COMET ISON OBSERVNG CAMPAIGN (CIOC) SBAG Update Jan – Jul 2013

CIOC Team established Jan 2013 at SBAG-8. Reporting monthly to Lindley Johnson, Kelly Fast, and Jim Green set up Feb 2013. Demographically mixed and representative. Abundant opportunity for post-docs & young scientists to contribute.

Members chosen from SBAG: Lisse, Fernandez, Battams, Kelley, Knight, Vervack, Warner, Yanamandra-Fisher, DiSanti.

Mantra: Facilitate, facilitate, facilitate. Bottom line is to maximize the science returned from Comet ISON, by involving every telescope in the solar system in ISON observations.

CIOC Contact Info: http://www.isoncampaign.org (Committee & news)
https://dnnpro.outer.jhuapl.edu/isonworkshop/Home.aspx (Workshop)

CIOC Achievements/Products

- NASA-NSF Opportunity Letter: e.g. SMA, GEMINI
- NASA KECK PUBIC CALL (MOWG Business)
- NASA IRTF PUBLIC CALL (MOWG Business)
- SOLAR TELESCOPE OBSERVING
- Mars Fleet: MRO,MAVEN, Curiosity, Opportunity, Mars Express(?), Working With Cometeers & Practicing for comet C/2013 A1 (Siding Spring) in Oct 2014
- Mercury Fleet: MESSENGER, Working With Cometeers, Observing Encke too
- Solar Fleet: Hinode, SDO, SOHO, STEREO, following up on Comet 2011 W3 (Lovejoy)
- CIOC WEBSITE (information, news, links, no archiving) http://www.isoncampaign.org
- NASA CIOC Facebook page, blogs; Amateur involvement
- NASA HQ EPO: Ask an Astronomer; Media Point of Contact – e.g. NHK, Discovery Channel, BBC, etc.
- CIOC WORKSHOP: Aug 1-2, 2013 at APL https://dnnpro.outer.jhuapl.edu/isonworkshop/Home.aspx

Comet ISON Observing Campaign Website

New CIOC Website Established:
http://www.isoncampaign.org

- Latest news/updates about the comet
- Updated lightcurve
- Workshop information
- Resources for amateur/pro-am/professional astronomers
- Blog posts from CIOC Team members

Almost **3,000** pageviews in the first week since launch!

Backup ISON Big Science Picture Slides

Why Care About C/ISON 2012 S1?

- First passage through the inner solar system
  - Long arc from discovery and pre-discovery astrometry
  - More detailed dynamical studies than most "dynamically new" comets
- On a "sungrazing" orbit
  - Discovered much earlier than any previous sungrazer
  - Perihelion Nov 28, 2013 at a distance of 2.7 solar radii
- Rare combination of these two properties
  - Characterize the evolution of the comet throughout its inner solar system journey

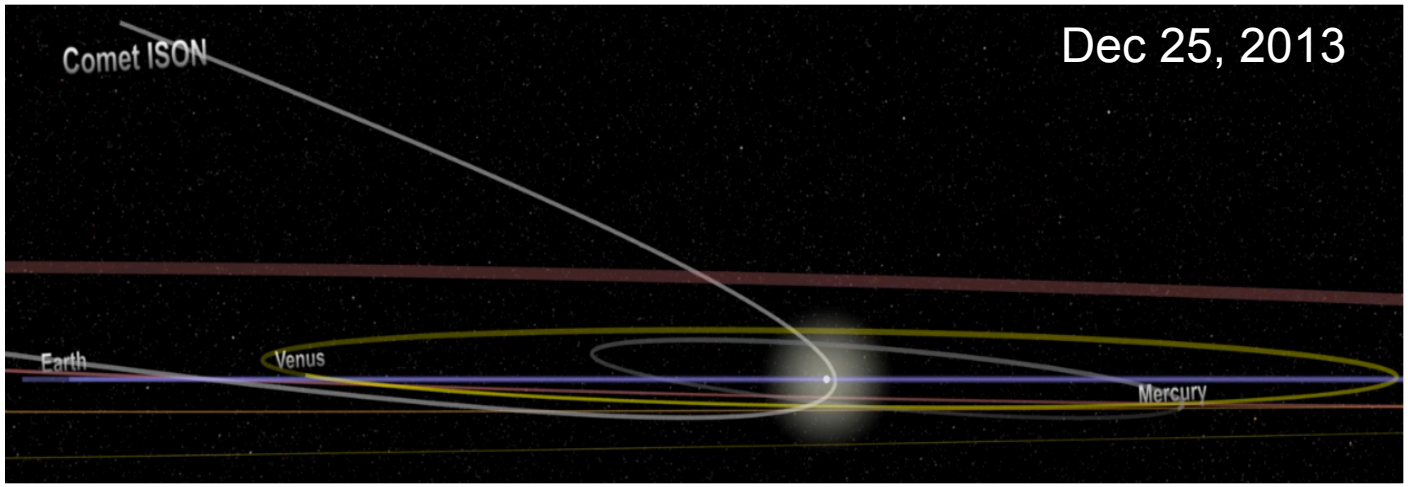
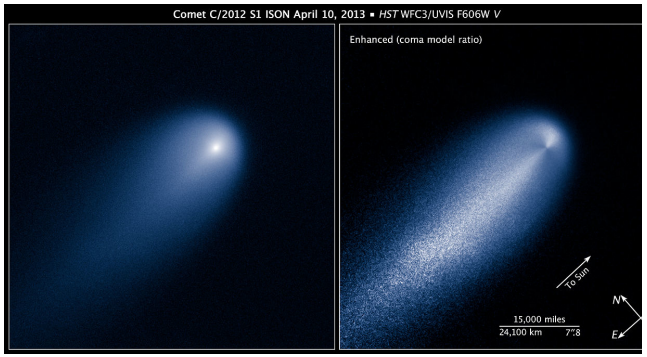
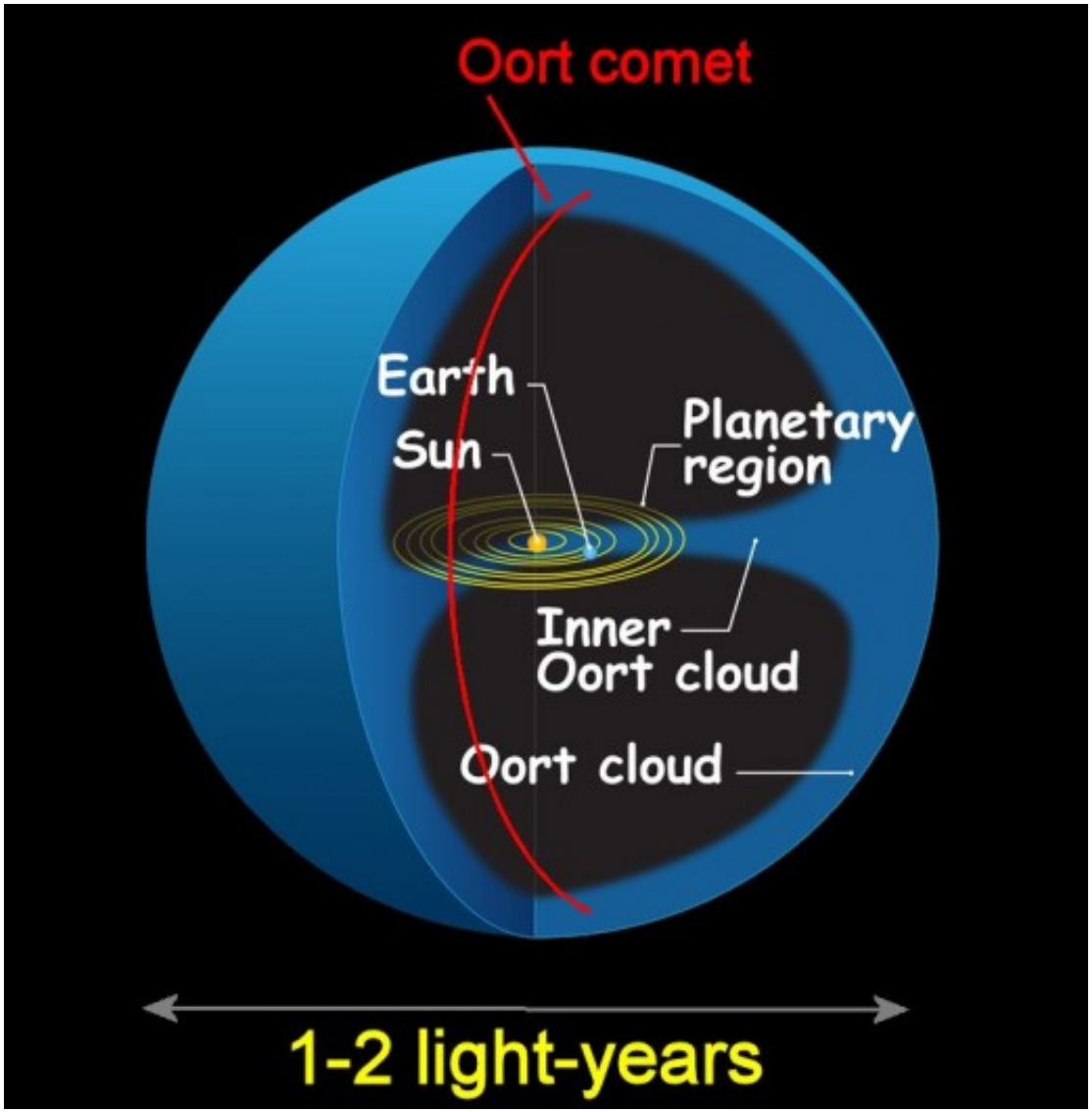


