Beta Taurids Video Campaign

Methods, observations, results

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Pracownia Komet i Meteorów

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Taurid swarm years

2002	-11
2009	13
2012	-29
2016	36
2019	-5
2026	18
2029	-23
2036	1

2005	11
2008	-30
2012	35
2015	-7
2022	17
2025	-25
2032	-1
2039	23

Sources: D.J. Asher S.V.M. Clube (1993) Q. J. R. Astron. Soc. 34, 481-511
https://www.cantab.net/users/davidasher/taurid/swarmyears.html

Initial plans

- Daylight observations of the 2019 return using dedicated low sensitivity allsky stations
- Telescopic observations of the lunar impacts caused by large Taurids

90 k€ grant application sent one year before the maximum

Grant application included:

- High resolution (better than full HD) autonomous allsky stations (day/night) - 8 pcs
- Low sensitivity wide angle camera with IR filters dedicated for daylight observations - 22 pcs
- Data server - 1 pcs
- Small telescope with camera for lunar impact observations - 4 pcs
- PC computers, HDD's etc

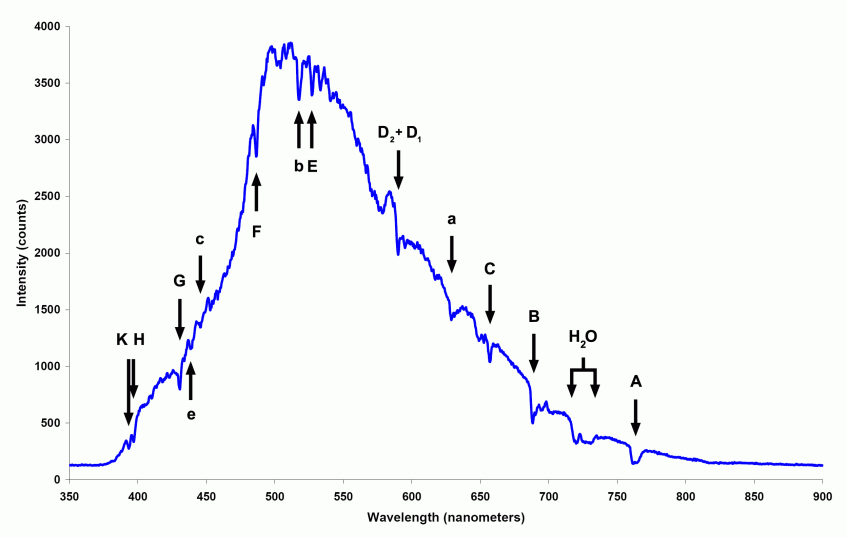

Dear Applicant:
We regret to inform you that your grant proposal has been rejected.
JORGE CHAM © 2013

Alternative plan

- Purchase components for limited number of low sensitivity stations
- Purchase filters for some PFN cameras
- Change the camera settings (gain, exposure time) for daylight observations during the expected maximum

