

# ACCURATE POSITIONS OF PLUTO AND ASTEROIDS OBSERVED IN BUCHAREST DURING THE YEAR 1932

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*Abstract.* The paper contains the observations of minor planets performed in Bucharest Astronomical Observatory in the year 1932 with the 380/6000 mm astrograph. Both Turner's (constants) and Schlesinger's (dependences) methods were used in the computation of the normal coordinates of the objects.

*Keywords:* photographic astrometry – minor planets.

## 1. INTRODUCTION

The article is a continuation of the complete investigation of Bucharest Wide-Field Plates Archive initiated in 2010; it contains the plates with asteroids observed in 1932. That year 185 plates were exposed and were stored in the archive, but were not reduced. After analysing them, 98 plates were detected to contain measurable minor planets.

The first observed positions in this year were of planet Pluto. They were exposed on 13×18cm plates, with 52 minutes exposure. The observations were performed by the famous Romanian astronomer Professor Gheorghe Demetrescu. The most difficult problem was the identification of the planet, the three plates obtained in 1932 having dozens of stars with up to 15 magnitudes. As all the observations were performed in the same month and the planet did not have a great proper motion, it was possible to superpose two plates and to identify Pluto.

The values  $(O-C)_\alpha$  and  $(O-C)_\delta$  were calculated by M. Svechnikov from the Institute of Applied Astronomy in Sankt Petersburg on the basis of precise positions obtained in Bucharest, which we integrated in Pluto's orbit. The values were very accurate.

## 2. ACCURATE POSITIONS OF ASTEROIDS

To determine more precise positions, we tried to take into account 4–6 reference

stars, whenever possible. We used *Positions and Proper Motions (PPM) Star Catalogue J 2000.0* or *Tycho Star Catalogue J 2000.0*, referring all the results to the epoch 2000.0.

To perform the observations, the 380/6000 mm astrograph with the field of  $2^{\circ} \times 2^{\circ}$  was used. The plates exposed were of  $13 \times 18$  cm and the measurements were performed by means of an ASCORECORD measuring machine. In the computations we used the same program for all plates. All computations were performed in double precision. Both Turner's (constants) and Schelsinger's (dependencies) methods were used for the computation of the normal coordinates of the object. In the method of the constants, the values were determined together with their errors – for every star the residuals were computed.

Table 1 contains: the number, the name of the asteroid, the observation moment (year, month, day and fraction of the day in UT),  $\alpha_{2000.0}$ ,  $\delta_{2000.0}$ .

Table 1

Pluto and asteroids observed during 1932 in Bucharest Observatory

Name	Data [UT]	$\alpha_{2000.0}$			$\delta_{2000.0}$		
		h	m	s	°	'	"
1	2	3			4		
Pluto	1932 01. 07.95017	7	35	54.645	+22	08	56.50
"	1932 01. 15.91495	7	35	11.033	22	11	06.97
"	1932 01. 29.88824	7	33	56.211	22	14	48.39
2 Pallas	1932 05. 31.88064	17	55	21.497	24	34	41.26
"	1932 05. 31.88523	17	55	21.274	24	34	42.21
3 Juno	1932 01. 07.86567	7	12	07.793	1	06	52.69
"	1932 01. 07.87012	7	12	07.536	1	06	54.75
4 Vesta	1932 11. 03.91854	4	19	25.325	12	53	29.89
"	1932 11. 03.92408	4	19	25.074	12	53	30.32
5 Astraea	1932 12. 05.91121	6	27	59.041	15	38	33.97
"	1932 12. 05.91640	6	27	59.293	15	38	33.32
"	1932 12. 13.88936	6	21	25.225	15	45	04.89
"	1932 12. 13.89430	6	21	25.393	15	45	04.48
8 Flora	1932 11. 30.93074	6	08	53.330	17	29	56.75
"	1932 11. 30.93420	6	08	53.114	17	29	57.45
11 Parthenope	1932 12. 05.86793	4	48	24.506	16	19	59.54
"	1932 12. 05.87247	4	48	24.810	16	19	59.60
12 Victoria	1932 10. 01.86327	23	01	45.600	8	41	57.67
12 Victoria	1932 10. 01.87020	23	01	45.818	8	42	02.52
14 Irene	1932 11. 30.88953	3	35	26.023	12	34	45.34