Image credit: NASA GSFC Scientific Visualization Studio

Why is C/ISON 2012 Important?



- Projected to get very bright
  - Everything on its surface will sublimate near perihelion
  - Allowing for many observations not commonly observable for comets
- Favorable viewing geometry for observing
  - Pre-perihelion from Mars, close approach 0.07 AU 10/1/2013
  - Pre-perihelion from Mercury, close approach 0.24 AU 11/18/2013
  - Very Close Solar Passage, within 0.008 AU ($1.7R_{Sun}$) 11/28/2013
  - Post-perihelion from Earth, close approach 0.42 AU, almost passing directly above north pole 12/26/2013
- Long lead time to perihelion
  - Discovered at 6 AU, more than one year before perihelion
  - Very long time to organize major observing campaign
- Observations planned from nearly all possible platforms in all wavelengths (see http://sungrazer. nrl.navy.mil/index.php?p=ison)



C/ISON has likely spent the 4.5 Gyr since its formation far from the Sun and the planets in the deep freeze of the Oort Cloud. For C/ISON to come from the depths of the Cloud, with more than a year's notice, at ~62^{o} inclination to the ecliptic and have close encounters with 3 of the 4 inner system planets ***and*** the Sun is incredibly rare, practically unique.

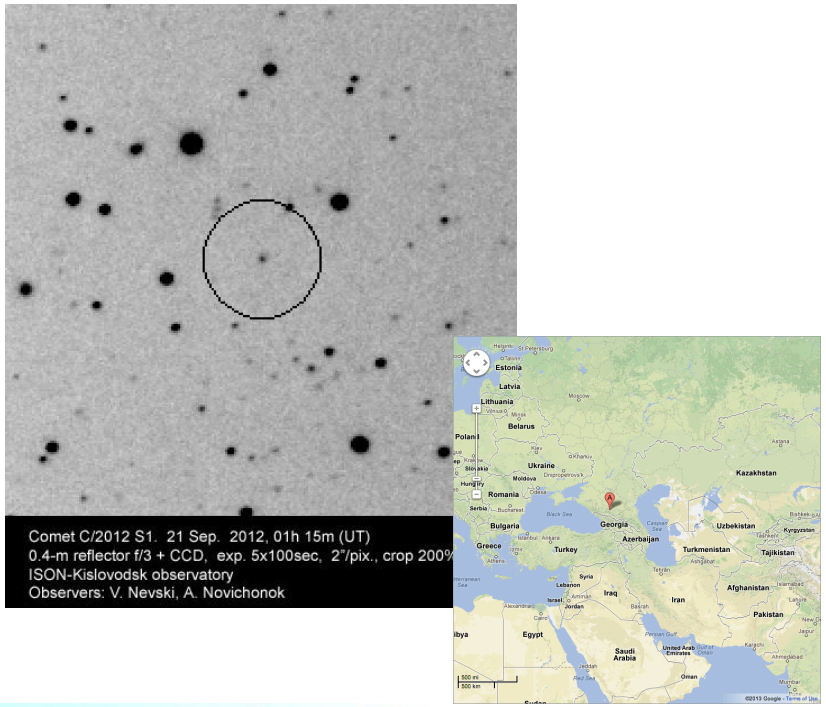
About The "K" Word

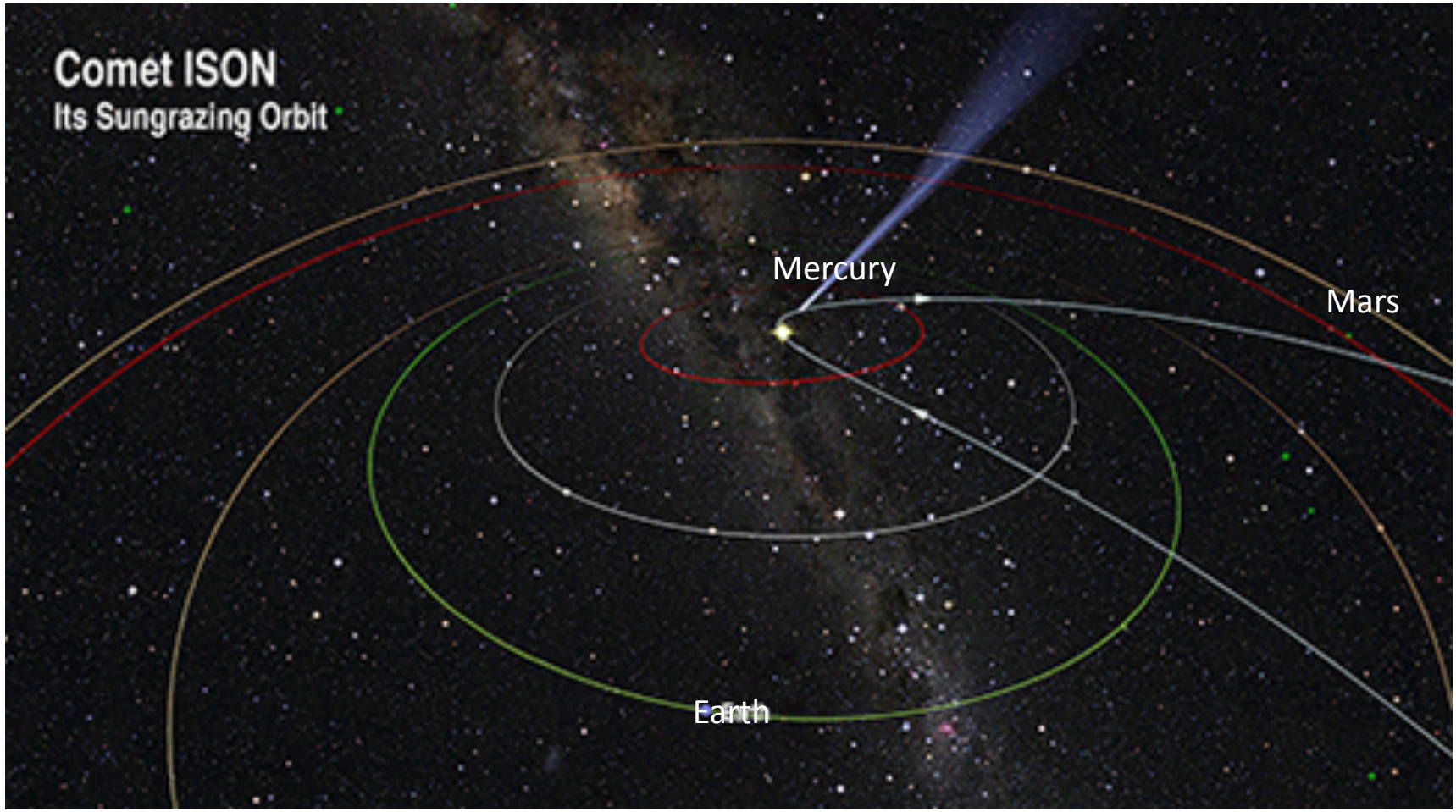
Timeline for Close Approaches

- Oct 1, Mars
- Nov18, Mercury
- Nov 28, Sol
- Dec 26, Earth

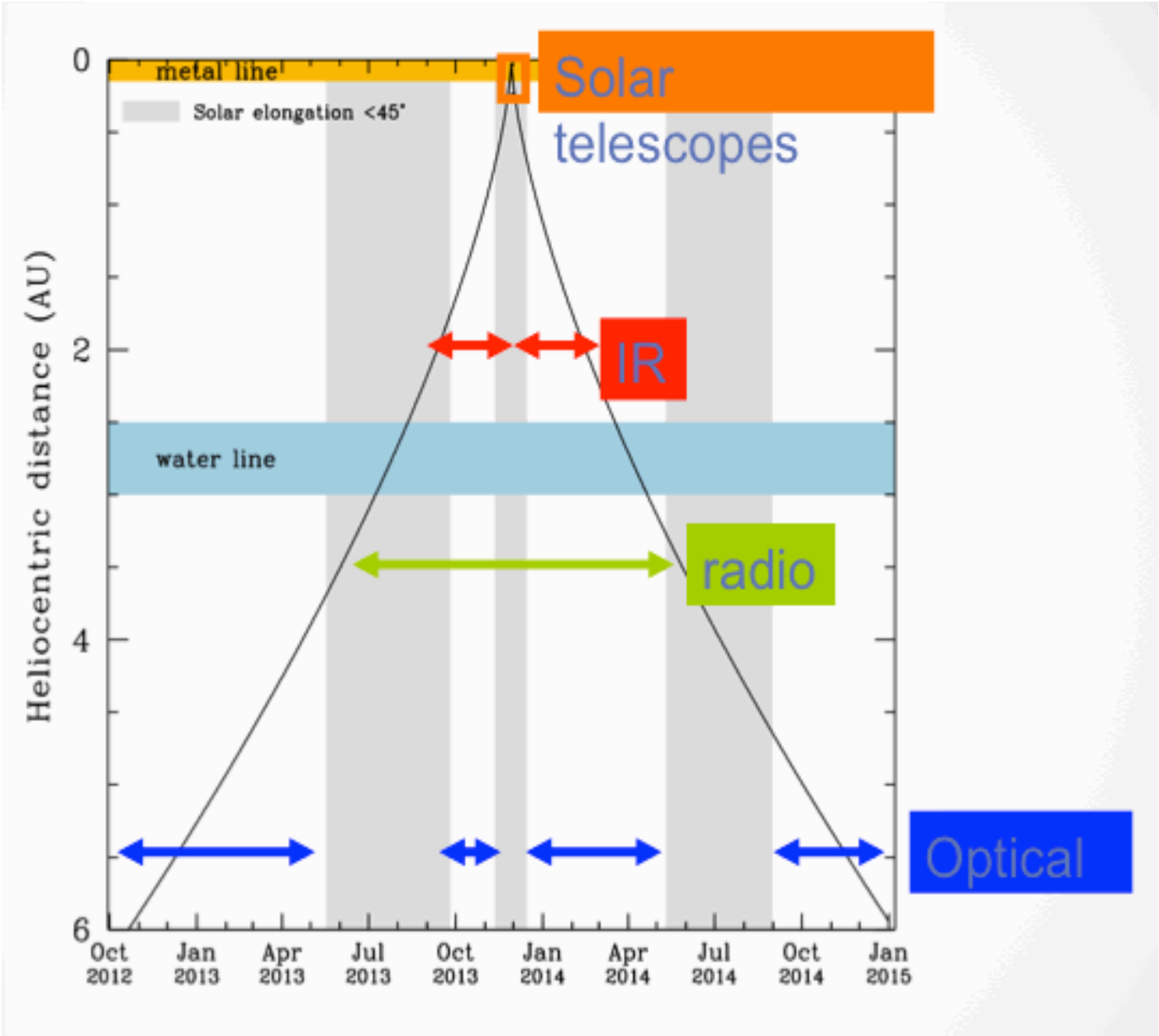
Comet ISON C/2012 S1

- Discovered September 21, 2012 by Vitali Nevski and Artyom Novichonok
- Used 0.4-m telescope at International Scientific Optical Network (ISON) near Kislovodsk, Russia
- Pre-discovery image from Mt Lemmon on Dec 28, 2011





ISON will have close encounters with Mars, Mercury, the Sun, and the Earth in 2013. Even counting long period comet C/1965 S1 (Ikeya-Seki) (with perihelion distance q = 1.7 R_{Sun}) and likely Oort Cloud comet C/1973 E1 (Kohoutek) (with q = 0.14 AU), such a combination of fortuitous observing circumstances for a highly pristine dynamically new Oort Cloud comet has not occurred in the modern era of solar system exploration (that started 50 years ago with the Mariner 2 flyby of Venus).

