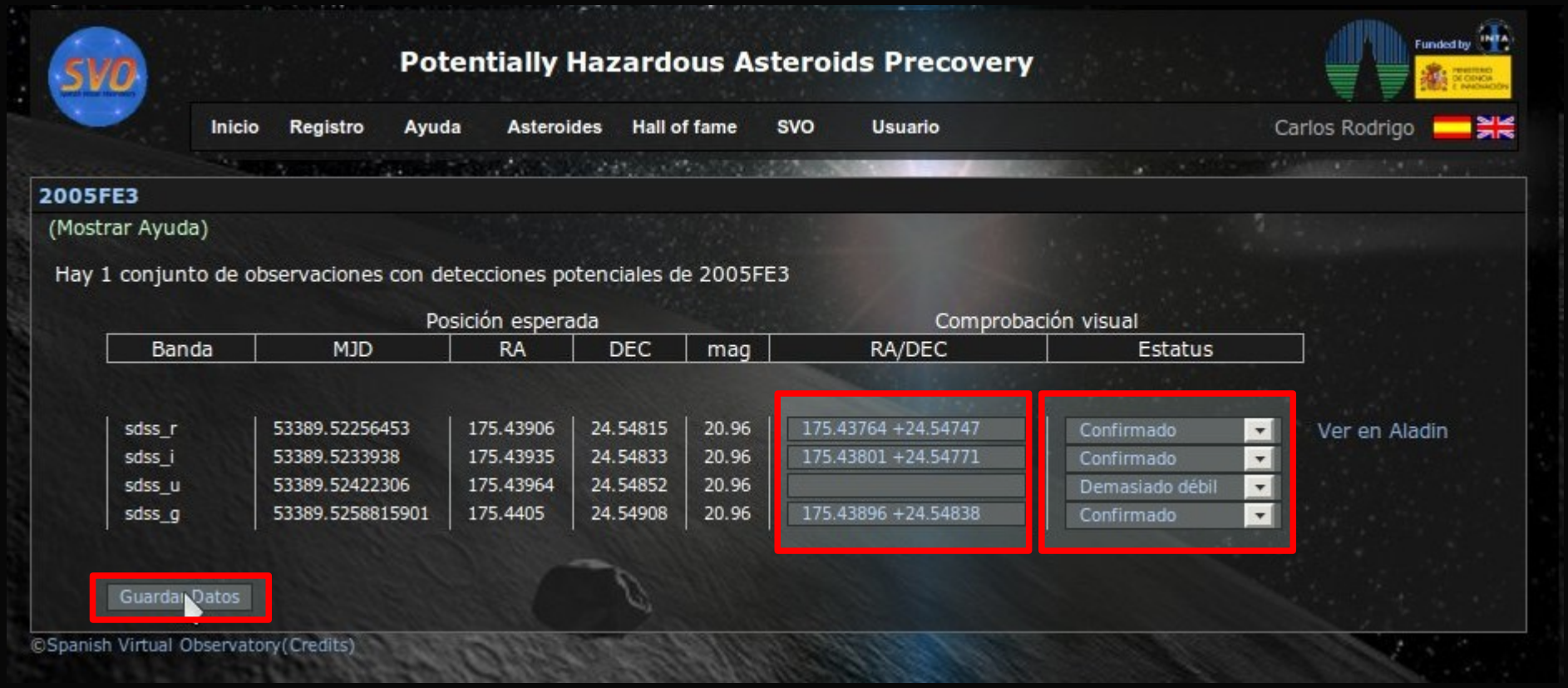
Ver en Aladin (script)

