光学多点同時観測の流星軌道計算結果

Meteor orbits by multistatic optical observation
(Simultaneous observation of head echo and TV meteor)

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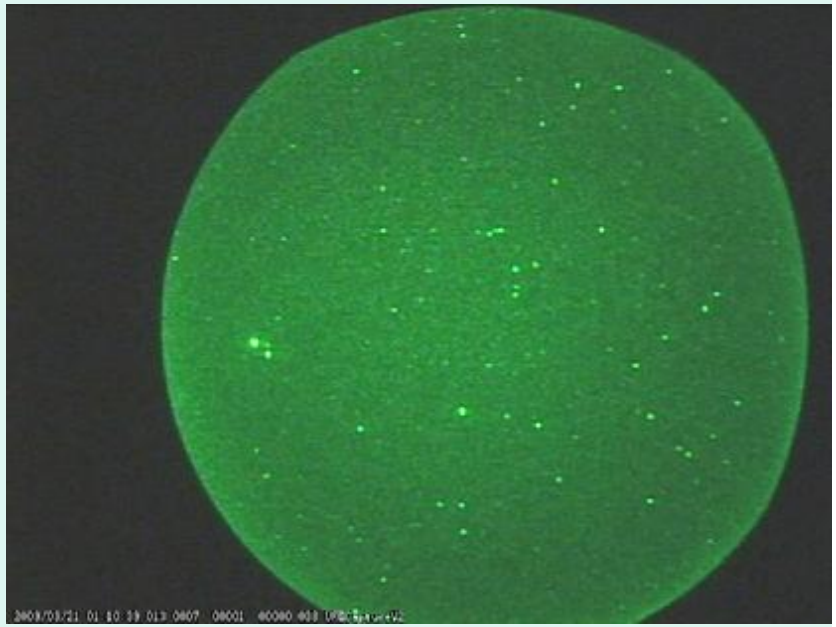
Johan Kero
Csilla Szasz
中村　卓司(T. Nakamura)

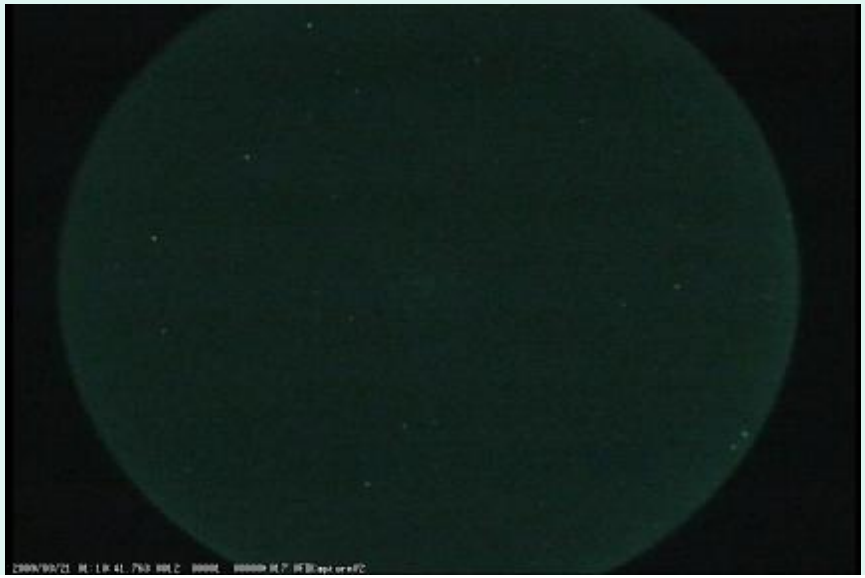
Four points of stations that carried out optics observation.
2010年における光学同時観測の4カ所の観測地点
2009年は、3カ所

Simultaneous meteor with three stations
2009-3-21, 01:10:41 JST
Absolute magnitude: +7.1mag.

