Less than one year up to the Last Total Solar Eclipse of the Millenium. Its Maximum Will Be in Romania

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Abstract. The total solar eclipse of August 11, 1999 will have its maximum in Romania. The umbral path on the Romanian territory is described. The scientific activity: meetings, observational programmes, as well as other activities intended to be performed on this occasion are presented. The International Association "ECLIPSA '99" is introduced.

Key words: solar eclipse – Romania

1. An exceptional event

The **total solar eclipse of August 11, 1999 (TSE)** will be an exceptional event, as:

- it is the **last TSE visible from Europe** for the following several decades;
- it is the **last TSE of this millenium**;
- the year when it takes place (the last one before... 'the end of the world') has became an inexhaustible source of the most absurd interpretations;
- the **totality band** practically **bisects Europe**, from North-West to South-East (the most populated zones);
- it crosses nine European countries, namely: England, France, Benelux, Germany, Austria, Hungary, Yugoslavia, Romania, and Bulgaria;
- it takes place in full summer, at suitable hours;
- it also takes place in full tourist season (an incredible affluence of tourists is expected).

2. The maximum will be in Romania

The TSE of August 11, 1999 will have its maximum in Romania from many standpoints. Here will be:

- the maximum duration of totality (**2 min 23 s**);
- the maximum coverage of the Sun (**103%**);
- the maximum height of the Sun above the horizon (59°);

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- the maximum width of the totality band (**112 km**);

- the highest probability of clear sky (at Mangalia, on the Black Sea shore, the cloud coverage degree is 2.5 and the chances of good weather reach **83%**).

To emphasize the exceptional situation of Romania as regards this eclipse, we have to add:

- the Romanian path of the eclipse lies through the most various relief forms;

- **Bucharest** is the only European capital situates exactly on the central line of the totality band;

- the **only professional astronomical observatory** lying on this line, which has a solar telescope, is in Bucharest, too;

- a second professional astronomical observatory situated in the totality band is also in Romania, at **Timişoara**;

- the next TSE visible from Romania will be only in **2236**.

All these arguments have to be corroborated by the special tourist attraction of the sites which lie on the totality band.

3. The eclipse path in Romania

The eclipse band enters our country through the Banat region, where the main city is Timişoara, which, historically speaking, is mentioned in documents dating as far back as A. D. 1212. Today Timişoara is a well-known and important cultural, academic, industrial, and historical center.

Also nearby the center line (about 30 km to North-West) there is another important town, Arad.

Of a special interest are the mountains crossed by the eclipse, namely Poiana Ruscăi, the Lotru Mountains, the Parâng Mountains, and, the most important of all, the Retezat Mountains, where the Romanian Academy owns a natural reservation. The highest peaks favourable to observations are Peleaga (2509 m) and Parâng (2518 m). The totality band will also pass over Târgu Jiu, the town where the world famous Romanian sculptor of genius Constantin Brâncuşi raised his Infinite Column to the sky.

Those who will come to Romania to watch the eclipse, but will not be able to climb the mountains, as well as those who will want to avoid the crowded cities, will be able to watch the event also from the Sub-Carpathian hills, strewn with beautiful monasteries, especially along the Olt river.

Although less picturesque, the Bărăgan plain offers many facilities to set up observation camps. Bucharest, Romania's capital, lies in the middle of this plain. Espenak and Anderson (1997) has written about this town: 'This city of two million people promises to be a prime eclipse-viewing site, in part because of the comfort and ease of access, and partly because of the excellent weather prospects and the long eclipse duration. Since the center line nearly bisects the city, eclipse-viewing can be done from the wide boulevards or one of the many city parks'.

However, even if the mountains offer the advantages of their height and marvelous landscape, and the hills those of their picturesque zones and homely villages, no less attractive is the shore of the Black Sea, where the good weather is very stable in August, where one can find a genuine constellation of hotels, where a very suitable observation camp or site is easy to set up.

The Table 1 surveys the most important towns lying in the totality band.

4. Meetings to be held in Romania in August '99

The aforesaid arguments also represent the main reason for which specialists or amateurs want to observe the eclipse from Romania and to use this opportunity for meeting each other, for exchanging ideas and opinions about the observational programmes intended to be performed during the eclipse, and - why not? - for learning Astronomy. The result: many international meetings centered on the eclipse day will be held, namely:

Table 1.