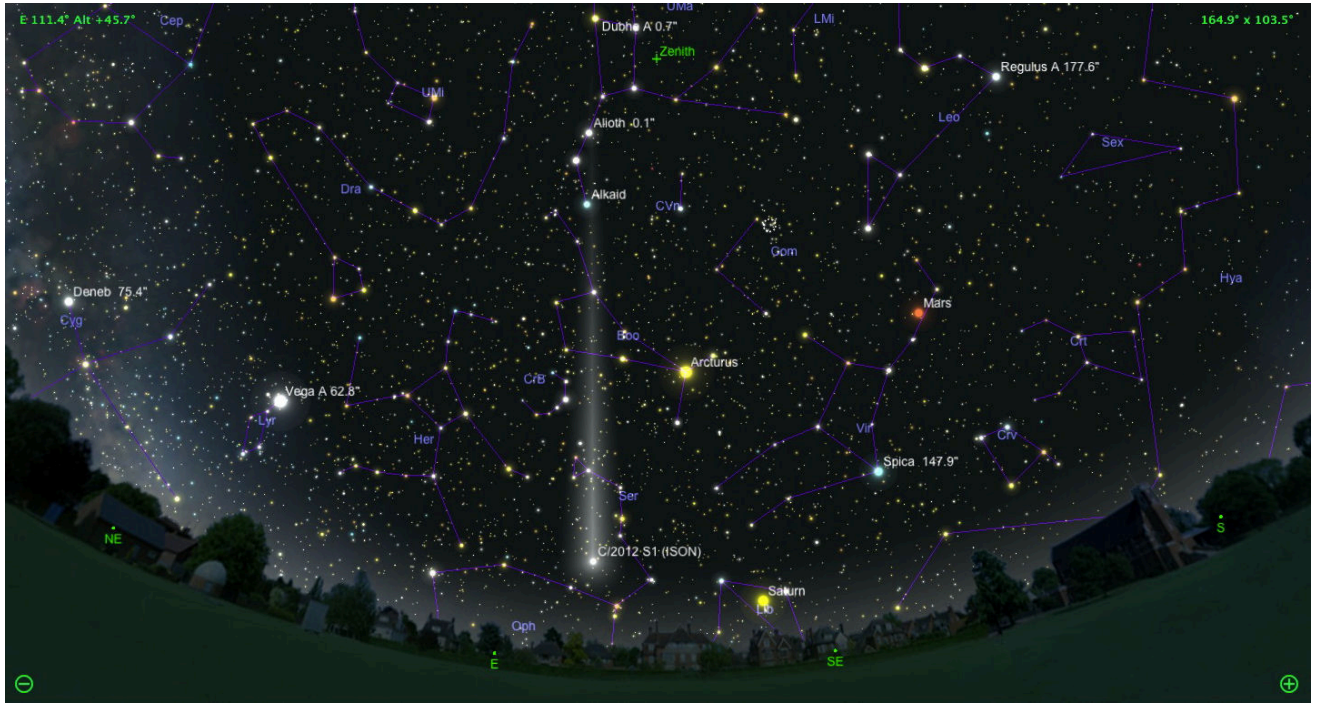


Schematic plot of the 2013 Earth-based Comet ISON observing windows. For reference, the close approach to Mars occurs on 01 Oct 2013; to Mercury, on 19 Nov 2013; to the Sun, on 28 Nov 2013; and to the Earth on 26 Dec 2013.

C/ISON will provide an amazing spectacle and fantastic observing opportunity for the best planetary seat in the solar system, Mars, when it comes within 0.07 AU of the planet on 01 Oct 2013.

Comet C/2012 S1 ISON: (Almost) Surely a Spectacular View

Lovejoy in late 2012
Credit: Colin Legg



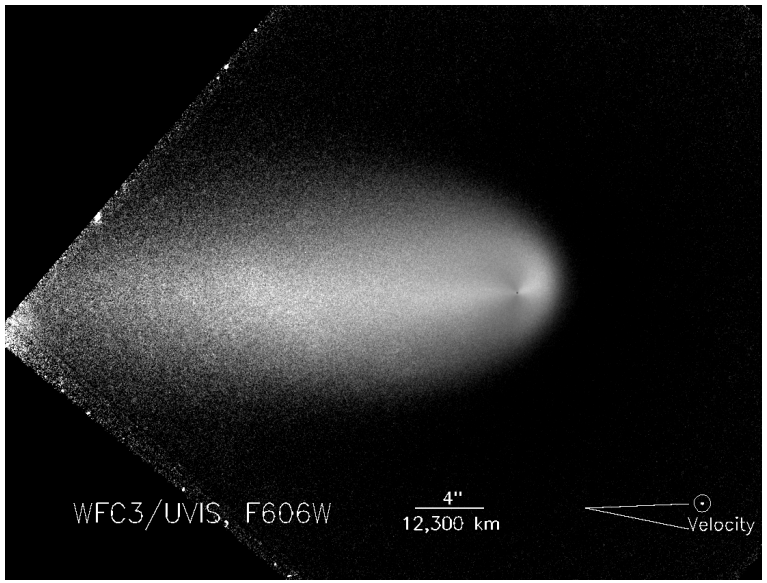
Expected view of ISON on Dec 10
Credit: Dave Eagle, www.eagleseye.me.uk