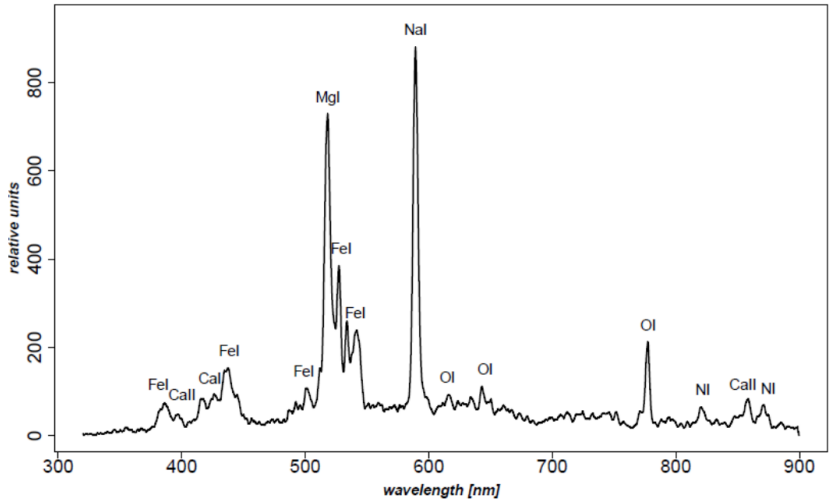
Filters selection

Spectrum of the daylight sky



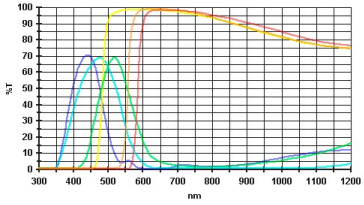
Filters selection

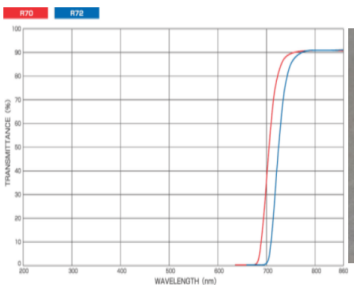
Taurid fireball spectrum (source: Matlovič, Rudawska 2017, 2015-11-05 22:02:51 UT)



Filters selection

Various filters considered



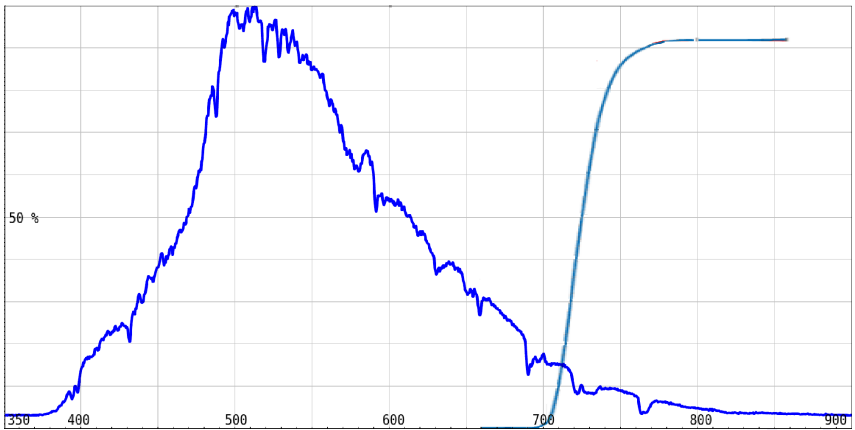


Filters selection

Best results for 720 nm filters

Daylight sky signal filtered/unfiltered ratio (350-900 nm)

21.1

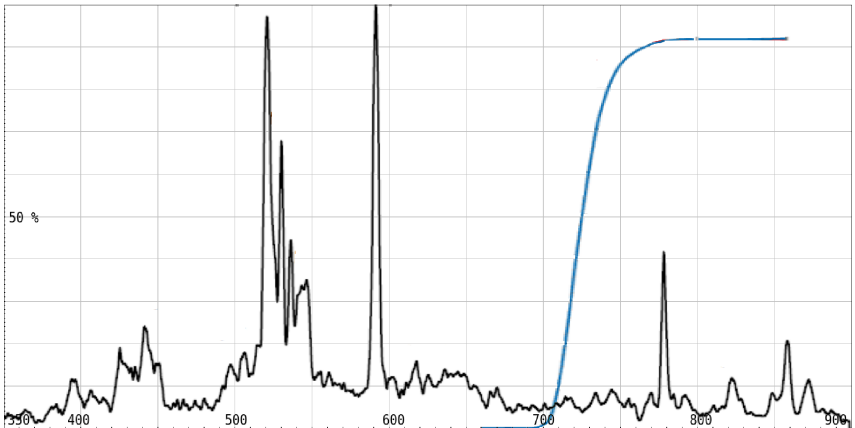


Filters selection

Best results for 720 nm filters

Taurid fireball signal filtered/unfiltered ratio (350-900 nm)

