

# Trajectory and orbit of the EN200204 Łaskarzew fireball

*Pavel Spurný\**, *Arkadiusz Olech†* and *Piotr Kędzierski‡*

Received 2004 March 31

## Abstract

The fireball of  $\sim -10$  mag was observed over Poland on February 20, 2004 at 18:54 UT. Except many visual observations the event was caught by two photographic stations: one in the Czech Republic and one in Poland. A description, ground track map, atmospheric trajectory and orbital data for the fireball are presented.

## 1 Introduction

The European Fireball Network (EN) is the project which main goal is to study properties of meteoroids and their relations to meteorites through photographic observations of fireballs. The first all-sky cameras, belonging to EN, were put into operation in Czechoslovakia in 1963. The number of cameras quickly grew up and now there are about 30 such stations located in several European countries (Spurný 1997).

Polish meteor observers associated in *Comets and Meteors Workshop (CMW)* have many successes in visual and telescopic observations. It is enough to say, that they collect about 2000 hours of visual observations and 200 hours of telescopic observations per year sending them regularly to *International Meteor Organization (IMO)* and publishing the results in *WGN* (Olech and Jurek, 2000, Olech, Wiśniewski and Gajos, 2001, Złoczewski, Jurek and Szaruga, 2003). Unfortunately, there is still lack of regular photographic meteor observations in Poland and therefore this country does not belong to EN. It is a serious problem, taking into account the fact that area of Poland is only slightly smaller than the area of Germany and four times larger than the area of the Czech Republic.

To change this situation the CMW decided to buy the photographic and video cameras with fast lenses in aim of regular monitoring of the sky over Poland. The details of this project will be published in the separate contribution to *WGN*. The first tests with the new photographic equipment were made in the end of 2003 and quite regular observing runs were started in late February of 2004. This paper presents the results obtained for the  $\sim -10$  mag fireball which was observed on February 20, 2004 over central Poland and was photographed at Polish station in Ostrowik near Warsaw and EN station no. 16 Lysá hora in the Czech Republic.

## 2 Observations

The EN station Lysá hora uses manually operated all-sky camera with very precise fish-eye objective Zeiss Distagon 3.5/30 mm. Usually one exposure per night is taken on the panchromatic sheet film Ilford FP4  $9 \times 12$  cm with a sensitivity of 125 ASA.

\*Astronomical Institute AV CR, Fričova 298, 251 65 Ondřejov, Czech Republic. Email: spurny@asu.cas.cz

†Copernicus Astronomical Center, ul. Bartycka 18, 00-716 Warszawa, Poland. Email: olech@camk.edu.pl

‡Warsaw University Observatory, Al. Ujazdowskie 4, 00-478 Warszawa, Poland. Email: pkedzier@astrouw.edu.pl

The station in Ostrowik uses four Canon T50 cameras equipped with Canon 1.4/50 mm lenses and mounted under the two-arm shutter having frequency of 5 Hz and producing 10 breaks/sec. The film Konica Centuria 800 ASA, developed under standard C-41 process, was used. The typical exposure times were 10-20 minutes.

### 3 The fireball

The fireball was seen on February 20, 2004 at 18:54 UT by many amateur astronomers in Poland. The most detailed description comes from Przemysław Żołądek from Nowy Dwór Mazowiecki who saw the fireball during his telescopic meteors watch. The animation made by him can be downloaded from: <http://ftp.pkim.org/info/202102bolid.gif> and the picture of the event caught in Ostrowik is shown in Fig. 1. We would like to point out that the animation is based only on the visual observation and in fact the trajectory presented there should be shifted several degrees to the south and terminated much closer to the horizon.