Shigaraki

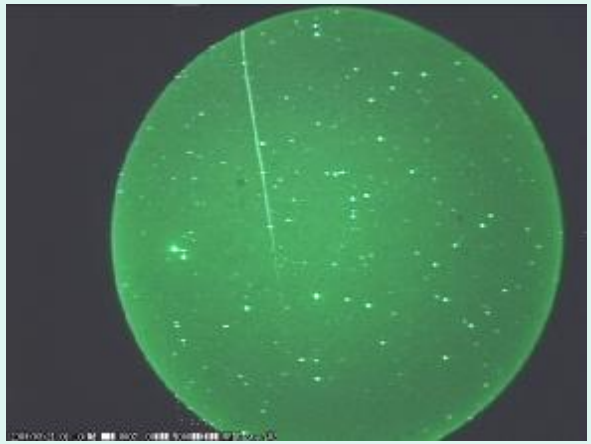


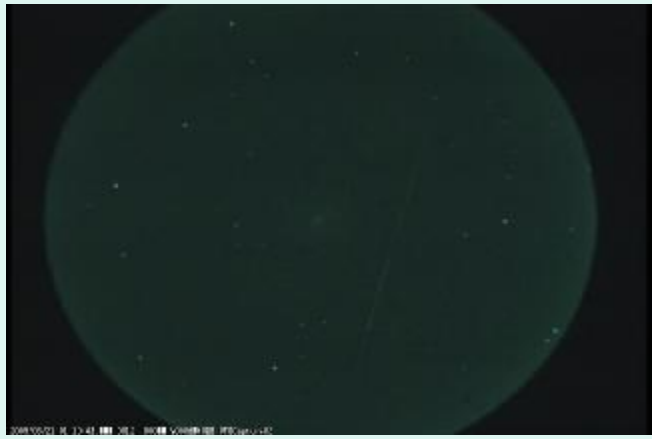
Muroh

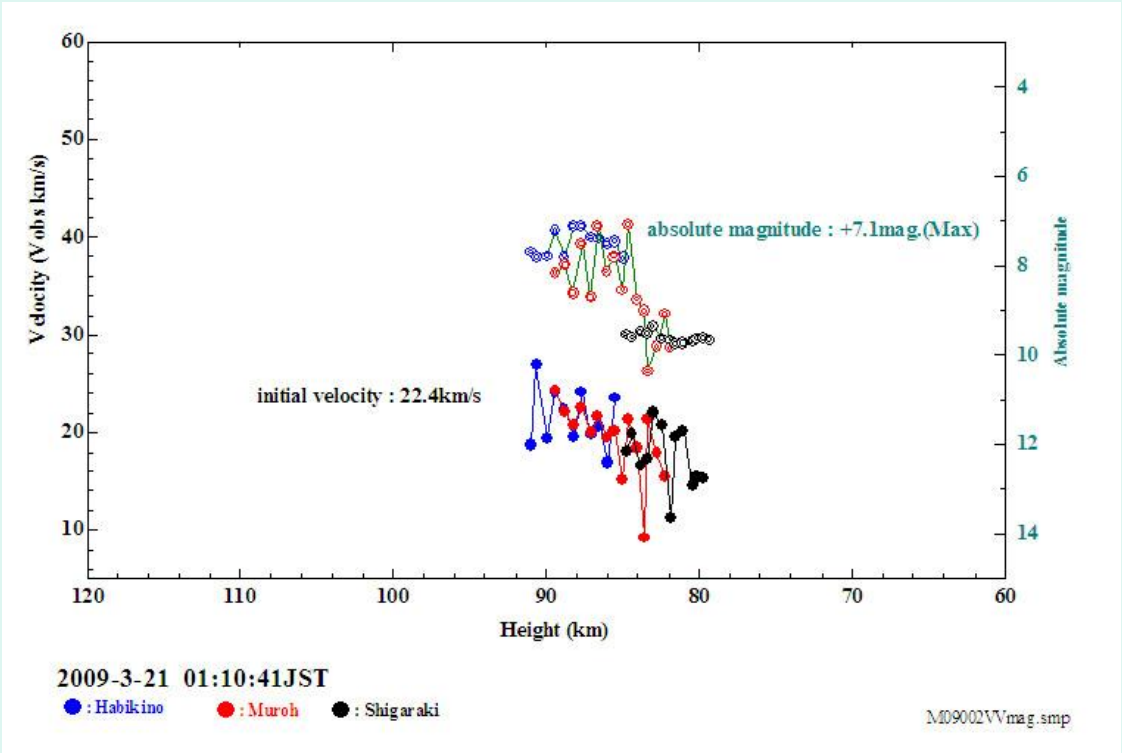


Habikino

Simultaneous meteor with three stations
2009-3-21, 01:10:41 JST
Absolute magnitude: +7.1mag.