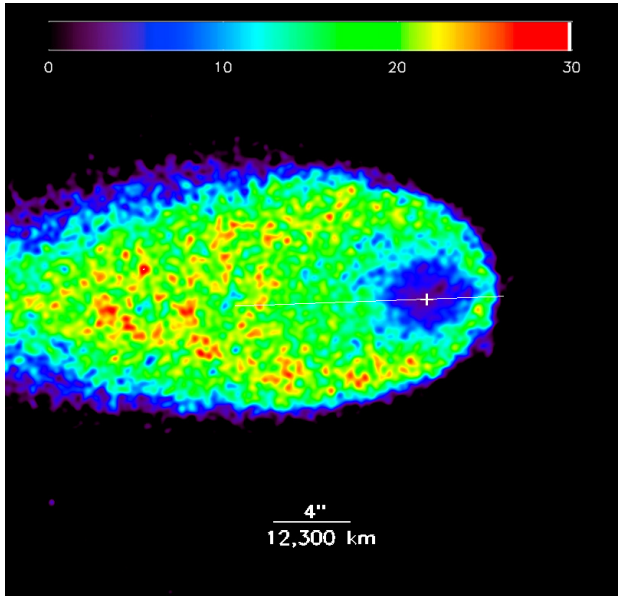
Some Early Comet ISON Results

- *Deep Impact*
- *SWIFT*
- *HST*
- *Spitzer*
- *The “K” Word*

SWIFT ISON Results

Deep Impact ISON Results

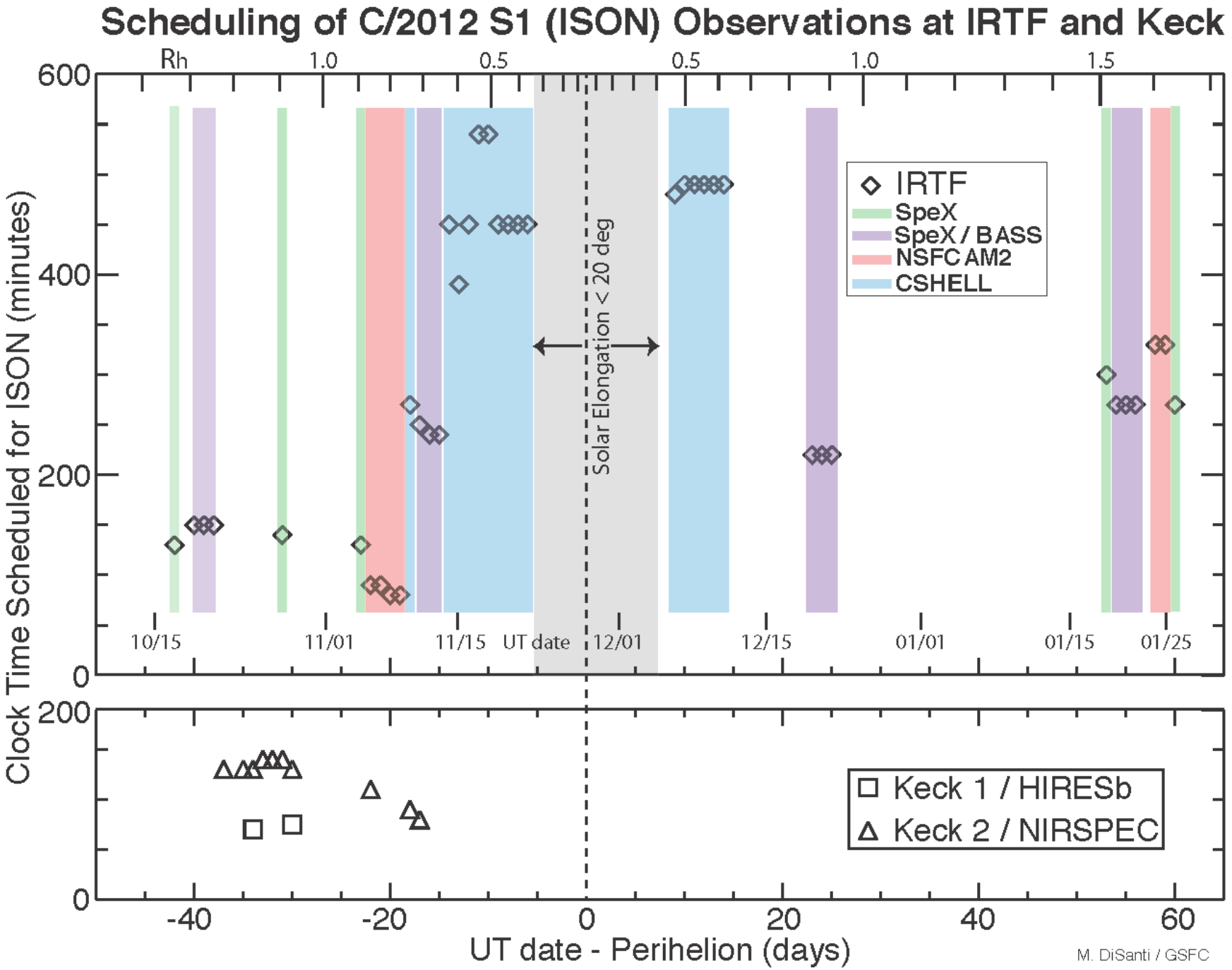




Results from the 10 April 2013 HST DDT observations of ISON. ***(Left)*** Li *et al.* (2013) Coma + nucleus WFC3 F606W (R-band) image of the comet with a 1/p profile removed, showing a simple, strong sunward asymmetry and trailing tail structure and little variation during the three 45-min long visits performed over 19 hrs. Finding a slowly varying coma dominated by emission from the (hottest) subsolar point is not unreasonable for a simple unprocessed spherical comet nucleus. The HST WFC3 IFOV is 40" x 40" wide. ***(Right)*** F438W/F606W 2-color map of the comet's nucleus, coma, and tail regions. Blue denotes regions of higher relative F438W emission, or bluer material, and red denotes redder regions with higher F606W. There is a mystery here – particle size changes caused by sublimation and fragmentation, decreasing the size of emitted dust, should create bluer dust farther from the nucleus. (Gas emission lines are not important in these filters, so we can focus on coma dust changes.) The best alternative explanation is that very icy dust is being emitted from the nucleus, and the ice is rapidly sublimating from this dust, leaving behind a redder remnant.

Anticipated Comet ISON Observations

- *NASA/IRTF*
- *Keck*
- *MRO*
- *MESSENGER*
- *SDO/SOHO/STEREO*


Scheduling of C/2012 S1 (ISON) Observations at IRTF and Keck
Rh
1.0
0.5
0.5
1.0
1.5
600
400
200
0
Clock Time Scheduled for ISON (minutes)
IRTF
SpeX
SpeX / BASS
NSFC AM2
CSHELL
Solar Elongation < 20 deg
10/15
11/01
11/15
UT date
12/01
12/15
01/01
01/15
01/25
200
0
Keck 1 / HIRESb
Keck 2 / NIRSPEC
-40
-20
0
20
40
60
UT date - Perihelion (days)
M. DiSanti / GSFC

Detailed Comet ISON Scheduling at IRTF and Keck

Telescope schedules, and availability of Comet ISON at NASA-IRTF and Keck in 2013B — M. DiSanti / GSFC

