POLISH FIREBALL NETWORK

The 2004 Perseid meteor shower – Polish Fireball Network double station results

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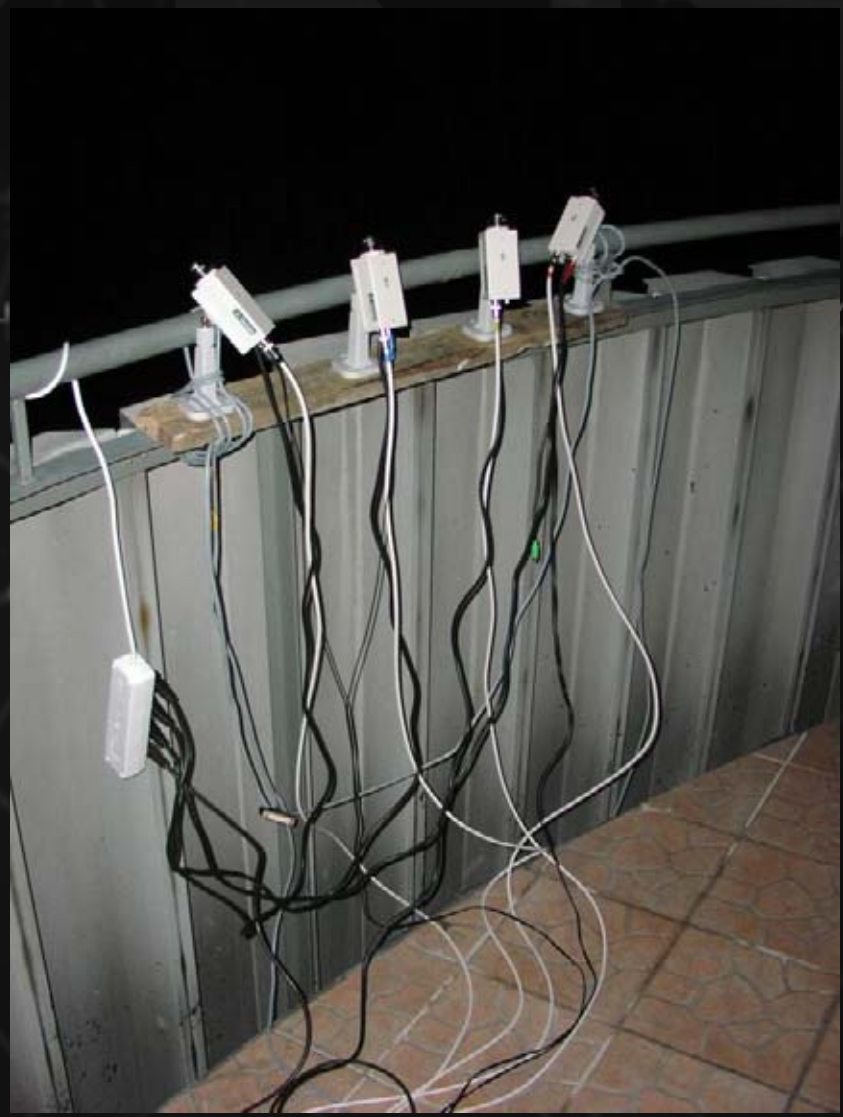
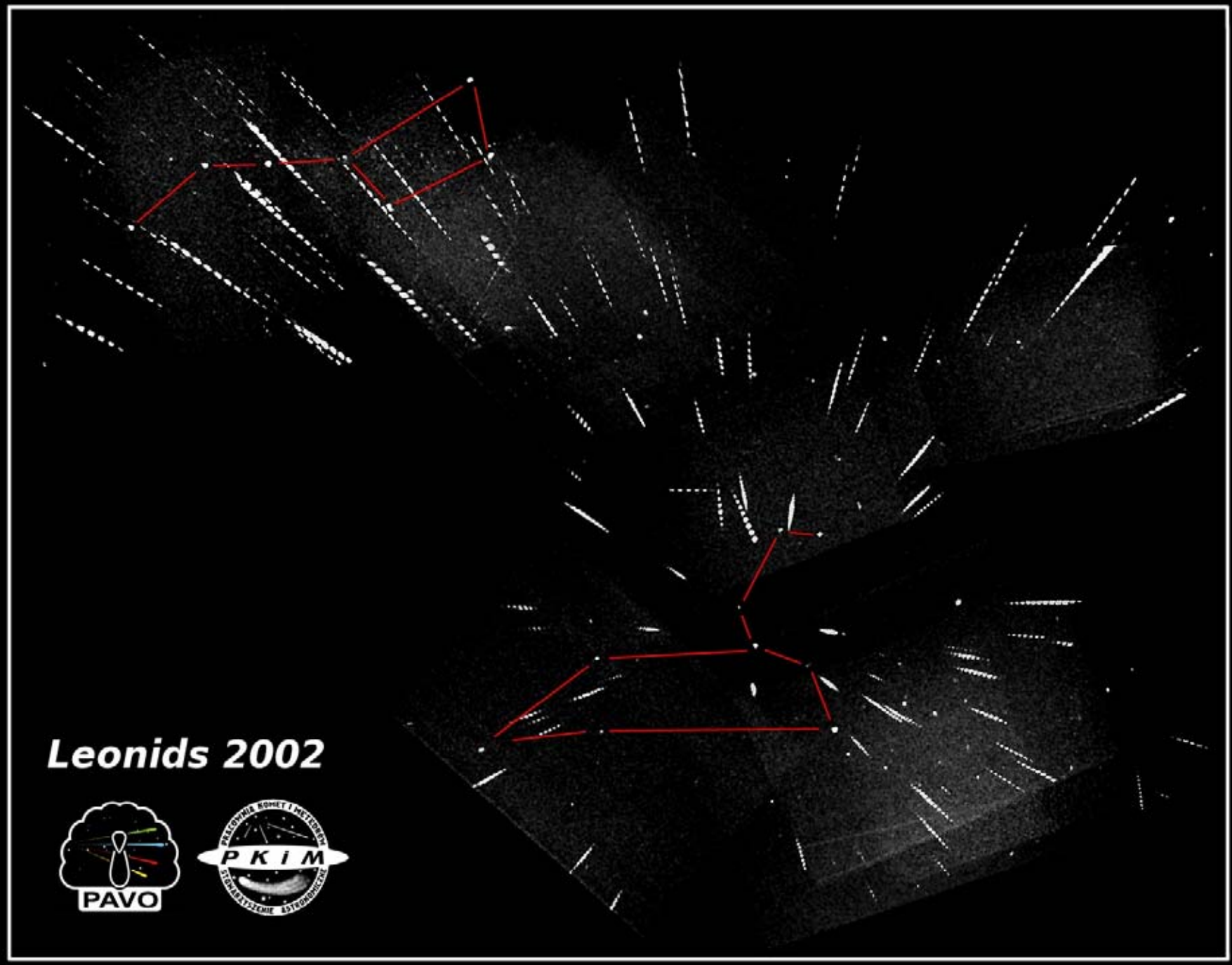
History: Polish Automated Video Observations (PAVO)

