THE ANALYSIS OF TOTAL SOLAR ECLIPSE OBSERVATIONS
ON AUGUST 11th, 1999 IN KIKINDA

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(Received: July 12, 2001)

SUMMARY: Because of poor meteorological conditions, the obtained observational material has not an even distribution in time. Therefore a special method was devised for treating this material. Using this method the durations of total and partial phases of this eclipse were established.

1. INTRODUCTION

At the location of the sport and recreation center "Jezero" in Kikinda with the geographical coordinates \( \varphi = 44^\circ 50'N, \lambda = 20^\circ 55'E \) and altitude \( h=81 \text{ m} \), the authors carried out solar eclipse photographing in poor meteorological conditions. The beginning of the eclipse could not be registered because of a totally overcast sky at the mentioned location. Strong rain which started at the sport and recreation center "Jezero" just before the beginning of the eclipse, prevented the team not only to start photographing but also to prepare in time the instrument and necessary equipment. During eclipse, the sky cleared so the team succeeded in making 31 shots. Unfortunately the distribution of the shots according to time was not very favorable because the photographs were taken at moments when conditions allowed it. However material permitted to obtain certain results. The totality was registered by two shots.

2. EQUIPMENT

The equatorial 80/800 mm was ceded by People’s Observatory in Belgrade. This small instrument by original construction did not have a driving clock so the authors mounted a simple slit through which the Solar image could be registered at the screen. This device proved very practical during photographing. "Zenit" camera has been used with black and white film FORTEPAN 100 ISO 100/210. On the instrument objective a set of red, green and yellow filters plus foil filter was placed. A short time before the eclipse, the computer clock was synchronized with a quartz clock which received time signals from Frankfurt. On R. Pavlović suggestion, time registration was performed so that the camera shooter activated at the same time the flashbulb, whose blaze together with time was registered at the computer screen by all the time active video camera.

Responsible for camera shootings were: G. Popović and D. Olević and for time registering: R. Pavlović and P. Jovanović.

3. THE OBSERVATIONAL MATERIAL

The first photograph of the event was taken after app. 50 minutes after the I contact, when the phase was already about 0.6. A total of 31 photographs was made, 3 of them during the totality. From the total of 20 analyzed shots (Fig.1) only 5 were taken in the period before the totality. The
majority of the other shots are grouped over the decreasing branch when the phase was already between 0.3 and 0.1. Only one shot was made immediately after III contact. Such a poor distribution of the shots by time very much directed the treatment of the observational material.

Let us assume for a moment that the totality duration \( \Delta t = T_3 - T_2 \) is known. Then it is possible to shift by \( \Delta t \) (or \(-\Delta t\)) one of the branches \( g(t) \), so that II and III contacts overlap. Thereupon, if we mirror the corresponding phase branch with respect to the axis of symmetry \( g(t) = 1 \), we will obtain a continuous function (Fig. 2). If these transformations are applied to the increasing phase branch, and the decreasing branch is not changed, then the resulting function \( f(t) \) has the following form:

\[
f(t) = \begin{cases} 
2 - g(t - \Delta t), & t \leq T_3 \\
g(t), & t > T_3.
\end{cases}
\]

(1)

It is possible to approximate the function \( f(t) \) using the method of least squares also with a continuous and smooth curve:

\[
f'(t) = a + bt^\nu,
\]

(2)
after III contact. Such a poor distribution of the majority of the other shots are grouped over the decreasing branch when the phase was already between 0.3 and 0.1. Only one shot was made immediately after III contact. Such a poor distribution of the shots by time very much directed the treatment of the observational material.

\[
\begin{align*}
T_1 &= \left( \frac{2 - a}{b} \right)^{\frac{1}{\nu}} - \Delta t \\
T_2 &= \left( \frac{1 - a}{b} \right)^{\frac{1}{\nu}} - \Delta t \\
T_3 &= \left( \frac{1 - a}{b} \right)^{\frac{1}{\nu}} \\
T_4 &= \left( a \right)^{\frac{1}{\nu}}.
\end{align*}
\]

(4)

As \( \Delta t \) is initially unknown, it is possible to obtain it by its variation, taking the value for which the mean square deviations between the fitted \( (g'(t)) \) and observed phase functions are minimal.

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Table 1. The 1999 solar eclipse duration

<table>
<thead>
<tr>
<th>Duration</th>
<th>Kikinda</th>
<th>NASA R. P.</th>
<th>(O - C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>total eclipse</td>
<td>0h01m34s.0</td>
<td>0h01m31s.4</td>
<td>+2s.6</td>
</tr>
<tr>
<td>partial eclipse</td>
<td>2h47m46s.9</td>
<td>2h47m46s.4</td>
<td>+0s.5</td>
</tr>
</tbody>
</table>

The contact moments are not registered due to unexpected problems with the clock.

Fig. 3. The eclipse phase variation after time shift and mirroring of the increasing phase branch.

REFERENCES