Pre-perihelion

	Utdate	Rh	Delta	Δ-dot	Inst	PI	HST(beg-end)	Elong[a]	min[b]	day-T
IRTF	17-Oct	1.32	1.65	-52.6	SpeX	Vervack	3 - 6	53	130	-42
	19-Oct	1.28	1.59	-52.5	SpeX/BASS	Sitko	3:30 - 6:30	53	150	-40
	20-Oct	1.26	1.56	-53.4	SpeX/BASS	Sitko	3:30 - 6:30	53	150	-39
	21-Oct	1.23	1.53	-52.3	SpeX/BASS	Sitko	3:30 - 6:30	53	150	-38
	28-Oct	1.08	1.33	-50.4	SpeX	Vervack	3:30 - 6:30	53	140	-31
	5-Nov	0.88	1.11	-44.6	SpeX	Vervack	3:30 - 6:30	49	130	-23
	6-Nov	0.86	1.08	-43.4	NSFCAM2	Jones	3 - 6	49	90	-22
	7-Nov	0.83	1.06	-42.0	NSFCAM2	Jones	3 - 6	48	90	-21
	8-Nov	0.80	1.03	-40.6	NSFCAM2	Jones	3 - 6	47	80	-20
	9-Nov	0.77	1.01	-39.0	NSFCAM2	Jones	3 - 6	46	80	-19
	10-Nov	0.75	0.99	-37.0	CSHELL	DiSanti	5 - 11	44	270	-18
	11-Nov	0.72	0.97	-35.0	SpeX/BASS	Sitko	4 - 9	43	250	-17
	12-Nov	0.69	0.95	-32.8	SpeX/BASS	Sitko	4 - 9	42	240	-16
	13-Nov	0.66	0.93	-30.2	SpeX/BASS	Sitko	4 - 9	40	240	-15
	14-Nov	0.63	0.91	-27.5	CSHELL	Dello Russo	5 - 13	38	450	-14
	15-Nov	0.60	0.90	-24.3	CSHELL	DiSanti	6 - 13	37	390	-13
	16-Nov	0.57	0.89	-20.9	CSHELL	DiSanti	5 - 13	35	450	-12
	17-Nov	0.54	0.87	-17.2	CSHELL	Bonev	5 - 14:30	33	540	-11
	18-Nov	0.50	0.87	-13.0	CSHELL	Bonev	5 - 14:30	30	540	-10
	19-Nov	0.47	0.86	-8.3	CSHELL	Dello Russo	6 - 14	28	450	-9
	20-Nov	0.43	0.86	-3.3	CSHELL	Dello Russo	6 - 14	25	450	-8
	21-Nov	0.39	0.86	3.5	CSHELL	Dello Russo	6 - 14	23	450	-7
	22-Nov	0.35	0.86	9.8	CSHELL	DiSanti	6 - 14	20	450	-6
	Total hours allocated for ISON@IRTF (AM<3.0, Pre-perihelion):								**106**	

Post-perihelion

Utdate	Rh	Delta	Δ-dot	Inst	PI	HST(beg-end)	Elong[a]	min[b]	day-T
7-Dec	0.47	0.67	-39.5	CSHELL	DiSanti	6:15-15	24	480	9
8-Dec	0.50	0.65	-37.5	CSHELL	DiSanti	6:15-15	27	490	10
9-Dec	0.53	0.63	-35.9	CSHELL	Dello Russo	6:15-15	29	490	11
10-Dec	0.57	0.61	-34.2	CSHELL	Dello Russo	6:15-15	32	490	12
11-Dec	0.60	0.59	-32.6	CSHELL	Dello Russo	6:15-15	34	490	13
12-Dec	0.63	0.47	-31.0	CSHELL	Dello Russo	6:15-15	37	490	14
21-Dec	0.88	0.45	-13.5	SpeX/BASS	Sitko	4 - 9	63	220	23
22-Dec	0.91	0.44	-11.0	SpeX/BASS	Sitko	4 - 9	66	220	24
23-Dec	0.93	0.44	-8.4	SpeX/BASS	Sitko	4 - 9	70	220	25
19-Jan	1.51	0.77	40.8	SpeX	Vervack	18:15-23:30	119	300	53
20-Jan	1.53	0.79	41.5	SpeX/BASS	Sitko	18:30-23:30	119	270	54
21-Jan	1.55	0.82	42.1	SpeX/BASS	Sitko	18:30-23:30	119	270	55
22-Jan	1.57	0.84	42.7	SpeX/BASS	Sitko	18:30-23:30	118	270	56
24-Jan	1.60	0.89	43.8	NSFCAM2	Jones	18:30-00:30	118	330	58
25-Jan	1.63	0.92	44.3	NSFCAM2	Jones	18:30-00:30	118	330	59
26-Jan	1.65	0.94	44.8	SpeX	Vervack	20-00:30	117	270	60
Total hours allocated for ISON@IRTF (AM<3.0,Post-perihelion):								**94**	

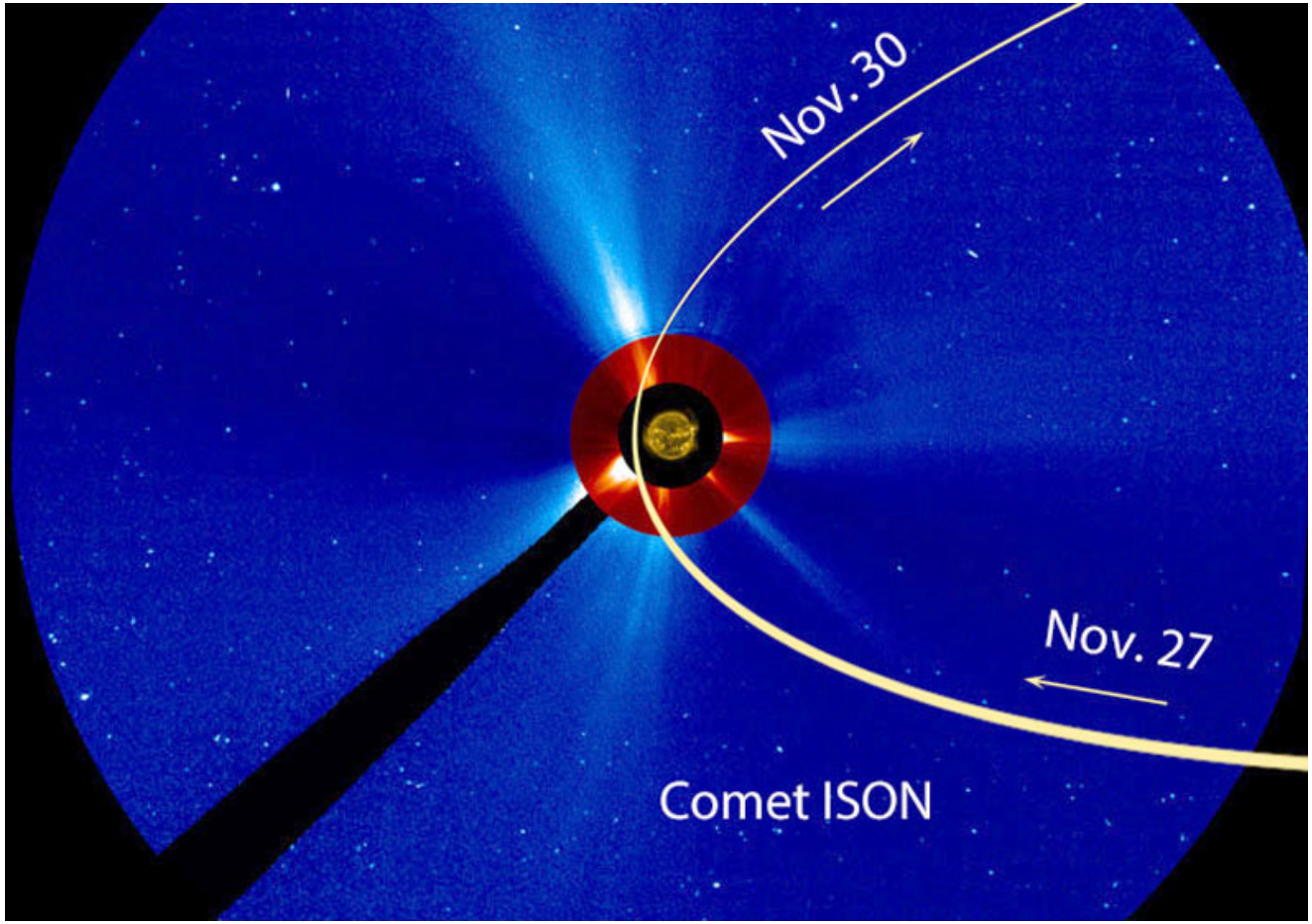
Total hours allocated for ISON at IRTF (AM<3.0, Pre- + Post-perihelion): 200