Guardar Datos

The citizen-science project



The citizen-science project



The citizen-science project

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Title:	Minor Planet Observations [645 Apache Point--Sloan Digital Sky Survey]
Authors:	Ivezic, Z.; Survey, S.; Galvez Ranera, E.; de Madrid, P.; Solano, E.; Bustabad Alonso, L.; Car Cuadrado Garcia, J.; de La Osa Lopez, J. M.; Gil Rey, J.; Gutierrez Bulnes, L.; Izarra Cala, J.; Pascual Gutierrez, J. I.; Rodriguez Perez, D.; Rodriguez Pumarada, C.; Vazquez, J.; Antoranz MuÑoz Barros, F. D.; Rojas Garcia, C.; Romero DueÑas, J. L.; Serrano Guinot, J. P.; Tapiole Gomez Sanchez-Tirado, M. A.; Leal, G.; Sixto Perez, A. J.; Valenzuela, J.; Sala Puig, C.; Baar
Publication:	Minor Planet Circular 75600, 1 (2011)
Publication Date:	08/2011
Origin:	MPC
Bibliographic Code:	2011MPC..75600...1I

Results


Identificación de asteroides cercanos a la Tierra
Inicio
Registro
Resumen
Ayuda
Asteroides
Astero-Dance
Hall of fame
Créditos
Usuario
25299 José Ramón Vidal Blanco
