

## FIRST ISON OBSERVATIONS FOR SATELLITE CONJUNCTION ANALYSIS IN THE WESTERN HEMISPHERE

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### RESUMEN

En este artículo se presentan observaciones de un par de objetos espaciales que se aproximaron a principios de Junio del 2016, observados conjuntamente por el Observatorio de Tarija en Bolivia y el Observatorio Mexicano de la Universidad de Sinaloa en Cosala en el contexto de la colaboración ISON. Estos objetos fueron el satélite activo STAR ONE C1 (2007-056A) en la posición GEO 65 grados oeste y el satélite pasivo LES 6 (1968-081D). La gran cantidad de mediciones que se obtuvieron en unas pocas noches permitieron reconstruir sus órbitas de manera precisa. El satélite pasivo LES 6 (con una amplitud de variación de brillo de 3 magnitudes) resultó ser demasiado débil para la apertura del telescopio de Cosala.

### ABSTRACT

In this paper we report on observations of a pair of approaching space objects in the beginning of June 2016, observed jointly by the Tarija Observatory in Bolivia and the Mexican observatory of Sinaloa University in Cosala in the context of the ISON collaboration. These objects were the STAR ONE C1 (2007-056A) active satellite in GEO position 65 deg west, and the passive satellite LES 6 (1968-081D). The large number of measurements obtained in a few nights allowed a precise orbit reconstruction. The passive satellite LES 6 (with a brightness amplitude variation of 3 magnitudes) was too faint for the small aperture of the Cosala telescope.

*Key Words:* space vehicles — telescopes



Fig. 1. Telescopes: On the left the Zeiss-60 cm in Tarija, on the right the ORI-25 cm of Cosala.

### 1. ISON RESEARCH IN SPACE DEBRIS

In the period from May 31st to June 8th 2016, we obtained a series of images of the approach between the satellites STAR ONE C1 (2007-056A) and LES 6 (1968-081D) with two telescopes in Tarija and one in Cosala (see Figure 1), in the context of the ISON project (Molotov et al. 2008).

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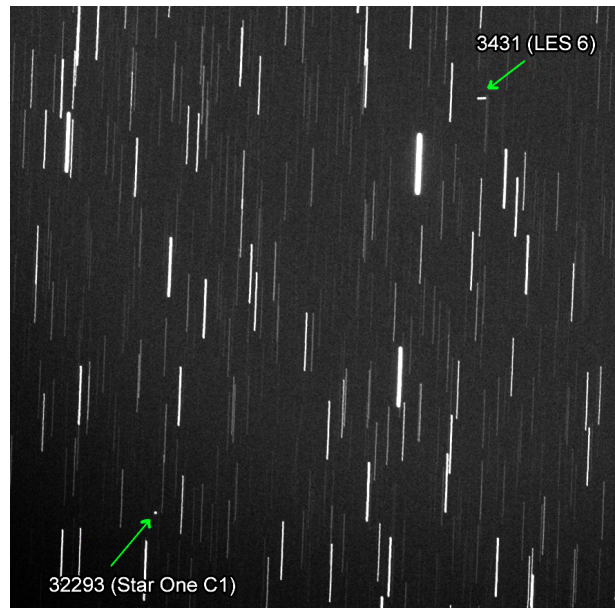


Fig. 2. One of our CCD images indicating the position of the satellites Les 6 and Star One C1 observed during our campaign.

### 2. ANALYSIS OF THE MEASUREMENTS

- The standard deviation for the faint Les 6 satellite along/across trail is 1.53/2.08 ( $1\sigma$  char-