Keck-1	25-Oct	1.15	1.41	-51.4	HIRESb	Cochran	53	70[c]	-34
	29-Oct	1.05	1.30	-49.9	HIRESb	Cochran	53	75[c]	-30
Keck-2	22-Oct	1.21	1.50	-52.1	NIRSPEC	Meech*	54	130	-37
	24-Oct	1.17	1.44	-51.7	NIRSPEC	Mumma	54	130	-35
	25-Oct	1.15	1.41	-51.4	NIRSPEC	Mumma	53	130	-34
	26-Oct	1.12	1.38	-51.1	NIRSPEC	Dello Russo	53	140	-33
	27-Oct	1.10	1.35	-50.8	NIRSPEC	Blake**	53	140	-32
	28-Oct	1.08	1.33	-50.4	NIRSPEC	Dello Russo	53	140	-31
	29-Oct	1.05	1.30	-49.9	NIRSPEC	Blake**	53	130	-30
	6-Nov	0.83	1.08	-43.4	NIRSPEC	Blake**	49	110	-22
	10-Nov	0.72	0.97	-35.0	NIRSPEC	Dello Russo	44	90	-18
	11-Nov	0.69	0.95	-32.7	NIRSPEC	Dello Russo	43	80	-17

* = UH-allocated time
** = CIT-allocated time
ALL OTHERS: NASA-ALLOCATED TIME

Availability of ISON at Keck(1+2) (hours): 23

[a] Solar elongation angle (degress)
[b] Clock minutes w/ AM<3.0 during scheduled times. Includes 30min setup/Inst change
[c] Clock minutes including 33.3 degree elevation limit in East at Keck-1

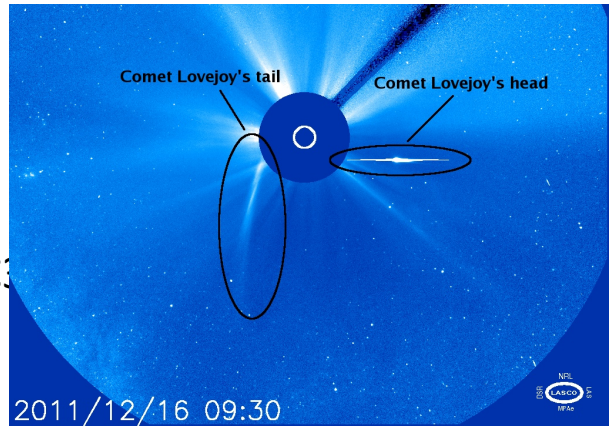


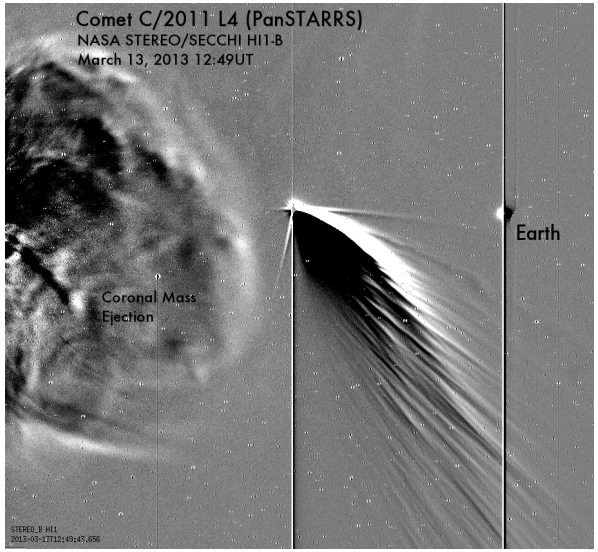
Comet ISON will be extremely well placed for observations by solar observatories in space and on the ground as it passes through perihelion at q = 0.0125 AU on 28 Nov 2013. The comet will pass within the coronagraph of the SOHO LASCO C3 camera shown here, close enough to vaporize the refractory dust in its coma and tail.

Heliophysics spacecraft plans for ISON observations

SOHO

- Will observe continuously in LASCO C3 and C2 coronagraphs from Nov 27-30.
- Requests have been made to DSN for extended realtime coverage during critical times (e.g. entering C3 fov and transiting C2) so that observations can be adjusted to accommodate brightness, etc.