16344 Fabio Arias Arias
15961 Alvaro Manchado
15641 José Luis Moreno Díaz
14450 Andres F. Montoya H.
10202 Valmir Martins de Morais
9899 Jose Vazquez
9133 Hernando Pachon Sanchez
8936 ANDRES NORTES NOLASCO
8199 Encarni Gomez Fernandez
7311 Tomás Vázquez Chiscano
Ver resumen hasta el 2013 - 7 - 7 Ver
Número de usuarios registrados: 3472
Número de usuarios que han hecho medidas: 461
Número de medidas realizadas: 327193
Número de objetos comprobados: 3038
Número de parejas objeto/imagen distintas comprobadas: 30801
Objetos para los que se han publicado medidas en el MPC: 633
Número de medidas publicadas en el MPC: 2767

Results

Table 1 Summary of the measurements reported to MPC. (1): Extended arc beyond last observation reported by the MPC. (2): New intermediate positions. (3): New observations for single opposition asteroids.

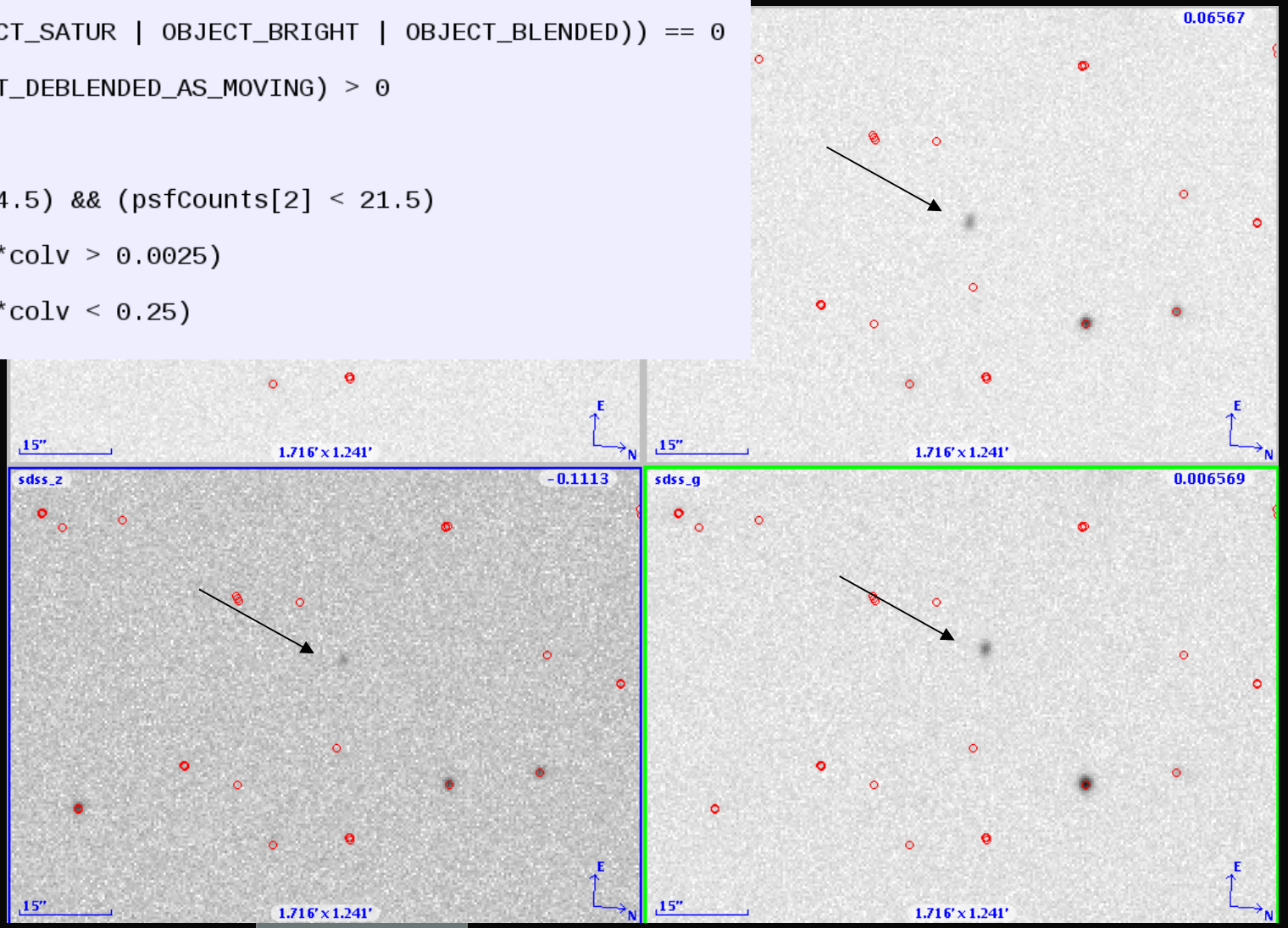
	PHA	Apollo	Aten	Amor	Total
Precovery	24	42	6	58	130
Extended[(1)]	4	13	—	12	29
Intermediate[(2)]	3	6	—	15	24
Single[(3)]	11	15	1	29	56
Total	42	76	7	114	239

