

# TELEVISION METEOR RADIANT MAPPING

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**Abstract.** We have carried out double-station TV meteor observations between 1990 and 1994. The orbits of 326 meteors have been determined from doubly observed meteors, and radiant distributions are studied. The mean magnitude of the observed meteors was as faint as +4.7, since I.I. (Image Intensifier) and Video cameras were used. Radiants were widely distributed over the celestial sphere. The velocity distribution showed some similarity with the distribution predicted by the theoretical radiant distribution from comets rather than that from asteroids. In all 13 showers including both major and minor meteor showers were detected from radiant distributions of the observed meteors; from the orbital elements and meteor velocities as well as from the radiant directions.

**Key words:** Meteor radiant, doubly observed television meteor

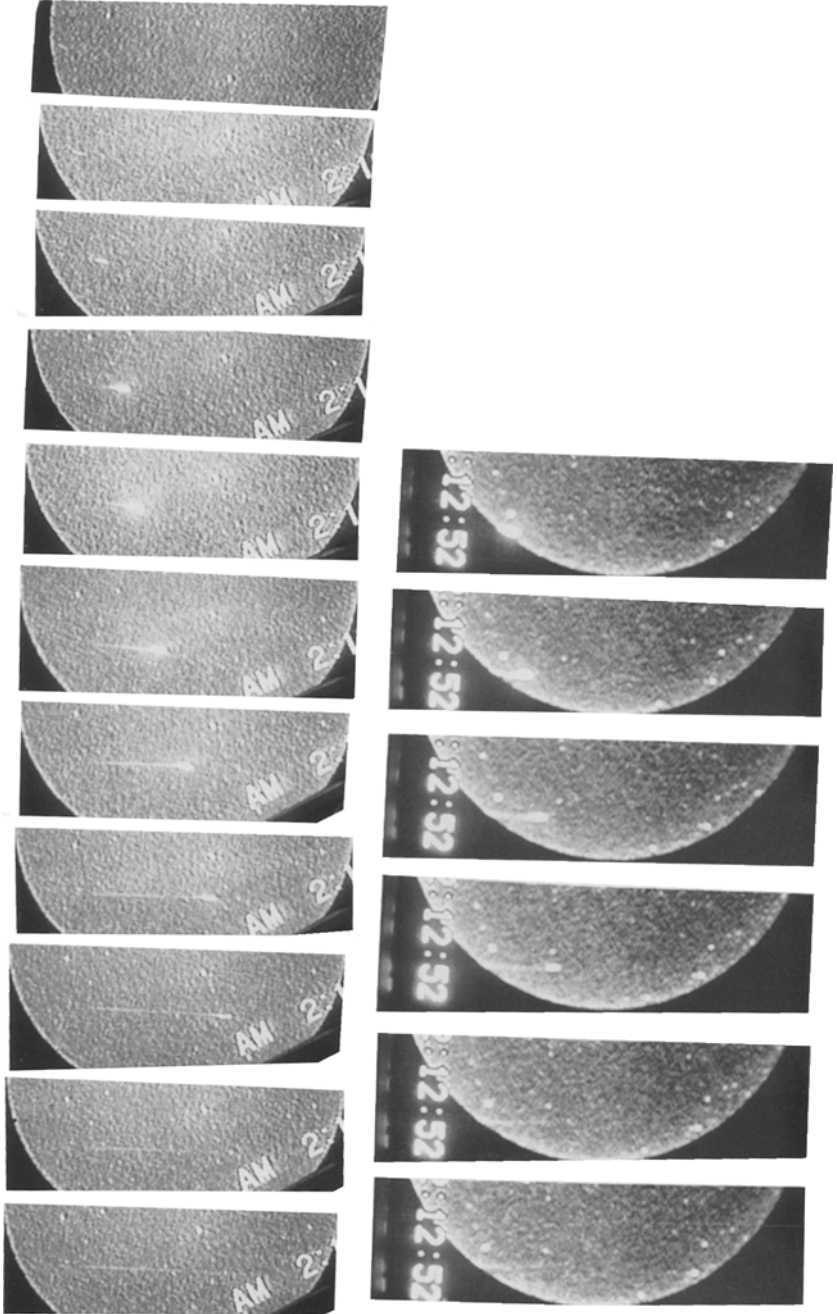
## 1 Introduction

A TV meteor observation system can detect faint meteors very effectively (Hawkes, 1993). Recently TV observations have been intensively carried out in Japan (Fujiwara, 1993). It is reported that TV meteors were recorded every 3 minutes in December 1991 (Ueda and Fujiwara, 1993).

Although faint meteors were mainly studied by radar meteor observations for many years, we are now able to study them by TV observations. Our group has been observing TV meteors continually, and has now collected a large amount of TV meteor data.

## 2 Observations

The observations were mainly carried out at Shigaraki, Shiga, Japan ( $136^{\circ} 06' 32''$  E,  $+34^{\circ} 51' 08''$  N) and at Muroh, Nara, Japan ( $136^{\circ} 00' 51''$  E,  $+34^{\circ} 34' 13''$  N). The baseline between the two locations was 33 km. Photographic lenses of f 85 mm F1.8 (Nikon) and f 85 mm F1.2 (Canon), with a field of  $16.9^{\circ}$  in diameter, were utilized. An image intensifier (Hamamatsu Photonics) and an 8 mm video camera were also used. The limiting star magnitude of this system was +8, and a meteor with magnitude of +7 could be recorded. Lenses of f 24 mm ( $53.0^{\circ}$  field of view) and f 58 mm ( $23.9^{\circ}$ ) were supplementary used.



### 3 Measurements

The recorded images were analyzed with a PC (Personal Computer). The meteor positions were measured on the 512x512 pixel, and the brightness was determined by 8 bits, i.e. a 256 gray level scale. The standard errors in the position and the brightness were 3' and 0.2 magnitude, respectively. The positions of 61 meteors, which were observed in the early part of the observations, were measured using the "Hogan-torapen" method by Yoshida et al. (1988) (with transparencies attached to the TV screen).

### 4 Summary of data

A total of 326 meteors were measured by double-station observations, and their radiant and orbits were determined. Among them, the radiant and orbits of 265 meteors are listed in Tables 1 and 2. The brightness measurements of the doubly observed TV meteors range from 0 to +7 in magnitude as shown in Figure 1. Meteors with +5 and +6 magnitudes were most commonly observed. The average brightness was +4.7 magnitude. Thus, the TV observations could record faint meteors which would not have been detected by photographic meteor techniques.

The standard deviation error in the obtained parameters was estimated by adding the errors of meteor position measurement in 10 different ways and calculating the deviation of the parameters. The error in the radiant determination was  $1.1^\circ$ .

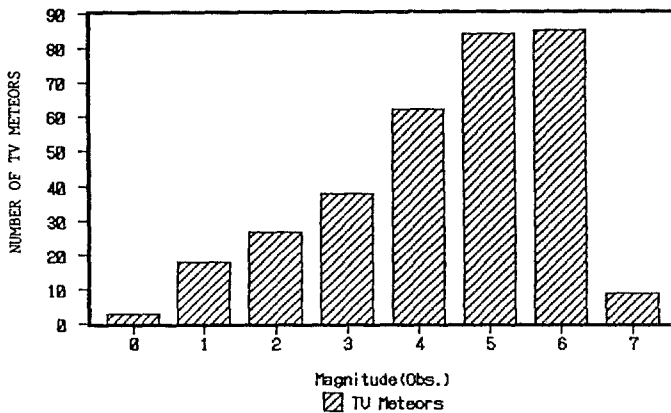


Figure 1: TV meteor magnitude distribution

TABLE-1. The radiant position, velocity and height of the TV meteors.