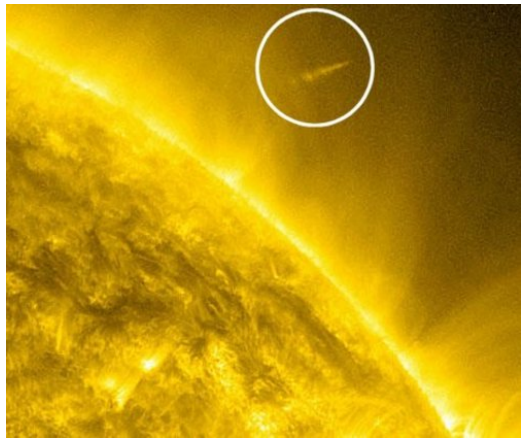


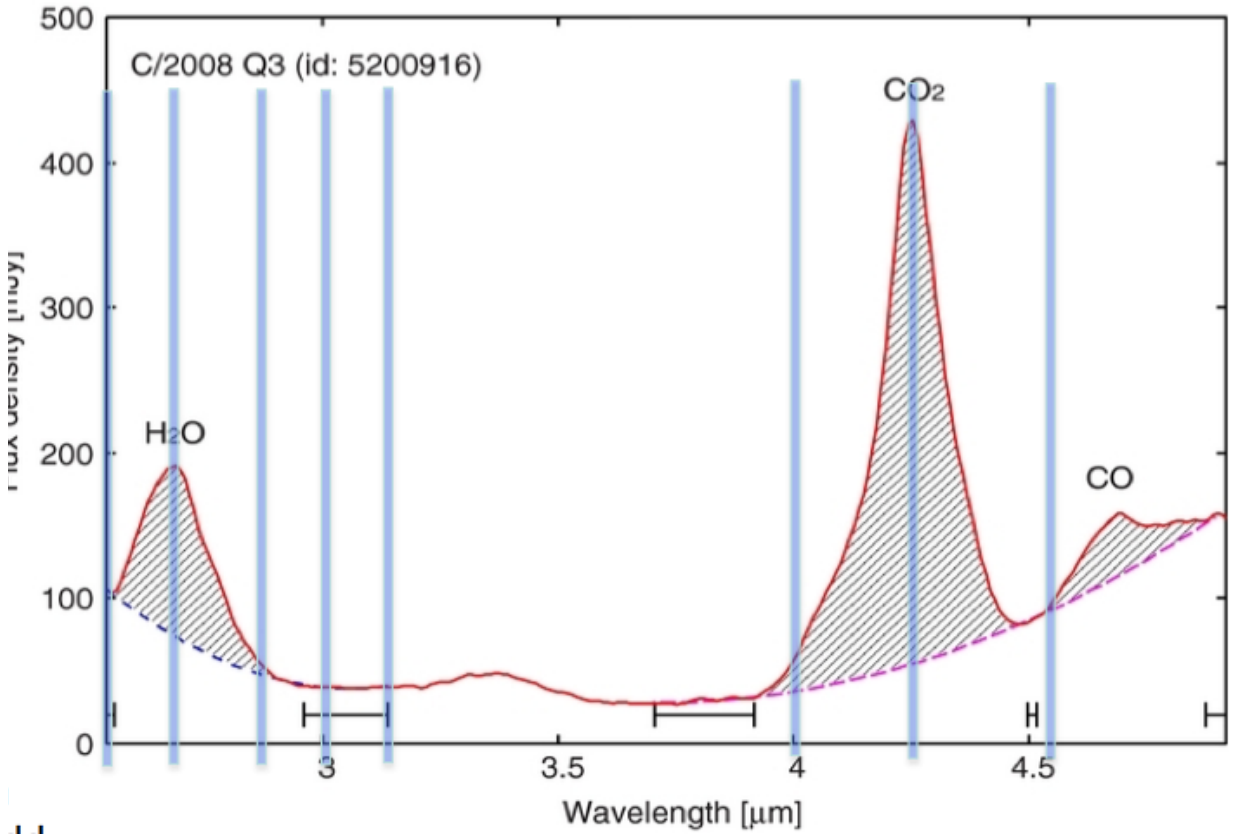
STEREO

Will observe ISON from October 10 through perihelion with heliospheric imagers, coronagraphs and EUV imagers on twin spacecraft in different locations on the far side of the Sun.

SDO

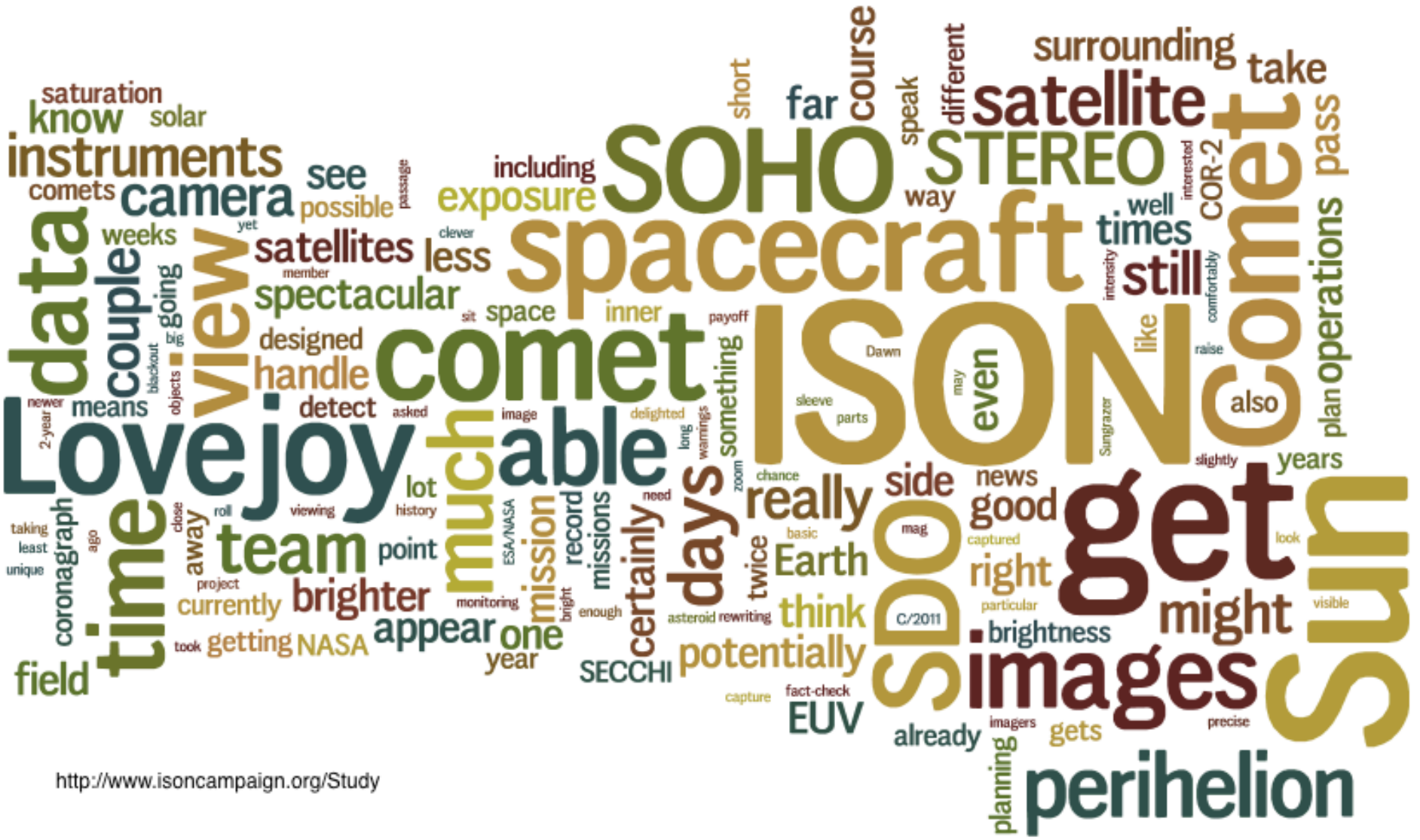
Currently plans to off-point to observe the perihelion passage of ISON





In this plot showing a 2.5 – 4.9 um *EPOXI* spectrum of comet C/2009 P1 (Garradd), the narrow blue vertical bars represent the 8 BRRISON photometric imaging passbands. Imaging of the comet by *Spitzer* on 13 Jun 2013 using the 10% wide IRAC 3.6 and 4.5 μm filters will help BRISSON plan its observing strategy. Ground based IRTF/SPeX 0.8 – 5.2 μm spectroscopy of the comet in October 2013 will help BRISSON perform its continuum subtractions and color corrections, and provide an independent measure of the comet's flux in regions of high atmospheric transmission outside the H_2O and CO_2 emission features.

ISON Wordle 1



ISON Wordle 2