Sep 2012.

- ✓ NEAs not detected by the SDSS pipeline

Results

```
WHERE (
   (objFlags & (OBJECT_SATUR | OBJECT_BRIGHT | OBJECT_BLENDED)) == 0
      &&
   (objFlags & OBJECT_DEBLENDED_AS_MOVING) > 0
      &&
   (objc_type == 6)
      &&
   (psfCounts[2] > 14.5) && (psfCounts[2] < 21.5)
      &&
   (rowv*rowv + colv*colv > 0.0025)
      &&
   (rowv*rowv + colv*colv < 0.25)
)
```



Present & future work

- New type of asteroids: Mars crossers ✓

- New surveys:
  - VISTA (VHS) ✓
  - UKIDSS

The paper

Astron. Nachr. / AN **999**, No. 88, 789 – 797 (2006) / **DOI** ***please set DOI!***

Precovery of near-Earth asteroids by a citizen-science project of the Spanish Virtual Observatory.

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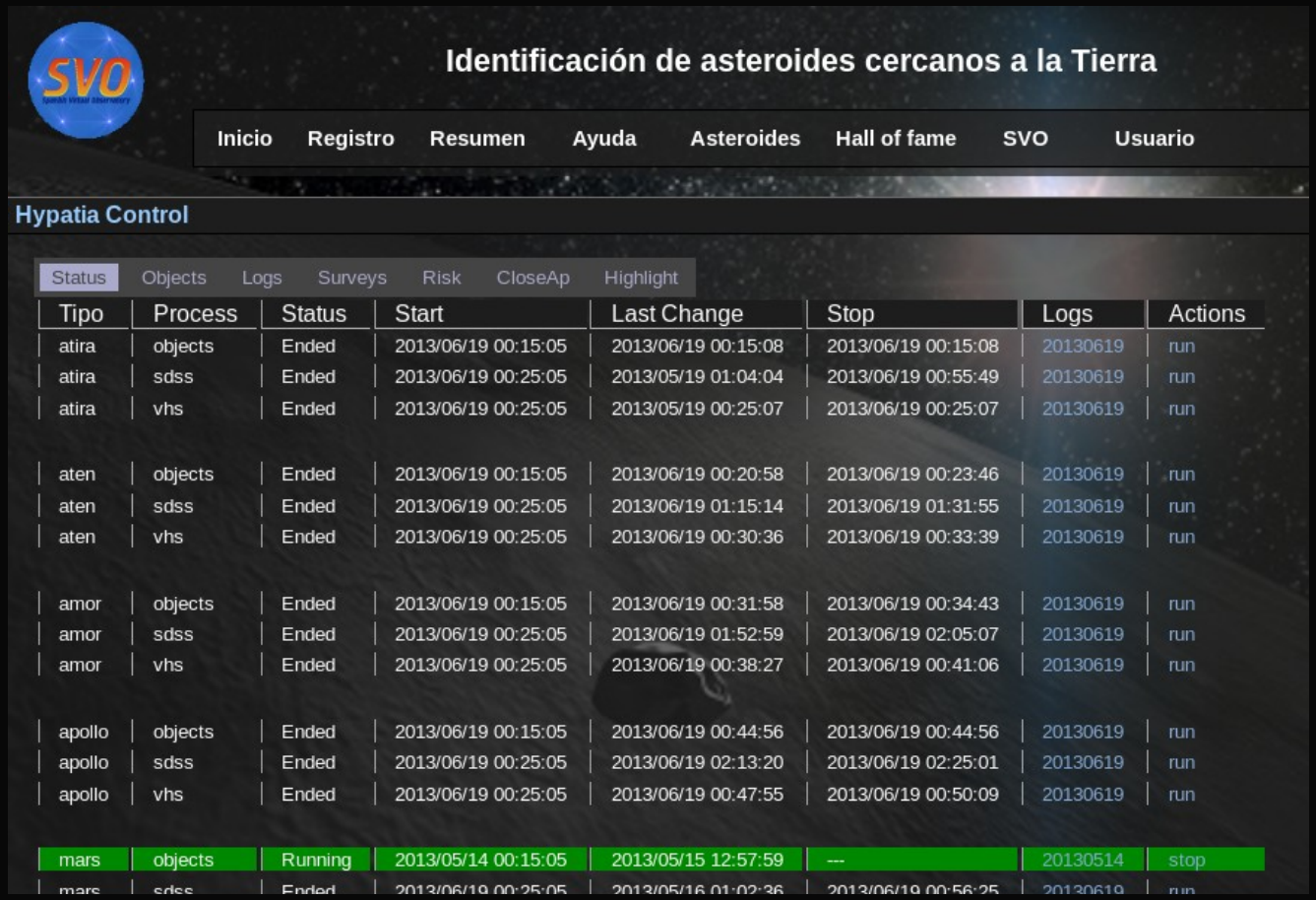
Key words Asteroids – astronomical databases: miscellaneous

This article describes a citizen-science project conducted by the Spanish Virtual Observatory (SVO) to improve the orbits of near-Earth asteroids (NEAs) using data from astronomical archives. The list of NEAs maintained at the Minor Planet