No.	DATE YYYYMMDD	UT hhmmss	RADIANT(2000.0)			Vobs. Km/s	dV Km/s	Vg Km/s	Q deg	obs. Mag.	abs. Mag.	Hb Km	Hm Km	He Km	dH Km	V error %	
			$\alpha$	$d\alpha$	$\delta$												$d\delta$
UF91001	19911116	173550	119.0	0.80	29.3	0.48			39.8	5.5	5.3	121	112	97	0.5		
UF91002	19911116	174605	154.8	0.88	22.5	0.34	71.7	0.4	70.5	18.1	3.1	2.9	120	113 *	107	0.2	11.2
UF91003	19911116	180339	179.7	1.79	23.3	0.75	65.1	0.3	63.8	14.9	6.7	6.4	115	115 *	111	0.3	13.9
UF91004	19911116	180834	161.9	2.59	30.3	0.84	68.3	0.8	67.1	15.9	5.9	5.6	123	115 *	115	0.3	24.4
UF91005	19911116	181801	190.7	5.00	39.1	0.94	57.9	0.3	56.5	10.6	6.1	5.7	111	108 *	108	0.3	15.4
UF91006	19911116	181933	152.2	1.08	40.9	0.16	66.2	0.5	65.1	21.9	6.5	6.4	108	103	96	0.2	23.0
UF91007	19911116	182636	133.4	4.00	59.6	2.13				6.0	5.0	4.9	115	103	90	1.4	
UF91008	19911116	184104	143.5	0.96	39.2	0.13	69.7	0.5	68.7	23.6	5.3	5.2	109	103	91	0.3	32.6
UF91009	19911116	185139	162.5	0.70	22.9	0.27	69.0	0.6	67.9	26.8	2.6	2.3 *	109	109	98	0.2	11.6
UF91010	19911116	185415	150.8	1.66	33.5	0.39	61.1	1.0	59.9	24.3	4.8	4.6	114	110	101	0.3	14.4
UF91011	19911116	185509	74.0	0.45	26.9	0.12	41.8	0.2	40.6	32.4	6.3	6.3	98	97	87	0.1	24.3
UF91012	19911116	191218	136.2	0.55	5.3	0.72	70.8	0.7	69.8	30.1	6.8	7.0	100	92	92	0.2	17.1
UF91013	19911116	191632	118.6	0.26	49.1	1.37	71.3	2.3		10.9	4.8	4.6	115	112	103	0.9	38.0
UF91014	19911116	192117	162.1	2.45	50.1	0.53	62.3	0.8	61.2	13.1	4.5	4.3	115	108	102	0.4	27.4
UF91015	19911116	192349	153.5	1.35	39.6	0.27	66.5	1.4		29.5	5.7	5.4	115	110	105	0.3	43.7
UF91016	19911116	194046	152.5	0.22	22.3	0.12	71.6	0.3	70.6	40.1	3.1	2.9	128	111	97	0.3	39.7
UF91017	19911116	194356	158.8	0.70	31.3	0.20	68.8	0.8	67.8	32.1	1.6	1.5	118	103	99	0.3	16.3
UF91018	19911116	194647	79.9	0.69	15.0	0.31	45.3	0.2	44.2	23.3	4.2	4.1	108	102	91	0.3	22.5
UF91019	19911116	200747	86.1	1.03	0.5	0.69	47.1	0.4	46.0	19.3	6.1	6.2	97	94	91	0.1	17.0
UF91020	19911116	201303	153.0	0.16	23.6	0.09	71.3	0.3	70.3	58.9	3.2	3.0	123	107	97	0.2	31.1
UF91021	19911117	180504	150.7	1.03	-5.2	1.05	70.6	0.5	69.4	19.0	6.2	5.9 *	116	113	111	0.2	28.8
UF91022	19911117	180735	182.7	2.98	46.5	0.35	68.6	0.7	67.5	13.8	5.1	4.8	117	113	105	0.3	18.5
UF91023	19911117	181003	108.6	0.22	14.1	0.24	63.6	0.6	62.6	55.2	5.5	5.3	114	108	103	0.2	11.5
UF91024	19911117	182158	182.2	10.12	63.6	0.35	46.8	0.9	45.3	5.9	2.9	3.0	99	97 *	89	0.7	9.2
UF91025	19911117	182428	129.9	1.24	21.0	0.56	89.1	1.8		30.8	5.6	5.3	116	111 *	108	0.3	13.0
UF91026	19911117	182810	150.3	2.69	28.8	0.79	66.1	1.1	64.9	20.3	6.5	6.3	116	109 *	109	0.2	6.5
UF91027	19911117	183002	220.7	2.68	38.1	1.78	46.6	0.2	44.9	9.4	6.1	6.0 *	109	106 *	105	0.5	26.0
UF91028	19911117	183025	62.4	0.99	15.9	0.48	29.9	0.2	28.0	24.5	4.9	5.0	101	95	94	0.1	32.7
UF91029	19911117	183220	59.3	2.13	32.8	0.47				28.6	6.4						
UF91030	19911117	183333	58.4	1.49	21.0	0.59	26.9	0.4	24.8	28.9	2.5	2.5 *	98	95	91	0.2	10.8
UF91031	19911117	183604	100.4	0.68	8.1	0.63	44.3	1.8	42.9	42.4	1.8	1.8	96	93	88	0.7	46.9
UF91032	19911117	183801	165.9	0.89	24.5	0.34	67.5	0.4	66.3	20.8	4.5	4.2	115	115	105	0.2	11.2
UF91033	19911117	183941	153.8	0.40	22.0	0.10	71.9	0.2	70.8	22.5	2.1	1.6	127	117 *	96	0.3	15.1
UF91034	19911117	184000	32.2	3.35	13.8	1.86	19.4	0.2	16.3	20.8	6.3	6.4	95	95	91	0.2	32.3
UF91035	19911117	184120	155.8	0.63	20.5	0.35	75.0	0.7	73.9	24.8	6.7	6.5	116	113	108	0.1	12.2
UF91036	19911117	184456	152.5	0.71	36.6	0.08	70.9	0.4	69.8	19.6	2.3	2.3	115	100	95	0.2	13.3
UF91037	19911117	185036	64.7	2.22	16.4	1.18	29.8	0.9	28.0	30.8	6.3	6.4 *	98	97	94	0.1	21.5
UF91038	19911117	185549	169.5	3.07	34.4	0.29	56.3	0.8	54.9	16.3	6.7	6.4	112	110	107	0.2	10.0
UF91039	19911117	190033	155.0	0.69	-7.4	0.59	66.0	0.4	64.8	18.4	4.6	4.4	118	111	106	0.2	10.9
UF91040	19911117	190049	146.4	0.48	-1.6	0.43	71.6	0.4	70.6	22.1	5.3	5.1	120	110	102	0.2	8.5
UF91041	19911117	190947	69.6	1.97	62.9	0.36	36.2	0.4	34.6	19.7	5.2	5.4	96	92	84	0.2	15.0
UF91042	19911117	191211	181.8	7.68	56.3	0.38	50.2	0.9	48.8	9.7	5.2	5.1	109	107	104	0.4	22.5
UF91043	19911117	191412	162.8	4.65	64.5	0.93	54.2	0.7	53.0	7.4	3.6	3.7	99	95	83	0.5	17.0
UF91044	19911117	191950	161.5	0.63	-9.6	0.75	57.4	2.5	56.1	20.1	5.0	4.8 *	112	108	101	0.1	13.9
UF91045	19911117	192751	146.0	0.42	16.8	0.30	76.1	0.5	75.1	32.6	5.8	5.6	117	110 *	101	0.1	11.2
UF91046	19911117	192814	80.8	0.44	23.9	0.13	21.1	0.1	18.2	39.0	5.3	5.5	91	87	79	0.1	31.9
UF91047	19911117	194241	168.3	1.88	26.7	0.35	39.9	0.5	38.1	23.1	6.5	6.4	107	105	104	0.1	40.5
UF91048	19911117	194327	150.7	0.41	-1.9	0.58	65.9	0.5	64.8	25.6	4.9	5.0	104	97	94	0.1	21.4
UF91049	19911117	194404	164.0	0.78	-26.0	0.78	51.4	0.2	50.0	15.9	5.4	5.4	103	99 *	96	0.2	10.6
UF91050	19911117	195024	153.9	0.48	4.9	0.63	66.8	0.9	65.7	23.7	4.3	4.1	116	108	106	0.2	14.9
UF91051	19911117	195313	151.6	4.84	49.8	3.63	62.8	4.1		7.6	4.5	4.4	112	106	102	1.1	46.2
UF91052	19911212	170127	156.9	0.30	13.4	0.13	65.1	0.4	63.9	47.0	5.8	5.7	106	95	94	0.1	14.3
UF91053	19911212	170645	125.2	0.81	-4.6	3.25	80.6	0.7		5.1	6.5	6.1	112	111	97	0.9	31.1
UF91054	19911212	171132	110.8	1.74	32.9	0.48	35.8	0.9	34.1	38.8	6.5	6.4	100	97	95	0.2	24.9
UF91055	19911212	172013	149.2	1.21	24.2	0.12	61.5	4.7	60.3	84.0	2.4	2.3	105	99	90	1.0	9.8
UF91056	19911212	173316	110.3	0.83	32.6	0.18	33.9	0.3	32.1	34.3	3.1	3.0	103	98	91	0.2	14.9
UF91057	19911212	173453	70.1	0.87	16.7	0.31	24.9	0.1	22.6	20.5	5.3	5.4	93	87	85	0.1	12.0
UF91058	19911212	173526	182.8	1.64	30.7	0.40	53.7	1.0	52.3	21.2	7.0	6.8	111	107	106	0.2	14.8
UF91059	19911212	173624	164.1	0.60	-27.1	1.12	61.9	0.5	60.7	18.5	6.5	6.1	107	107	104	0.2	12.9
UF91060	19911212	173631	110.8	0.96	32.5	0.20	34.9	0.3	33.1	30.4	3.6	3.4	102	97	90	0.1	13.5
UF91061	19911212	174059	178.8	0.28	1.8	0.26	70.1	0.2	68.9	25.1	5.6	5.2	112	108 *	97	0.2	12.8
UF91062	19911212	174059	187.1	0.52	-1.5	0.25	70.8	0.4	69.6	22.2	6.5	6.1	107	107	100	0.2	15.5
UF91063	19911212	174322	152.4	0.03	6.9	0.33	68.4	0.5	67.3	29.6	3.7	3.4	122	108	103	0.3	15.8
UF91064	19911212	174458	152.2	0.15	5.8	0.67	77.1	1.8	76.1	35.2	6.7	6.3	113	108	106	0.3	13.0
UF91065	19911212	174519	115.2	0.98	31.4	0.23	37.0	0.4	35.3	30.8	5.7	5.5	100	97	91	0.1	14.8
UF91066	19911212	175151	106.0	2.39	-15.7	2.68	39.1	0.6	37.6	9.8	1.9	1.9	92	92	84	0.2	21.8

