What do we know about Comet C/2012 S1 (ISON)?

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What I think everyone wants to say:

"Comet ISON will potentially be known as the Great Comet of 2013/2014."

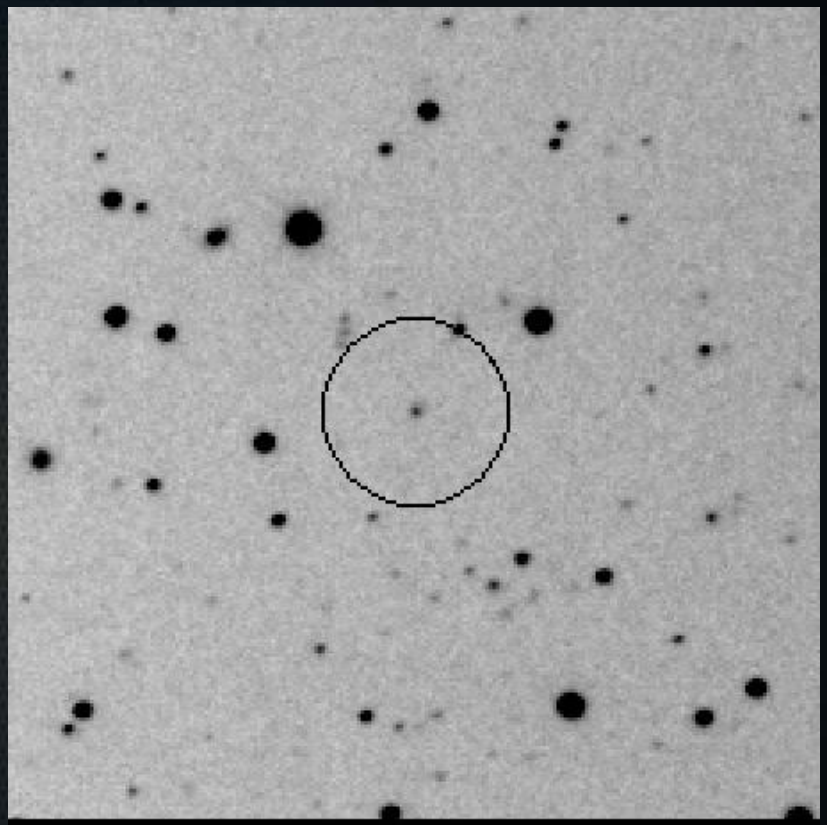
But, with good reason, what they will be sure to add:

"Only time will tell..."

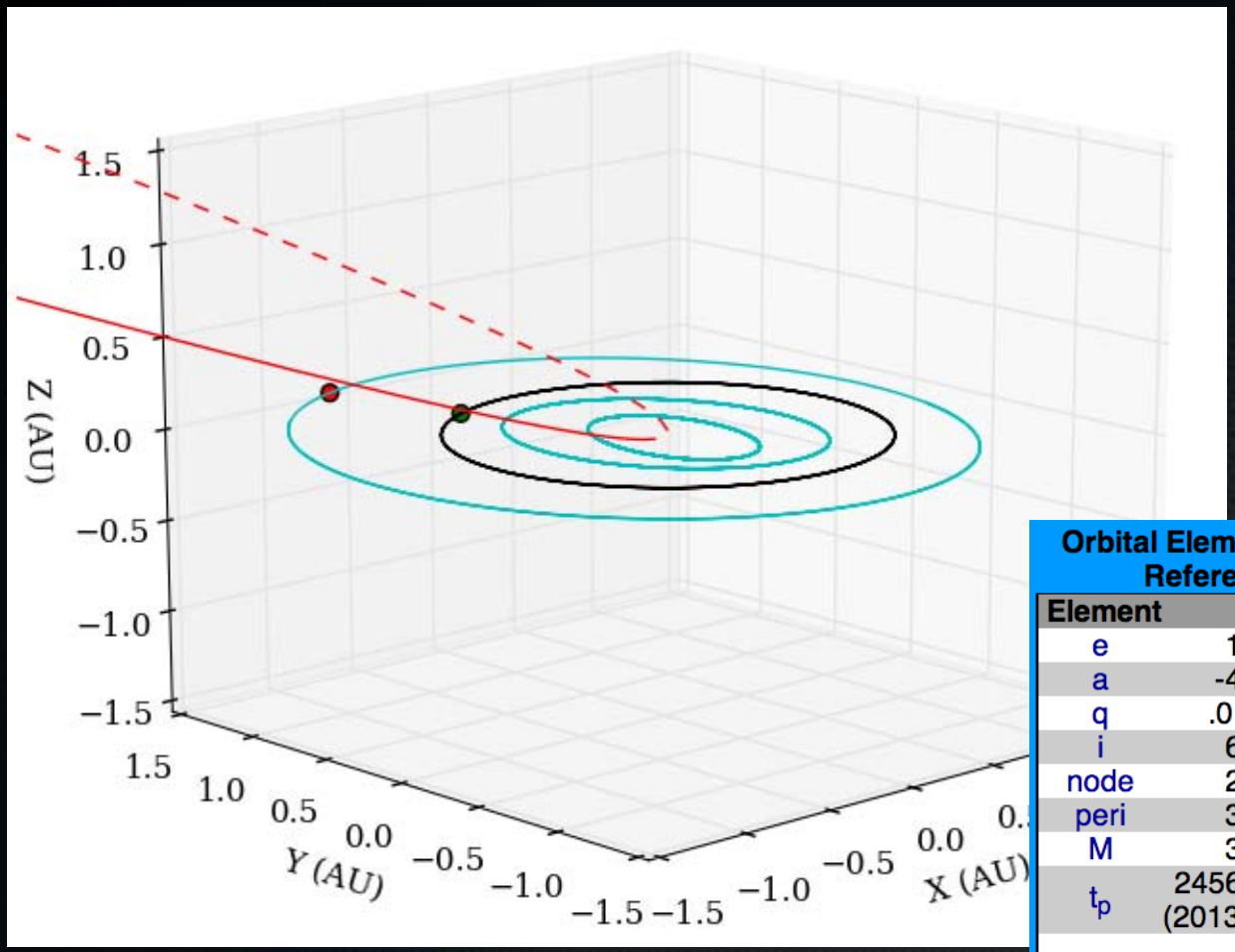
Discovery circumstances and orbital elements