5.9, mostly dependent of oxygen line



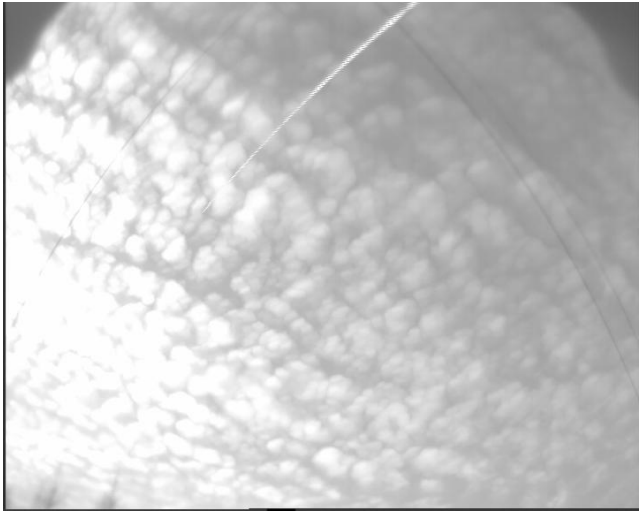
Filters selection

Results for all filters converted to magnitudes

Filter	Daylight losses [mag]	Fireball losses [mag]	Difference [mag]
Baader Yellow	0.2	0.27	-0.07
Baader Orange	0.87	0.76	0.11
Baader Red	1.54	1.38	0.16
Hoya 720	3.3	1.92	1.38

Meanwhile - daylight detection, 2019 02 08 14:35:55 UT

Standard PAL camera without filters, without any adjustments. Thin clouds on the sky



Meanwhile - daylight detection, 2019 02 08 14:35:55 UT

The same fireball registered by car camera

June 2019 - media has been informed about possible fireballs...

June 2019 - media has been informed about possible fireballs...

Whats happened next...

Cameras used for daylight observations

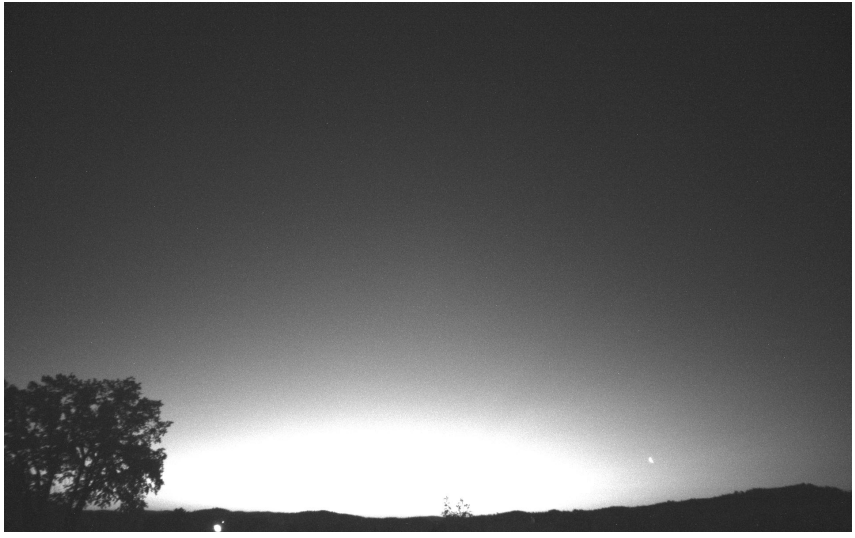
Folowing cameras were switched to daylight observations between 20.06 and 15.07.2019:

