Pre-perihelion Observations of Comet C/2012 S1 (ISON) by the Subaru Telescope

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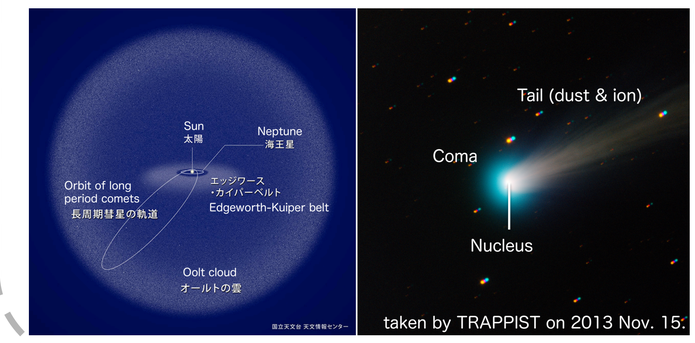
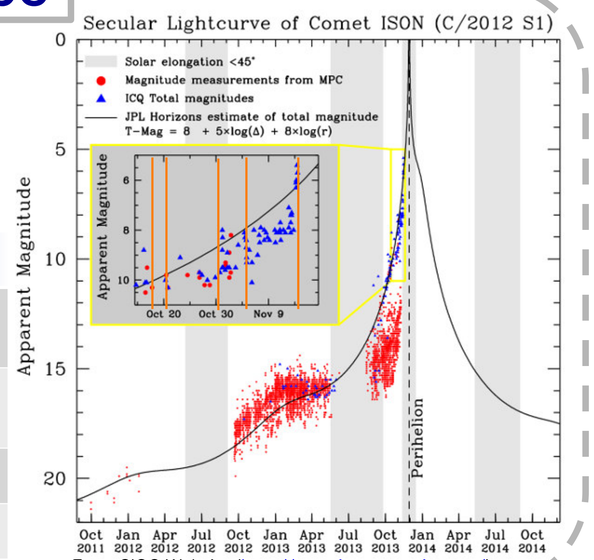
Comet C/2012 S1 (ISON) was discovered at 6.3 AU from the Sun and expected to be very bright at the perihelion passage (q = 0.01247 AU) on Nov. 28, 2013. Thanks to its brightness many observations by the Subaru telescope with different instruments were performed in pre-perihelion (from Oct. to Nov. 2013). Here we summarize the preliminary results of the observations performed by the Subaru Telescope and discuss about the nature of the comet that disintegrated near the perihelion passage.

Comet ISON & Observations with the Subaru Telescope

- Comets are frozen reservoirs of the materials in the solar nebula. As a cometary nucleus approaches the sun, coma and tails appear.
- Comet ISON was a sungrazing comet from the Oort cloud and disintegrated at its perihelion passage.
- The Subaru Telescope observed comet ISON with several instruments (methods & wavelengths).



UT Date on 2013	P.I.	Instrument	Method	Filter or Wavelength
Oct. 19, 21	T. Ootsubo	COMICS	Imaging Spectroscopy	N8.8 & N12.4 filter 8–13 μm (R=250)
Oct. 31	M. Yagi	FOCAS	Imaging Spectroscopy	V band (550 nm) 380–760 nm (R=1000)
Nov. 5	HSC team	HSC	Imaging	*i* band (760 nm)
Nov. 15	Y. Shinnaka	HDS	Spectroscopy	550–830 nm (R=72000)

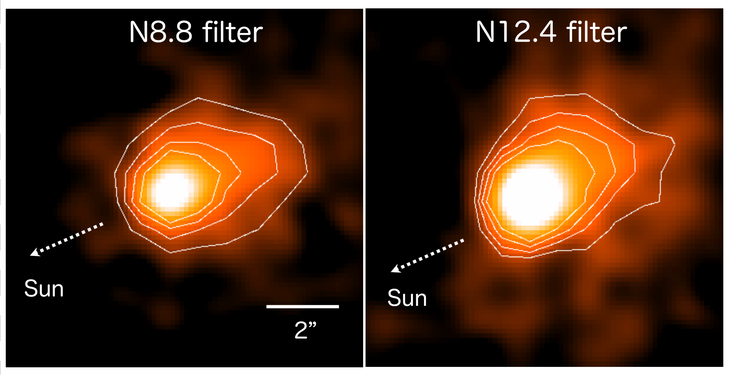


From CIOC Website (http://www.isoncampaign.org/)

Highlights

COMICS

In order to understand how comets has the materials which formed under high and cold temperature environments, the Mid-IR spectroscopic observation is important.