- Leonids 2002
- first video observations

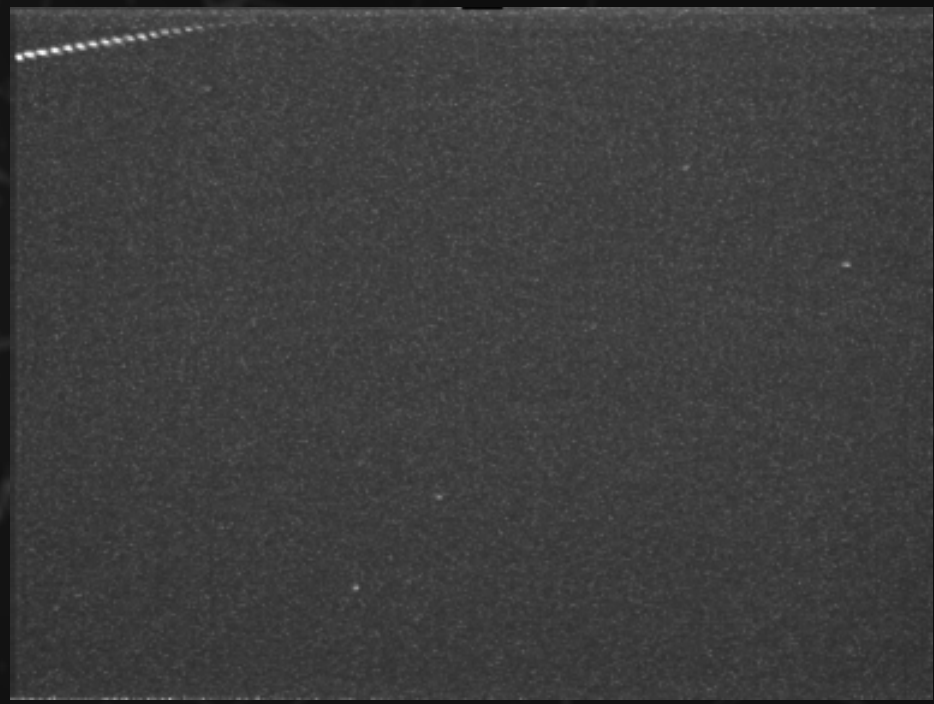



Leonids 2002
PAVO
PKiM

Polish Automated Video Observations (PAVO)

- Leonids 2003
- 2003 11 20 21:52:37 UT (first video double station meteor)