Station	Camera	Observer	Filter	Gain	Camera type
PFN 06 Kraków	MDC14	Maciej Kwinta	ND 16	Reduced	Digital HD
PFN 29 Klecza Dolna	MDC13	Mariusz Szlagor	IR 720	Reduced	Digital HD
PFN 32 Chełm	MDC08	Maciej Maciejewski	ND 16	Reduced	Digital HD
PFN 32 Chełm	PAV43,35,36,60	Maciej Maciejewski	ND 16	Reduced	PAL
PFN 38 Podgórzyn	MDC15	Tomasz Krzyżanowski	IR 720	Reduced	Digital HD
PFN 40 Otwock	PAVO9, PAVO3	Zbigniew Tymiński	ND 4	Reduced	PAL
PFN 41 Twardogóra	PAV45, PAV53	Henryk Krygiel	ND 16	Auto	PAL
PFN 50 Brzozówka	MDC24	Andrzej Skoczewski	none	Reduced	Digital HD
PFN 62 Szczecin	MDC05	Zbigniew Laskowski	none	Reduced	Digital HD
PFN 63 Starowa Góra	MDC26	Arkadiusz Raj	ND 4	Auto	Digital HD
PFN 67 Nieznaszyn	PAVO2, PAV78	Walburga Węgrzyk	ND 4	Auto	PAL
PFN 73 Chrzanów	PAVO1, PAVO2, PAVO3	Paweł Zaręba	ND 16	Auto	PAL
Warszawa (temporary)	PAVO3	Karol Fietkiewicz	none	Auto	PAL

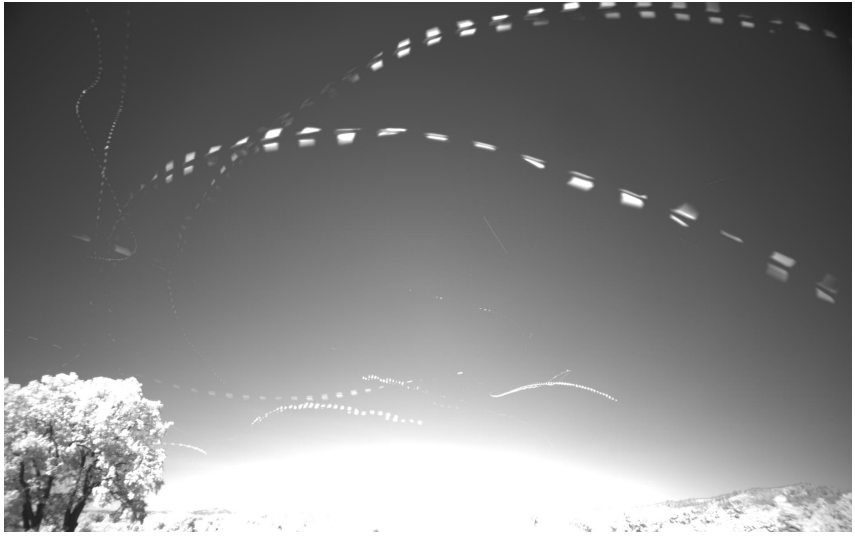
Digital cameras were active from 0 UT to the sunset of the following day
PAL cameras were active roughly from dawn to dusk. Other PFN cameras worked at night