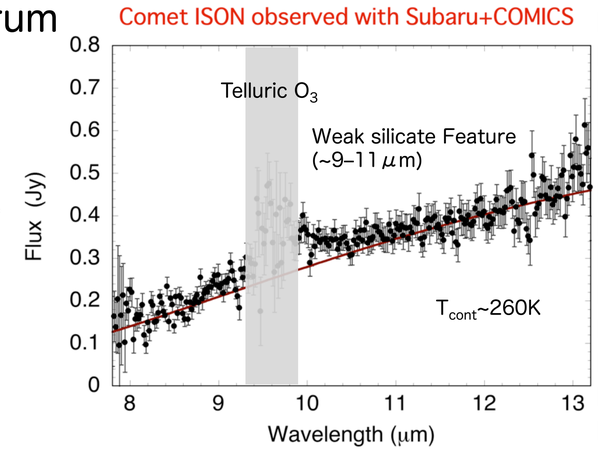


Imaging obs. (Left)

- Images with N8.8 and N12.4 filters (exp.=200 sec for each) with a FoV of 40" x 30". The left images are for 10" x 10".
- Dust coma was slightly elongated along the anti-solar direction.

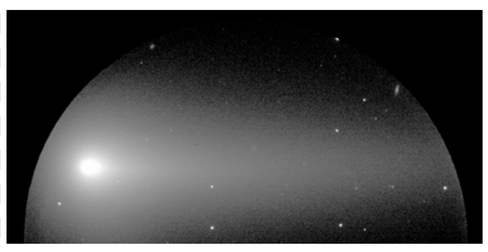
Spectroscopic obs. (Right)

- N band low-res. (R~250) spectrum (exp. = 400 sec).
- Strong continuum and weak overlapped silicate feature excess at around 9–11 microns.
- This silicate feature could be attributed to the small sized grains of amorphous silicate.
- No clear features for crystalline silicate were detected.



FOCAS

Dust mineralogy of comet ISON revealed by COMICS might indicate its peculiar origin. How about mixing ratios of radicals and dust properties in optical?

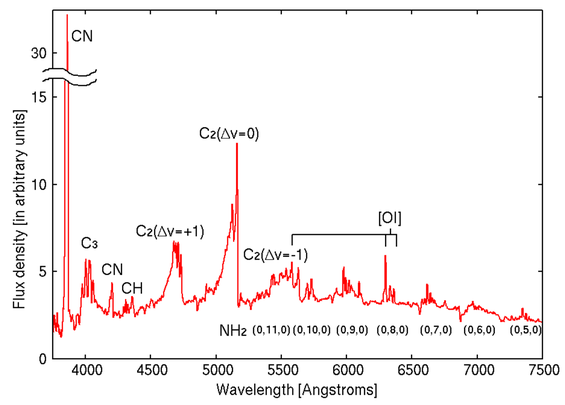


Imaging obs. (Left)

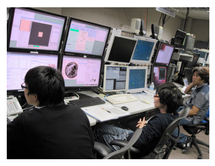
- V band image of comet ISON (exp. = 5 sec) with a FoV of 3' x 6'.
- This image is the best for studies about fine structure of the dust/gas coma.