Spin-off

- ✓ Rapid response

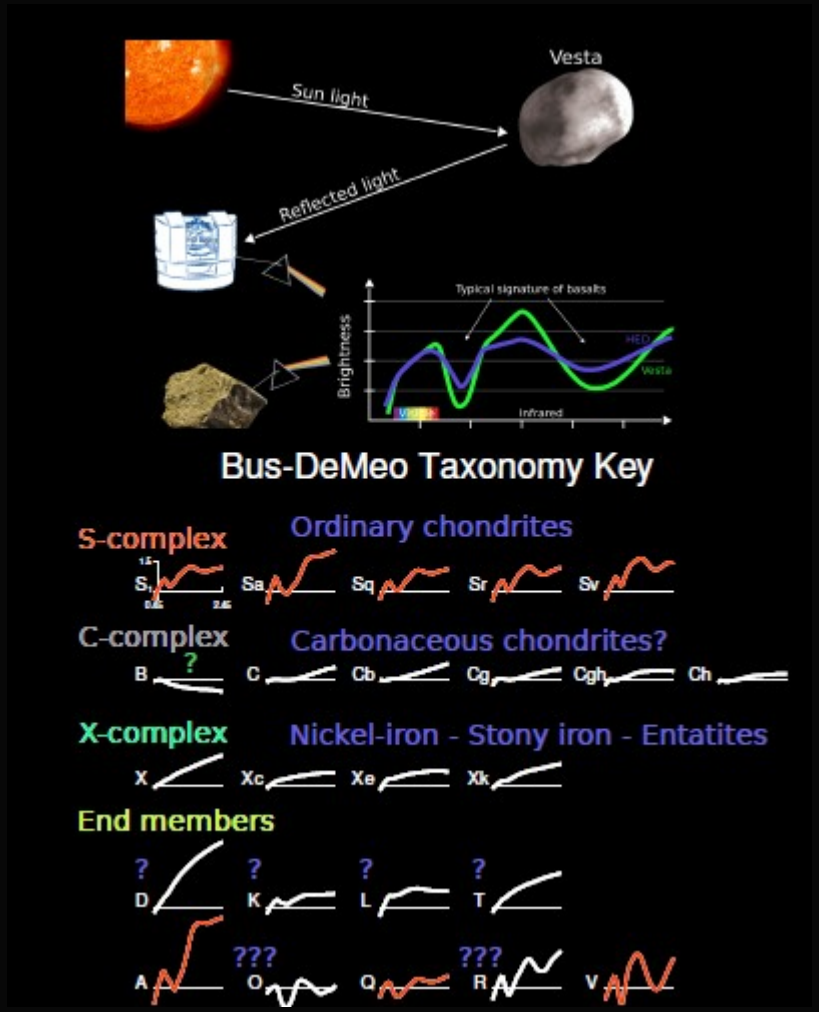


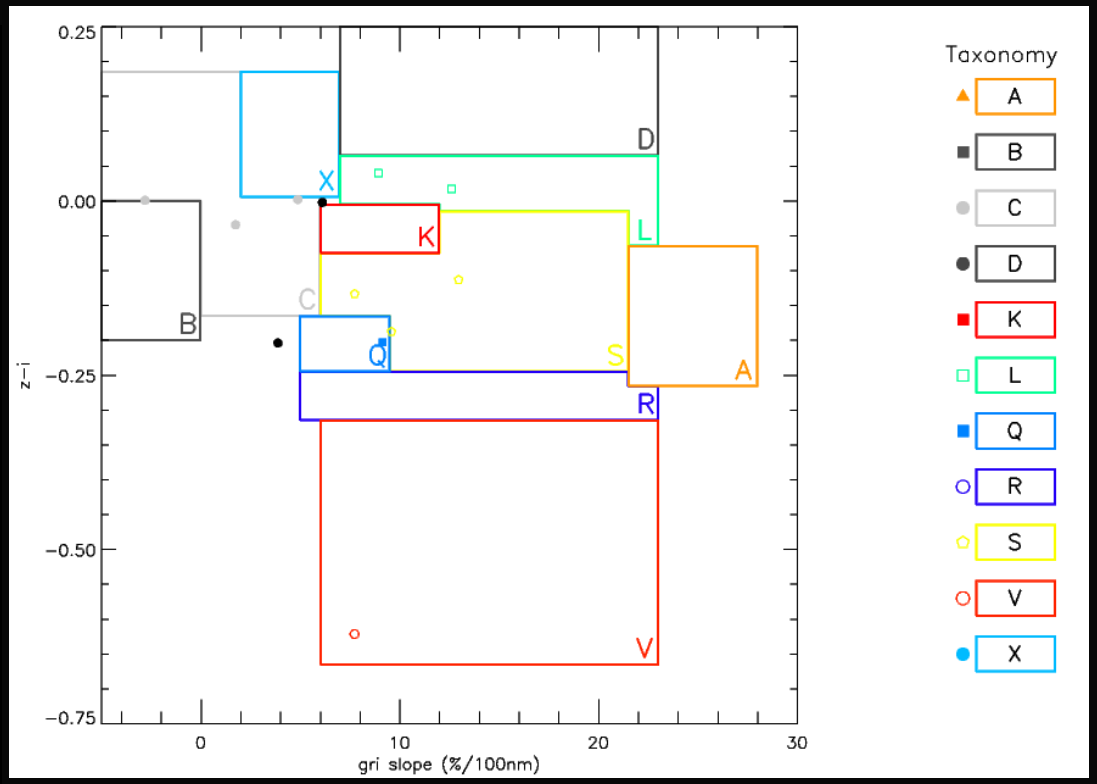
Tipo	Process	Status	Start	Last Change	Stop	Logs	Actions
atira	objects	Ended	2013/06/19 00:15:05	2013/06/19 00:15:08	2013/06/19 00:15:08	20130619	run
atira	sdss	Ended	2013/06/19 00:25:05	2013/05/19 01:04:04	2013/06/19 00:55:49	20130619	run
atira	vhs	Ended	2013/06/19 00:25:05	2013/05/19 00:25:07	2013/06/19 00:25:07	20130619	run
aten	objects	Ended	2013/06/19 00:15:05	2013/06/19 00:20:58	2013/06/19 00:23:46	20130619	run
aten	sdss	Ended	2013/06/19 00:25:05	2013/06/19 01:15:14	2013/06/19 01:31:55	20130619	run
aten	vhs	Ended	2013/06/19 00:25:05	2013/06/19 00:30:36	2013/06/19 00:33:39	20130619	run
amor	objects	Ended	2013/06/19 00:15:05	2013/06/19 00:31:58	2013/06/19 00:34:43	20130619	run
amor	sdss	Ended	2013/06/19 00:25:05	2013/06/19 01:52:59	2013/06/19 02:05:07	20130619	run
amor	vhs	Ended	2013/06/19 00:25:05	2013/06/19 00:38:27	2013/06/19 00:41:06	20130619	run
apollo	objects	Ended	2013/06/19 00:15:05	2013/06/19 00:44:56	2013/06/19 00:44:56	20130619	run
apollo	sdss	Ended	2013/06/19 00:25:05	2013/06/19 02:13:20	2013/06/19 02:25:01	20130619	run
apollo	vhs	Ended	2013/06/19 00:25:05	2013/06/19 00:47:55	2013/06/19 00:50:09	20130619	run
mars	objects	Running	2013/05/14 00:15:05	2013/05/15 12:57:59	---	20130514	stop
mars	sdss	Ended	2013/06/19 00:25:05	2013/05/16 01:02:36	2013/06/19 00:56:25	20130619	run

