Camelopardalids expedition
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This paper describes preliminary results of the Polish Fireball Network expedition to observe the outburst of the particles stream of comet 209P/LINEAR. According to the theoretical calculations the predicted shower radiated from Camelopardalis constellation and reached its maximum on May 24th 2014. The selection of observation sites and equipment is presented. Eleven analog cameras, digital cameras and DSLR cameras were used in the double station observing system. As a result 174 meteors were recorded, 32 of them were Camelopardalids. Using data from the maximum night the 15 orbits of meteors were calculated – 5 orbits have orbital parameters similar to the expected values for Camelopardalids.

1 Introduction

209P/LINEAR was discovered on February 3rd 2004 by Lincoln Near-Earth Asteroid Research (LINEAR). The comet orbit gets close to the Earth's orbit and further analysis showed possibilities for an increased meteor activity from this comet on May 24\textsuperscript{th} 2014. A number of authors presented models according to which the maximum number of meteors could be seen between $6^\circ00^\prime$ and $8^\circ00^\prime$ UT (Table 6j of Jenniskens 2006; Vaubaillon 2012\textsuperscript{1}; Jenniskens and Lyytinen 2014; Ye and Wiegert 2014). The radiant of these meteors is located in the constellation of Camelopardalis.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{logo.png}
\caption{Logo of Camelopardalids expedition by P. Zaręba.}
\end{figure}

Because of the possibility to observe meteors from this comet, confirmed by many independent analyzes, we decided to prepare an expedition with three persons (authors of this paper) to observe the Camelopardalids. The logo of the expedition is presented in \textit{Figure 1}.

\textsuperscript{1} http://www.imcce.fr/langues/en/ephemerides/phenomenes/meteor/DATABASE/209_LINEAR/2014/index.php

2 Expedition

\textit{The choice of the observation place}

The time of the expected maximum activity was unfavorable for European observers. At about 7h00m UT on May 24\textsuperscript{th} the Sun is above the horizon and prevents the registration of meteors by the Polish Fireball Network cameras. Analyzing all options for the best place to watch the outburst we took into account:

\begin{itemize}
\item the height of the Sun below the horizon at the moment of the maximum;
\item the height of radiant at the moment of the maximum;
\item moment of Moon rise;
\item the length of the night.
\end{itemize}

These criteria limited the area of potential observations to the vicinity of the border between Canada and the United States. Further factors which were taken into account were:

\begin{itemize}
\item the darkness of the sky;
\item weather statistics;
\item the possibility of tornadoes;
\item the probability of the aurora borealis occurrence;
\item the cost of transport and accommodation;
\item the ability to work with local observers of meteors;
\item the necessity to have a visa (USA);
\item the easiness to carry the large amounts of equipment across the border.
\end{itemize}

None of the members of the expedition had a US visa. In order to avoid additional costs and complications we chose for an expedition to Canada.

We were able to find a direct cheap flight connection from Poland to Toronto. Thanks to the information obtained from Prof. P. Brown we have selected the area of Tobermory, Bruce Peninsula as the likely darkest
place, away from areas of frequent tornadoes. It is also in close proximity to an active fireball network conducted by the University of Western Ontario.

In the neighborhood of Tobermory we were able to rent a house that perfectly suited our purposes (Figure 2). The house had two balconies facing south-east, one of them was a spacious terrace with a wide field of view. This place had become our base and the first observing point (A).

With the help of Prof. P. Brown and Z. Krzeminski we contacted The Fox Observatory. This place was used as a second observation point (B).

**3 Results**

A summary of the number of registered events has been presented in Table 1. The number of Camelopardalids remained significantly below the expectations, but no doubt, they were distinguished among other meteors. It has turned out that the most effective instrument were a pair of cameras with 6mm lenses. The ZWO 120MM camera with the Fujinon 1.8mm was most effective in capturing Camelopardalids (see Figure 5). Cameras with a smaller field of view were significantly less effective. No meteor spectra have been recorded.

Using the data from the maximum night, 15 meteor orbits were calculated. 5 orbits have orbital parameters similar to the expected values for Camelopardalids.

For spectroscopic observations the PointGrey BlackFly 09 M digital camera, two Canon digital SLR cameras, and one Tayama C3102-01A1 analog camera were used.

**4 Conclusion**

The maximum of Camelopardalids proved the accuracy of the modeling of meteoroid streams. The Earth crossed the stream of meteoroids at the time it was expected. The number of meteors from this stream was much smaller than expected which greatly reduced the number of registered and calculated meteor trajectories.

The expedition was a very important experience. With well-prepared equipment, all components worked as
Table 1 – Summary of the results

<table>
<thead>
<tr>
<th>Camera</th>
<th>Lens</th>
<th>Loc.</th>
<th>Meteors</th>
<th>CAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINTRON 12V6</td>
<td>Panasonic 0.75/6mm</td>
<td>A</td>
<td>44</td>
<td>7</td>
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<td>Computar 0.8/6mm</td>
<td>B</td>
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<td>5</td>
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<tr>
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<td>Tokina 1.3/8mm</td>
<td>B</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>WATEC Ultimate</td>
<td>Panasonic 0.75/9mm</td>
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<td>2</td>
</tr>
<tr>
<td>WATEC Ultimate</td>
<td>Computar 0.8/3.8mm</td>
<td>B</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>ZWO ASI120MM</td>
<td>Fujinon 1.4/1.8mm</td>
<td>A</td>
<td>29</td>
<td>12</td>
</tr>
<tr>
<td>PointGrey BlackFly 09 M</td>
<td>Tamron 1.0/3-8mm (Spectra)</td>
<td>A</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Tayama C3102-01A1</td>
<td>Ernitec 1.2/8mm (Spectra)</td>
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<td>0</td>
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</tr>
<tr>
<td>Canon 550D</td>
<td>Canon 3.5/10-20mm</td>
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<td>0</td>
</tr>
<tr>
<td>Canon 1000D</td>
<td>Porst 1.8/35mm (Spectra)</td>
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<td>0</td>
</tr>
<tr>
<td>Canon 1000D</td>
<td>Danubia 2.8/35mm (Spectra)</td>
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<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>174</td>
<td>32</td>
</tr>
</tbody>
</table>

Orbits

15 5

expected. Luckily the weather was perfect for observing at both locations. The collected data will be used for more detailed analysis.

Acknowledgment

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We would like to thank Roman Piffl for providing us the ZWO ASI 120MM camera and Fujinon 1.4/1.8mm, and Maciej Maciejewski for providing us a number of Mintron cameras and fast lenses. We would like to thank Prof. Peter Brown and Zbyszek Krzeminski for helping to find a suitable place for observations, and many valuable advices. We would like to thank John Hlynialuk for inviting us to the Fox Observatory for our observations. We would like to thank Glenn Aishford for his hospitality in Willow Bank. We would like to thank Paweł Zaręba for the design of the expedition logo.

References