"	1932 11. 30.89369	3	35	25.767	+12	34	45.61
18 Melpomene	1932 06. 11.92820	18	30	09.914	- 7	56	58.76
"	1932 06. 11.93443	18	30	09.604	- 7	56	58.99
21 Lutetia	1932 11. 29.90161	4	41	45.038	+21	12	28.99
"	1932 11. 29.90576	4	41	44.746	21	12	28.86
25 Phocaea	1932 10. 29.93738	4	14	04.284	9	53	20.82
"	1932 10. 29.94292	4	14	04.544	+ 9	53	24.99
26 Proserpina	1932 09. 28.84018	23	19	59.804	- 9	05	52.17
"	1932 09. 28.84710	23	19	59.492	- 9	05	53.97
27 Euterpe	1932 09. 30.91713	2	13	33.573	+10	33	01.49
"	1932 09. 30.92510	2	13	33.230	+10	32	59.81
32 Pomona	1932 06. 21.91543	20	01	59.993	-12	20	35.07
"	1932 06. 21.92167	20	02	00.260	-12	20	34.74
34 Circe	1932 10. 25.96803	2	56	41.392	+11	42	39.94
"	1932 10. 25.97444	2	56	41.738	11	42	42.03
39 Laetitia	1932 10. 22.86923	2	43	00.902	0	43	53.07
"	1932 10. 22.87476	2	43	00.359	0	43	50.67
42 Isis	1932 04. 07.89460	14	00	06.399	0	39	21.09
"	1932 04. 07.91012	14	00	06.149	0	39	22.68
45 Eugenia	1932 01. 05.84797	7	00	29.570	15	39	19.10
"	1932 01. 05.85207	7	00	29.803	15	39	18.07
52 Europa	1932 10. 29.85635	1	36	49.834	- 1	19	39.28
"	1932 10. 29.86223	1	36	49.576	1	19	40.38
56 Melete	1932 05. 25.92276	17	51	43.236	10	04	30.12
"	1932 05. 25.92969	17	51	43.009	-10	04	31.05
57 Mnemosyne	1932 09. 30.91713	2	10	35.741	+11	07	03.57
"	1932 09. 30.92510	2	10	35.498	11	06	59.74
60 Echo	1932 01. 05.84797	6	58	42.190	15	31	35.49
"	1932 01. 05.85207	6	58	42.423	15	31	34.90
62 Erato	1932 10. 29.90379	2	58	38.420	13	14	26.62
"	1932 10. 29.91002	2	58	38.099	13	14	25.24
66 Maja	1932 10. 22.85225	1	52	03.841	13	42	10.95
"	1932 10. 22.85779	1	52	03.544	13	42	10.75
68 Leto	1932 10. 29.88665	2	18	27.964	11	35	22.09
"	1932 10. 29.89115	2	18	28.214	11	35	22.15
77 Friga	1932 10. 23.97419	2	52	00.238	19	06	08.07
"	1932 10. 23.97938	2	51	59.949	19	06	07.18
79 Eurynome	1932 10. 25.90397	4	07	25.796	17	47	02.91
"	1932 10. 25.91367	4	07	25.521	17	46	59.56

85 Io	1932 02. 08.84277	8	25	43.851	2	22	26.54
"	1932 02. 08.84866	8	25	43.567	2	22	27.96
89 Julia	1932 12. 05.89805	6	31	27.764	41	50	05.30
"	1932 12. 05.90230	6	31	28.047	41	50	05.25
"	1932 12. 13.87513	6	21	02.468	41	33	23.52
"	1932 12. 13.87790	6	21	15.101	+41	33	22.35
94 Aurora	1932 04. 01.91598	13	08	39.775	-10	04	20.92
100 Hekate	1932 03. 29.85631	12	17	35.338	+ 6	15	12.38
"	1932 03. 29.86220	12	17	35.592	+ 6	15	09.96
114 Kassandra	1932 07. 06.94129	20	03	00.644	-14	35	03.20
"	1932 07. 06.94821	20	03	00.684	-14	35	07.20
119 Althea	1932 12. 05.88143	5	11	34.996	+15	25	26.78
"	1932 12. 05.88662	5	11	35.335	15	25	27.28
121 Hermione	1932 11. 30.91718	4	47	17.715	21	35	28.66
"	1932 11. 30.92226	4	47	17.455	21	35	28.79
124 Alkeste	1932 09. 27.90108	0	21	58.072	2	40	46.07
"	1932 09. 27.90402	0	21	58.239	2	40	47.10
129 Antigone	1932 05. 09.87236	14	39	22.762	6	35	46.82
"	1932 05. 09.87721	14	39	22.710	+ 6	35	46.80
135 Hertha	1932 09. 26.93636	23	39	36.483	- 0	54	10.50
"	1932 09. 26.94121	23	39	36.740	0	54	09.54
138 Tolosa	1932 09. 30.82156	23	14	31.803	10	22	54.74
"	1932 09. 30.82745	23	14	31.560	-10	22	55.27
143 Adria	1932 09. 27.86229	23	45	27.109	+ 7	13	20.40
"	1932 09. 27.86783	23	45	26.836	7	13	19.74
144 Vibilia	1932 10. 29.87158	1	51	21.126	4	25	12.31
"	1932 10. 29.87643	1	51	21.379	+ 4	25	12.38
156 Xanthipe	1932 07. 06.84122	17	58	01.109	-14	14	52.93
"	1932 07. 06.84710	17	58	01.095	14	14	52.95
"	1932 07. 07.85649	17	57	30.471	14	10	09.83
"	1932 07. 07.86133	17	57	30.428	-14	10	19.06
159 Aemilia	1932 04. 03.82601	12	07	40.324	+ 6	35	45.83
"	1932 04. 03.83294	12	07	40.563	6	35	45.77
161 Athor	1932 10. 22.83528	0	46	09.694	5	13	40.12
"	1932 10. 22.84186	0	46	09.314	5	13	40.15
168 Sibylla	1932 10. 25.82883	0	48	56.145	6	29	38.21
"	1932 10. 25.83576	0	48	55.907	+ 6	29	36.11
176 Iduna	1932 05. 21.89114	15	41	42.862	- 1	07	02.83
"	1932 05. 21.89864	15	41	43.229	1	07	06.02

