Tracking and Identification of Anonymous ISON Objects

Overview

Over the past few months, I have been attempting to track several objects listed in the ISON catalog that are not currently matched with items in the hobbyist tracking list (classfd.tle), and that have not yet been identified as matching unclassified objects. This paper aims to discuss my findings and present options for future effort, including a list of objects that would be practical to independently track.

Anyone who is interested in observing, or has questions or comments on this paper, may contact me at allenb_young@yahoo.com

Background

The "ISON catalog" referred to herein is maintained at http://spacedata.vimpel.ru/ As stated on that website, "Orbits with a period of over 200 minutes are mainly investigated, which basically include geostationary space objects and objects with large eccentricity orbits."

Among the hundreds of objects that ISON tracks are many of the classfd.tle objects of this type of orbit. Through the arduous efforts of many observers and analysts (particularly Mike McCants), most of the hobbyist objects were previously correlated with ISON objects.

However, there remained a fair number of objects being routinely tracked by ISON that were reported to have standard magnitudes of 7.5 or brighter. This hinted that these objects might be tracked independently by hobbyists, and perhaps identified. I had been observing ISON objects for the last few years, and had seen several, but had not systematically approached tracking them. I decided to dig deeper into this tantalizing prospect and have spent the last four months pushing the envelope of the remote imaging equipment that I use. The fundamental questions were:

- Can any more of these anonymous ISON objects be identified with known objects?
- Are any of the brighter targets consistently trackable using hobbyist equipment?
- Of the objects that are trackable but do not correlate with known objects, would it be possible to identify them via orbital evolution and visual characteristics?

Methods

I selected the objects to observe based on several factors. Only objects with a standard magnitude of 7.5 or higher, and with orbits that would be observable by the equipment available were selected. Several objects have been lost by ISON or I have decided to drop them from my study because of multiple failures in recovering them. Objects that were previously included in classfd.tle as 90XXX have also been removed from the active list, as they are already available for hobbyist tracking. Although I had previously seen several objects before beginning this study, I rejected all previous tracking due to a lack of complete records.

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I created an Excel workbook to record observations and identification of the objects studied. A summary of that workbook appears in the Appendix.

The equipment used included remote imaging telescopes available via itelescopes.net and a public observatory in Perth Australia. Pertinent details of that equipment also appears in the Appendix.

Results

Many anonymous objects that were observed were found to match existing unclassified and declassified objects. For identification, the standard full catalog and the new hobbyist (80000 series) element sets from Space-Track were used, as well as the classfd.tle file. As shown below, I have added these objects to my personal copy of the cvelems.txt file and would propose this information is used when analyzing weekly ISON updates.

Table 1

Identified Objects (cvelems.txt)

ISON ID	NORAD ID	COPSAR ID	NAME
42200	39989	2008-011-DN	BREEZE-M DEB
61900	42482	1989-006-CJ	ARIANE 2 DEB
64001	33579	1989-006-BX	ARIANE 2 DEB
66001	42485	1989-006-CM	ARIANE 2 DEB
75201	40187	2011-077-L	CZ-3B DEB
75400	40189	2011-077-N	CZ-3B DEB
110001	43179	2018-013-B	FALCON 9 R/B
145101	23467	1995-003-A	UFO 4 (USA 108)
146406	27525	2002-043-A	KALPANA 1 (METSAT 1)
157502	43282	1969-013-C	TITAN 3C TRANSTAGE DEB

After combing through the ISON objects in this manner, I analyzed the remaining items for a shortlist of objects to be tracked in future. First, I determined a subjective score for each object left on the list. The score is based on the percentage of time that the object was found and was bright enough to be imaged and provide a track that could be reduced and reported.

These select few of the objects comprise the Proposed Active List of Trackable ISON Anonymous Objects (Table 2 below), as they have been found to be bright enough, steady, and have favorable positions to be readily tracked by available equipment. In each case, I was able to image, track, and reduce observations every time I tried to observe the object. There are additional objects that were trackable nearly every time, but only ones seen on each attempt are included here. None of these objects are currently included in the classfd.tle list for hobbyist tracking.

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Table 2

Proposed Active List of Trackable ISON Anonymous Objects

ISON Catalog Number	Standard Magnitude (per ISON)	Inclination (ι) °	Mean Daily Motion (n)	Average Observable Magnitude
25900	6.5	63.1	5.62	10.3
44902	6.5	63.4	3.20	11.9
49000	6.5	63.3	2.94	12.0
53801	6.5	62.9	2.69	12.2
64302	6.5	9.9	2.23	12.6
68200	4.5	27.4	2.13	10.7
68300	5.5	63.1	2.11	11.8
69501	6.5	5.4	2.07	12.8
69800	5.5	63.3	2.06	11.8
70400	6.5	62.9	2.04	12.8
71000	4.5	26.2	2.03	10.8
76100	6.5	7.8	1.88	13.0
78302	4.5	22.3	1.84	11.0
143744	5.5	5.5	1.01	13.1

In comparing the Active List to all of the existing unclassified elements available from Space-Track at a similar epoch of the specific ISON report, I have not been able to positively identify any items as having similar orbital characteristics. A look at the orbital characteristics of the active list indicates there are three groups of objects:

1. **Molniya type orbits.** Active List items that are probably debris from launches of this type.
2. **Geostationary object of low inclination.** These may indicate objects associated with classified payloads, although this is not certain.
3. **GTO type orbits of moderate inclination.** Also may be associated with classified payloads.

