Bull. Astron. Belgrade № 147 (1993), 41 – 44

UDC 521.8:523.45-87*1-87*2
Preliminary report

ECLIPSE OF JUPITER SATELLITE IO BY EUROPA ON APRIL 3, 1991 OBSERVED AT BELGRADE OBSERVATORY

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(Received: February 15, 1993)

SUMMARY: The results of the photoelectric recording of the eclipse of Jovian satellite Io by satellite Europa on April 3, 1991 are presented. This event gave us the opportunity to obtain not only the light curve of the phenomenon, but also the Europa's radius.

The observation of Jupiter satellite Io's eclipse by Europa was carried out on April 3, 1991. at Belgrade Observatory (L=-20°30′49″.6; Φ = 44°48′ 12″.4; h = 260m) with the Zeiss Equatorial Refractor of 65cm aperture and 1055cm focal length and polarimeter (photomultiplier EMI 9502B; glass filter 2mm GG11) with stationary analyzer (polaroid). The 60″ diaphragm contained only the eclipsed satellite Io's image. The analogous data registering was performed on the Servogor paper recorder. The time from the standard Rohde-Schwarz clock of the Observatory's Time Service was registered on the paper sheet. The error of the overall timing is probably less than one second. The sky brightness measurement was executed after the end of the phenomenon. Generally, in our measurements the sky signal is stable during a short time interval of several minutes.

The recorded signal on the paper sheet was averaged over five seconds intervals (one centimeter on the paper) throughout the recording. These data of the Io signal (130 points) in the arbitrary units after subtraction of the sky signal are presented in Table 1 and in Fig. 1. The points numbered 39 through 43 are missed because of checking of the satellite's position on the diaphragm. The measurements between numbers 92 and 117 are corrected for the effects caused by the different positions of the satellite image on the diaphragm.

The Io signal was sinusoidally modulated by about 20 seconds period throughout the observation. That was because Jupiter image near the outer edge of the diaphragm drifted periodicaly by the imperfect telescope diurnal motion. This was confirmed in a special experiment after the eclipse.

From the very beginning of the observation there set in a weakening of the signal lasting till the beginning of the umbral eclipse. After the end of the umbral eclipse the signal was getting ever stronger approximately during the same time interval as the one assotiated with its weakening before the phenomenon. This could be explained as a consequence of the penumbral eclipse.

On the basis of our photoelectric data the duration of the eclipse was $355^s.4$, starting at $18^h\ 28^m\ 31^s.0$ UT, with maximum at $18^h\ 31^m\ 46^s.9$ and ending at $18^h\ 34^m\ 26^s.4$ UT. The best fitting with the

Table 1. Eclipse of Jupiter satellite Io by Europa observed in Belgrade on April 3, 1991 (at 18^h UT).

No	UT	SIGNAL
1	$26^m\ 58^s.0$	64.8
2	27 3.0	64.5
3	27 8.1	64.1
4	27 13.1	63.9
5	27 18.1	63.6
6	27 23.2	63.4
7	27 28.2	63.4
8	27 33.2	63.2
9	27 38.3	62.9
10	27 43.3	62.7
11	27 48.3	62.6
12	27 53.4	62.6
13	27 58.4	62.4
14	28 3.4	62.4
15	28 8.4	62.2
16	28 13.5	62.4
17	28 18.5	62.4
18	28 23.5	62.3
19	28 28.5	62.1
20	28 33.6	61.8
21	28 38.6	61.6
22	28 43.6	61.2
23	28 48.7	61.0
24	28 53.7	60.8
25	28 58.7	60.6
26	29 3.7	60.0
27	29 8.7	59.2
28	29 13.7	58.9
29	29 18.8	58.2
30	29 23.8	57.6
31	29 28.9	56.8
32	29 33.9	56.4
33	29 38.9	55.5
34	29 43.9	54.3
35	29 49.0	53.8
36	29 54.0	53.0
37	29 59.0	52.6
38	30 4.1	52.0
39	30 9.1	–
40	30 14.2	–
41	30 19.2	–
42	30 24.3	–
43	30 29.3	–
44	30 34.4	49.0
45	30 39.5	48.6
46	30 44.6	48.1
47	30 49.7	47.0
48	30 54.8	46.5