No.	DATE	UT	RADIANT(2000.0)			Vobs. dV Vg			Q	obs.	abs.	Hb	Hm	He	dH	V error	
	YYYYMMDD	hhmmss	$\alpha$	$\delta$	$\delta$	Km/s	Km/s	Km/s	deg	Mag.	Mag.	Km	Km	Km	Km	%	
UF91067	19911212	175532	115.6	0.96	33.4	0.13	36.7	0.4	35.1	30.4	4.2	4.1	104	95	88	0.2	18.5
UF91068	19911212	180354	112.5	0.32	33.1	0.07	35.2	0.1	33.5	32.3	1.6	1.6	106	90	78	0.1	14.9
UF91069	19911212	180410	150.1	0.18	17.6	0.28	56.3	1.2	55.1	58.6	6.2	5.9	107	102	97	0.3	27.4
UF91070	19911212	180706	165.9	1.80	-13.2	2.70	59.6	2.2	58.3	22.3	5.8	5.4	* 111	111	108	0.3	36.6
UF91071	19911212	180706	176.2	0.71	18.3	0.27	69.9	1.1	68.7	34.8	5.7	5.3	115	111	105	0.3	23.4
UF91072	19911212	180720	177.7	0.84	5.9	0.83	69.3	1.1	68.1	31.5	5.7	5.4	107	104	101	0.2	8.7
UF91073	19911212	180834	133.0	4.44	-26.1	9.11				2.0	5.5	5.2	117	110	107	1.2	
UF91074	19911212	180925	131.6	1.18	13.9	0.38	59.4	1.4	58.4	31.1	6.2	5.9	108	105	99	0.2	12.2
UF91075	19911212	180939	173.2	0.62	19.8	0.26	66.6	0.9	65.4	38.7	5.7	5.4	111	110	101	0.2	11.3
UF91076	19911212	181000	131.2	0.93	0.3	0.86	60.3	0.9		13.1	2.9	2.5	112	107	95	0.5	42.2
UF91077	19911212	181043	111.2	1.92	33.1	0.39	33.7	0.6	31.9	31.1	6.4	6.3	99	94	92	0.2	17.0
UF91078	19911212	181125	110.7	2.05	32.6	0.44	36.6	0.7	34.9	32.2	5.5	5.5	100	96	92	0.2	34.4
UF91079	19911212	181157	161.6	0.45	6.4	0.54	73.6	1.0	72.6	42.5	6.6	6.5	103	97	96	0.2	5.3
UF91080	19911212	181257	97.0	4.19	33.7	0.64	29.5	0.6	27.5	22.0	6.4	6.3	99	95	92	0.3	29.6
UF91081	19911212	181431	202.4	5.44	50.9	0.64	52.4	1.0	51.0	7.5	1.7	1.7	110	99	* 99	0.7	28.0
UF91082	19911212	181444	138.4	0.59	17.2	0.36	64.1	1.2	63.1	33.5	6.4	6.3	103	99	91	0.4	34.6
UF91083	19911212	181527	143.1	0.82	25.5	0.40	57.0	1.7	55.9	74.9	5.6	5.2	112	110	104	0.2	12.6
UF91084	19911212	181554	105.9	3.03	32.7	0.57	30.9	0.8	28.9	31.5	4.9	4.9	96	96	90	0.2	15.9
UF91085	19911212	181624	101.8	1.58	-4.7	1.03	40.9	0.4	39.6	14.6	3.3	3.2	103	101	94	0.2	13.7
UF91086	19911212	181935	127.3	1.85	20.2	0.62	54.7	1.6	53.6	34.1	4.9	4.7	102	102	97	0.2	12.1
UF91087	19911212	181944	156.8	0.07	-16.6	0.52	64.6	0.4	63.5	12.8	2.1	1.7	108	102	92	0.3	19.5
UF91088	19911212	182250	188.3	0.48	24.3	0.13	63.6	0.5	62.4	28.7	2.9	2.5	116	109	101	0.2	11.1
UF91089	19911212	182300	109.9	0.75	32.9	0.15	34.2	0.2	32.5	28.3	3.3	3.3	102	93	83	0.2	16.7
UF91090	19911212	182954	153.3	0.40	29.2	0.28	61.7	1.4	60.6	82.6	5.6	5.4	105	103	97	0.3	13.3
UF91091	19911212	183043	117.2	1.19	31.4	0.62	37.3	0.6	35.7	37.8	4.7	4.7	* 97	95	86	0.2	17.6
UF91092	19911212	183202	188.5	0.55	-8.4	0.52	69.3	7.5	68.1	20.5	5.5	5.1	121	113	* 109	0.3	10.8
UF91093	19911212	183324	222.5	6.53	50.1	0.26	38.5	0.5	36.6	8.7	5.4	5.2	105	101	99	0.5	22.4
UF91094	19911212	183527	150.8	7.13	37.3	6.25	50.6	18.8	49.2	36.7	4.5	4.3	101	97	94	2.9	23.8
UF91095	19911212	183635	192.1	0.96	-11.6	1.22	65.1	0.6	63.9	18.3	6.5	6.1	118	112	* 112	0.2	18.3
UF91096	19911212	183729	114.6	1.02	32.8	0.13	36.3	0.3	34.7	27.7	6.0	5.9	100	98	89	0.1	17.3
UF91097	19911212	183850	112.6	1.63	32.5	0.36	37.8	0.6	36.2	30.8	6.8	6.8	102	100	94	0.2	19.4
UF91098	19911212	184135	125.4	0.50	0.7	0.35	55.0	0.3	53.9	17.1	1.7	1.5	* 114	103	86	0.2	21.6
UF91099	19911212	184521	165.2	0.48	31.0	0.51	67.2	2.8	66.1	80.3	6.8	6.5	111	109	103	0.4	4.9
UF91100	19911212	184521	153.1	0.44	8.5	2.01	65.0	2.1	63.9	30.1	7.3	7.0	114	109	107	0.3	45.9
UF91101	19911212	184542	152.8	0.37	27.7	0.16	60.6	0.9	59.5	78.8	4.7	4.4	113	107	101	0.2	12.7
UF91102	19911212	185551	137.2	0.71	25.3	0.18	61.7	0.7	60.7	30.0	3.2	2.8	114	105	98	0.2	18.1
UF91103	19911212	185742	177.6	0.21	17.3	0.21	68.2	0.6	67.1	62.0	6.2	5.9	111	106	94	0.2	13.7
UF91104	19911212	185959	109.4	3.19	32.5	0.67	33.0	0.7	31.3	25.5	6.6	6.5	97	97	93	0.2	13.2
UF91105	19911212	190341	106.4	2.50	33.5	0.37	35.3	0.4	33.7	21.5	6.9	6.8	100	96	92	0.2	20.6
UF91106	19911212	190349	100.7	1.72	7.4	0.71	42.9	0.3	41.7	15.8	3.3	3.2	101	96	* 94	0.2	9.8
UF91107	19911212	190524	194.0	0.48	-5.0	0.65	67.7	0.5	66.4	23.5	6.4	6.2	107	104	98	0.2	17.6
UF91108	19911212	190741	146.1	1.45	9.2	1.22	51.8	2.5	50.6	24.1	5.8	5.4	110	109	104	0.5	33.7
UF91109	19911212	190843	200.1	1.16	23.3	0.34	57.3	1.1	55.9	28.8	5.9	5.6	103	103	98	0.2	13.6
UF91110	19911212	191352	184.7	0.47	30.2	0.20	63.1	1.2	61.9	51.1	3.2	2.9	113	105	101	0.2	16.5
UF91111	19911212	191541	111.3	1.28	37.7	0.22	35.2	0.3	33.6	23.7	4.6	4.6	101	95	86	0.2	11.6
UF91112	19911212	191700	158.4	1.57	9.7	2.13				8.8	7.1	6.7	111	110	102	0.5	
UF91113	19911212	191726	115.4	1.04	33.7	0.22	38.9	0.3	37.5	26.4	6.3	6.3	102	97	88	0.2	14.4
UF91114	19911212	191835	158.2	0.87	17.6	0.94	50.4	2.2	49.1	24.8	4.0	4.0	96	93	89	0.8	29.6
UF91115	19911212	192246	145.6	1.15	3.2	0.88	66.5	0.9	65.6	14.3	6.3	5.9	106	106	94	0.4	30.3
UF91116	19911212	192644	156.3	1.16	33.4	0.26	62.9	1.7	61.8	50.0	6.7	6.3	110	108	102	0.3	27.5
UF91117	19911212	192732	115.2	2.34	31.8	0.39	36.9	0.5	35.4	23.8	6.3	6.2	101	99	94	0.2	13.5
UF91118	19911212	192738	130.3	1.04	2.6	0.60	60.9	0.5	60.0	14.7	4.5	4.1	113	108	98	0.3	8.9
UF91119	19911212	192751	181.0	0.40	23.0	0.42	65.1	1.2	63.9	63.8	4.2	4.0	114	107	102	0.3	12.8
UF91120	19911212	192913	146.7	3.50	40.3	1.41	42.7	1.7	41.3	27.8	7.1	6.8	107	103	101	0.3	29.0
UF91121	19911212	193619	168.9	0.22	13.4	1.03	70.5	2.1	69.5	31.5	2.7	2.4	118	108	* 108	0.3	7.6
UF91122	19911212	193624	159.2	2.51	-27.4	6.46	55.2	1.1	54.0	3.8	4.4	3.9	111	110	105	1.0	37.5
UF91123	19911212	193800	111.3	1.85	32.7	0.31	35.5	0.3	33.9	22.7	6.5	6.3	99	99	91	0.2	15.1
UF91124	19911212	193806	165.9	0.59	24.8	0.25	64.3	1.1	63.3	71.6	6.7	6.3	115	109	103	0.3	14.9
UF91125	19911212	194139	177.8	0.09	12.9	0.44	79.1	0.7	78.1	24.1	4.2	3.8	122	111	99	0.7	27.6
UF91126	19911212	194228	110.2	1.94	31.4	0.52	35.8	0.3	34.3	20.8	6.1	6.0	99	97	91	0.2	10.4
UF91127	19911212	194413	261.4	2.76	42.0	0.59	32.9	0.2	30.6	7.2	2.3	2.2	104	99	* 97	0.4	16.7
UF91128	19911212	194417	157.5	0.49	33.7	0.11	64.2	0.5	63.2	46.9	2.9	2.6	123	107	97	0.2	14.3
UF91129	19911212	194913	200.4	4.93	46.8	2.18	54.9	2.7	53.6	11.8	6.7	6.5	108	106	104	0.4	38.3
UF91130	19911212	200044	188.5	0.34	18.3	0.26	56.3	0.7	55.0	59.2	6.1	6.1	103	97	* 93	0.2	14.3
UF91131	19911212	200157	112.5	2.10	33.2	0.43	37.2	0.3	35.7	18.9	2.1	1.9	104	94	* 94	0.2	6.9
UF91132	19911212	200331	159.6	1.24	-0.2	1.24	78.3	1.2	77.5	10.4	5.3	5.1	109	100	95	0.5	22.7
UF91133	19911212	200937	113.2	2.14	33.2	0.43	36.0	0.2	34.4	18.9	3.8	3.6	101	95	* 93	0.2	7.1
UF91134	19911212	201044	216.2	5.05	56.1	1.88	51.6	0.4	50.2	3.5	3.1	3.0	112	99	89	1.3	37.6
UF91135	19911212	201755	113.5	3.35	34.4	0.86	35.8	0.6	34.3	24.4	6.3	6.4	* 92	92	89	0.1	5.5
UF91136	19911212	201944	151.0	1.25	4.1	0.80	73.1	1.1	72.4	16.9	6.3	5.9	120	110	107	0.3	30.6
UF91137	19911212	202142	193.1	0.81	27.9	0.41	33.7	1.3		61.3	6.3	6.2	99	96	92	0.2	38.3

No.	DATE YYYYMMDD	UT hhmmss	RADIANT(2000.0)			Vobs. dV		Vg Km/s	Q deg	obs. Mag.	abso. Mag.	Hb Km	Hm Km	He Km	dH Km	V %	error %
			$\alpha$	$d\alpha$	$\delta$	$d\delta$	Km/s										
UF91138	19911212	202324	80.8	2.75	12.6	1.74	29.6	0.2	27.8	17.1	6.6	6.5	99	99	97	0.2	12.2
UF91139	19911212	202453	198.5	0.78	11.3	0.74	55.8	1.4	54.4	44.5	6.5	6.2	109	106	103	0.3	13.6
UF91140	19911212	202950	114.3	1.53	33.2	0.38	34.6	0.2	33.0	19.8	5.3	5.1	101	98	90	0.2	10.4
UF91141	19911212	203103	233.3	4.19	2.0	3.11	13.3	0.3	6.6	35.7	4.6	5.0	82	79	76	0.3	23.3
UF91142	19911212	203256	59.8	1.52	15.0	1.17	17.3	0.1	13.8	19.5	5.2	5.3	92	91	90	0.2	9.8
UF91143	19911212	203426	114.0	1.77	34.0	0.29	37.4	0.2	36.0	18.7	6.1	5.8	105	104	94	0.2	16.3
UF91144	19911212	203822	113.8	1.83	32.9	0.62	36.4	0.2	34.9	19.8	6.2	6.1	101	99	93	0.2	14.3
UF91145	19911212	203911	232.7	38.81	75.6	3.55	33.1	0.8	31.1	5.2	5.0	4.7	105	105	101	0.6	33.2
UF91146	19911212	204052	118.4	4.74	4.4	2.77	48.8	0.7	47.8	13.9	6.1	5.7	108	107	105	0.3	6.6
UF91147	19911212	204451	168.4	0.62	53.6	0.51	56.8	0.4	55.7	22.0	1.3	1.0	117	105	94	0.2	19.4
UF91148	19911212	132341	109.5	18.15	46.4	15.27	67.5	4.1	66.4	5.3	1.8	1.6	92	88	78	3.2	67.7
UF91149	19911212	142324	105.2	1.81	32.3	0.80	32.4	1.7	30.3	49.2	2.7	2.6	88	87	84	1.5	56.8
UF91150	19911212	143838	110.2	0.32	33.5	0.91	35.4	1.5	33.5	64.2	1.8	1.8	99	92	83	0.6	51.2
UF91151	19911212	151216	153.3	3.80	12.9	0.40	71.9	0.9	70.7	14.1	2.4	1.9	114	109	106	0.8	21.3
UF91152	19911212	152218	116.9	1.78	32.4	0.19	33.3	0.7	31.2	30.6	2.4	2.5	98	89	85	0.5	36.9
UF91153	19911212	155444	112.9	4.21	32.9	2.80	34.0	2.4	32.0	32.8	2.7	2.3	97	92	90	0.5	20.0
UF92001	19920829	163721	49.7	1.18	-14.5	1.47	62.0	0.3	60.7	14.4	2.9	2.7	114	106	106	0.4	15.7
UF92002	19920829	164034	311.0	5.94	55.1	0.61	33.5	1.1	31.7	29.5	5.5	5.5	100	100	95	0.2	12.8
UF92003	19920829	164628	33.3	4.35	33.3	1.31	71.4	3.2	70.4	8.6	6.9	6.8	111	105	102	0.7	25.1
UF92004	19920829	164919	273.1	2.00	2.9	8.33	22.3	0.3	19.7	4.6	5.6	6.1	80	80	79	0.9	50.2
UF92005	19920829	171252	90.6	4.68	1.9	2.51	61.3	0.3	59.9	4.0	2.0	2.1	* 96	94	92	0.9	10.9
UF92006	19920829	172300	270.6	1.38	58.2	0.48	23.8	0.1	21.3	20.1	2.1	2.3	100	93	88	0.2	14.3
UF92007	19920829	172723	43.5	0.66	5.8	0.91	55.8	0.8	54.5	28.1	3.1	3.1	103	99	95	0.2	14.3
UF92008	19920829	173313	347.4	1.39	-0.9	2.04	27.1	0.4	25.0	17.0	6.2	6.2	101	98	* 95	0.3	19.1
UF92009	19920829	173326	75.3	1.18	36.3	0.15	74.2	0.6	73.1	8.6	2.9	2.8	119	107	* 100	0.4	40.7
UF92010	19920829	173805	53.6	1.68	24.5	0.62	39.7	1.9	38.8	6.1	5.1	4.9	118	109	* 99	0.9	35.5
UF92011	19920829	173934	67.1	3.92	43.8	0.36	53.7	1.2	52.3	15.2	5.9	5.8	101	99	* 95	0.3	9.3
UF92012	19920829	180059	43.2	4.09	51.9	0.36	57.7	0.5	56.5	39.2	4.0	3.9	111	104	97	0.2	16.4
UF92013	19920829	180216	86.1	0.92	-17.3	0.97	56.2	0.1	54.7	11.9	5.1	4.9	110	109	* 106	0.2	3.0
UF92014	19920829	180616	53.2	3.07	27.7	1.91	55.0	2.0	53.7	25.9	7.0	6.8	110	110	104	0.4	32.0
UF92015	19920829	182431	72.6	1.18	-4.9	1.44	68.0	0.7	66.8	14.9	5.9	5.7	114	107	* 107	0.2	13.2
UF92016	19920829	182555	348.6	2.46	-23.2	3.19	31.3	0.2	29.5	13.5	6.0	6.0	105	101	* 101	0.3	9.9
UF92017	19921117	160508	69.5	0.13	13.6	0.21	36.2	0.3	34.4	52.7	0.8	0.9	113	91	* 88	0.4	13.8
UF92018	19921117	161233	143.0	8.15	63.3	0.45	87.4	0.2	66.3	6.0	6.0	5.7	118	110	* 102	0.5	17.1
UF92019	19921117	161408	111.9	0.74	-31.3	0.72	51.3	0.1	49.9	14.4	1.1	0.8	* 108	107	* 99	0.3	6.0
UF92020	19921117	163202	120.0	0.35	25.0	0.09	69.2	0.2	68.1	25.0	1.8	1.7	131	103	* 98	0.2	15.9
UF92021	19921117	163714	81.9	0.91	17.3	0.59	49.3	2.5	48.1	61.6	5.4	5.5	98	93	* 93	0.3	9.7
UF92022	19921117	163823	170.7	1.64	17.5	0.81	66.9	0.2	65.6	14.5	6.4	6.2	112	110	108	0.4	21.5
UF92023	19921117	163950	135.3	1.11	24.4	0.16	69.5	0.5	68.3	19.0	5.2	4.8	115	112	102	0.2	12.9
UF92024	19921117	165851	347.5	9.63	75.0	0.58	28.3	0.2	26.2	9.1	4.3	4.3	* 100	95	91	0.3	22.1
UF92025	19921117	165912	168.8	3.04	24.9	1.01	66.7	0.2	65.4	13.9	5.8	5.5	113	113	109	0.4	10.7
UF92026	19921117	170341	126.6	0.63	10.8	0.36	72.1	0.5	71.0	21.8	1.7	1.5	130	111	* 111	0.3	8.3
UF92027	19921117	170704	127.4	0.78	12.8	0.29	69.4	0.6	67.2	23.7	5.3	4.9	118	115	102	0.3	21.8
UF92028	19921117	173114	177.2	2.21	32.2	0.63	64.9	0.4	63.6	13.7	4.4	4.1	* 112	112	106	0.3	8.7
UF92029	19921117	173651	159.0	2.69	37.3	0.28	66.4	0.5	65.1	13.5	6.3	6.1	114	106	103	0.3	23.3
UF92030	19921117	173704	120.2	1.29	11.2	0.55	70.0	1.5	68.9	32.7	7.2	7.2	105	102	99	0.2	14.1
UF92031	19921117	175315	118.3	1.19	32.1	0.19	81.3	2.1	80.4	39.0	5.3	5.3	114	103	96	0.6	47.0
UF92032	19921117	180542	140.2	1.09	28.5	0.42	61.4	1.3	60.2	33.9	5.6	5.7	103	97	94	0.3	10.1
UF92033	19921117	181514	54.2	1.15	9.7	0.59	20.9	0.2	18.0	24.3	6.1	6.3	99	93	92	0.2	31.5
UF92034	19921117	182231	20.4	6.72	58.7	1.26	23.6	0.2	21.1	16.1	6.3	6.4	98	97	93	0.3	29.1
UF92035	19921117	182408	70.6	3.91	-32.6	7.03	47.4	0.2	46.3	5.4	7.2	7.2	103	100	100	0.7	34.9
UF92036	19921117	182803	121.9	0.44	23.0	0.34	63.9	1.2	62.9	68.0	4.8	4.8	104	103	96	0.2	12.5
UF92037	19921117	183008	138.1	0.57	3.8	0.66	64.4	0.7	63.2	26.6	5.5	5.4	113	106	100	0.3	16.3
UF92038	19921117	184035	145.1	0.58	10.0	0.19	70.3	0.5	69.2	26.4	4.7	4.3	117	108	100	0.2	14.3
UF92039	19921117	184310	132.7	0.95	28.5	0.17	57.5	0.5	56.3	46.2	1.9	1.8	118	108	98	0.2	8.0
UF92040	19921117	184740	109.7	0.35	15.0	0.76	23.5	0.5	20.7	36.4	5.1	5.2	97	90	83	0.9	28.5
UF92041	19921117	185251	131.4	0.42	2.9	0.51	68.2	0.9	67.2	33.0	6.1	6.0	116	103	102	0.2	17.8
UF92042	19921117	190610	156.5	0.46	20.9	0.13	69.6	0.5	68.5	31.4	4.8	4.6	109	102	94	0.2	14.0
UF92043	19921117	190625	47.1	1.85	18.0	0.60	24.9	0.1	22.7	19.9	4.8	4.7	109	95	95	0.2	13.4
UF92044	19921117	190926	41.6	2.15	29.0	0.75	22.3	0.2	19.7	21.5	5.5	5.7	98	92	91	0.3	12.6
UF92045	19921117	190939	176.0	5.99	53.7	0.36	60.9	1.0	59.7	11.2	6.6	6.4	113	109	* 105	0.3	19.2
UF92046	19921117	191107	165.3	0.80	20.5	0.25	66.7	0.5	65.5	25.1	3.4	3.3	114	108	100	0.2	9.7
UF92047	19921117	191348	63.2	1.22	22.0	0.66	22.8	0.4	20.3	29.1	4.5	4.6	93	92	89	0.2	18.4
UF92048	19921117	192015	152.8	0.30	22.1	0.10	72.5	0.4	71.4	34.3	0.8	0.4	* 123	112	95	0.2	11.7
UF92049	19921117	192530	161.0	0.89	25.2	0.30	66.4	0.8	65.2	25.6	3.4	3.1	117	112	* 108	0.2	20.4
UF92050	19921117	193104	159.9	4.28	56.2	1.31	61.4	1.3	60.3	10.3	4.7	4.5	110	106	96	0.6	17.8
UF92051	19921122	121951	67.6	4.27	20.7	2.13	25.7	0.5	22.9	8.0	3.9	3.9	100	96	90	0.6	30.4