PFN73 Chrzanów - PAVO1, PAVO2, PAVO3 with ND16 filters

PFN38 MDC15 with IR720 filter - just before sunrise



PFN38 MDC15 with IR720 filter - tons of birds and insects



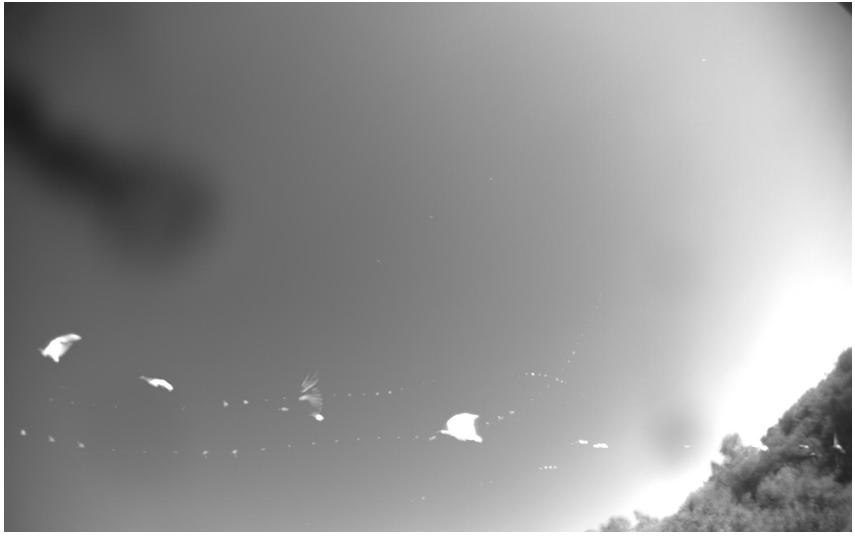
PFN06 MDC14 with ND16 filter - airplane

PFN06 MDC14 with ND16 filter - airplane at low altitude

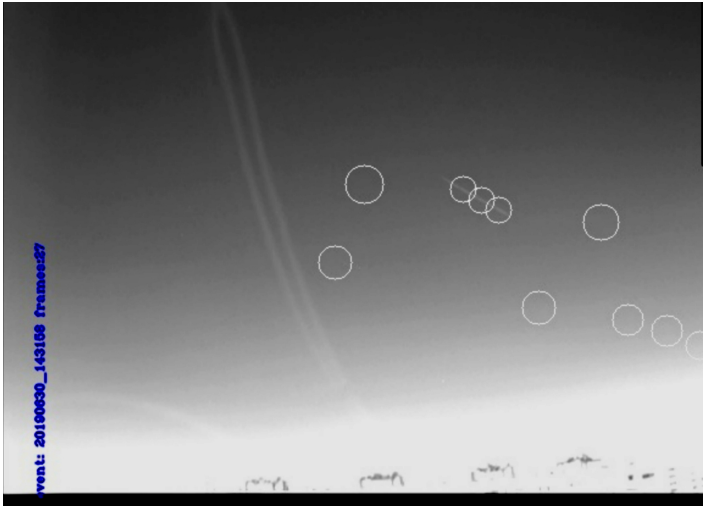
PFN40 PAV52 - "false iridiums" - planes approaching Warsaw airport

PFN50 MDC24 - birds..

PFN50 MDC24 - afterbirds..