VO – CS – NEAs – Precov. - The project

Spin-off

- ✓ Asteroid taxonomy

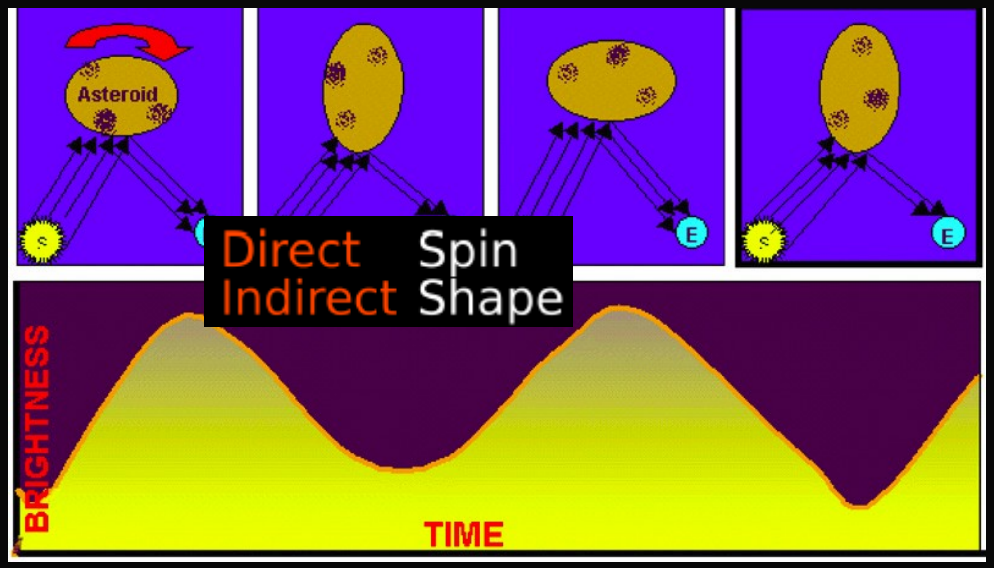




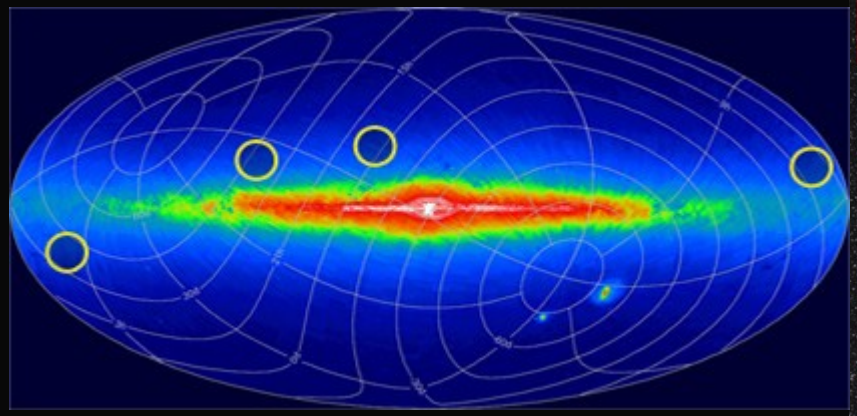
+ IR (UKIDSS, VISTA)

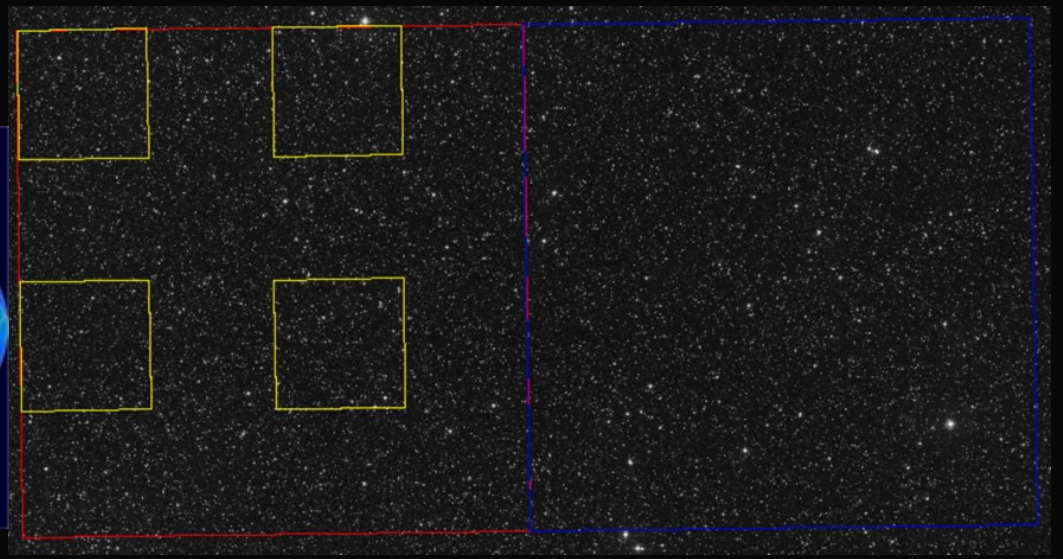
Spin-off

- ✓ Light curves



The WFCAM Transit Survey





Summary

- ✓ Outreach is important
  - ✓ They pay for your research. It is important to tell society what you do and why it is important.
  - ✓ Contacting young people is the way to ensure the long-term sustainability of Science.
  - ✓ People don't care science → Not true.

- ✓ Archives play a fundamental role in modern astrophysics. → *Science at zero cost.*

- ✓ *VO is THE infrastructure to efficiently extract the knowledge hidden in archives.*