No.	DATE YYYYMMDD	UT hhmmss	RADIANT(2000.0)			Vobs. dV Vg			Q deg	obs. Mag.	abs. Mag.	Hb Km	Hm Km	He Km	dH Km	V error %	
			$\alpha$	$\delta$	$\delta$	Km/s	Km/s	Km/s									
UF92052	19921122	122628	350.4	0.91	42.4	0.22	17.8	0.3	14.1	42.4	2.5	2.7	98	87	80	0.2	23.6
UF92053	19921122	122921	54.0	4.49	36.1	1.66	20.5	0.7	17.0	21.7	5.1	5.4 *	91	88	84	0.2	27.3
UF92054	19921122	130924	40.4	0.16	11.4	0.60	18.7	0.3	15.0	63.0	1.8	2.3	86	78	71	0.1	20.9
UF92055	19921122	135708	69.7	3.50	25.7	1.75	23.3	1.0	20.4	27.8	5.7	5.8	96	95	92	0.6	20.2
UF92056	19921122	172348	87.5	0.44	13.4	1.38	39.9	0.9	38.4	40.1	4.6	4.6	103	98 *	98	0.1	17.4
UF92057	19921122	173336	64.6	1.36	-3.1	1.43	29.1	0.3	27.1	13.0	3.4	3.4	104	96 *	96	0.2	20.0
UF92058	19921122	174154	116.0	0.28	5.4	0.59	60.0	0.5	58.9	32.9	5.8	5.9	101	95	92	0.1	13.3
UF92059	19921122	174319	176.9	0.92	-11.9	0.61	60.1	0.1	58.7	9.0	5.0	5.0 *	98	97 *	95	0.3	13.1
UF92060	19921122	175542	134.6	2.07	28.0	0.70	75.6	1.5	74.6	9.6	6.6	6.3	112	110 *	101	0.4	10.1
UF93001	19930319	151432	178.1	0.71	2.3	1.09	24.5	0.5	21.8	31.6	5.8	5.8	101	95	94	0.3	44.9
UF93002	19930319	151446	202.8	0.50	-15.8	0.85	37.9	0.4	36.0	24.8	3.1	3.0	97	95	88	0.2	18.7
UF93003	19930319	151651	257.4	12.02	63.8	1.94	30.6	0.4	28.3	9.5	6.9	6.7	103	101	98	0.4	19.6
UF93004	19930319	151755	213.8	0.98	5.5	0.60	34.3	0.7	32.2	26.5	5.3	5.4	94	90	83	0.3	20.6
UF93005	19930319	152326	208.1	3.24	28.3	1.89	28.2	0.9	25.8	11.4	4.9	4.8	100	95	91	0.5	54.6
UF93006	19930319	153924	177.8	7.87	7.0	3.59	16.6	1.8	12.4	17.2	5.4	5.5	88	88	84	0.4	46.4
UF93007	19930319	160836	203.6	0.98	11.1	1.17	23.1	2.4	20.2	87.7	4.0	4.0	104	96	91	1.5	24.2
UF93008	19930319	161656	201.8	0.93	4.2	0.48	33.8	0.9	31.9	88.4	6.4	6.4	95	88	82	0.3	27.0
UF93009	19930319	162512	247.9	3.28	64.1	1.41	30.1	0.2	27.8	12.3	6.3	6.2	101	93 *	89	0.3	30.9
UF93010	19930319	164254	248.6	3.11	13.8	0.50	66.9	1.2	65.8	6.7	5.7	5.7	103	95 *	93	0.8	29.1
UF93011	19930319	164715	227.2	0.94	-27.0	1.35	63.3	0.7	62.1	15.9	5.8	5.4	115	113 *	106	0.5	18.9
UF93012	19930319	170144	200.4	1.26	3.9	2.02	33.6	1.5	31.8	18.7	4.0	4.2	100	90	85	1.5	48.0
UF93013	19930319	170739	312.1	17.59	44.3	1.80	35.7	0.2	33.7	5.3	6.5	6.4	101	100	99	0.7	33.6
UF93014	19930319	170834	221.7	8.82	-18.8	15.01	23.0	3.1	20.0	23.9	6.4	6.3	100	98	95	0.3	28.3
UF93015	19930319	171831	256.2	2.57	56.2	1.05	32.7	0.5	30.6	12.1	4.7	4.7	105	94	89	0.3	16.8
UF93016	19930319	172531	203.8	1.55	-7.8	1.75	31.1	0.8	29.1	12.3	6.3	6.1	102	99	93	0.4	49.2
UF93017	19930319	173436	265.7	2.83	0.9	1.06	65.0	2.0	63.8	10.7	4.5	4.1	112	110	103	0.6	19.1
UF93018	19930319	173820	197.4	2.57	-6.3	1.80	38.5	0.8	37.0	5.7	2.0	2.0	101	94	86	0.7	61.2
UF93019	19930319	174436	274.9	15.12	-39.5	8.83	11.9	0.2	3.6	22.3	4.3	4.6	81	81	78	0.2	40.7
UF93020	19930319	175456	213.1	3.49	21.2	1.37	37.9	2.4	36.3	32.7	5.8	5.7	97	92 *	88	0.6	24.0
UF93021	19930319	175517	257.9	4.21	14.7	0.22	69.8	2.9	68.7	6.4	4.1	3.7	116	109	104	0.8	49.7
UF93022	19930319	180430	256.4	1.05	1.5	0.61	66.3	1.2	65.1	18.8	5.1	4.8	117	107	104	0.4	21.1
UF93023	19930319	181422	249.5	2.43	18.6	0.26	79.6	4.2	74.7	15.8	6.1	5.9	114	107	105	0.7	27.4
UF93024	19930319	181737	209.9	2.07	-3.6	1.73	32.4	0.7	30.6	7.6	5.6	5.4	105	98	92	0.6	62.9
UF93025	19930319	182048	292.3	1.73	-0.7	0.58	69.4	0.4	68.2	8.9	6.2	6.1	105	99	98	0.4	17.6
UF93026	19930319	183016	278.0	7.55	69.6	2.41	24.3	0.4	21.5	13.2	6.3	6.3	101	99	94	0.3	26.3
UF93027	19930319	183626	175.6	8.04	9.7	1.86	19.4	0.3	18.3	7.9	5.7	5.9	88	88	86	0.4	30.5
UF93028	19930319	183814	197.0	2.96	-13.3	2.01	58.9	2.1	58.0	3.2	3.0	2.7	119	104 *	99	1.4	31.6
UF93029	19930319	184230	240.8	0.14	-8.0	0.54	62.0	0.7	60.9	35.4	6.9	6.6	107	105	94	0.3	17.7
UF94001	19940506	171443	304.1	0.86	-11.8	4.86	72.9	0.4	71.8	6.5	4.4	4.0	107	100 *	100	0.9	17.8
UF94002	19940506	171636	256.2	1.11	27.3	1.26	37.5	1.2	35.8	70.5	4.0	3.8	102	97	92	0.4	21.3
UF94003	19940506	172029	337.4	1.28	0.2	1.61	67.7	0.4	66.4	24.0	4.7	4.2	117	114 *	114	0.3	14.2
UF94004	19940506	172257	338.4	0.46	-0.8	0.41	68.1	0.1	66.8	26.6	3.2	2.8 *	121	115 *	112	0.4	6.5
UF94005	19940506	172749	252.4	1.26	27.6	1.09	34.5	1.0	32.7	63.9	3.2	3.3	90	90	81	0.4	13.9
UF94006	19940506	172857	338.6	0.52	-0.8	0.57	65.9	0.2	64.5	28.6	4.7	4.3	114	105	102	0.5	14.0
UF94007	19940506	173044	338.0	0.47	-0.5	0.26	67.0	0.3	65.7	32.7	1.2	0.5	123	103	94	1.2	8.1
UF94008	19940506	173419	349.3	0.69	9.5	0.39	59.8	0.2	58.4	34.5	4.5	4.5	102	98 *	98	0.2	8.2
UF94009	19940506	173807	243.6	2.05	13.9	0.95	31.9	0.6	30.0	36.1	2.9	2.8	98	93	86	0.5	9.1
UF94010	19940506	174217	338.9	1.64	-0.4	1.72	69.9	0.5	68.6	24.6	3.3	3.0	117	112 *	111	0.7	9.2
UF94011	19940506	174729	245.7	2.53	-11.9	3.15	26.2	0.4	23.9	37.2	4.5	4.6	91	90	86	0.3	12.2
UF94012	19940506	175204	243.4	1.39	-11.7	1.58	34.5	0.2	32.9	32.9	4.9	4.8	93	92	88	0.2	11.6
UF94013	19940506	175648	271.2	1.17	-23.6	2.76	39.0	0.3	37.3	22.9	5.1	5.2	96	92	89	0.3	12.8
UF94014	19940506	180237	337.5	0.33	0.1	0.57	69.3	0.2	68.0	22.8	3.3	2.6	120	115	108	0.5	9.1
UF94015	19940506	180625	339.3	0.59	-1.6	0.89	67.7	0.2	66.4	24.4	1.4	1.2	121	108 *	106	0.5	12.3
UF94016	19940506	181108	339.7	1.12	-2.6	1.60	60.3	0.9	65.6	23.8	3.6	2.9	116	109	103	1.9	27.8
UF94017	19940506	182656	339.7	0.60	-3.4	1.00	64.6	0.4	63.3	23.6	4.7	4.3	114	107	104	0.4	14.7
UF94018	19940506	183133	338.8	0.87	-1.3	1.05	65.6	0.6	64.3	29.8	2.6	1.9	113	108	99	1.0	9.8
UF94019	19940506	183227	258.3	1.56	20.3	1.43	38.1	0.6	36.6	38.8	2.7	2.5	95	95 *	86	0.3	12.6
UF94020	19940506	183715	337.6	1.03	0.9	1.03	69.1	0.5	67.9	30.1	4.7	4.2	116	112	102	0.4	16.4
UF94021	19940506	183844	244.3	1.10	-17.1	1.51	33.8	0.1	32.1	29.2	5.0	4.8	102	97	93	0.3	11.5
UF94022	19940506	184659	338.1	1.35	-0.5	1.35	67.4	0.4	66.1	19.3	3.8	3.3	115	113	100	0.6	16.2
UF94023	19940506	185957	305.2	1.22	6.6	2.76	56.1	1.2	54.8	23.1	3.1	2.7	100	97	91	0.8	14.2