Ostrowik

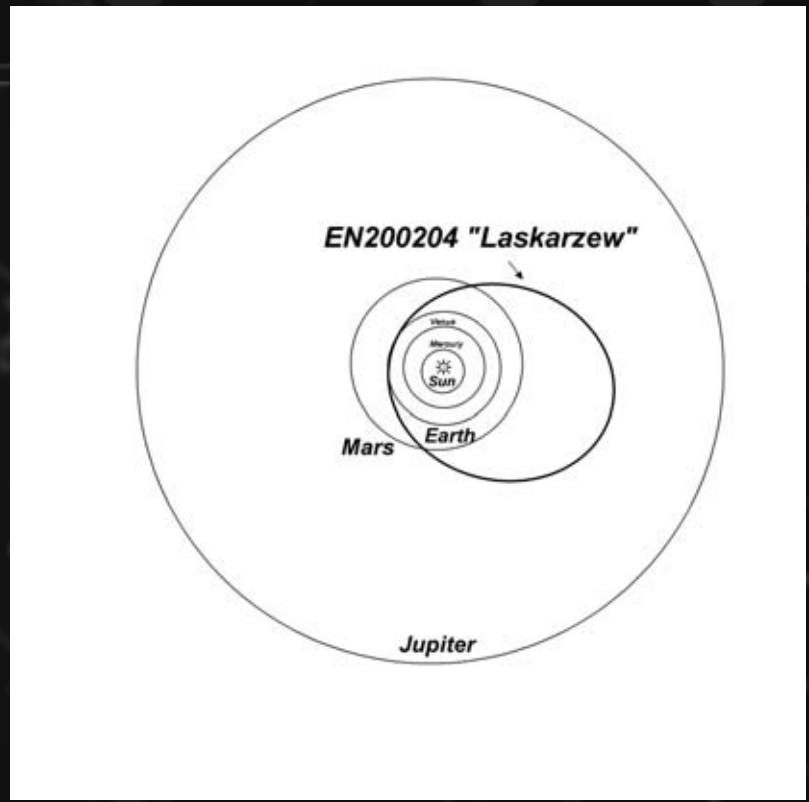


Złotokłos

Polish Fireball Network

EN200204 Łaskarzew

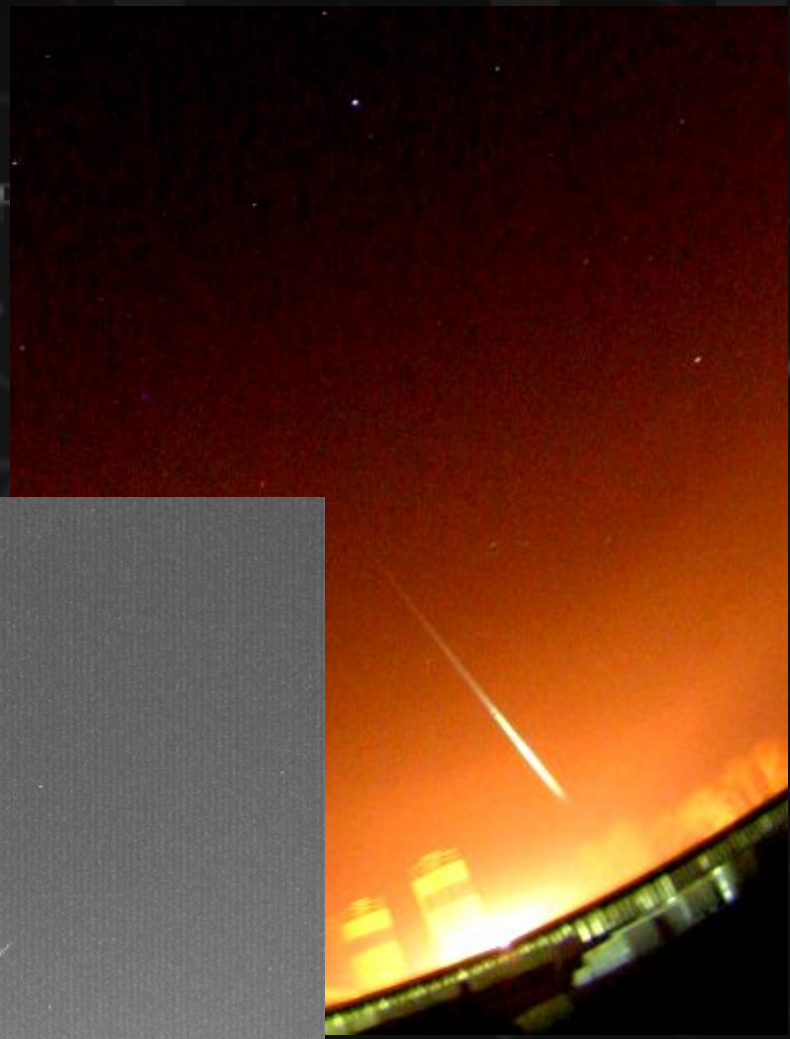
20 02 2004 18:54 UT -10 mag. Ostrowik



Polish Fireball Network

Polish Automated Video Observations (PAVO)

and photographic observations



Polish Fireball Network

2005 – 2007 observations

Polish Fireball Network

camera: CCTV ~0.01 lux, (Minitron, Siemens)

lens: f=4mm F/1.2 (Ernitec, Computar)

computer: PII 400MHz 128MB RAM (or better)

softwear: MetRec

FOV: 66x51 deg

LM met: 2 mag

LM stars: 4 mag

~ 1 mereor/hour

Polish Fireball Network

Polish Fireball Network

Video Stations of PFN

PFN03 Złotokłos	PAVO3, PAVO4
PFN05 Poznań	PAVO5, PAV11, PAV24
PFN06 Kraków	PAVO6, PAVO7
PFN13 Toruń	PAV14, PAV15
PFN14 Zielona Góra	PAV17, PAV18, PAV19
PFN17 Gdynia	PAV20, PAV21
PFN18 Łódź	PAV22, PAV23
PFN19 Kobiernice	PAVO8
FPN20 Urzędów	PAV25,PAV26
PFN21 Białystok	PAVO9
PFN22 Czernice Borowe	PAV10, PAV27
PFN23 Warszawa	PAV13
PFN25 Aleksandrów Łódzki	PAV28
PFN26 Łódź	PAV29, PAV30
reorganization: from september	
PFN27 Burzynin	PAV12, PAV16
PFN28 Kielce	PAV31, PAV32