Atmospheric trajectory of doubly TV meteor 2009-3-21, 01:10:41 JST

2009年9月の同時流星で、軌道計算ができたものが8個
8 doubly TV meteors on September 2009

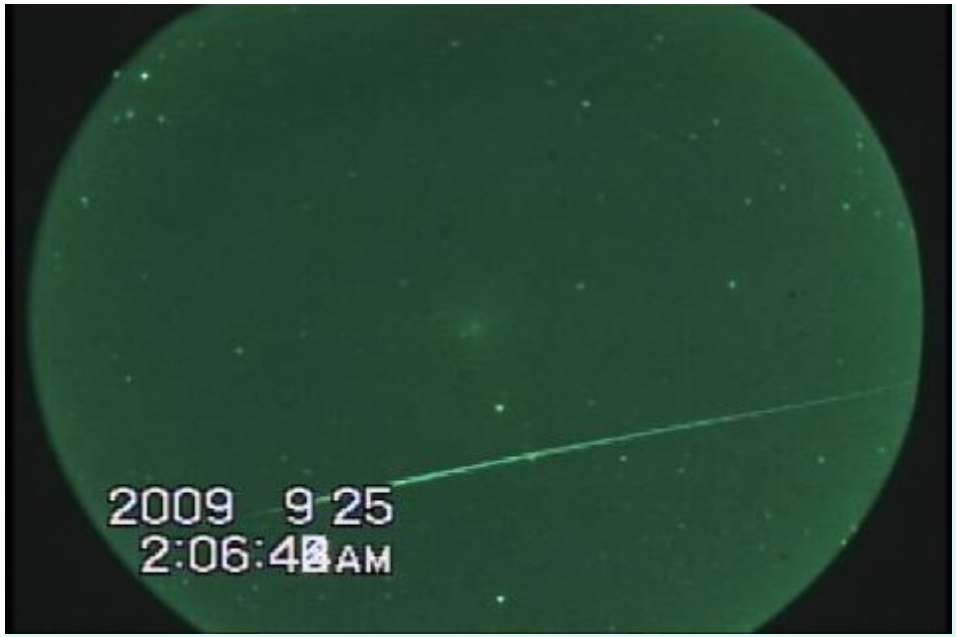
Shigaraki Lens:f200mm, ICCD, 3.9×2.9°

Sep. 25, 2009	1:05:28	**	M09179 XX
Sep. 25, 2009	1:10:44	**	M09180 XX
Sep. 25, 2009	2:06:43	**	M09181 XX
Sep. 25, 2009	2:09:24	**	M09182 OX
Sep. 25, 2009	3:16:04	**	M09183 XX
Sep. 25, 2009	3:31:37	**	M09184 XX
Sep. 27, 2009	1:30:25	*	M09189 XO
Sep. 27, 2009	3:23:10	*	M09190 XX

Habikino, lens:f200mm, F2.0, I.I. LM. 8.5mag, 7.0°

Sep. 25, 2009	1:05:29	**	M09069D XX
Sep. 25, 2009	1:10:44	**	M09070D XO
Sep. 25, 2009	2:06:44	**	M09072D OX
Sep. 25, 2009	2:09:25	**	M09073A OX
Sep. 25, 2009	3:16:05	**	M09078A OX
Sep. 25, 2009	3:31:37	**	M09079B OO
Sep. 27, 2009	1:30:25	*	M09093D OO
Sep. 27, 2009	3:23:10	**	M09095A XX

Image Intensifier ,
Movie of the example (2001 Leonid meteor strom)