Discovered by Nevski and Novichonok on 2012 Sep 21 using a 0.4-m telescope in Russia, part of the International Scientific Optical Network (ISON), a group of observatories for observing space debris, asteroids and gamma-ray bursts.

Pre-discovery observations from the Mount Lemmon Survey (2011 Dec 28) and Pan-STARRS (2012 Jan 28) were quickly identified in the Minor Planet Center's database, giving us a good orbit at the time the comet was announced (2012 Sep 24).



Comet C/2012 S1. 21 Sep. 2012, 01h 15m (UT)
0.4-m reflector f/3 + CCD, exp. 5x100sec, 2"/pix., crop 200%
ISON-Kislovodsk observatory
Observers: V. Nevski, A. Novichonok



Orbital Elements at Epoch 2456253.5 (2012-Nov-22.0) TDB
Reference: JPL 11 (heliocentric ecliptic J2000)

Element	Value	Uncertainty (1-sigma)	Units
e	1.000002666578981	2.6582e-07	
a	-4693.431423839063	468.01	AU
q	.01251540558338073	1.1298e-06	AU
i	61.78520483544418	0.0037876	deg
node	295.7507876820328	0.00067524	deg
peri	345.5008917120939	0.00040379	deg
M	359.9988602884392	0.00017045	deg
t_p	2456625.314733264673 (2013-Nov-28.81473326)	0.0067037	JED
period	n/a n/a	n/a n/a	d yr
n	3.065267346472312E-6	4.5849e-07	deg/d
Q	n/a	n/a	AU

Red solid line – ISON pre-perihelion
Red dashed line – ISON post-perihelion
Red circle – Mars on 2013 Oct 02, Delta~0.07 AU
Green circle – Earth on 2014 Jan 15, Delta~0.03 AU

Potentially related to the Great Comet of 1680?

Orbital Elements at Epoch 2456253.5 (2012-Nov-22.0) TDB
Reference: JPL 11 (heliocentric ecliptic J2000)

Element	Value	Uncertainty (1-sigma)	Units
e	1.000002666578981	2.6582e-07	
a	-4693.431423839063	468.01	AU
q	.01251540558338073	1.1298e-06	AU
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period	n/a n/a	n/a n/a	d yr
n	3.065267346472312E-6	4.5849e-07	deg/d
Q	n/a	n/a	AU

Orbital Elements at Epoch 2335000.5 (1680-Nov-29.0) TDB
Reference: SAO_2008 (heliocentric ecliptic J2000)

Element	Value	Uncertainty (1-sigma)	Units
e	0.999986	n/a	
a	444.4285714	n/a	AU
q	0.006222	n/a	AU
i	60.6784	n/a	deg
node	276.6339	n/a	deg
peri	350.6128	n/a	deg
M	359.99795	n/a	deg
t_p	2335019.9876 (1680-Dec-18.48760000)	n/a	JED
period	n/a n/a	n/a n/a	d yr
n	0.0001052	n/a	deg/d
Q	888.8509209	n/a	AU

