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# Leonid movie taken with an electric-cooled color CCD camera

By

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**Abstract:** Working group "Real?Universe" is acting for the purpose to tell a beauty of starlit sky and to make people become familiar to universe. As a part of our activity we observed Leonid meteor storm 2001. The observed movie contained many meteors and meteor trails. From the educational view, this observation achieved one of our purpose, since we see such exciting movie for the first time.

## 1. ACTIVITY OF REAL? UNIVERSE

Since the science and the technology are developing in the present age, we have been able to live with the basis of artificial lighting. However, in compensation for this benefit, it is fact that we loose the opportunity to look up at a starlit sky. Therefore, there are many people, not only children but also our generation, who have never seen meteor, the Milky Way, and so on. To improve these situations, we try to offer the starlit sky's movie which tell a beautiful starlit sky. We expected that everybody feel a starlit sky familiar and interested in it. It is enough for us that they just feel "it's beautiful!" From the above matter, the movie we offered needs to contain intimate elements for feeling it familiar. For example, airplane, clouds, and used to seeing scene which is important. When we are going to make the movie containing familiar scene for many people, it is difficult to achieve our aims by our activity only. So, it is also important purpose to spread the procedure of making movie for many people. The flow for creating a movie is shown easily as follows. This way is very simple, so everyone can do it.

1. Take starlit images by electric-cooled color CCD camera periodically.
2. The continuous still images transform into an animation by editing software.

In order to spread the beauty of starlit sky, we have done some activities which is taking image of night sky, making an animation of it, and spreading it. Based on those reasons,

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we came to photo the Leonid meteors 2001. From the experiences of the past observation of diurnal motion, we thought that the meteors are hard to detect. Because the moving velocity of meteors is fast. Although we have some insecurity about taking photo of meteors, we had decided to make observation of Leonids, because it is said that Leonids contains many bright meteors.

## 2. OBSERVATION

We used an electric-cooled color CCD camera connected with the wide-angle lens. The camera is an equipment which can make long exposure, so it is able to photo faint objects. The obtained images are color that is similar to real image as seen by our own eyes, so we can get a more realistic movie.

One of main purpose of using wide-angle lens is taking a wide range of starlit sky and containing a used to seeing scene. This is important that people can understand at a glance what is observed and what is going on in the image.

This CCD camera requires about 16 seconds for reading out data after exposure. Therefore, the photo interval time of 1 minute is derived from 40 seconds exposure time and 20 seconds dead time.

Here is an observation parameter.

1. Data. (18th Nov 2001, 18–28, JST.)
2. Place. (Misato observatory Wakayama pref.)
3. Two sets of electric-cooled color CCD camera. (Bitran Co.: BJ-31C, BJ-32C)
4. Wide-angle lens. (Tokina Co.: TC3514, C-mount, f/3.5mm, F1.4)
5. Direction. (East and West)
6. Exposure time. (40seconds, 1minutes interval)

Preservation form of taken image is preferable to use FITS format, since it has a wide range for the value of intensity. But according to your purpose, preservation form may change to other format, for example, BMP format.

Continuously observed still image are easily transformed into one animation by editing software (Ozawa, 2001). The movie editing software is sold by some company, so please choose something which is suitable for your environment. In this case, we used "DVgate Assemble" which is installed in our note PC (VAIO, Sony Co.).

## 3. RESULTS

We succeeded to taking the Leonids south sky's movie, but unfortunately, east sky's observation had been failed because of machine trouble.

We see many meteors in the images (Fig. 1). Therefore, we can make an impressive movie of Leonid meteor storms. From the educational view, this observation achieved one of our purposes, since we see such exciting movie first time.

Total observation time of this movie is about 10 hours, from 18:00 to 28:00 at Nov 18, 2001 (JST). It contains the Leonids peak time at Japan which was expected at around 27 o'clock. So, after midnight we see the number of meteors is gradually increasing.

As an unexpected result, we also detected some meteor trails (Fig. 2). We can see phenomenon that a shape of meteor trails changes with time and the biggest meteor trails of this


Fig. 1: Many Leonid meteors in the images.


Fig. 2: The biggest meteor trails of this Leonid night is seen in left side from the center.

night which is appeared at 25:45 surviving over 1 hours.

For meteors and meteor trails, a scientific approach of this data is made by Yadoumaru, et al. (2002).

## 4. CONCLUSIONS

For the purpose of spreading a beauty of night sky to many people, we are trying to offer the starlit sky's movie. As a part of our activity, we succeeded in observing Leonid meteor storm 2001 and in presenting an exciting movie of it. In this movie, not only many meteors but also meteor trails were seen.

Detecting meteors in the movie results from Leonids contains many bright meteors and meteor trails result from a merit of this procedure, i.e., long exposure. From these results, we may conclude that our observation procedure is effective to observe not only meteors but also meteor trails.

Although this observation was stopped around 28:00 by an accident, it is satisfied for showing an aspect of Leonid's night sky, since the movie contains expected peak time around 27 o'clock.

As future works, we will continue to present the beauty of starlit sky more and more by the movie taken with method described above. It is also important to increase our movie contents not only the diurnal motion, a motion of a planet and a comet and so on. As an educational purpose we will offer some application to a natural phenomenon. For example, clouds motion, blooming flowers, and so on.

Moreover, we indicated in the first half of this paper, in order to make everyone can take images by themselves, it is important to spread the creation method of movie for many people those who want to take a photograph. For general public, an expensive equipment is difficult to use. The price of the equipment, electric-cooled color CCD camera, that we used at this time is about 4000 dollars. In order to attain everyone can take such movies, it need to approach that the equipments has to be cheap and easy for user. Now, we are testing with the camera of 2000 dollars and 500 dollars. As progress, faint objects, such as the Milky Way, could be observed by 2000 dollars camera. It means that this camera has a sufficient performance to spread the beauty of a starlit sky. The camera of 500 dollars is still under test.

We hope to keep on providing various movies at various places and opportunities. The detailed information of photographing and the observed movie are opend to public on our web page (`http://www.obs.jp/links/RealUniverse/index-e.html`).

## REFERENCES

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