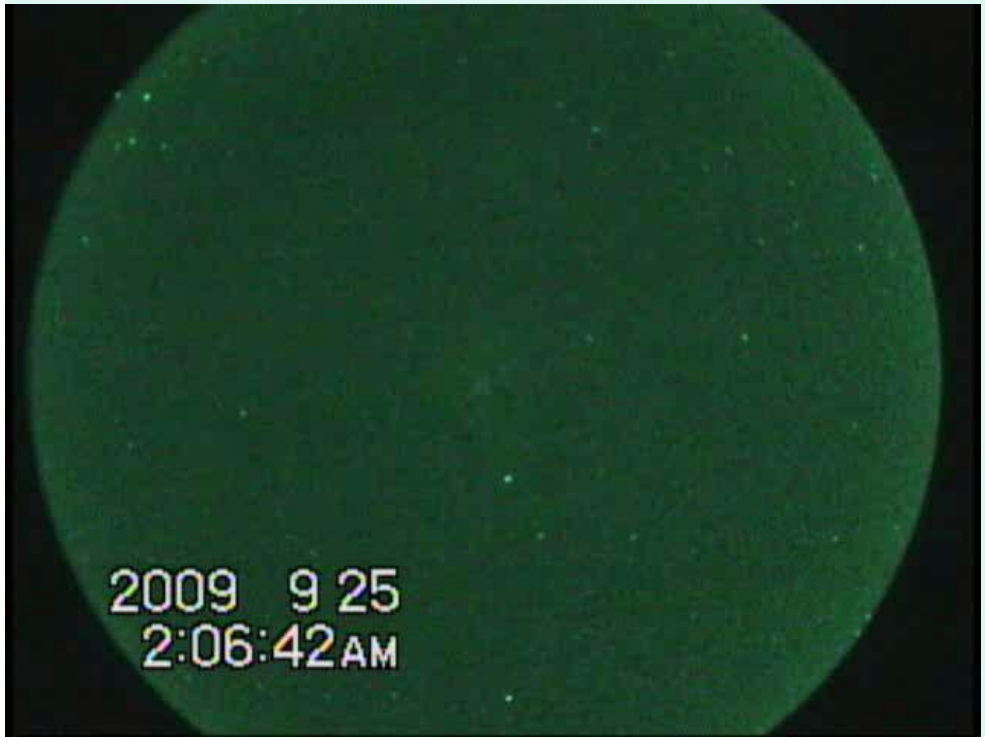
doubly TV meteor

Image Intensifier

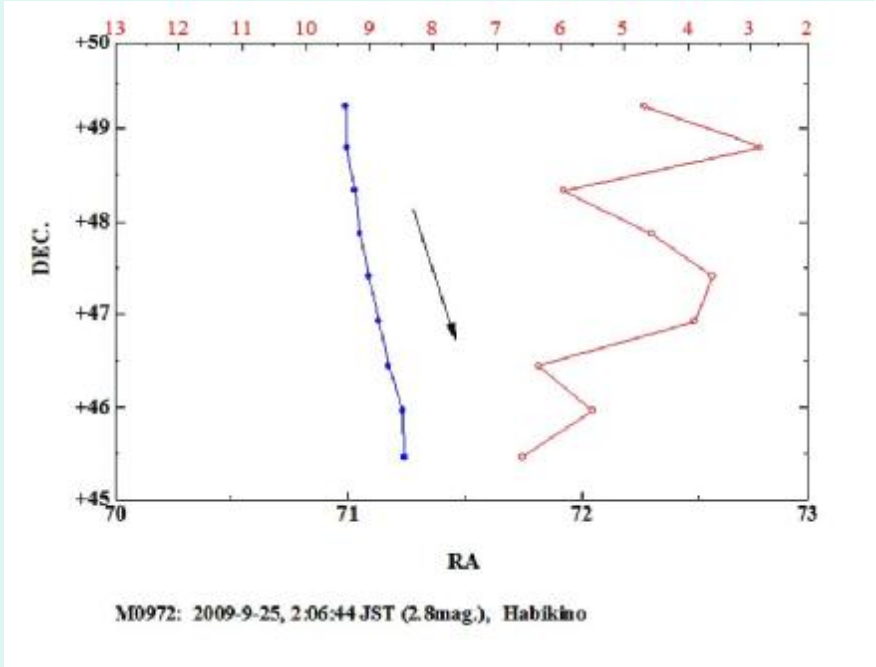
lens:f200mm, F2.0,

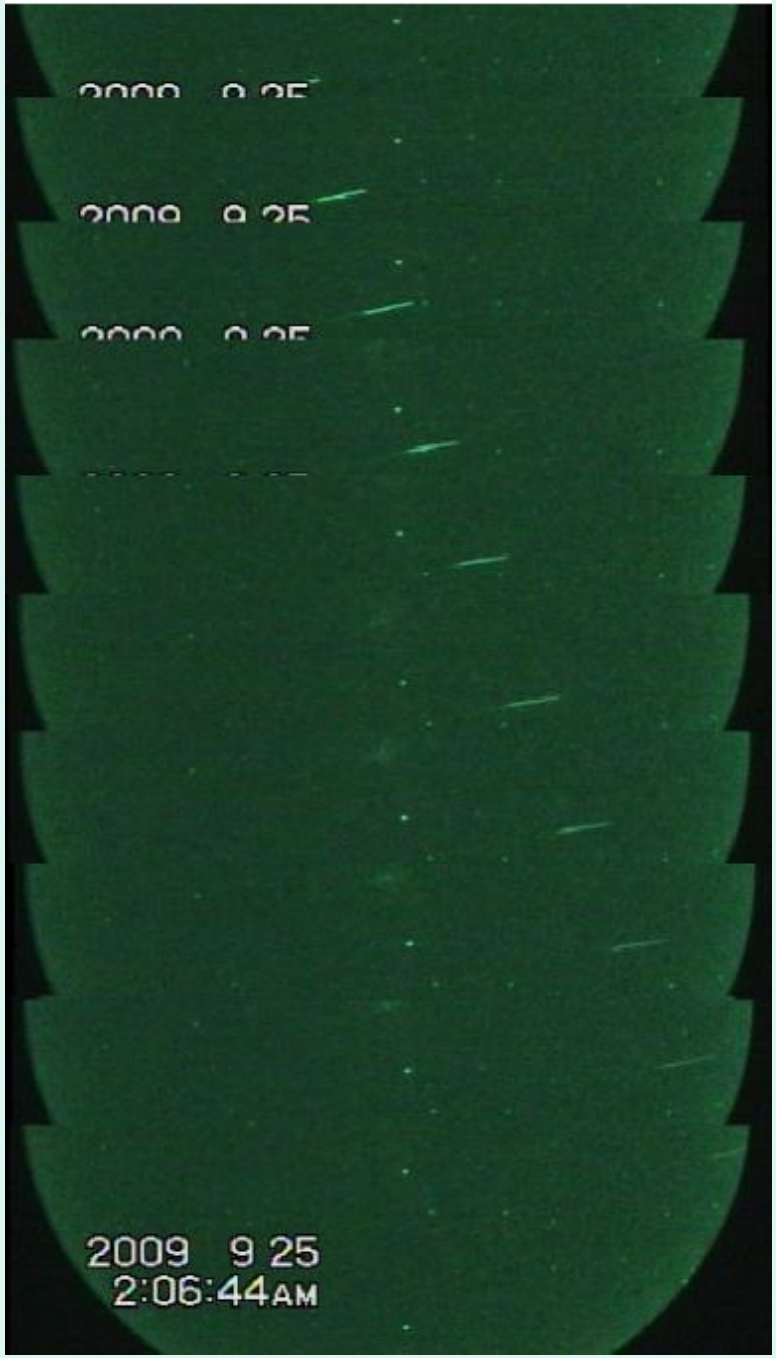
LM. 8.5mag, 7.0°

Movie



Mag.