The fireball traveled its 40.46 km luminous trajectory in 3.22 seconds and terminated at an altitude of 36.2 km. In fact, it is not real terminal point because on both stations terminal part of the luminous trajectory is either out of the field of view (Ostrowik) or behind the objects on the horizon (Lysá hora, where the end of the fireball is behind roof of the station; visible terminal point is there only 5.1 degrees above ideal horizon and 340 km (!) far from the station). So it is not excluded that the terminal height could be much lower, possibly below 30 km. It would imply that some smaller part of initial mass of the order of hundreds of grams in the maximum could survive and land on the ground. This is also supported by quite high value of the velocity at the photographic end of the trajectory. It is very probable that the body could still decelerate to the velocity of some 5 km/s, which could reach just around 30 km altitude. Then the most probable impact area for only very small meteorites would lie northward of the city Garwolin and a little bit south of small village called Puznów Nowy with the center defined by the following coordinates:  $\lambda = 21.6461^\circ$  E and  $\phi = 51.9095^\circ$  N. However the determination of this impact area is not very reliable because we have no data about real end of the fireball luminous trajectory and we do not know real atmospheric profile up to some 35 km during the fireball flight over this predicted impact area.

The beginning of the fireball was photographed at the height of 71.0 km over place located about 10 km NE of Kozienice. The maximum brightness of around  $-10$  mag was reached over Łaskarzew. The end of the photographed trajectory was seen at the height of 36.3 km. The luminous trajectory of the Łaskarzew fireball is shown in Fig. 2 and all important data are collected in Table 1. The orbit of the meteoroid which caused the EN200204 Łaskarzew fireball is shown in Fig. 3.

The meteoroid of initial mass of about 2 kg entered the atmosphere with the velocity of 13.4 km/s and during its detected flight decelerated to a velocity of 10.0 km/s. The observed radiant of the event is at  $\alpha = 90.9^\circ$  and  $\delta = +21.4^\circ$ .

**Acknowledgments.** This work was partially supported by KBN grant 2 P03D 003 25 to K. Mularczyk.

#### References

- Spurný P. (1997) "Photographic monitoring of fireballs in Central Europe", SPIE Proceedings, Vol. 3116, p. 144-155
- Olech A. and Jurek M. (2000) "1996-1998 Polish Telescopic Meteor Database", *WGN*, **28**, 226-228
- Olech A., Wiśniewski M. and Gajos M. (2001) "Polish Visual Meteor Database 1996-1998", *WGN*, **29**, 214-217
- Złoczewski K., Jurek M. and Szaruga K. (2003) "Polish Visual Meteor Database 1999-2001", *WGN*, **31**, 174-176

Table 1: Characteristics of the EN200204 Łaskarzew fireball

2004 February 20, T = 18 <sup>h</sup> 54 <sup>m</sup> 00 <sup>s</sup> ± 20 <sup>s</sup> UT			
Atmospheric trajectory data			
	<b>Beginning</b>	<b>Max. light</b>	<b>Terminal</b>
Velocity [km/s]	13.4 ± 0.2	—	10.0 ± 0.4
Height [km]	71.0 ± 0.2	—	36.3 ± 0.2
Longitude [°E]	21.5874 ± 0.0007	—	21.6266 ± 0.0005
Latitude [°N]	51.6324 ± 0.0006	—	51.8130 ± 0.0005
Dynamic mass [kg]	2	—	—
Absolute magnitude	−3	−10*	—*
Slope [°]	59.59 ± 0.04	—	59.41 ± 0.04
Total length [km]		40.46	
Duration [s]		3.22	
Fireball type		I or II	
Stations	Lysá hora, Ostrowik		
Radiant data (J2000.0)			
	<b>Observed</b>	<b>Geocentric</b>	<b>Heliocentric</b>
Right ascension [°]	90.92 ± 0.10	88.50 ± 0.13	—
Declination [°]	21.40 ± 0.10	12.6 ± 0.5	—
Ecliptical longitude [°]	—	—	66.1 ± 0.2
Ecliptical latitude [°]	—	—	−2.20 ± 0.03
Initial velocity [km/s]	13.4 ± 0.2	7.5 ± 0.4	36.8 ± 0.3
Orbital data (J2000.0)			
<i>a</i> [AU]	2.02 ± 0.11	$\omega$ [°]	13.6 ± 0.2
<i>e</i>	0.52 ± 0.03	$\Omega$ [°]	151.4310 ± 0.0003
<i>q</i> [AU]	0.9793 ± 0.0006	<i>i</i> [°]	2.20 ± 0.03
<i>Q</i> [AU]	3.1 ± 0.2		