From Here

The only two plausible final outcomes of this study would be either to identify each of these with a known unclassified element set from Space-Track, or to determine that there is an unlisted classified object that we have not previously been tracking. I do not think it is reasonable to assume that ISON would be tracking an object that Space – Track is incapable of finding.

Further attempts at identification is the next step; my current plan is to continue tracking the Active List. Although there is a 14-day lag on the elements published by ISON, it has proven possible to ID the objects. Due to the selection methodology, the Active List may contain fewer debris objects, which will

tend to suffer less uncertainty due to old element sets. With more data, especially watching orbit fluctuations and optical behavior, it may be possible to identify objects not readily matched by element set comparison alone.

Cooperation with other observers would lead to better results. Inclusion of the Active List as 90XXX items (or any other label) would help facilitate this crowd sourcing of observations.

Appendix

Equipment used:

T18 at MPC I89 COSPAR 7777 38.165653 -2.326735 5150ft, 1650m Nerpio, Spain

T9, T12 at MPC Q62 COSPAR 7778 -31.2733 149.0644 3400ft, 1122m Siding Spring, NSW, Australia

T14, T20 at MPC H06 COSPAR 7779 32.92 -105.528 7298ft, 2225m Mayhill, New Mexico USA

R-COP at MPC 323 COSPAR 7782 -32.008 116.135 984ft, 300m Perth, WA, Australia

T68 at MPC Q67 COSPAR 7784 -33.3967 149.4917 2081ft, 650m Bathurst NSW, Australia

For TXX items, refer to https://www.itelescope.net/obs-sso/

R-COP at Perth Observatory:

Info	
APERTURE:	0.4 m
FOCAL LENGTH:	1850.0 mm
F-RATIO:	5.2
FILTERS:	Open
CCD SIZE:	2184 x 1472 (6 um pixels)
FOV:	27.6 x 18.6 arcmins
SITE:	Perth Observatory

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Tracking Spreadsheet Summary

Code	Desig	Seen	Trax	Tries	Score	ISON Mstd	Date First Seen	Retired	ID	ID Date	cvelems updated?	Notes
14802		0	0	0	0%	3.5						May not exist
						6.5		20100	90110		Extant	
25900	50001A	4	4	4	100%	6.5	10/29/18					
25902	50002A	3	2	3	67%	6.5	10/29/18					
				3				31403				drop
								31600				lost by ISON
								32000	90113		Extant	
33203	50063A	1	1	4	25%	6.5	1/26/19					
				1				33300	41699	12/17/18	Me	
33304		0	0	1	0%	6.5						
33704	50004A	2	1	2	50%	6.5						
				2				33717				drop
								33800	41675	9/21/18	Yes	
				1			10/29/18	33901				lost by ISON
	50006A			1			11/26/18	33907				drop
34100	50007A	0	0		0%	6.5						
34300	50008A	1	1	1	87%	7.5						
	50009A							34403	43527	9/17/18	Me	
				1				34418				drop
				1				34610				drop
								35200	90117		Extant	
37400	50030A	3	1	5	20%	6.5	3/7/18					
								37600	90097		Extant	
				1				40300				drop
40900	50011A	1	0	3	0%	6.5	11/19/18					
								41200				drop

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Code	Desig	Seen	Trax	Tries	Score	ISON Mstd	Date First Seen	Retired	ID	ID Date	cvelems updated?	Notes
								41700	90120		Extant	
								42000	90118		Extant	
	50012A					5.5		42200	39989	2/8/19	Me	
42901	50013A	1	1	2	50%	6.5						
								44900				drop
44902	50031A	3	3	3	100%	6.5	11/15/18					
45000	50058A	2	0	1	0%	8.5						
46500	50014A	4	0	8	0%	4.5	3/10/18					drop
								46601				drop
47403		1	0	3	0%	6.5						
								47601	90108		Extant	
47802		2	0	6	0%	4.5						
48200		0	0	1	0%	6.5						
	50015A							48203				drop
49000	50045A	1	1	1	100%	6.5						
49102		0	0		0%	7.5						
								49200	90114		Extant	
50402		0	0	5	0%	6.5						
50500		2	0	4	0%	6.5	11/26/18					
								51100	90116		Extant	
				2				52400				drop
51300		0	0		0%	6.5						
53800		0	0	1	0%	5.5						
53801	50060A	1	1	1	100%	6.5						
								52601				very faint, partial trail
								54102	90109		Extant	
54301		0	0	1	0%	6.5						