M09072, A meteor picture every each frame

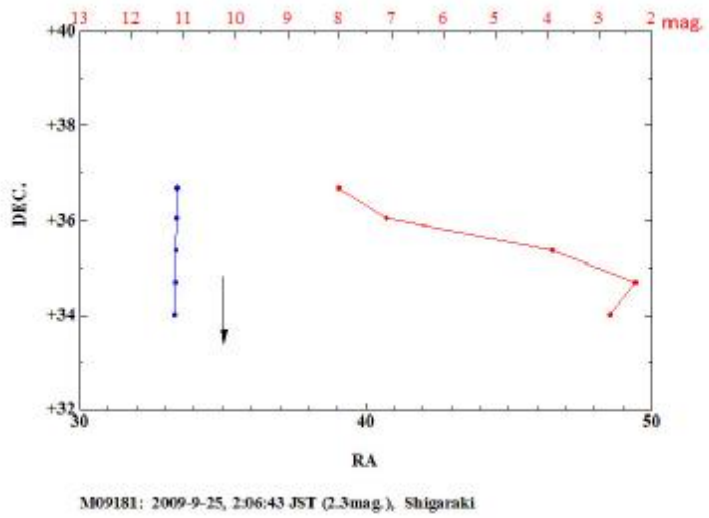
各フレームごとの流星画像

doubly TV meteor

ICCD

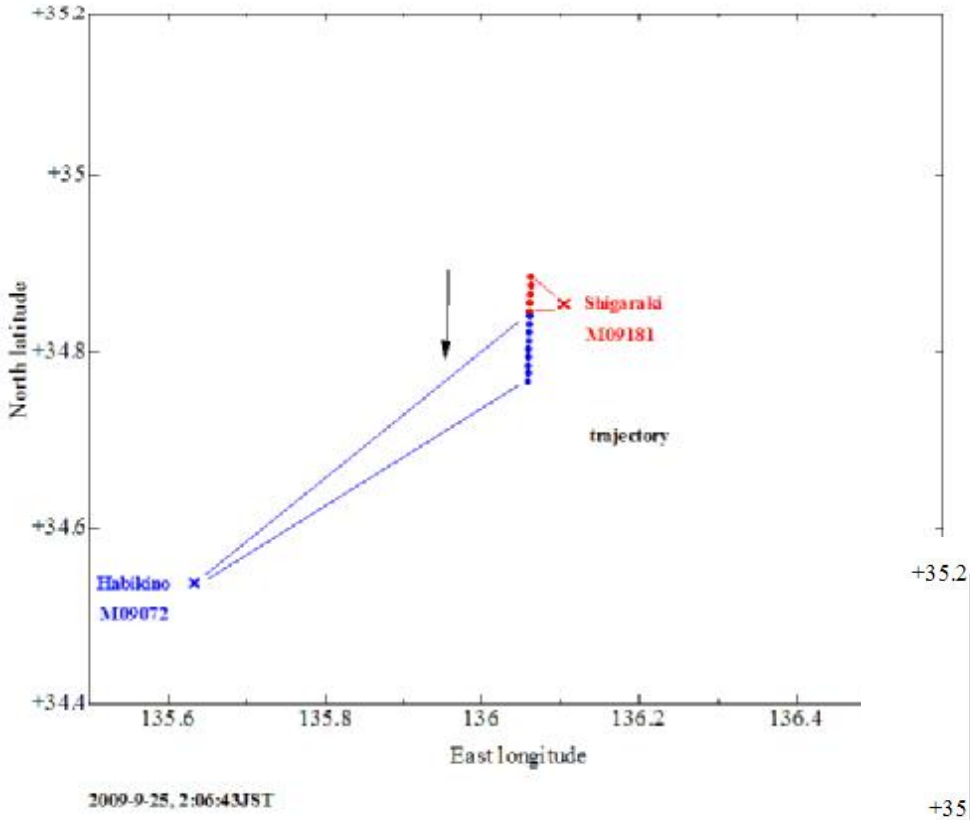
Lens:f300mm,
3.9×2.9°

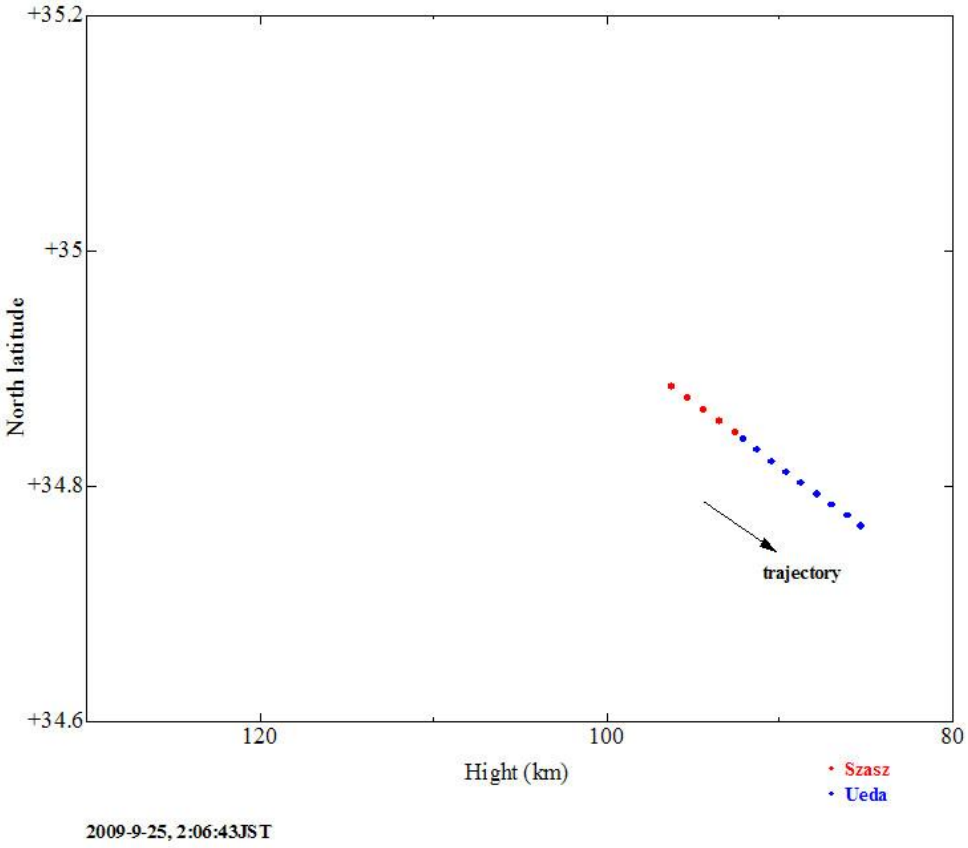
Movie



Atmospheric trajectory of doubly TV meteor

Sep. 25, 2009 2:06:43 JST





2009-9-25, 2:06:43JST, doubly TV meteors

M09072, 位置測定精度A measurement error：0.026°（=1.6′）
Software: RBAviMeteor (T. Kumamori) and mexy4.bas(M. Ueda)

The time of appearance: ±1s (a precision of 1 second)

Corrected radiant: R.A.　44.8°　±4.5°
DEC. +86.2°　±0.6°

Initial velocity:　41.2km/s ±1.6km/s

The radiants and orbits of 8 doubly TV meteors (Sep., 2009)

TABLE-1. The radiant positions, velocities and heights of TV meteors.

No.	DATE YYYYMMDD	UT hhmmss	RADIANT(2000.0) αG	dα	δG	dδ	V∞ Km/s	V error km/s	VG Km/s	Vh km/s	Q deg	obs. Mag.	abso. Mag.	Hb Km	*	Hm Km	He Km	*	dH Km	log (mass)	Max/L
M09179	20090924	160528	97.1	7.07	41.3	3.5	54.0	10.8	52.6	26.1	8.8	6.7	6.4	109.9	*	102.1	100.6	*	1.2	-3.94	0.8182
M09180	20090924	161044	82.4	2.51	43.6	0.9	59.6	4.0	58.3	32.6	16.1	6.2	5.8	103.3	*	100.6	97.8		0.3	-4.31	0.6000
M09181	20090924	170643	44.8	4.54	86.2	0.6	41.2	1.6	39.6	37.7	41.0	2.8	2.7	92.1		91.3	85.3	*	0.2	-2.74	0.2222