14(+2) working stations with
26(+4) video cameras

3 cameras for tests and tele-video project:
PAVO1, PAVO2, PAV33 -> Warszawa or Ostrowik

Photographic Stations of PFN

PFN01	Ostrowik	digital camera (300D)
PFN04	Warszawa	digital camera (350D)
PFN09	Żabików	analog camera
PFN16	Nysa	digital cameras (300D, A60, A60, A60)
PFN24	Gniewowo	digital camera (D70)

total: 21 stations, 33 video cameras and 8 photo cameras, ~30 person in PFN

Polish Fireball Network ;) ☺

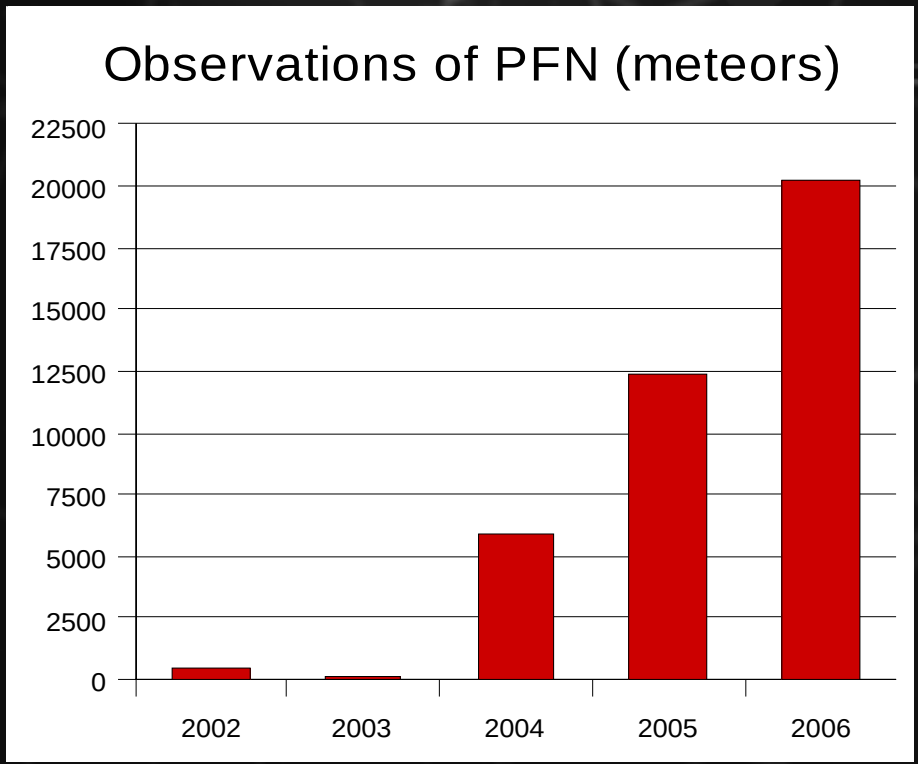
Polish Fireball Network

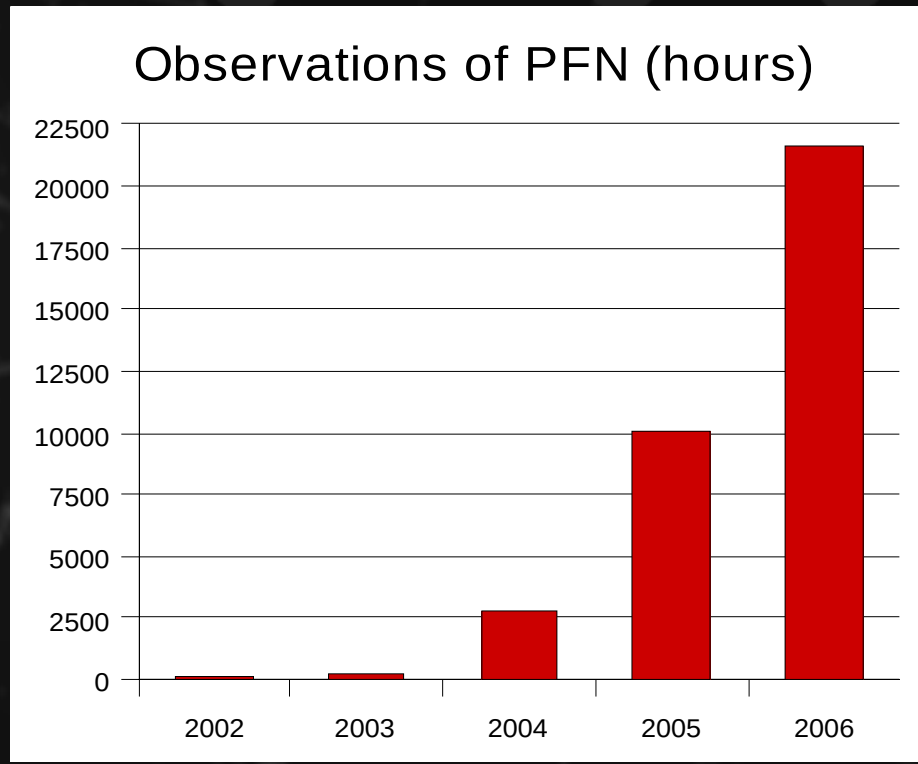
Polish Automated Video Observations (PAVO)

PFN	Location	2002	2003	2004	2005	2006	2007	TOTAL
PFN01	Ostrowik	60.6	72.4	536.3	641.3	0.0	0.0	1310.6
PFN02	Warszawa	53.1	65.4	0.0	0.0	0.0	0.0	118.5
PFN03	Złotokłos	0.0	54.8	502.1	879.0	637.2	0.0	2073.1