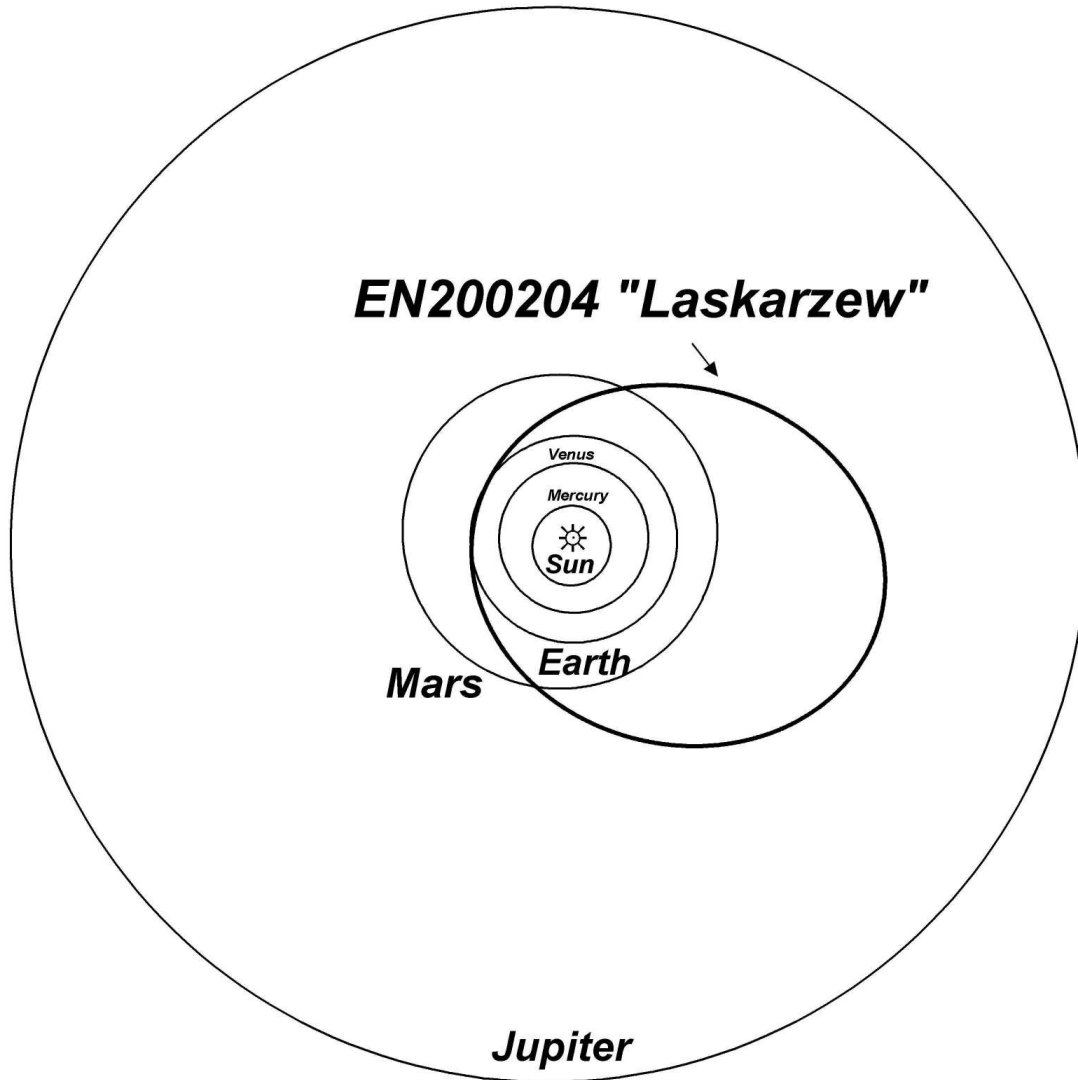
\* - The fireball leaves the FOV of the camera when its brightness still increases or at least did not fade significantly. It implies that also in the maximum the fireball could be still brighter.



*Figure 1* - The picture of the the EN200204 Łaskarzew fireball taken by Canon T50 camera with Canon 1.4/50 mm lens in Ostrowik near Warsaw. The brightest object in the picture is planet Saturn.



Figure 2 - Luminous trajectory of the EN200204 Łaskarzew fireball.



*Figure 3 - Schematic display of the EN200204 Łaskarzew fireball orbit projected onto the ecliptic plane.*