M09182	20090924	170924	70.1	0.10	10.8	0.5	67.3	1.6	66.2	41.2	43.6	3.5	3.2	111.8		104.8	103.0	*	0.1	-3.49	0.8333
M09183	20090924	181604	56.9	1.74	79.4	0.5	47.8	6.3	46.4	39.8	42.2	6.5	6.2	107.1		103.1	100.0	*	0.2	-3.88	0.5714
M09184	20090924	183137	87.5	0.10	21.6	0.3	62.6	9.5	61.4	31.9	62.0	7.1	6.6	108.8		107.0	101.6		0.1	-4.62	0.4000
M09189	20090926	163025	68.5	0.93	55.6	0.7	59.2	13.9	58.0	38.9	42.3	5.2	4.8	111.0		106.0	98.8		0.4	-3.77	0.5000
M09190	20090926	182310	13.8	3.06	8.4	3.4	30.3	1.8	28.4	36.9	7.0	5.3	5.1	101.3	*	98.8	95.0	*	0.3	-2.84	0.5000

TABLE-2. The orbital elements of TV meteors.

(eq.J2000.0)

No.	DATE YYYYMMDD	UT hhmmss	a AU	e	q AU	Ω deg	i deg	ω deg	P yr
M09179	20090924	160528	0.815	0.257	0.6058	181.611	141.132	20.149	0.736
M09180	20090924	161044	1.260	0.306	0.8741	181.615	140.487	243.168	1.414
M09181	20090924	170643	2.571	0.613	0.9956	181.652	70.836	191.350	4.122
M09182	20090924	170924	13.074	0.951	0.6432	1.654	157.046	74.696	47.273
M09183	20090924	181604	4.740	0.794	0.9781	181.700	82.533	199.298	10.319
M09184	20090924	183137	1.184	0.213	0.9318	1.708	176.391	53.474	1.288
M09189	20090926	163025	3.507	0.766	0.8198	183.588	117.378	234.547	6.569
M09190	20090926	182310	2.170	0.840	0.3467	183.661	2.694	295.642	3.196