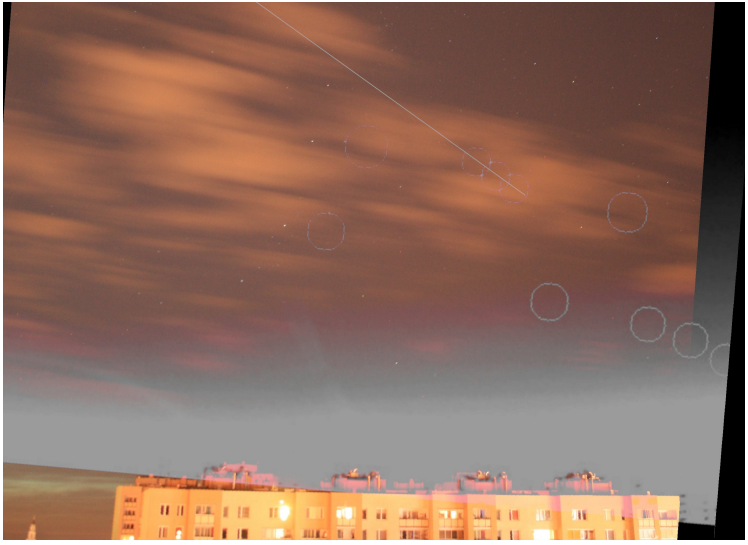


Daylight fireball detection - analog camera, Warsaw



2019-06-30 14:31:56 UT

Image calibration



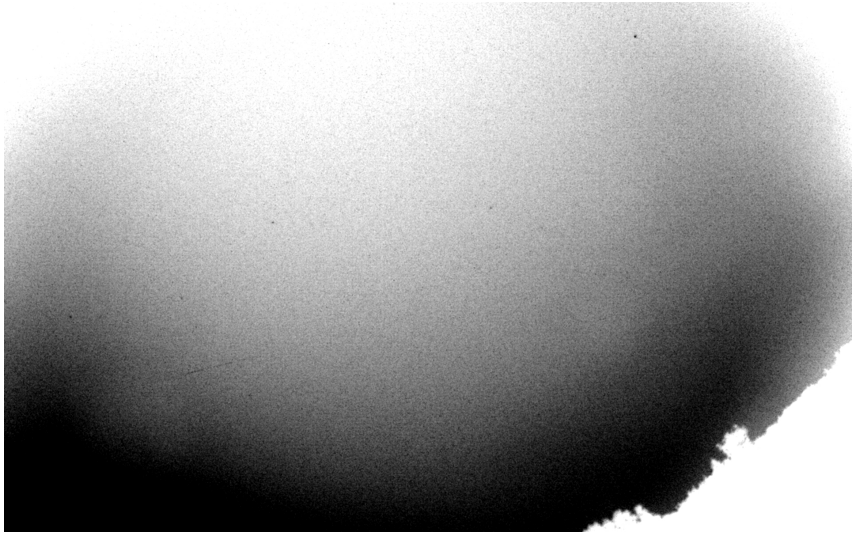
Detection 2019-06-30, Warsaw

- There is no second detection, trajectory calculations not possible
- Fireball trail back prolongation fits to helion source
- This is not Beta Taurid fireball

A meteor before sunrise, 2019-06-30 01:23:11

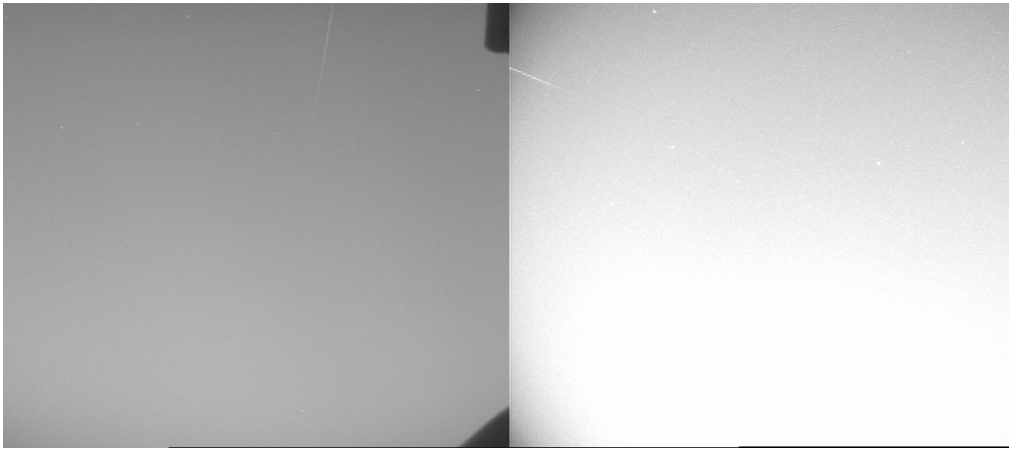
PFN24 Brzozowka, MDC50, without filters, gain reduced