PFN04	Warszawa	0.0	30.3	59.0	0.0	0.0	0.0	89.3
PFN05	Poznań	0.0	0.0	1005.2	3727.0	5584.1	1052.5	11368.8
PFN06	Kraków	0.0	0.0	510.5	1655.5	3992.9	656.3	6815.1
PFN07	Kraków	0.0	0.0	108.0	67.3	0.0	0.0	175.3
PFN10	Telatyn	0.0	0.0	7.1	0.0	0.0	0.0	7.1
PFN11	Nowa Iwiczna	0.0	0.0	21.3	115.2	0.0	0.0	136.5
PFN12	Lublin	0.0	0.0	0.0	255.9	0.0	0.0	255.9
PFN13	Toruń	0.0	0.0	0.0	1447.0	1658.0	293.9	3398.9
PFN14	Zielona Góra	0.0	0.0	0.0	216.9	685.5	0.0	902.5
PFN17	Gdynia	0.0	0.0	0.0	595.1	1724.9	0.0	2320.0
PFN18	Łódź	0.0	0.0	0.0	256.7	1528.0	0.0	1784.6
PFN19	Kobiernice	0.0	0.0	0.0	190.5	515.2	0.0	705.6
PFN20	Urzedów	0.0	0.0	0.0	0.0	2016.6	638.0	2654.6
PFN21	Białystok	0.0	0.0	0.0	0.0	880.0	95.6	975.6
PFN22	Czernice Borowe	0.0	0.0	0.0	0.0	1806.2	0.0	1806.2
PFN23	Warszawa	0.0	0.0	0.0	0.0	963.9	247.9	1211.8
TOTAL	Poland	113.7	222.9	2749.4	10047.3	21992.5	2984.1	38110.0