TABLE-2. The orbital element of the TV meteors.

No.	DATE YYYYMMDD	UT hhmmss	a AU	da AU	e	de	q AU	$\Omega$ deg	i deg	di deg	$\omega$ deg	d $\omega$ deg	P yr	abso. Mag.
UF91001	19911116	173550												5.3
UF91002	19911116	174605	12.0	15.5	0.92	0.03	0.97	234.0	160.6	0.1	185.3	2.0	41.3	2.9
UF91003	19911116	180339	15.5	3.4	0.96	0.01	0.80	234.0	135.4	0.7	101.7	2.9	61.1	6.4
UF91004	19911116	180834	6.4	10.3	0.85	0.06	0.95	234.0	143.4	0.7	156.2	3.9	16.3	5.6
UF91005	19911116	181801	20.6	54.2	0.96	0.04	0.77	234.0	103.6	1.8	123.1	2.1	93.7	5.7
UF91006	19911116	181933	7.8	8.7	0.88	0.04	0.97	234.0	132.4	0.5	196.7	0.7	21.8	6.4
UF91007	19911116	182636												4.9
UF91008	19911116	184104	-7.8	2.4	1.12	0.04	0.91	234.0	139.3	0.4	212.0	0.4		5.2
UF91009	19911116	185139	4.9	1.3	0.82	0.04	0.89	234.0	154.1	0.3	140.6	3.0	10.8	2.3
UF91010	19911116	185415	1.3	0.1	0.27	0.07	0.96	234.0	141.5	0.7	209.0	6.6	1.5	4.6
UF91011	19911116	185509	7.8	0.4	0.98	0.00	0.13	234.0	11.1	0.3	318.2	0.6	21.7	6.3
UF91012	19911116	191218	8.1	15.9	0.88	0.06	0.94	54.0	160.8	0.7	26.0	0.9	23.0	7.0
UF91013	19911116	191632												4.6
UF91014	19911116	192117	51.9	110.8	0.98	0.05	0.99	234.1	114.7	1.1	186.9	1.3	374.3	4.3
UF91015	19911116	192349												5.4
UF91016	19911116	194046	10.5	4.5	0.91	0.03	0.98	234.1	162.2	0.1	172.3	0.6	33.9	2.9
UF91017	19911116	194356	5.6	60.7	0.88	0.07	0.98	234.1	143.8	0.5	166.3	1.6	13.3	1.5
UF91018	19911116	194647	13.5	1.3	0.99	0.00	0.09	54.1	29.8	0.7	146.1	1.2	49.3	4.1
UF91019	19911116	200747	10.5	1.9	0.98	0.00	0.21	54.1	66.4	1.4	125.9	0.9	33.8	6.2
UF91020	19911116	201303	9.4	4.7	0.89	0.03	0.98	234.1	159.9	0.1	172.6	0.4	28.7	3.0
UF91021	19911117	180504	24.9	22.3	0.96	0.03	0.92	55.0	151.6	0.9	329.4	2.9	124.6	5.9
UF91022	19911117	180735	-2.4	0.3	1.41	0.06	0.99	235.0	122.0	0.7	182.7	2.0		4.8
UF91023	19911117	181003	-13.0	39.4	1.02	0.02	0.25	55.0	155.5	0.6	118.5	1.7		5.3
UF91024	19911117	182158	2.5	0.2	0.60	0.02	0.99	235.0	82.7	2.1	185.9	5.6	3.9	3.0
UF91025	19911117	182428												5.3
UF91026	19911117	182810	2.0	0.6	0.52	0.10	0.98	235.0	151.7	0.4	195.4	5.6	2.9	6.3
UF91027	19911117	183002	-6.4	2.5	1.11	0.02	0.72	235.0	68.0	1.1	119.6	0.6		6.0
UF91028	19911117	183025	2.7	0.1	0.85	0.00	0.41	55.0	5.4	0.2	106.3	1.3	4.4	5.0
UF91029	19911117	183220												
UF91030	19911117	183333	2.2	0.1	0.78	0.01	0.47	235.1	0.6	0.2	280.9	2.0	3.2	2.5
UF91031	19911117	183604	1.1	0.1	0.94	0.00	0.07	55.0	87.5	7.0	157.1	1.7	1.1	1.8
UF91032	19911117	183801	3.9	0.5	0.78	0.02	0.86	235.0	148.6	0.3	135.0	2.7	7.6	4.2
UF91033	19911117	183941	13.2	4.2	0.93	0.02	0.98	235.0	162.1	0.1	171.6	0.7	47.8	1.6
UF91034	19911117	184000	3.3	0.5	0.76	0.03	0.80	235.2	0.3	0.3	235.7	3.6	6.0	6.4
UF91035	19911117	184120	-4.5	1.7	1.22	0.06	0.97	235.0	163.6	0.2	165.8	1.7		6.5
UF91036	19911117	184456	-6.1	1.2	1.16	0.03	0.98	235.0	140.4	0.3	191.8	0.5		2.3
UF91037	19911117	185036	2.2	0.1	0.83	0.01	0.38	55.0	5.5	0.4	111.0	3.6	3.4	6.4
UF91038	19911117	185549	1.2	0.0	0.31	0.02	0.80	235.0	125.3	1.8	100.6	8.9	1.2	6.4
UF91039	19911117	190033	2.8	0.2	0.71	0.01	0.80	55.0	148.3	0.6	302.4	2.6	4.6	4.4
UF91040	19911117	190049	46.0	116.5	0.98	0.03	0.98	55.0	155.5	0.3	347.3	1.3	311.6	5.1
UF91041	19911117	190947	3.0	0.1	0.82	0.01	0.54	235.1	48.4	0.8	270.2	0.8	5.3	5.4
UF91042	19911117	191211	2.4	0.1	0.58	0.02	0.98	235.1	91.3	2.1	169.3	4.6	3.6	5.1
UF91043	19911117	191412	41.2	54.9	0.98	0.02	0.95	235.1	93.0	1.3	203.7	1.7	264.1	3.7
UF91044	19911117	191950	1.1	0.1	0.62	0.03	0.43	55.1	142.1	3.2	242.5	10.1	1.2	4.8
UF91045	19911117	192751	-3.7	0.1	1.27	0.05	0.98	235.1	175.0	0.2	188.2	0.6		5.6
UF91046	19911117	192814	0.9	0.0	0.62	0.00	0.33	235.2	0.6	0.1	318.5	0.4	0.8	5.5
UF91047	19911117	194241	0.6	0.0	0.80	0.01	0.12	235.1	110.0	2.8	8.9	0.3	0.4	6.4
UF91048	19911117	194327	1.9	0.1	0.53	0.03	0.90	55.1	155.8	0.6	319.0	3.2	2.7	5.0
UF91049	19911117	194404	1.4	0.0	0.69	0.01	0.44	55.1	105.1	1.1	248.7	0.3	1.7	5.4
UF91050	19911117	195024	1.9	0.3	0.53	0.05	0.88	55.1	169.7	0.6	314.2	5.9	2.6	4.1
UF91051	19911117	195313												4.4
UF91052	19911212	170127	1.8	0.1	0.64	0.02	0.64	260.3	172.9	0.2	263.4	2.2	2.4	5.7
UF91053	19911212	170645												6.1
UF91054	19911212	171132	1.4	0.0	0.89	0.01	0.15	260.3	23.1	1.9	323.0	1.9	1.6	6.4
UF91055	19911212	172013	2.1	9.0	0.82	0.11	0.38	260.3	152.8	2.9	291.4	17.6	3.1	2.3
UF91056	19911212	173316	1.2	0.0	0.86	0.01	0.17	260.3	19.9	0.7	322.0	0.7	1.4	3.0
UF91057	19911212	173453	6.0	0.3	0.89	0.01	0.67	80.3	3.6	0.1	71.5	0.8	14.9	5.4
UF91058	19911212	173526	1.0	0.1	0.04	0.02	0.92	260.3	121.3	1.2	300.1	50.3	0.9	6.8
UF91059	19911212	173624	2.7	0.1	0.64	0.02	0.95	80.3	124.5	1.0	336.8	2.3	4.3	6.1
UF91060	19911212	173631	1.3	0.0	0.88	0.00	0.16	260.3	21.3	0.8	323.1	0.8	1.5	3.4
UF91061	19911212	174059	3.3	0.2	0.72	0.02	0.92	260.3	177.9	0.2	147.3	1.4	5.9	5.2
UF91062	19911212	174059	10.8	3.7	0.93	0.02	0.75	260.3	177.1	0.1	120.2	2.0	35.3	6.1
UF91063	19911212	174322	4.3	1.0	0.84	0.03	0.67	80.3	171.7	0.5	71.8	1.7	8.9	3.4
UF91064	19911212	174458	-1.6	0.7	1.50	0.16	0.79	80.3	170.5	0.8	48.4	2.6		6.3
UF91065	19911212	174519	1.2	0.0	0.91	0.01	0.11	260.3	26.3	1.1	330.5	1.0	1.4	5.5
UF91066	19911212	175151	2.6	0.2	0.82	0.00	0.47	80.3	55.8	1.4	99.0	4.7	4.2	1.9