Town	Totality duration	Time of maximum (UT)
Arad	2 m 14 s	10 h 56 m 42.8 s
Bucureşti	2 m 22 s	11 h 06 m 58.9 s
Călăraşi	2 m 16 s	11 h 09 m 27.1 s
Caransebeş	1 m 57 s	10 h 58 m 59.8 s
Curtea de Argeş	2 m 14 s	11 h 03 m 41.6 s
Deva	1 m 47 s	10 h 59 m 48.0 s
Drăgăşani	1 m 34 s	11 h 03 m 27.0 s
Haţeg	2 m 20 s	11 h 00 m 07.1 s
Hunedoara	2 m 10 s	10 h 59 m 54.0 s
Jimbolia	1 m 38 s	10 h 55 m 57.4 s
Lipova	2 m 15 s	10 h 57 m 23.7 s
Lugoj	2 m 18 s	10 h 58 m 10.6 s
Lupeni	2 m 22 s	11 h 00 m 50.5 s
Mangalia	2 m 03 s	11 h 12 m 03.9 s
Moreni	1 m 45 s	11 h 05 m 32.6 s
Petroşani	2 m 23 s	11 h 01 m 03.5 s
Piteşti	2 m 23 s	11 h 04 m 18.4 s
Ploieşti	1 m 26 s	11 h 06 m 17.5 s
Râmnicu Vâlcea	2 m 22 s	11 h 03 m 10.0 s
Sânnicolau Mare	2 m 19 s	10 h 55 m 32.9 s
Slobozia	0 m 16 s	11 h 09 m 04.4 s
Timişoara	2 m 02 s	10 h 56 m 53.3 s
Târgovişte	2 m 08 s	11 h 05 m 16.0 s
Târgu-Jiu	1 m 46 s	11 h 01 m 17.8 s
Urziceni	1 m 28 s	11 h 07 m 35.4 s
Vulcan	2 m 23 s	11 h 00 m 56.6 s

- a Summer School, at post-doctoral level, **'Advances in Solar Research at Eclipses, from Ground and from Space'**, proposed to NATO by Observatoire de Paris-Meudon (Prof. J.-P. Zahn) and the Astronomical Institute of the Romanian Academy (Dr. M. Stavinschi);

- the **24th ISYA** (International School for Young Astronomers), organized under the auspices of the IAU and UNESCO (Dr. Michèle Gerbaldi);

- the **10th Triennial Assembly of the IUAA** (International Union of Amateur Astronomers), European Section (President: Prof. Rinaldo Roggero);

- the **3rd International Conference of Salt**, organized by American and Romanian scientists (Prof. N. Cristescu, USA);

- the **15th Congress of the Association of Cosmic Space Explorers**;

- a Romanian-Japanese conference.

Recently Romania joined the ERASMUS/SOCRATES European academic programme. Within this framework, the Department of Physics of the Bucharest University and the Astronomical Institute of the Romanian Academy took into account the education of the young people for the eclipse by special courses of general astrophysics and solar physics. The cooperation with other scientific and educational institutions belonging to countries interested in observing the event was also considered.

5. Romanian Programmes for the Eclipse

The scientific programmes related to the eclipse will be mainly performed at the Bucharest Observatory of the Astronomical Institute of the Romanian Academy. (As we have already said, this observatory is situated exactly on the central line of the umbral path, very near the maximum of the eclipse.) Of course, the Observatory of Timişoara, belonging to the same Institute, will also achieve the programmes established for its instruments. As to the third observatory of the Institute, that of Cluj-Napoca (where the eclipse will be seen only as partial), it will be involved, too, in characteristic projects.

The main instruments to be used are the following ones:

- a **Zeiss refractor** (13/195 cm) for white-light observations of the solar photosphere and a smaller refractor with a Lyot-Öhman H_α filter for the chromospheric observations;

- a **double astrograph** of Prin-Merz construction (38/600 cm) with a field of $2^\circ \times 2^\circ$, endowed with a photographic camera that uses 24 cm $\times$ 24 cm plates, and with a HiSis 22 CCD camera of 768 $\times$ 512 pixels;

- a **Cassegrain telescope** of Zeiss construction (50/750 cm) endowed with a SBIG ST-6 V CCD camera of 375 $\times$ 242 pixels;

- a **Cassegrain telescope** (30/169 cm) equipped with a photomultiplier of the type EMI 9862 Q, at Timişoara Observatory;

- a **Schmidt-Cassegrain telescope** of Meade construction (40/406 cm), equipped with a CCD camera of 768 $\times$ 512 pixels, at Cluj-Napoca Observatory.