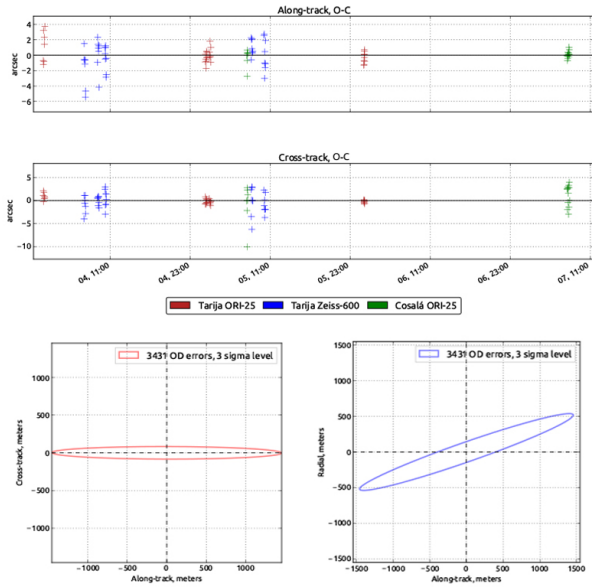


Fig. 3. Observations of the Les 6 passive satellite. Upper panel is the O-C along and across trail. The lower panel shows the computed error ellipsoids.

acterization of semi-axis error ellipsoid are [515.0,45.9,27.7]m) (see Figure 3),

- The standard deviation for the brighter Star One C1 satellite along/cross trail is 0.91/ 0.31 ( $1\sigma$  characterization of semi-axis error ellipsoid are [1136.5,154.9,38.4]m) (see Figure 4),
- Two conjunctions occurred: 43.5 km distance on 20:15:18 UT 2016-06-07 and 30.1 km distance on 08:09:32 UT 2016-06-09 (the distance diminished due to maneuvers over Star One C1).

### 3. ISON IS INTERESTED TO ENLARGE ITS COLLABORATION

- Joint observation campaigns to exchange measurements,
- Installation of 18-cm to 40-cm aperture telescopes to share the data,
- Production of 50-cm to 65-cm telescopes under scientific grants for future joint observations,
- Service on provision of measurements (from survey and tracking observations), orbital data, and conjunction analysis,
- The ISON project is open for cooperation and invites new partners to join us in different ways.

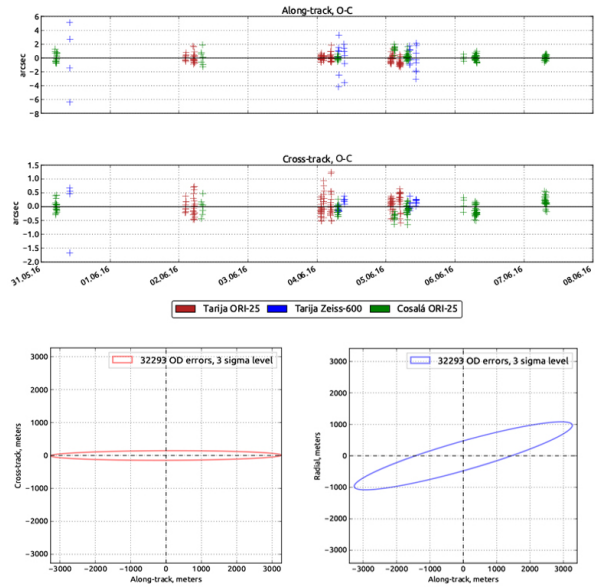


Fig. 4. Observations of the Star One C1 active satellite. Upper panel is the O-C along and across trail. The lower panel shows the computed error ellipsoids.

### 4. CONCLUSIONS

- The ISON project is continuously developing new observatories are joining, new telescope subsystems are assembled, and the Keldysh Institute of Applied Mathematics (KIAM) database is upgrading. 71 telescopes at 34 observing facilities have produced 15.4 million measurements on space debris in 2015,
- The KIAM database keeps a records of about 4100 high altitude objects, including 1300+ space debris objects in GEO, this is 41% more than in any other available source,
- KIAM performs orbit determination and conjunction analysis on a routine daily basis,
- ISON developed the concept of a second wave asteroid survey (Molotov et al. 2012, three 40 cm telescopes discovered 13 NEAs and 7 comets, obtained 1 million measurements), and carries out regular photometry observations (9 binary asteroids discovered so far, 5 with YORP-effect).

### REFERENCES

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