A meteor before sunrise, 2019-06-30 01:23:11



A meteor before sunrise, 2019-06-30 01:23:11

Two other detections: PFN48 PAV64, PFN06 PAV79

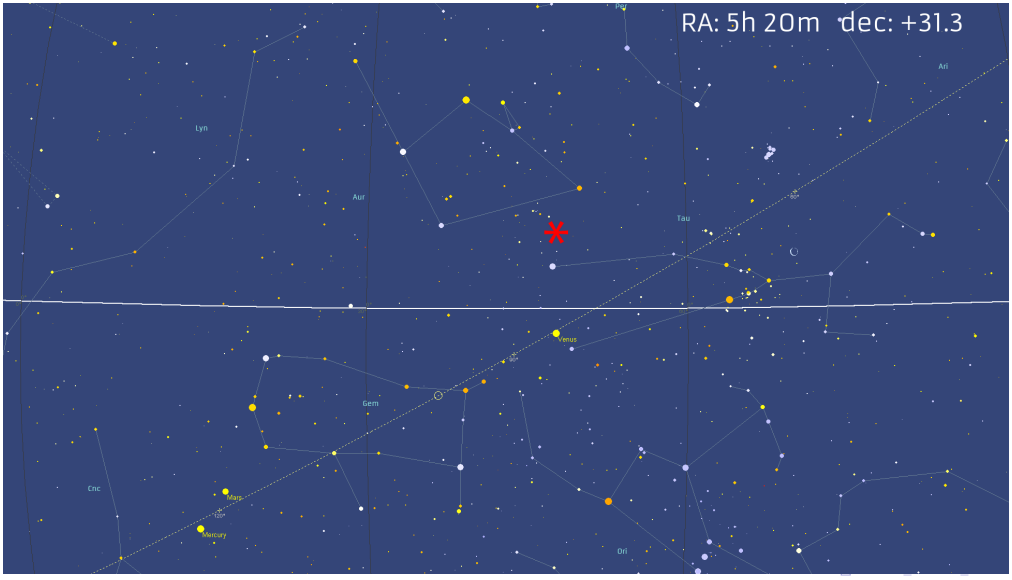


Meteor trajectory

Atmospheric trajectory data

	Beginning	Terminal
Velocity [km/s]	31.7 ± 0.1	31.5 ± 0.1
Height [km]	93.3 ± 0.6	87.8 ± 0.1
Longitude [deg E]	21.340 ± 0.004	20.872 ± 0.001
Latitude [deg N]	49.977 ± 0.002	49.7065 ± 0.0006
Slope [deg]	7.0 ± 0.8	6.6 ± 0.8

Apparent radiant



Orbital elements

	PyFN	Meteor Toolkit
a	2.05	1.97
e	0.8512 $\pm$0.071	0.8434 $\pm$0.057
i	7.56 $\pm$0.41	7.35 $\pm$1.04
q	0.3061 $\pm$0.005	0.3088 $\pm$0.077
ω	58.52 $\pm$0.93	58.67 $\pm$0.70
Ω	97.74 $\pm$0.00015	97.78 $\pm$0.005
Period	2.93	2.7704

Calculated using two independent routines (PyFN, Zoladek 2011 ; Meteor Toolkit, Dmitriev,Lupovka,Gritsevich 2018)

Orbital elements comparison

	PyFN	Meteor Toolkit	2015 TX24	2005 UR	2005 TF50	2005NX39
a	2.05	1.97	2.268	2.263	2.273	2.475
e	0.8512	0.8434	0.8720	0.8793	0.8686	0.8747
i	7.56	7.35	6.042	6.965	10.687	13.93
q	0.3061	0.3088	0.2903	0.2732	0.2988	0.3104
Arg	58.52	58.67	127.018	141.036	159.885	38.862
Node	97.74	97.78	32.9933	0.2698	0.678	121.123
Period	2.93	2.7704	3.419	3.407	3.429	3.89

Best similarity - 2005NX39 - D' (Drummond) = 0.048

Comparison with IAU MDC list

	$L_\odot$	RA	Dec	Vgeo	a	q	e	i	ω	Ω	Reference
172 ZPE	74.5	67.4	23.4	26.4	1.55	0.335	0.7841	3.8	58.4	75.0	Brown 2018
173 BTA	93.5	82.0	20.0	27.4	1.66	0.325	0.8042	3.6	238.3	277.0	Brown 2018
Meteor	97.7	80.2	31.3	29.9	2.05	0.306	0.8512	7.6	58.52	97.7	

Summary

- PFN conducted a video campaign devoted to daylight fireball detection between 20.06 and 15.07 2019
- Multiple cameras has been converted to daylight operation using IR or neutral density filters
- There is no daylight Taurid detection
- There is one daylight fireball of unknown origin (probably from helion source)
- The only one meteor from Taurid complex - 30.06.2019 01:23 UT was a Zeta Perseid (not a member of 7:2 resonance stream)
- PC computers, HDD's etc

Thank you for your attention