No	UT	SIGNAL
49	$30^m\ 59^s.9$	45.8
50	31 5.0	45.7
51	31 9.7	45.1
52	31 14.7	44.5
53	31 19.6	44.4
54	31 24.6	44.1
55	31 29.6	43.7
56	31 34.5	43.5
57	31 39.5	43.2
58	31 44.4	42.9
59	31 49.4	42.9
60	31 54.3	43.1
61	31 59.3	43.5
62	32 4.2	44.0
63	32 9.1	44.9
64	32 14.3	46.0
65	32 19.5	47.2
66	32 24.6	48.0
67	32 29.8	48.9
68	32 35.0	49.5
69	32 40.2	49.9
70	32 45.4	50.7
71	32 50.5	51.5
72	32 55.7	52.5
73	33 0.9	53.1
74	33 6.1	54.4
75	33 11.3	55.1
76	33 16.4	56.2
77	33 21.6	56.9
78	33 26.8	58.0
79	33 32.0	58.8
80	33 37.2	59.7
81	33 42.3	60.4
82	33 47.5	60.5
83	33 52.7	61.3
84	33 57.9	61.5
85	34 3.1	61.7
86	34 8.2	61.8
87	34 13.4	61.8
88	34 18.6	61.9
89	34 23.8	62.2
90	34 29.0	62.5
91	34 34.1	62.7
92	34 39.3	62.5
93	34 44.5	62.4
94	34 49.7	62.4
95	34 54.9	62.3
96	35 0.0	62.6

Table 1 continued

No	UT	SIGNAL
97	$35^m\ 5^s.2$	62.5
98	35 10.4	62.5
99	35 15.6	62.5
100	35 20.8	62.6
101	35 26.0	63.2
102	35 31.2	63.1
103	35 36.3	63.5
104	35 41.5	63.6
105	35 46.7	63.7
106	35 51.9	63.8
107	35 57.1	63.9
108	36 2.2	64.0
109	36 7.4	64.1
110	36 12.6	64.0
111	36 17.8	64.2
112	36 23.0	64.0
113	36 28.1	64.1

No	UT	SIGNAL
114	$36^m\ 33^s.3$	64.8
115	36 38.5	64.9
116	36 43.7	65.0
117	36 48.9	65.0
118	36 54.0	65.2
119	36 59.2	65.3
120	37 4.4	65.3
121	37 9.6	65.2
122	37 14.8	64.9
123	37 19.9	64.9
124	37 25.1	64.7
125	37 30.3	64.5
126	37 35.5	64.8
127	37 40.7	65.0
128	37 45.8	64.9
129	37 51.0	64.8
130	37 56.2	64.8