179 Klytemnestra	1932 07. 02.90166	18	12	41.595	18	49	43.34
"	1932 07. 02.91482	18	12	41.245	-18	49	42.50
187 Lamberta	1932 03. 28.81601	11	05	38.354	+15	48	56.33
"	1932 03. 28.82132	11	05	38.113	15	48	54.47
189 Phythia	1932 10. 23.94198	4	02	47.499	17	09	44.58
"	1932 10. 23.94718	4	02	47.338	17	09	44.64
195 Eurykleia	1932 01. 30.91165	9	08	25.632	26	00	18.93
"	1932 01. 30.91663	9	08	25.434	26	00	19.51
201 Penelope	1932 10. 24.90427	2	28	06.635	5	56	06.09
"	1932 10. 24.91016	2	28	06.349	+5	56	03.82
206 Hersilia	1932 05. 31.85960	15	28	25.970	-12	58	41.85
"	1932 05. 31.86653	15	28	25.674	-12	58	41.79
211 Isolda	1932 11. 30.90350	3	50	25.534	+22	29	28.50
"	1932 11. 30.90823	3	50	25.817	+22	29	29.58
236 Honoria	1932 07. 07.94236	20	27	44.783	- 7	01	59.99
"	1932 07. 07.94860	20	27	44.531	7	02	00.42
238 Hypatia	1932 04. 07.86286	13	44	19.482	4	37	15.53
"	1932 04. 07.87255	13	44	19.181	4	37	12.43
240 Vanadis	1932 09. 27.88116	23	56	47.163	4	02	52.72
"	1932 09. 27.88688	23	56	47.451	4	02	50.80
245 Vera	1932 09. 27.75871	23	40	07.606	10	37	40.31
"	1932 09. 27.76430	23	40	07.277	-10	37	40.87
250 Bettina	1932 01. 05.86667	7	19	26.060	+42	02	43.35
"	1932 01. 05.87097	7	19	26.364	+42	02	42.66
261 Primno	1932 09. 28.87896	23	45	47.522	- 8	03	11.32
289 Nenetta	1932 12. 15.84686	4	58	45.334	+12	16	31.32
"	1932 12. 15.85379	4	58	45.443	+12	16	31.42
306 Unitas	1932 09. 26.91524	23	26	41.823	-11	43	32.08
"	1932 09. 26.92147	23	26	42.092	11	43	29.72
308 Polyxo	1932 04. 01.85815	12	10	45.398	0	43	46.71
322 Phaeo	1932 07. 07.87103	18	54	32.964	16	04	30.62
"	1932 07. 07.87622	18	54	32.648	16	04	30.07
324 Bamberga	1932 03. 28.84209	11	38	11.137	6	28	18.59
"	1932 03. 28.84492	11	38	10.863	6	28	18.00
"	1932 04. 01.83587	11	35	00.277	6	11	57.73
"	1932 04. 01.83933	11	35	00.108	6	11	56.15
"	1932 04. 01.84280	11	34	59.889	- 6	11	55.50
334 Chicago	1932 12. 13.82873	3	39	51.467	+13	42	26.46
"	1932 12. 13.83704	3	39	51.808	13	42	26.32