No.	DATE YYYYMMDD	UT hhmmss	a AU	da AU	e	de	q AU	$\Omega$ deg	i deg	di deg	$\omega$ deg	d $\omega$ deg	P yr	abso. Mag.
UF91138	19911212	202324	7.7	20.5	0.93	0.03	0.53	80.4	9.6	0.6	88.1	3.2	21.5	6.5
UF91139	19911212	202453	1.1	0.1	0.63	0.02	0.40	260.4	137.2	1.2	56.5	7.3	1.1	6.2
UF91140	19911212	202950	1.1	0.0	0.88	0.00	0.14	260.4	25.0	1.3	326.7	0.8	1.2	5.1
UF91141	19911212	203103	0.9	0.0	0.24	0.03	0.66	260.4	4.9	0.8	41.5	4.1	0.8	5.0
UF91142	19911212	203256	2.1	0.1	0.61	0.01	0.82	80.4	2.1	0.2	55.4	1.2	3.1	5.3
UF91143	19911212	203426	1.4	0.0	0.91	0.00	0.13	260.4	30.7	1.7	326.1	1.0	1.6	5.8
UF91144	19911212	203822	1.3	0.0	0.90	0.00	0.13	260.4	27.0	2.0	326.9	0.9	1.5	6.1
UF91145	19911212	203911	3.4	3.9	0.72	0.10	0.96	260.4	50.8	3.2	199.8	0.8	6.3	4.7
UF91146	19911212	204052	2.6	1.6	0.96	0.01	0.10	80.4	84.4	10.0	146.5	7.8	4.2	5.7
UF91147	19911212	204451	-17.7	11.2	1.05	0.02	0.81	260.4	98.4	0.7	229.4	1.0		1.0
UF91148	19911212	132341	-0.4	0.1	1.69	0.07	0.30	260.1	79.2	0.8	275.7	13.6		1.6
UF91149	19911212	142324	1.3	0.2	0.83	0.03	0.22	260.2	15.0	2.3	314.5	1.7	1.6	2.6
UF91150	19911212	143838	1.4	0.2	0.88	0.02	0.16	260.2	23.0	2.6	321.6	0.4	1.6	1.9
UF91151	19911212	151216	-9.5	9.2	1.07	0.10	0.70	260.2	176.6	1.4	243.9	3.4		2.0
UF91152	19911212	152218	1.0	0.1	0.87	0.01	0.13	260.2	23.4	0.4	330.2	0.8	1.0	2.5
UF91153	19911212	155444	1.2	0.1	0.87	0.04	0.16	260.2	21.8	2.6	324.4	4.8	1.3	2.3
UF92001	19920829	163721	-31.3	15.0	1.02	0.01	0.75	336.7	119.2	1.3	60.2	1.8		2.7
UF92002	19920829	164034	30.7	68.2	0.97	0.03	0.92	156.7	47.5	1.7	214.7	2.1	170.0	5.5
UF92003	19920829	164628	-1.8	4.7	1.40	0.31	0.71	156.7	144.3	2.0	240.3	4.8		6.8
UF92004	19920829	164919	-2.0	1.3	1.49	0.33	0.98	156.7	10.9	8.0	197.2	4.2		6.1
UF92005	19920829	171252	2.7	1.1	0.78	0.08	0.61	336.7	134.2	4.7	275.2	2.7	4.6	2.1
UF92006	19920829	172300	3.3	0.1	0.70	0.01	1.01	156.7	33.1	0.2	186.3	0.4	6.0	2.3
UF92007	19920829	172723	1.1	0.1	0.71	0.01	0.32	336.7	153.4	1.8	129.6	2.7	1.2	3.1
UF92008	19920829	173313	1.7	0.0	0.76	0.01	0.40	156.7	4.2	0.8	293.7	1.9	2.2	6.2
UF92009	19920829	173326	-2.7	2.4	1.35	0.06	0.93	156.7	157.1	0.1	150.6	2.3		2.8
UF92010	19920829	173805	-0.5	0.1	3.03	0.25	0.97	156.7	172.2	0.9	199.3	1.0		4.9
UF92011	19920829	173934	0.9	0.1	0.22	0.07	0.69	156.7	134.2	1.2	38.3	15.1	0.8	5.8
UF92012	19920829	180059	2.1	0.2	0.55	0.03	0.94	156.7	118.4	0.5	216.9	1.0	3.0	3.9
UF92013	19920829	180216	3.9	0.4	0.77	0.02	0.89	336.7	105.5	0.9	316.4	0.3	7.8	4.9
UF92014	19920829	180616	0.8	0.1	0.41	0.06	0.48	156.7	161.3	2.6	323.5	15.5	0.7	6.8
UF92015	19920829	182431	-11.6	6.4	1.09	0.04	1.00	336.8	134.3	1.6	351.2	1.7		5.7
UF92016	19920829	182555	9.5	7.6	0.95	0.02	0.50	336.8	17.1	0.5	92.3	4.7	29.1	6.0
UF92017	19921117	160508	4.9	0.5	0.94	0.01	0.28	55.7	13.0	0.1	118.2	0.2	10.7	0.9
UF92018	19921117	161233	-0.9	0.0	1.97	0.01	0.88	235.7	104.3	0.3	213.4	3.0		5.7
UF92019	19921117	161408	14.8	2.0	0.94	0.01	0.89	55.7	86.6	0.1	37.1	1.1	57.1	0.8
UF92020	19921117	163202	-4.9	0.7	1.10	0.01	0.47	235.7	170.0	0.1	270.3	0.4		1.7
UF92021	19921117	163714	-5.3	7.2	1.01	0.01	0.06	55.7	29.4	3.1	151.3	1.0		5.5
UF92022	19921117	163823	3.5	0.3	0.80	0.02	0.69	235.7	155.2	0.3	109.0	2.4	6.7	6.2
UF92023	19921117	163850	5.8	3.3	0.87	0.04	0.78	235.7	166.6	0.3	236.8	0.4	14.0	4.8
UF92024	19921117	165851	5.5	0.3	0.84	0.01	0.90	235.7	37.7	0.2	215.7	2.2	12.9	4.3
UF92025	19921117	165912	3.6	0.3	0.77	0.03	0.83	235.7	145.5	0.8	129.3	5.3	6.7	5.5
UF92026	19921117	170341	-5.0	2.0	1.15	0.04	0.72	55.7	164.5	0.3	60.0	0.4		1.5
UF92027	19921117	170704	5.5	3.1	0.88	0.04	0.87	55.7	167.8	0.2	72.3	1.0	13.0	4.9
UF92028	19921117	173114	12.5	2.4	0.93	0.01	0.82	235.7	127.8	0.8	130.4	2.8	44.1	4.1
UF92029	19921117	173851	5.4	1.0	0.82	0.03	0.99	235.7	134.4	0.7	180.5	3.0	12.7	6.1
UF92030	19921117	173704	-4.6	20.6	1.12	0.10	0.57	55.7	160.7	0.7	78.8	3.1		7.2
UF92031	19921117	175315	-0.6	0.1	2.03	0.19	0.59	235.7	157.5	0.6	246.8	2.5		5.3
UF92032	19921117	180542	1.2	0.2	0.43	0.05	0.71	235.8	154.9	0.7	267.4	9.7	1.4	5.7
UF92033	19921117	181514	1.7	0.0	0.62	0.00	0.64	55.8	5.5	0.1	85.1	1.4	2.2	6.3
UF92034	19921117	182231	3.1	0.4	0.74	0.03	0.82	235.8	24.7	0.5	233.9	3.3	5.5	6.4
UF92035	19921117	182408	-0.8	0.1	2.00	0.16	0.79	55.8	53.9	1.0	45.1	5.6		7.2
UF92036	19921117	182603	3.0	1.3	0.86	0.03	0.40	235.8	173.4	0.5	285.9	4.6	5.2	4.8
UF92037	19921117	183008	1.6	0.1	0.45	0.05	0.87	55.8	156.3	0.6	52.2	2.6	2.0	5.4
UF92038	19921117	184035	3.5	0.6	0.72	0.05	0.98	55.8	173.4	0.1	8.5	1.2	6.5	4.3
UF92039	19921117	184310	1.0	0.0	0.59	0.00	0.42	235.8	155.5	0.4	303.5	2.9	1.0	1.8
UF92040	19921117	184740	0.6	0.0	0.81	0.01	0.12	55.8	10.7	0.4	166.1	0.3	0.5	5.2
UF92041	19921117	185251	4.8	3.9	0.82	0.07	0.84	55.8	153.1	0.6	47.8	1.7	10.4	6.0
UF92042	19921117	190610	3.6	0.6	0.73	0.04	0.97	235.8	161.7	0.3	162.0	1.8	6.9	4.6
UF92043	19921117	190825	4.2	0.4	0.85	0.01	0.63	236.0	0.2	0.1	257.7	1.9	8.7	4.7
UF92044	19921117	190926	2.7	0.1	0.75	0.01	0.69	235.8	7.3	0.2	253.2	1.8	4.5	5.7
UF92045	19921117	190930	-4.6	0.9	1.21	0.05	0.99	235.8	104.3	1.6	175.9	2.7		6.4
UF92046	19921117	191107	2.5	0.2	0.67	0.02	0.83	235.8	155.3	0.3	126.2	3.3	4.0	3.3
UF92047	19921117	191348	1.3	0.0	0.64	0.01	0.48	235.8	0.6	0.2	288.3	2.6	1.5	4.6
UF92048	19921117	192015	42.6	39.4	0.98	0.03	0.99	235.8	162.5	0.2	177.3	0.6	277.7	0.4
UF92049	19921117	192530	2.3	0.3	0.59	0.05	0.94	235.8	150.9	0.5	149.4	4.4	3.4	3.1
UF92050	19921117	193104	-6.0	1.3	1.16	0.04	0.96	235.8	107.5	1.6	199.2	1.8		4.5
UF92051	19921122	121951	1.6	0.2	0.71	0.03	0.46	60.5	1.0	1.0	106.5	72.5	2.0	3.9