Our scientific projects are the following ones:

1. White-light observations of the corona at Bucharest and Timişoara, during the totality phase;

2. Coronal structure observations at the distance of $1 - 5R_{\odot}$ (streamers, helmet, arches);

3. Coronal structure evolution;

4. Spicule observations;

5. Monochromatic coronal observations in green and red lines, as well as in continuum;

6. Determination of the contact times C1 and C4 (exterior contacts);

7. Einstein effect;

8. Infrared coronal observations from space.

An international jury chaired by Prof. Jay M. Pasachoff, Head of the IAU Working Group 'Eclipses' is examining the proposals for different scientific programmes applied to these instruments.

We must mention that our programmes, as well as those of other colleagues, were initially proposed within the framework of a NATO ARW (Advanced Research Workshop) held at Sinaia, on June 1996. The papers have already been published by Mouradian and Stavinschi (1997) and Maris (1998).

6. Other programmes

Taking into account the fact that such an event will be very impressive for the public, we have also thought of a program of scientific education.

Its first objective is the building of a Planetarium with a dome of 8.5 m diameter in Bucharest (actually, right in the park of the Astronomical Observatory), with space enough for exhibitions of astronomical phenomena, and 65 conference seats.

We are also preparing for the eclipse brochures, booklets, books, videotapes.

A station is being built outside Bucharest, for astrophysical observations, for which we hope to purchase a 1-meter class telescope. Part of the instruments which are now in the Capital will be moved there.

We do our best to improve the present observational endowments by purchasing some new CCD cameras, field telescopes of Meade-type, as well as by updating our database.

7. The International Association 'Eclipsa '99' (E '99)

The proximity of the event increases the number of representatives of various scientific institutions, astronomical societies, even touring agencies (all over the world), that require specific informations or tourist ones. Several touring agencies contacted us. Some of them could offer many interesting informations: *Visit Romania* (the sponsor of the romanian participation at this workshop), *condor* and *Sun Med International*.

To cover the extremely wide range of problems raised by this event (let us mention only the enormous flux of tourists expected), as well as to collect the necessary funds for such a huge program, we have set up the **International Association 'Eclipsa '99'**.

This is a non-governmental, non-political, and non-profit organization, including both individuals and legal persons. One of its aims is to prepare optimum conditions for the observation of the TSE of E '99.

To accomplish its goals, 'E '99' collaborates with similar institutions from Romania and abroad, with specialists from related fields, as well as with cultural, tourist and trade institutions, i.e., with everybody who wants and can contribute to the good preparation of such an event.

The funds of 'E '99' come from the subscriptions of its members (40 USD per year for individual persons, 200 USD per year for collective ones), as well as from donations and legacies.

'E'99' will continue its activity even after the eclipse (under the name of 'Astronomia 21'), when its main goal will be to keep alive the interest in the science of Astronomy, which is both ancient and modern.

Considering that the last total solar eclipse of this millenium actually is the eclipse of Europe, we are happy that the Council of Europe approved the 'Eclipse'99' project and placed it under its patronage. The International Planetarium Society (IPS) is also supporting the project - especially the cooperation between European Planetariums along the total eclipse path.

References

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Discussion

Question (S. Koutchmy): *Isn't there a risk of overlapping between the summer school planned by Romanien Astronomers and the colloquium planned by the Turkish astronomers?*

Answer (M. Stavinschi): It is not a problem. The school lasts at minimum 10 days. So, the specialist who will teach there, could go from Romania to Turkey (or viceversa) during this period in about one hour of flight.

Question (E. Cliver): *I think it is remarkable that the path of totality crosses directly over Bucharest. When was the last time that the path of totality crossed directly over this major city? Has it ever happened before?*

Answer (M. Stavinschi): Oh no, certainly not in the past twelve centuries.