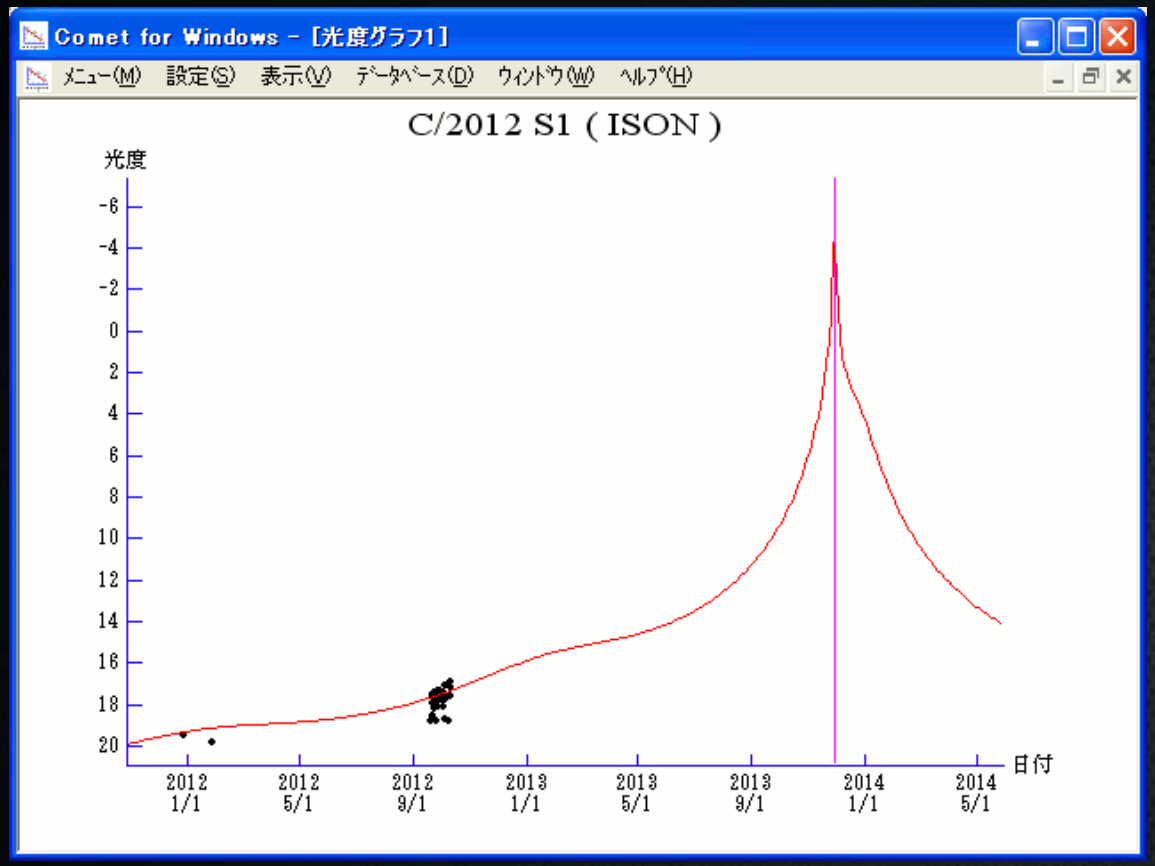
"Staartster (komeet) boven Rotterdam"
Lieve Verschuier (c.1680)

Best “modern-era” equivalent: Comet Ikeya-Seki (The Great Comet of 1965, C/1965 S1)

International Comet Quarterly
“Brightest comets since 1935”

peak m1	Comet
(-10)	C/1965 S1 (Ikeya-Seki)
(-5.5)	C/2006 P1 (McNaught)
-3.0	C/1975 V1 (West)
(-3)	C/1947 X1 (Southern comet)
(-1)	C/1948 V1 (Eclipse comet)
-0.8	C/1995 O1 (Hale-Bopp)
(-0.5)	C/1956 R1 (Arend-Roland)
(-0.5)	C/2002 V1 (NEAT)
0.0	C/1996 B2 (Hyakutake)
0.0	C/1969 Y1 (Bennett)

Roger Lynds/NOAO/AURA/NSF



Brightening versus heliocentric distance is near a power-law slope of -4 (Yoshida 2013).

This slope would be expected if the comet had already been near the Sun (i.e., a fragment of an earlier sungrazer).

Currently, the comet is at 5 AU, so it is difficult to predict what will really happen once it arrives in the inner-solar system.

Note that the apparent visual magnitude at perihelion is around -10, i.e., off the scale of this plot! "Brighter than the full Moon"? (-13)

Potential interesting events:

- Disintegration ~ C/1999 S4 (LINEAR), C/2010 X1 (Elenin) – seems less likely, based on current potential relationship to comet 1680
- Fragmentation and outbursts – can occur at anytime for any comet for many reasons(!)
- Fragmentation near perihelion – may see short lived fragments post-perihelion, e.g., Ikeya-Seki
- Disintegration near perihelion – remaining dust may still form a bright tail, e.g., comet C/2011 W3 (Lovejoy)

Comet Lovejoy, post-perihelion
Dan Burbank/NASA/ISS

Sungrazers offer rarely observed physical regimes.

Gives the opportunity to observe metals in bulk quantities.

Thermally and mechanically tests comet nuclei:

- Kreutz group estimated to be within their Roche limit at perihelion Ikeya-Seki was at 0.0078 AU = 1.7 Rsun
- ISON is close, 0.013 AU = 2.8 Rsun

But, for many projects, every bright comet counts!