No.	DATE YYYYMMDD	UT hhmmss	a AU	da AU	e	de	q AU	$\Omega$ deg	i deg	di deg	$\omega$ deg	d $\omega$ deg	P yr	abso. Mag.
UF92052	19921122	122628	4.2	0.4	0.77	0.02	0.95	240.6	13.9	0.2	204.1	4.2	8.6	2.7
UF92053	19921122	122921	1.5	0.2	0.57	0.04	0.66	240.6	9.0	1.0	265.7	4.0	1.9	5.4
UF92054	19921122	130924	2.5	0.1	0.67	0.02	0.81	60.6	1.8	0.1	56.9	0.2	3.9	2.3
UF92055	19921122	135708	1.3	0.1	0.64	0.03	0.46	240.6	2.7	0.9	291.4	3.1	1.4	5.8
UF92056	19921122	172348	2.1	0.3	0.94	0.01	0.12	60.8	26.9	0.8	143.6	1.2	3.1	4.6
UF92057	19921122	173336	5.3	0.4	0.89	0.01	0.58	60.8	20.5	0.1	82.7	1.8	12.1	3.4
UF92058	19921122	174154	3.7	0.1	0.92	0.01	0.31	60.8	136.8	0.9	115.9	1.0	7.1	5.9
UF92059	19921122	174319	2.1	0.6	0.86	0.01	0.30	60.8	146.9	0.7	239.8	4.0	3.1	5.0
UF92060	19921122	175542	-1.5	0.6	1.47	0.15	0.72	240.8	160.5	0.2	236.8	1.0		6.3
UF93001	19930319	151432	2.3	0.2	0.73	0.02	0.60	359.1	1.0	0.6	266.2	0.3	3.4	5.8
UF93002	19930319	151446	1.4	0.1	0.92	0.00	0.11	179.1	15.4	0.7	148.7	0.4	1.7	3.0
UF93003	19930319	151651	5.7	0.9	0.82	0.02	0.99	359.1	44.4	0.4	187.0	3.9	13.4	6.7
UF93004	19930319	151755	1.1	0.1	0.83	0.01	0.19	359.1	34.7	0.8	322.2	1.2	1.2	5.4
UF93005	19930319	153256	1.6	0.2	0.64	0.04	0.58	359.1	32.1	0.5	274.6	1.0	2.0	4.8
UF93006	19930319	153924	1.3	0.1	0.41	0.08	0.75	359.1	2.2	1.3	261.4	80.9	1.4	5.5
UF93007	19930319	160836	1.0	0.1	0.58	0.07	0.44	359.2	15.7	2.8	302.1	2.0	1.1	4.0
UF93008	19930319	161656	1.7	0.2	0.85	0.02	0.26	359.2	19.4	0.7	307.7	1.2	2.2	6.4
UF93009	19930319	162512	6.2	0.2	0.84	0.01	0.98	359.2	43.0	0.3	192.7	1.4	15.3	6.2
UF93010	19930319	164254	-1.7	0.6	1.47	0.13	0.82	359.2	116.2	0.4	225.9	1.9		5.7
UF93011	19930319	164715	-108	173.5	1.00	0.02	0.26	179.2	153.1	1.4	118.9	1.1		5.4
UF93012	19930319	170144	1.8	0.3	0.85	0.03	0.27	359.2	17.6	2.8	305.8	0.7	2.5	4.2
UF93013	19930319	170739	6.1	21.0	0.87	0.09	0.81	359.2	51.2	2.7	127.1	5.8	15.1	6.4
UF93014	19930319	170834	0.7	0.0	0.76	0.08	0.15	179.2	3.2	3.8	162.1	74.3	0.5	6.3
UF93015	19930319	171831	3.4	0.2	0.71	0.02	0.99	359.2	50.3	0.7	192.5	1.3	6.2	4.7
UF93016	19930319	172531	1.1	0.0	0.83	0.01	0.18	359.2	3.3	2.1	323.0	0.9	1.1	6.1
UF93017	19930319	173436	3.1	13.9	0.68	0.19	0.99	359.2	137.0	0.2	192.9	4.7	5.4	4.1
UF93018	19930319	173820	3.1	0.2	0.94	0.01	0.18	359.2	2.0	2.4	313.3	58.4	5.6	2.0
UF93019	19930319	174436	0.8	0.0	0.22	0.04	0.64	179.2	2.2	0.2	186.0	3.4	0.7	4.6
UF93020	19930319	175456	2.8	0.8	0.85	0.04	0.42	359.2	47.4	5.1	225.1	1.0	4.6	5.7
UF93021	19930319	175517	-1.3	1.1	1.70	0.31	0.94	359.2	118.7	0.9	203.7	3.1		3.7
UF93022	19930319	180430	8.7	11.1	0.90	0.11	0.87	359.2	136.0	0.2	222.6	1.7	25.7	4.8
UF93023	19930319	181422	-0.4	0.1	3.02	0.50	0.88	359.2	115.8	1.1	211.6	0.7		5.9
UF93024	19930319	181737	1.0	0.0	0.86	0.01	0.14	359.3	16.1	3.3	328.6	0.7	1.0	5.4
UF93025	19930319	182048	-5.1	0.6	1.13	0.02	0.65	359.3	150.4	0.4	109.7	3.7		8.1
UF93026	19930319	183016	2.5	0.1	0.60	0.01	0.99	359.3	34.5	1.0	173.9	1.8	4.0	6.3
UF93027	19930319	183626	1.7	0.2	0.58	0.02	0.72	359.3	3.7	1.6	255.3	7.1	2.2	5.9
UF93028	19930319	183814	-0.8	0.1	1.08	0.02	0.06	179.3	32.9	1.3	144.6	6.4		2.7
UF93029	19930319	184230	2.8	0.6	0.86	0.02	0.40	359.3	149.3	0.3	287.2	3.2	4.7	6.6
UF94001	19940506	171443	-5.9	1.2	1.15	0.03	0.90	46.0	166.4	4.3	217.0	1.1		4.0
UF94002	19940506	171636	4.6	3.1	0.85	0.06	0.71	46.0	54.1	1.7	249.3	4.1	9.8	3.8
UF94003	19940506	172029	46.8	642.4	0.99	0.02	0.61	46.0	161.4	2.1	101.6	3.0	320.2	4.2
UF94004	19940506	172257	-44.7	85.3	1.01	0.01	0.60	46.0	164.0	0.6	101.1	0.8		2.8
UF94005	19940506	172749	3.5	0.8	0.80	0.04	0.72	46.0	48.1	1.7	249.7	2.5	6.6	3.3
UF94006	19940506	172857	5.8	0.4	0.91	0.01	0.55	46.0	163.6	0.8	92.4	1.1	13.9	4.3
UF94007	19940506	173044	11.7	3.5	0.95	0.01	0.58	46.0	163.0	0.5	97.9	1.3	40.2	0.5
UF94008	19940506	173419	3.0	1.5	0.97	0.00	0.24	46.0	139.6	0.7	56.5	1.4	27.1	4.5
UF94009	19940506	173807	2.8	0.2	0.80	0.01	0.56	46.0	35.1	1.7	270.4	1.4	4.6	2.8
UF94010	19940506	174217	-4.7	1.4	1.13	0.03	0.62	46.0	163.8	2.3	105.4	3.3		3.0
UF94011	19940506	174729	1.1	0.0	0.71	0.01	0.32	46.0	10.4	2.2	310.2	1.1	1.2	4.6
UF94012	19940506	175204	2.2	0.1	0.88	0.00	0.25	46.0	15.2	1.7	306.6	0.8	3.2	4.8
UF94013	19940506	175648	0.8	0.0	0.99	0.00	0.01	226.1	2.3	9.1	174.8	87.2	0.7	5.2
UF94014	19940506	180237	-7.7	1.1	1.08	0.01	0.63	46.1	162.1	0.7	106.6	0.9		2.6
UF94015	19940506	180625	164.7	186.1	1.00	0.01	0.57	46.1	166.1	1.0	97.9	1.3	2114	1.2
UF94016	19940506	181108	11.9	42.9	0.95	0.07	0.55	46.1	168.1	2.1	94.5	5.6	40.9	2.9
UF94017	19940506	182656	3.4	0.4	0.85	0.01	0.51	46.1	169.5	1.3	85.7	2	6.2	4.3
UF94018	19940506	183133	5.1	1.6	0.89	0.02	0.55	46.1	164.7	1.3	91.5	3.3	11.6	1.9
UF94019	19940506	183227	2.6	0.2	0.78	0.01	0.58	46.1	56.8	1.6	268.6	3.0	4.2	2.5
UF94020	19940506	183715	-7.3	4.6	1.09	0.03	0.63	46.1	160.6	1.3	106.0	2.4		4.2
UF94021	19940506	183844	1.8	0.0	0.87	0.00	0.22	46.1	7.1	1.7	312.3	0.7	2.3	4.8
UF94022	19940506	184659	25.5	39.4	0.98	0.02	0.59	46.1	163.0	1.5	99.5	2.2	128.6	3.3
UF94023	19940506	185957	1.1	0.1	0.20	0.03	0.90	46.1	130.0	0.9	250.6	24.5	1.2	2.7

**Explanation to Table 1:**

Y: Year

M: Month (4 :April, 5 :May, 11 :November, 12 :December etc.)

D: Date (UT)

$\alpha$ : Radiant point. Right Ascension (2000.0) in degrees corrected for both zenithal attraction and diurnal aberration and the estimated error.

$\delta$ : Radiant point. Declination (2000.0) in degrees corrected for both zenithal attraction and diurnal aberration and the estimated error.

V obs.: Observed velocity (km/sec) and the estimated error.

Vg: The velocity corrected for both the zenithal attraction and the diurnal aberration.

Q: The angle between the meteor trajectories as seen from the two stations and the estimated error.

obs. mag.: The observed magnitude of the meteor.

abs. mag.: The absolute magnitude of the meteor.

Hb: The height at which the meteor was first observed.

He: The height at which the meteor vanished and the estimated error.

V error: This percent is the scatter of the velocity of each positions of 1/30 second on TV meteor.

**Explanation to Table 2:**

a, da: Semi-major axis (AU) and probable error.

e, de: Eccentricity and probable error.

q: Perihelion distance (AU).

$\Omega$ : Longitude of the ascending node ( $^{\circ}$ ).

i, di: Inclination of the orbit ( $^{\circ}$ ) and probable error.

$\omega$ ,  $d\omega$ : Argument of perihelion ( $^{\circ}$ ) and probable error.

P: Period (year)

## 5 Meteor radiant mapping

Figure 2 shows the distribution of the radiants of 326 TV meteors. The straight and curved lines in the figure indicate the celestial equator and the ecliptic, respectively. The blank areas in the figure are due to the fact that all the sky was not covered by the observations.

Figure 3 shows the distribution of geocentric velocities less than 40 km/s. The 121 meteors selected by this criterion did not concentrate around the ecliptic.

Figure 4 shows the distribution of theoretical radiants from Apollo-Amor asteroids according to Hasegawa et al. (1992). The 215 radiants are distributed around the ecliptic with some deviation.

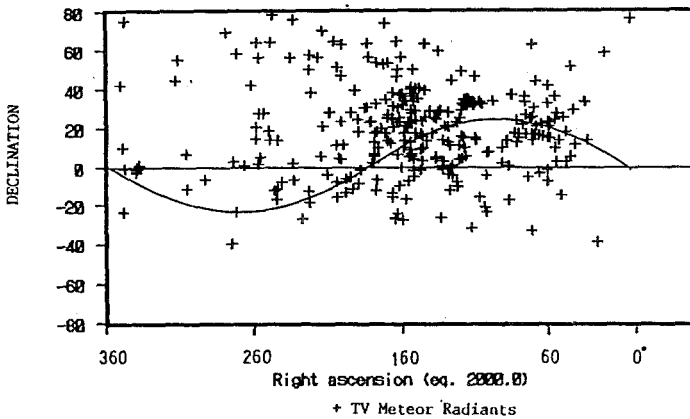


Figure 2: Map of the TV meteor radiants (1990-1994)

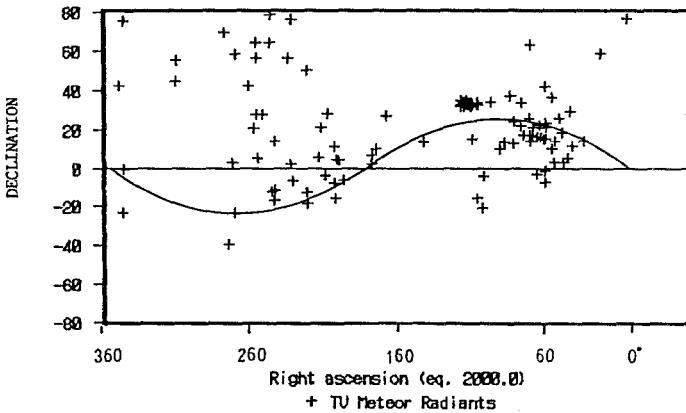


Figure 3: Map of the TV meteor radiants (1990-1994).  $V_g < 40$  km/s.

Figure 5 shows the distribution of the theoretical radiants from comets obtained by Drummond (1981). The 289 radiants are distributed almost uniformly over the celestial sphere.