346 Hermentaria	1932 04. 07.88294	13	50	04.504	1	41	35.42
"	1932 04. 07.88848	13	50	04.257	1	41	36.92
"	1932 04. 12.85159	13	46	02.847	2	02	48.44
"	1932 04. 12.85713	13	46	02.555	2	02	49.51
349 Dembowska	1932 12. 13.86266	4	44	49.180	31	06	59.74
"	1932 12. 13.86647	4	44	49.402	+31	06	59.80
354 Eleonora	1932 07. 07.90912	19	34	12.422	- 7	23	31.05
"	1932 07. 07.91466	19	34	12.129	7	23	32.49
"	1932 07. 09.90955	19	32	32.613	7	35	14.39
"	1932 07. 09.91440	19	32	32.914	- 7	35	12.28
363 Padua	1932 12. 13.84708	4	18	37.946	+22	28	22.11
"	1932 12. 13.85347	4	18	38.280	22	28	21.81
375 Ursula	1932 11. 03.85136	1	57	22.989	34	15	10.54
"	1932 11. 03.85621	1	57	22.630	+34	15	08.57
377 Campania	1932 07. 06.92778	19	57	59.744	-10	07	04.13
385 Ilmatar	1932 01. 29.85171	8	05	58.165	+36	13	49.15
"	1932 01. 29.85500	8	05	57.802	36	13	48.22
402 Chloe	1932 04. 03.85337	13	43	54.197	9	26	04.66
410 Chloris	1932 01. 07.85379	7	07	28.705	24	37	58.45
432 Pythia	1932 05. 09.89608	14	55	31.274	0	14	41.80
"	1932 05. 09.90110	14	55	31.597	+ 0	14	42.60
"	1932 05. 16.85025	14	48	31.189	- 0	06	37.93
"	1932 05. 16.85493	14	48	30.956	0	06	38.60
442 Eichsfeldia	1932 06. 21.84029	16	59	36.760	13	52	26.79
"	1932 06. 21.84549	16	59	36.475	13	52	27.39
444 Gyptis	1932 05. 24.91857	17	06	44.188	9	40	17.14
"	1932 05. 24.92446	17	06	43.898	- 9	40	15.39
447 Valentina	1932 01. 29.92535	8	20	45.747	+25	13	50.88
481 Emita	1932 11. 03.82903	1	21	25.848	- 2	53	01.15
"	1932 11. 03.83387	1	21	25.638	2	53	01.41
487 Venetia	1932 05. 24.89520	16	41	10.538	10	21	54.08
"	1932 05. 24.90143	16	41	10.920	-10	21	54.23
516 Amherstia	1932 01. 30.89032	8	45	45.041	+26	29	53.57
524 Fidelio	1932 10. 23.85905	1	41	53.729	24	26	06.91
"	1932 10. 23.86442	1	41	53.382	+24	26	05.94
532 Herculina	1932 05. 21.91258	16	42	41.250	- 3	20	03.67
"	1932 05. 21.91535	16	42	41.130	- 3	20	04.23
545 Messalina	1932 09. 27.81641	23	14	52.930	+ 1	47	09.02
"	1932 09. 27.82143	23	14	52.708	1	47	08.57

578 Happelia	1932 10. 25.93098	1	02	21.713	4	38	02.29
"	1932 10. 25.93791	1	02	21.175	4	38	00.43
644 Cosima	1932 10. 25.93098	1	02	14.727	5	02	22.42
"	1932 10. 25.93791	1	02	14.396	5	02	21.29
673 Edda	1932 10. 23.87654	2	31	47.343	15	50	22.19
"	1932 10. 23.88381	2	31	46.993	15	50	19.78
704 Interamnia	1932 11. 30.94390	6	26	16.029	30	12	11.59
"	1932 11. 30.94805	6	26	15.795	+30	12	10.67
737 Arequipa	1932 06. 21.86003	17	50	27.943	- 0	14	21.30
"	1932 06. 21.86488	17	50	28.209	0	14	21.56
"	1932 07. 02.88504	17	41	29.356	0	14	58.11
"	1932 07. 02.89093	17	41	29.053	- 0	14	58.82
742 Edisona	1932 12. 15.86868	4	13	36.867	+22	58	54.31
"	1932 12. 15.87595	4	13	37.162	22	58	54.17
792 Metcalfia	1932 01. 30.87127	7	40	34.849	+12	42	18.55

### 3 CONCLUSIONS

We consider that the recovery of these old observational data will be useful because in that period there were not many minor planet observations. These accurate positions are fitted for improving the orbits of the observed minor planets. We decided to recover all the unreduced data from our archive and to include them in the astronomical database.

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