Spectroscopic obs. (Right)

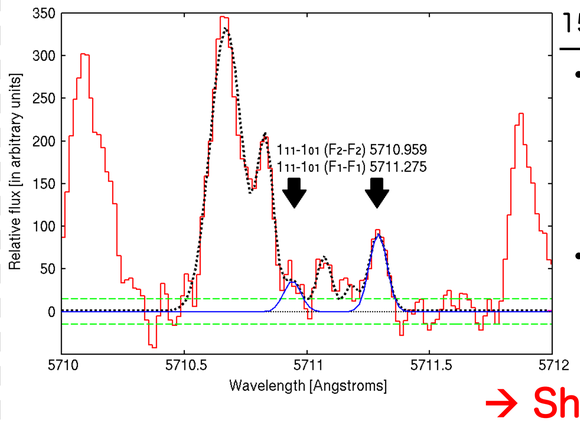
- Low-res. (R~1000) in the optical.
- Molecular emission bands of CN, C_3, C_2, NH_2 and [OI] lines.
- Mixing ratios (X/H_2O) for those radicals and the color of dust reflectivity seem to be normal.



HDS



HDS observed comet ISON immediately after the beginning of the outburst on Nov 14UT. Many gas emission lines were detected with high-S/N ratios.



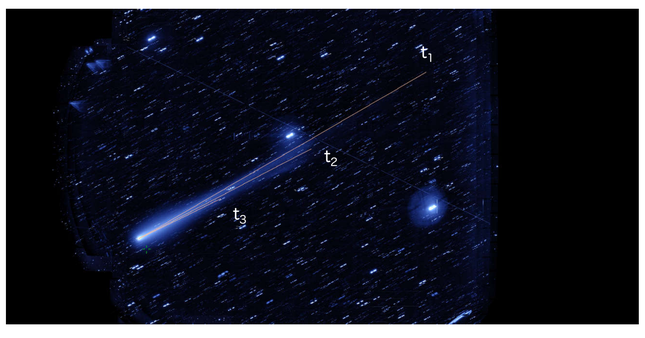
$^{15}NH_2$ (Left)

- The first report of $^{15}NH_2$ detection in a single comet (red: observed, black: unidentified features, blue: $^{15}NH_2$).
- $^{14}NH_2/^{15}NH_2$ in comet ISON is similar to $^{12}C^{14}N/^{12}C/^{15}N$ in other comets (~150).

→ Shinnaka et al. (2014), ApJL, in press.

HSC

HSC project team observed comet ISON during a non-sidereal tracking test of an intensive commissioning run. We checked the public image which was open in the press release.

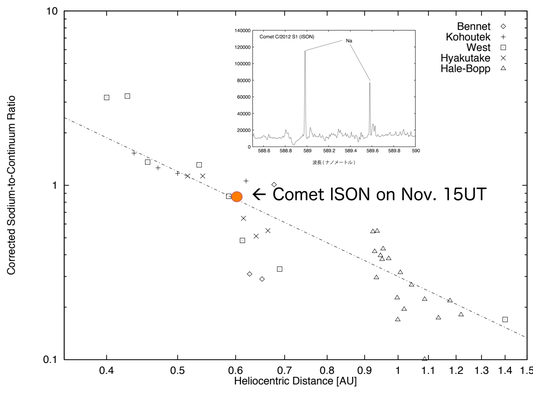


- Wide-field images of comet ISON in *i*-band (FoV is 1.5' in diameter).
- Dust and ion tails (probably H_2O^+) could be revealed.
- Synchron analysis reveals the history of dust release (orange lines correspond to the synchron curves (t_1=T–1000, t_2=T–100, and t_3=T–50 days, respectively).
- This observation demonstrates the great capability of HSC for the study of cometary tails (of dust, ion, and neutral sodium).

Press release: http://subarutelescope.org/Topics/2013/11/17/index.html
HSC Project Website: http://www.naoj.org/Projects/HSC/

Neutral sodium (Right)

- The sodium-to-continuum ratio can estimate the origin of Na formed in cometary coma.
- That ratio of comet ISON was typical for sodium release from dust grains compared to other comets if we consider the Swings effect of Na emission.



More detailed information can be found in Shinnaka's poster.