There is a significant difference between the radiant distributions, Figures 4 and 5. That is, the theoretical radiants from the Apollo-Amor asteroids exist along the ecliptic, but those from comets distribute uniformly over the celestial sphere. One should note that there is not a one to one correspondence between the observed meteor radiants and the theoretical radiants. So, in this study we have compared the statistical distributions of the radiants. Then, we found that the observed radiants of the TV meteors showed similarity with the radiant distribution from the comets. However, the radiant distribution of the observed meteors with geocentric velocity less than 40.0 km/s was partly concentrated along the ecliptic.

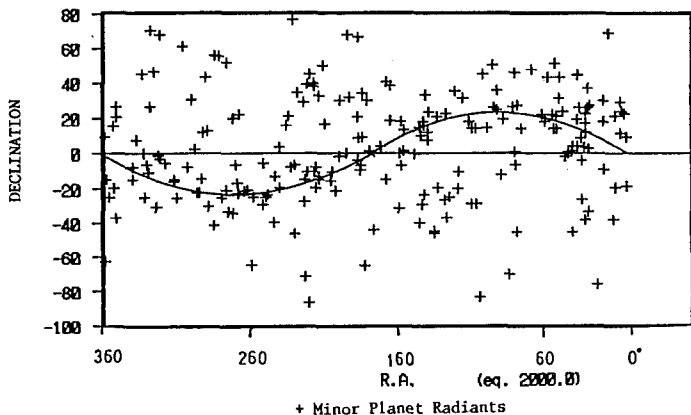


Figure 4. Map of the theoretical meteor radiants (Minor Planets) by Hasegawa et al. 1992.

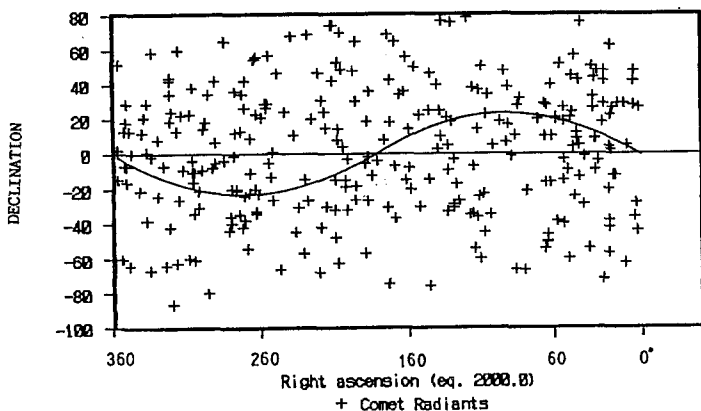


Figure 5. Map of the theoretical meteor radiants (Comets) by Drummond, 1981.

## 6 Distribution of the velocities

Figure 6 shows the distribution of the geocentric velocities of the observed TV meteors. In this figure, the meteors belonging to the  $\eta$  Aquarids in May, Leonids in November, and Geminids in December were removed. The total meteor number used in this figure was 258. There is a major and a minor peak at the 60 km/sec level and the 20 km/sec level, respectively, in the velocity distribution.

The distribution of geocentric velocities of the theoretical radiants from the Apollo-Amor asteroids is plotted in Figure 7 (Hasegawa et al., 1992). A peak is found at the 10 km/sec level.

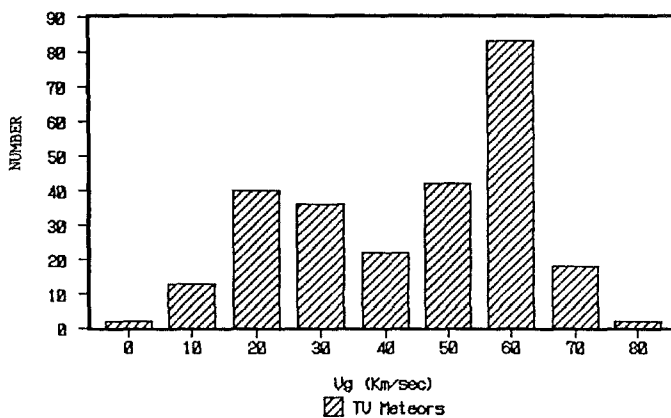


Figure 6. The geocentric velocity distribution of TV meteors

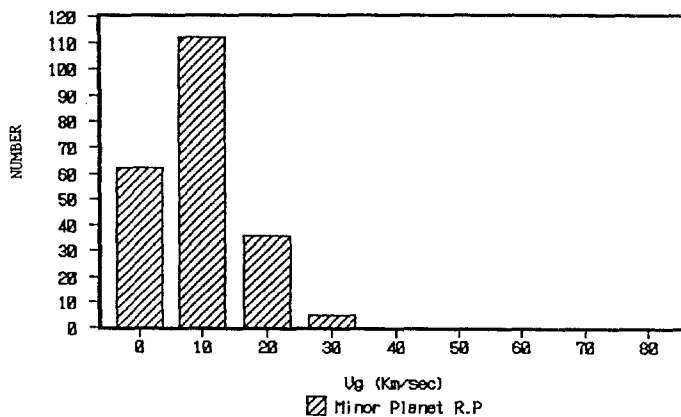


Figure 7. The geocentric velocity distribution of Minor Planet meteors

The distribution of the geocentric velocities of theoretical radiants from comets is shown in Figure 8 (Drummond, 1981). A peak exists at the 60 km/sec level.

There is a clear difference between the velocity distributions of the meteors predicted from comets and asteroids. The former ranges between 0 km/sec with a peak at the 60 km/sec level, while the latter exists from 0 km/sec to 40 km/sec with a peak at the 10 km/sec level.

The observed TV meteors showed a peak at the 60 km/sec level, which is similar to the velocity distribution derived from cometary meteoroids.

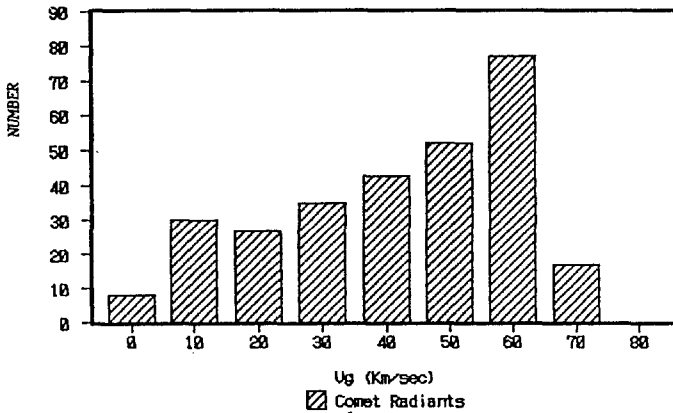


Figure 8. The geocentric velocity of Cometary meteors

## 7 Detection of meteor showers

The existence of meteor shower activity has been judged by the following process. First, the concentration of the radiants is checked. Then, the similarity of the velocities and the orbital elements is further investigated. As for the known meteor showers the D-criterion (Southworth and Hawkins, 1963) and D'-criterion (Drummond, 1979) based on the orbits of the showers (Cook, 1973) were used. Drummond showed the condition of the meteor shower activity to be  $D \leq 0.250$  or  $D' \leq 0.105$ .

Figure 9 shows the radiant distribution of the 130 TV meteors observed on November 16 and 17 in 1990, 1991 and 1992, where 6 radiants (A-F) has been detected. However, a further investigation will be important since the determination of radiants based on only a few meteors may not be statistically significant.

The detected showers in Figure 4 are as follows:

A: Northern Taurids

B: Southern Taurids



C:  $\zeta$  Taurids

D: Leonids. Although the number of meteors was not very large in 1990-1992, the shower activity did exist. The rather wide distribution of the radiants is due to the errors in the measurement of meteor position.

E,F: Unknown meteor showers. However, meteor numbers are as small as 2-3.

Figure 10 shows the distribution of the radiants of 102 TV meteors observed  $\times$  on December 12, 1991. 5 meteor showers (G-K) were detected:

G: Geminids. A very active shower, and the observed radiant by TV meteors is outstanding.

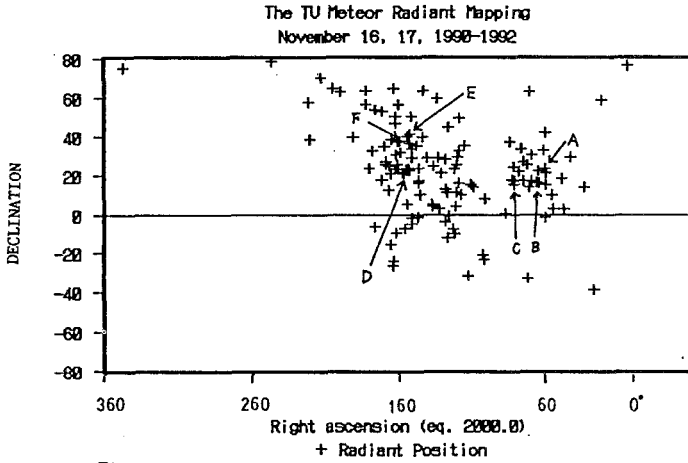


Figure 9.

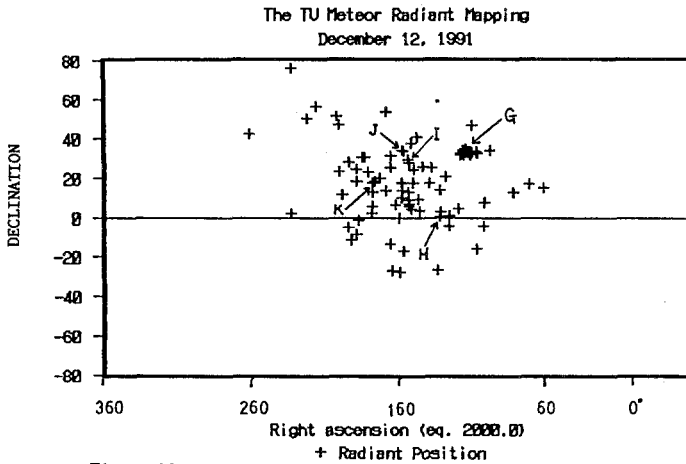


Figure 10.

H:  $\sigma$  Hydrids

I: Unknown meteor shower

J: Leo Minorids (December). A shower confirmed by visual observations. Our TV observations could also determine the orbit of this shower, which is found to be similar to be that of the Coma Berenicids.

K: Unknown meteor shower

Figure 11 shows the radiant distribution of the TV meteors observed on May 6, 1994.

L:  $\eta$  Aquarids. Visible for only 2 hours before sunrise in Japan. However, we have observed 12 TV meteors.

M: Unknown meteor shower

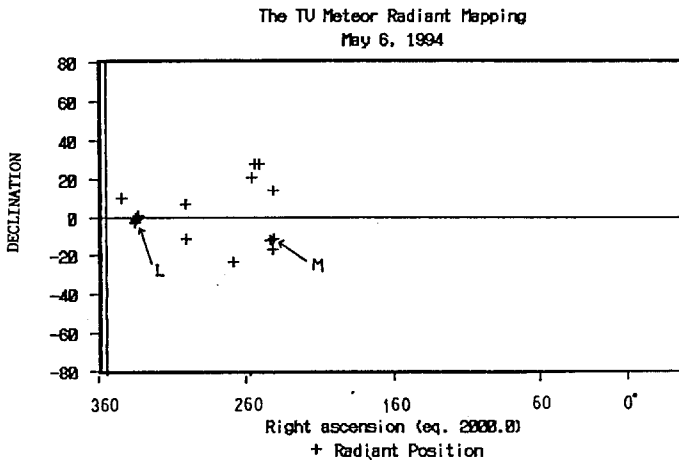


Figure 11.

## 8 Conclusions

The meteor radiants determined by the double-station TV observations were found to be spread widely over the celestial sphere. Their geocentric velocities had a peak at the 60 km/sec level, which is similar to the velocity distribution expected from cometary meteors. This suggests that the major part of the TV meteors observed in our study were associated with comets and that the TV meteors from Apollo-Amor asteroids were small in number.

13 meteor showers were detected among the observed TV meteors by investigating the concentration of the radiants and the similarity of velocities and orbital elements. They consist of major meteor showers, such as  $\eta$  Aquarids (May), Leonids (November) and Geminids (December), and minor meteor showers determined by a few meteors.

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