The Photometric Study of the Comet C/2007 N3 (Lulin)

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Abstract

This work studies the brightness of comet C/2007 N3 (Lulin) when it came closer to the Earth in 2009. We found that the comet's brightness brightened from 12 mag in January 2009 and increased until the 25th of February when the brightness peaked. The brightness reached the highest magnitude which was 6.44 that day and then it started to decrease. We compare our observations with the theoretical prediction from the JPL Horizons Ephemeris and found that the light curve has similar shape but the normalization differs slightly.

Introduction

The comet C/2007 N3 (Lulin) comet is a special comet in this decade because it had two tails in a different directions (the "anti-tail"). Lulin's orbit is nearly parallel with the orbit of the earth so when it got closer to the earth, the dust tail that is left along the comet's otbit appeared in one direction while the ion tail which is caused by the solar wind and always points directly away from the Sun appears to be in the opposite direction. The relative position between the Earth, the comet and the Sun at the time of Lulin's closest approach which resulted in Lulin's tails pointing to different directions is shown in Fig. 1. We studied this unique comet photometrically by observing it with the Robotic Optical Transient Search Experiment (ROTSE)'s 0.45-meter robotic telescope (*www.rotse.net*) in Texas, USA, remotely from January – February 2009.

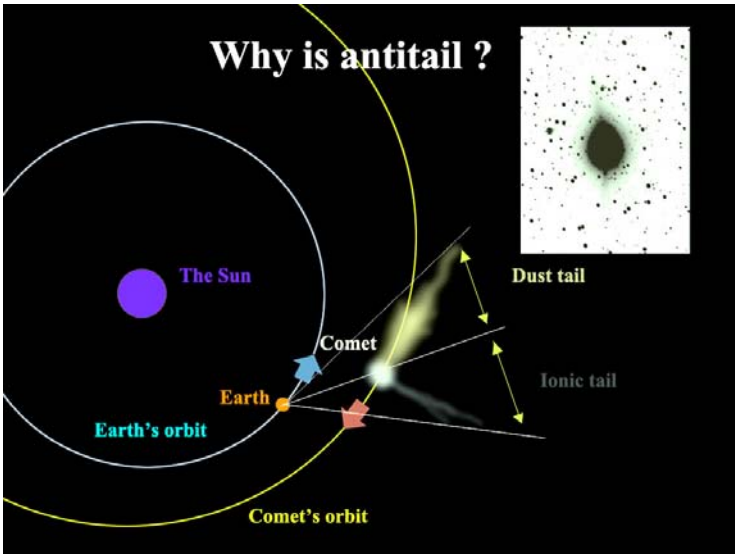

Fig. 1. The formation of Lulin's opposite tails

Methodology

We performed aperture photometry (using the *Iris* software) on the comet and the nearby reference stars of known brightness to estimate the magnitude of the comet at each time by the equation

$$m1 - m2 = 2.5 \log \frac{(im2)}{(im1)}$$

Fig. 2. (Left to Right) Image of comet C/2007 N3 (Lulin) taken on January 24, February 25 and April 20, 2009, respectively

The uncertainties in the measurement are mainly due to the extension of the comet's coma. It is difficult to define a proper photometric aperture for the comet because it is very diffuse (note the appearance in Fig. 2). Therefore we asked 11 friends to independently performed photometry with their own aperture criteria and we estimated the uncertainties by taking the standard deviation (SD) of the distribution of those independent measurements. The lightcurve of Lulin comet is shown in Fig. 3.

Data Analysis

We compare the brightness of the comet from our analysis and the theoretical prediction from the JPL Horizons (*http://ssd.jpl.nasa.gov/horizons.html*), shown in Fig. 3. We found that the general shape of the light curve from our observation agrees very well with the theoretical prediction. However, the normalization of the lightcurve differs slightly. Specifically, we observed that the comet's brightness peaked brighter than the prediction. This could be due to the fact that assumptions of the model (such the coma sublimation rate) are different than the actual comet. We will explore the effect of model assumptions in the future works using a larger sample of comet light curves.

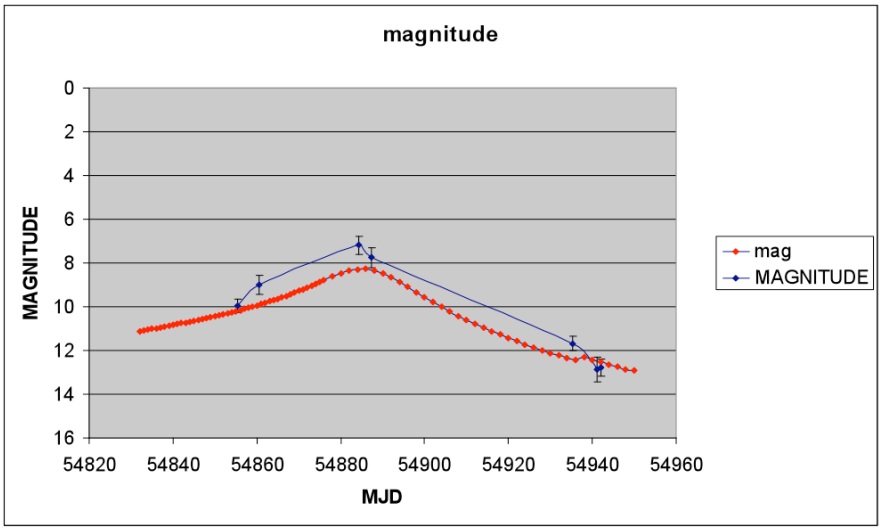

Fig. 3 Lulin's theoretical brightness from JPL Horizons (smooth line) and our observations (points with error bars)

Conclusion

From the data analysis the brightness of C/2007 N3 comet (Lulin) that was taken by ROTSE telescope, we found that the brightness of the comet C/2007 N3 (Lulin) increased since the beginning of January and peaked on February 25th, 2009. We found that the observed brightness is slightly brighter than the theoretical predictions but the overall shape of the lightcurve agrees well.