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Short-term variability of comet C/2012 S1 (ISON) at 4.8 AU from the Sun

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Abstract

We observed comet C/2012 S1 (ISON) during 6 nights when it was at ~4.8 AU from the sun in February 2013. At this distance the comet was not very active and it was possible to detect photometric variations probably due to the rotation of the comet nucleus. This differential photometry data allow us to obtain a tentative rotational period by means of a Fourier periodogram analysis.

1. Introduction

Comet C/2012 S1 (ISON) –hereafter ISON– was discovered at 6.3 AU from the Sun on September 21st 2012 by V. Nevskiand and A. Novichonok using the International Scientific Optical Network (ISON) [3]. The orbit of the comet was quickly computed using precovery images from the Mount Lemmon Survey and Pan-STARRS facilities. The computed orbit was nearly parabolic, which pointed out to a dynamically new comet coming directly from the Oort cloud, with a nucleus probably composed with fresh ices never irradiated by the Sun, like the comet C/1995 O1 (Hale-Bopp). Due to this, a huge activity near the perihelion was expected with a large rate of ices sublimation and dust dragging by the activity from the comet nucleus.

ISON was a sungrazing comet which passed at 0.012 AU (2.7 Solar radii) from the Sun on November 28th 2013, reaching a V magnitude at perihelion -based on STEREO images- ~ -2 mags [1]. ISON finally did not survive the perihelion and its nucleus totally vanished [4]. The observations presented here was done around 293-287 days prior the perihelion, when comet was not very active, and photometry could be used to extract information of the nucleus itself.

2. Results

ISON was observed during 6 nights on February 8-9, 11-14, 2013, for several hours each night, when the comet was at heliocentric distances of 4.84-4.78 AU and geocentric distance of 4.01 AU. Images of the comet were obtained from the f/3 0.77 m telescope located at La Hita Observatory in Toledo, Spain, using a 4k x 4k CCD camera.

Aperture photometry was done in order to get relative magnitude variations versus time. Using calibrated star field we also obtain, from the relative photometry, R-magnitudes of ISON versus time. Because the field of view of the instrument is nearly 1 degree we could use the same reference stars in at least several nights, which allows us to obtain high accuracy relative photometry.

We applied a Fourier periodogram analysis (Lomb technique [2]) to get possible periodicities for the observed brightness variability, probably related with the rotation of the comet nucleus. We studied the possible effect of the seeing variations during the same night and from night to night in the search for brightness periodicities. These seeing variations had not affected the derived periodicity.

The comet light curve obtained is very shallow, with a peak-to-peak amplitude well below 0.1 mag. A tentative (single–peaked) rotational period of ~14.35 hours for the ISON's nucleus is obtained from our analysis. We discuss this and other possible solutions for the rotational period of ISON.

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