2010-8-13,
Location: Shigaraki, Shiga
Observer: J. Kero
Camera: ICCD,
Lens: f85mm
LM. : 8.5mag.
Fild of view: 8.8×6.4°

Software: UFOCaptureV2 and AnalyzerV2 (SonotaCo)

Location: Habikino, Osaka
Observer: M. Ueda
Camera: Watec-CCTV Camera, WAT-902H2 ULTIMATE,
Lens: f25mm F0.95
LM. : 6.5mag.
Fild of view: 14.2×10.3°
Software: UFOCaptureV2 and AnalyzerV2 (SonotaCo)

Location: Muroh, Nara
Location: Niishin, Aichi

Camera: Watec-CCTV Camera, WAT-902H2 ULTIMATE,
Movie of the example (The reentry of a HAYABUSA into the Earth's atmosphere, 2010-6-13)

5 doubly TV meteors on August 2010

Data of TV meteors

2010-8-13

No.	Time JST	Observer	Obs. Station	lens	Fild of view	beginning	end
M10072	2:49:22.92 ±0.03S	J. Kero	Shigaraki	85mm	8.8×6.4°	×	×
M10073	3:10:31.23	J. Kero	Shigaraki	85mm	8.8×6.4°	×	○
M10074	3:14:25.57	J. Kero	Shigaraki	85mm	8.8×6.4°	×	○
M10075	3:23:35.77	J. Kero	Shigaraki	85mm	8.8×6.4°	×	○
M10076	3:37:48.80	J. Kero	Shigaraki	85mm	8.8×6.4°	×	○

No.	Time JST	Observer	Obs. Station	lens	Fild of view	beginning	end
M10067	2:49:22.0 ±1s	M. Ueda	Habikino	25mm	14.2×10.3°	×	×
M10068	3:10:30.2	M. Ueda	Habikino	25mm	14.2×10.3°	○	○
M10069	3:14:24.4	M. Ueda	Habikino	25mm	14.2×10.3°	○	○
M10070	3:23:34.7	M. Ueda	Habikino	25mm	14.2×10.3°	○	○
M10071	3:37:47.8	M. Ueda	Habikino	25mm	14.2×10.3°	○	○