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Code	Desig	Seen	Trax	Tries	Score	ISON Mstd	Date First Seen	Retired	ID	ID Date	cvelems updated?	Notes
								56300				drop
57100	50064A	1	1	3	33%	6.5						
58600	50061A	2	2	3	79%	5.5						
				2				58804				lost
59300		0	0		0%	6.5						
								59501	90101		Extant	
								59700	90106		Extant	
								60601	90111		Extant	
								61100	90119		Extant	
				2				61900	42482	11/26/18	Me	
								62200	90112		Extant	
62401	50053A	1	1	2	59%	5.5	12/21/18					
62800	50016A	3	3	5	71%	5.5	9/10/18					
62801		1	0	5	0%	6.5						
								63001	40195	9/21/18	Yes	
								63200	90099		Extant	
	50047A							63204				drop
								63700	90115		Extant	
63901	50056A	4	2	5	47%	5.5	12/21/18					
	50065A							64001	33579	1/26/19	Me	
64201		0	0		0%	6.5						
64302	50052A	3	2	2	100%	6.5						
				1				64800	90103		Extant	
64901		0	0	1	0%	6.5						
65200		0	0		0%	5.5	2/24/18					
65601		0	0	1	0%	6.5						
65900		1	0	2	0%	6.5						

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Code	Desig	Seen	Trax	Tries	Score	ISON Mstd	Date First Seen	Retired	ID	ID Date	cvelems updated?	Notes
				1				66001	42485	12/17/18	Me	
66602		0	0		0%	6.5						lost
67101		0	0		0%	5.5						lost
								67200				drop
67904		0	0		0%	7.5						
68200	50017B	1	1	1	144%	4.5	1/6/18					
68201	50067A	2	1	2	50%	6.5						
				2				68206				drop
68300	50054A	2	1	1	118%	5.5	12/21/18					
				1				68600	90107		Extant	
69501	50066A	1	1	1	100%	6.5	1/26/19					
								69600	90121		Extant	
69701		1	0	3	0%	6.5	12/21/18					
69800	50040A	1	1	1	118%	5.5	11/26/18					
				1			11/25/18	69901				drop
								70200	90096		Extant	
70201	50034A	1	1	2	59%	5.5	11/16/18					
70203		0	0	1	0%	5.5						
70400	50062A	2	2	2	100%	6.5						
70500	50019A	5	3	6	72%	4.5	10/28/18					
70702		1	0	3	0%	6.5						
71000	50020A	9	9	9	144%	4.5	10/18/18					
				1				71100				lost by ISON
71300		0	0	2	0%	6.5						
71500	50043A	1	1	2	59%	5.5	11/27/18					
71603		0	0		0%	6.5						
72203	50068A	2	1	3	29%	7.5						

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Code	Desig	Seen	Trax	Tries	Score	ISON Mstd	Date First Seen	Retired	ID	ID Date	cvelems updated?	Notes
72301		0	0		0%	6.5						
72702		0	0		0%	6.5						
								73503				drop
74103	50059A	1	0		0%	9.5						lost
74403		0	0		0%	6.5						
74501		1	0	1	0%	5.5	12/9/18					
74900		1	0	2	0%	6.5	11/15/18					
				3			11/26/18	74901				drop
				4				75201	40187	2/5/19	Me	
				1				75400	40189	2/5/19	Me	
76100	50055A	3	3	3	100%	6.5						
76701	50057A	1	0	2	0%	6.5	12/21/18					
				1			10/18/18	77501				lost by ISON
78301	50041A	2	1	4	25%	6.5	11/26/18					
78302	50037A	1	1	1	144%	4.5	11/25/18					
							11/25/18	78306				drop
78503		0	0		0%	5.5						
78603	50049A	1	0	1	0%	5.5	12/9/18					
78703		1	0		0%	5.5						
78902		1	0		0%	5.5						
79201		1	0	2	0%	6.5						
79601		0	0		0%	5.5						
	50059A							80100				
81301		0	0	1	0%	6.5						
82100		0	0		0%	6.5						
	50022A			2				110001	43179	12/17/18	Me	
126200		0	0	1	0%	5.5						

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Code	Desig	Seen	Trax	Tries	Score	ISON Mstd	Date First Seen	Retired	ID	ID Date	cvelems updated?	Notes
							11/19/18	137101				drop
139001		1	0	1	0%	5.5						
	50033A							139102				drop
								140912	43340	4/27/18		
				1				142316				drop
143104	50023A	0	0		0%	3.5						FIND
143558		0	0		0%	5.5						
143744	50069A	1	1	1	118%	5.5	10/25/18					
144304		0	0	1	0%	5.5						
								144402	90100		Extant	
								144505				lost by ISON
	50024A			1			11/15/18	145101	23467	11/15/18	Me	Declassified
								146406	27525	11/25/18	Me	
147902		0	0		0%	4.5						
151400		0	0		0%	6.5						
154400		0	0		0%	5.5						
				2				157502	43282	12/17/18	Me	
170800		0	0		0%	6.5						
180700		0	0		0%	6.5						
193700		0	0		0%	*5.5*						ISON dropped
515500	50025A	0	0		0%	3.5						