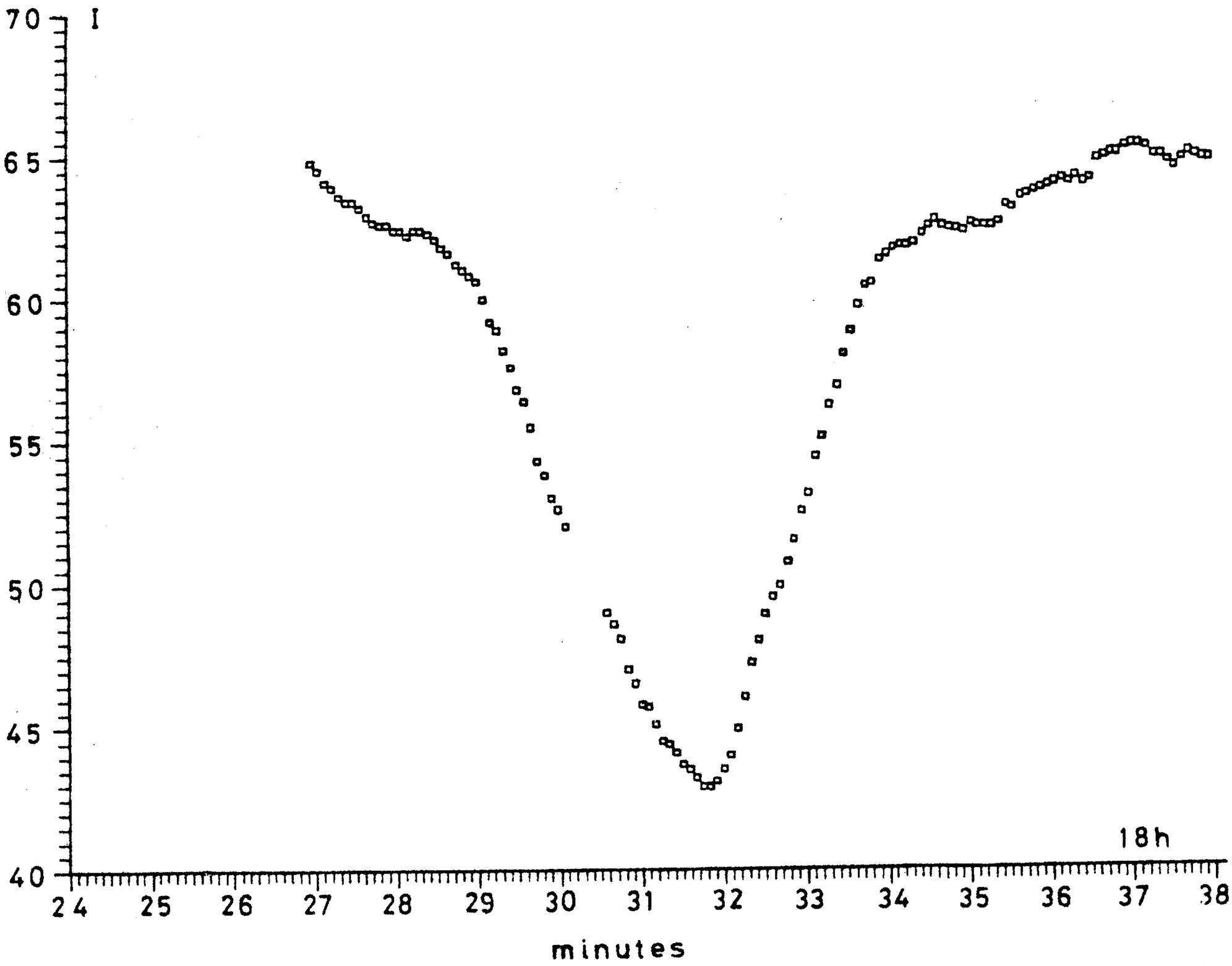

Fig.1. Photoelectric signal of Io (in arbitrary units) during the eclipse by Europa on April 3,1991 observed in Belgrade.

ephemerides is for the maximum of the eclipse. The existing asymmetry of the light curve and earlier beginning and ending of the eclipse compared with the ephemerides deserve a further analysis.

Using such results of photometrictric observations, we derived the semidiameter ratio $R_2/R_1 = 0.75 \pm 0.005$ (assuming that both satellites have the uniform surface brightness and the same albedos). The value of the radius R1 of Io, obtained with a high degree of precision by Taylor (1972) from the occultation of Beta Scorpii by this satellite, is used in determination of Europa's radius

$$R_2 = 1372.7km.$$

Acknowledyments – This work has been supported by Ministry for Science and Technology of Serbia through the project "Physics and Motions of Celestial Bodies".

REFERENCES

Taylor, G. E.: 1972, *Icarus*, **17**, 202.

Arlot, J. E., Camishel, H., Link, F.: 1974, *Astron. Astrophys.* **35**, 115.

ПОМРАЧЕЊЕ ЈУПИТЕРОВОГ САТЕЛИТА ИО САТЕЛИТОМ ЕВРОПА 3. АПРИЛА 1991. ГОДИНЕ

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УДК 521.8:523.45-87*1-87*2

Претходно саопштење

У овом раду саопштени су основни резултати посматрања помрачења Јупитеровог сателита Ио сателитом Европа са Астрономске опсерваторије у Београду 3. априла 1991. године. Дата је крива промене сјаја и изведен полупречник сателита Европа.