2010-8-13, 3:14:24JST

doubly TV meteor,

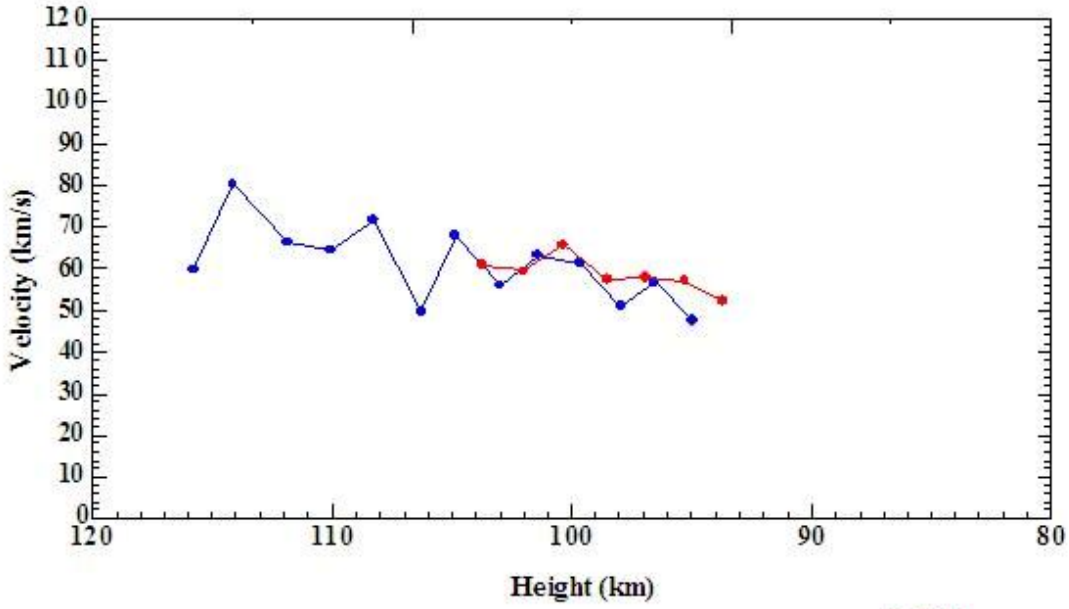
No. M10069

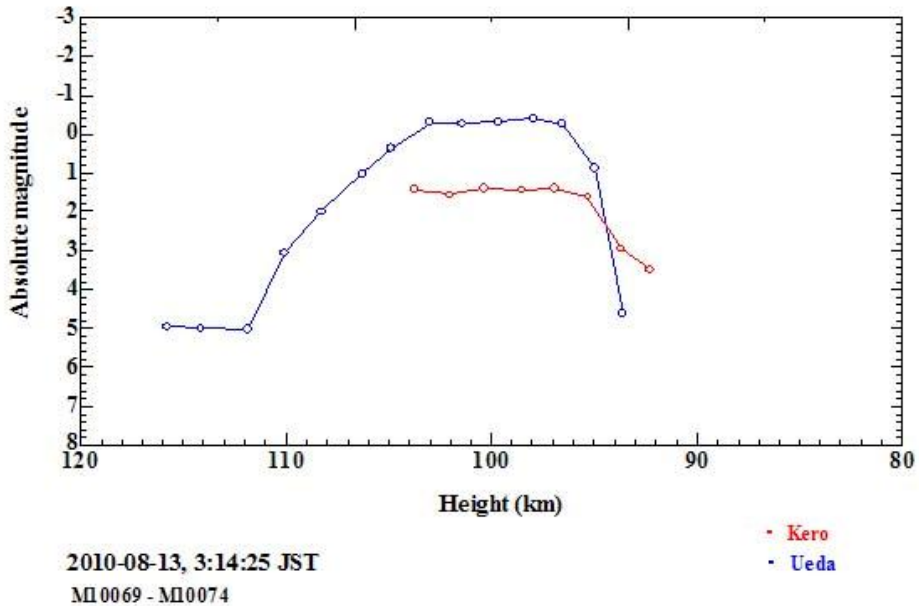
Habikino

Movie

2010-8-13, 3:14:25.57JST
doubly TV meteor,
No. M10074
Shigaraki

Movie


Velocity (km/s)
Height (km)
Kero
Ueda
2010-08-13, 3:14:25 JST
MI0069 - MI0074


Absolute magnitude
Height (km)
Kero
Ueda
2010-08-13, 3:14:25 JST
MI0069 - MI0074

The radiants and orbits of 5 doubly TV meteors (Aug., 2010)

TABLE-1. The radiant positions, velocities and heights of TV meteors.

	DATE	UT	RADIANT(2000.0)				V_∞	V error	V_G	V_h	Q	obs.	abso.	Hb		Hm	He		dH	log	Max/L
No.	YYYYMMDD	hhmmss	α_G	$d\alpha$	δ_G	$d\delta$	Km/s	km/s	Km/s	km/s	deg	Mag.	Mag.	Km	*	Km	Km	*	Km	(mass)	
M10067	20100812	174922	27.8	0.10	-3.8	0.61	64.4	12.3	63.3	40.4	34.4	1.4	1.3	113.6	*	104.5	98.5	*	0.1	-2.10	0.6364
M10068	20100812	181030	48.2	0.94	58.3	1.00	59.4	8.2	58.2	40.6	55.7	3.8	3.4	108.1		102.5	99.5		0.5	-3.43	0.6667
M10069	20100812	181424	46.6	0.88	58.0	0.49	60.3	7.8	59.2	41.3	65.3	-0.1	-0.4	115.8		97.9	93.6		0.4	-1.59	0.7857
M10070	20100812	182334	46.0	0.57	57.2	0.51	56.0	14.2	54.8	37.1	71.0	4.3	3.8	112.6		107.4	100.9		0.3	-3.33	0.5000
M10071	20100812	183747	47.6	0.20	57.0	0.30	59.7	17.6	58.6	40.3	55.4	1.3	0.9	114.6		106.5	98.0		0.6	-2.33	0.5455

	DATE	UT	a	e	q	Ω	i	ω	P	Shower
No.	YYYYMMDD	hhmmss	AU		AU	deg	deg	deg	yr	
M10067	20100812	174922	7.348	0.9245	0.5549	319.769	149.040	86.660	19.919	Spo.
M10068	20100812	181030	-11.141	1.0854	0.9515	139.784	113.837	151.980	-	PER
M10069	20100812	181424	20.331	0.9529	0.9570	139.786	113.004	152.382	91.671	PER
M10070	20100812	182334	2.367	0.6015	0.9431	139.792	110.845	144.645	3.641	PER
M10071	20100812	183747	6.979	0.8642	0.9481	139.801	114.078	149.449	18.438	PER

光学同時観測から得られるもの
Result by Simultaneous optics observation
同時流星
Doubly meteor
1.**出現時刻(The time of apperance)**：今までの精度はkeroさんらは0.033秒以内、上田は1秒以内、 次回からは、岡本さんらは0.010秒以内となる。
2.**位置(Right ascension, Declination)**
位置測定精度：Image Intensifier, lens:f200mm, F2.0,- - - 0.026°
Watec TTCV Camera f25mm, F0.95- - - 0.015°
3.**光度(Magnitude)**： 流星経路上の写ったフレームごとの光度。同時流星（M01069, -0.4mag., M01074, 1.6mag.)の最大光度の絶対光度で1.8等の差があった。精度は悪い。
4.**速度(Velocity)**： 流星経路上の写ったフレームごとの速度。速度誤差Vobs 60.3km/s ±7.8km/s(M10069 – M10074)
5.**実経路(**Atmospheric trajectory)： 大気圏中の飛行経路、経度、緯度、高さ
6.**その他**： 測光質量(Total ablated mass)、日心軌道(orbital element) 、

Thank you very much.

END