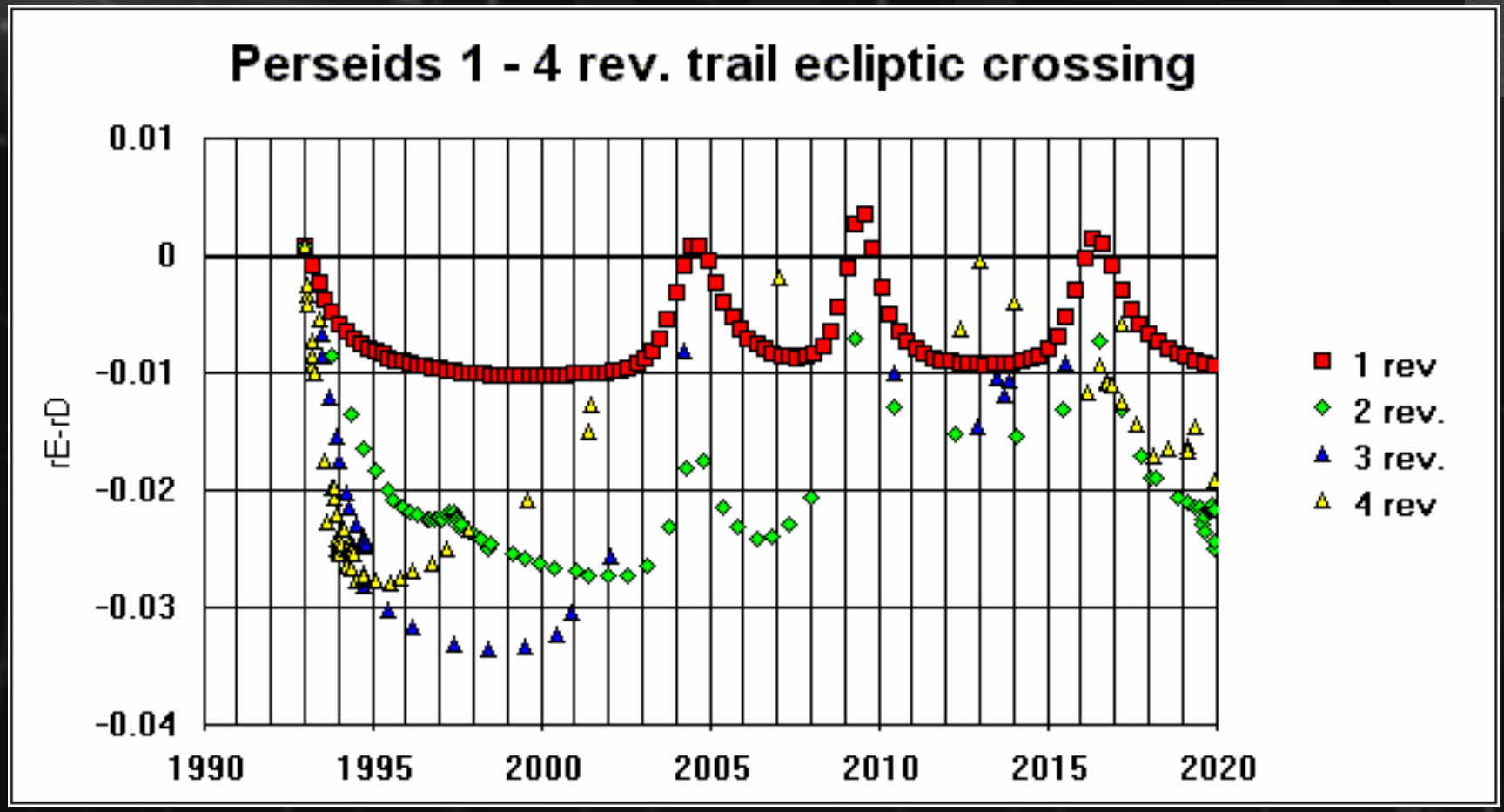
Polish Fireball Network

Polish Automated Video Observations (PAVO)



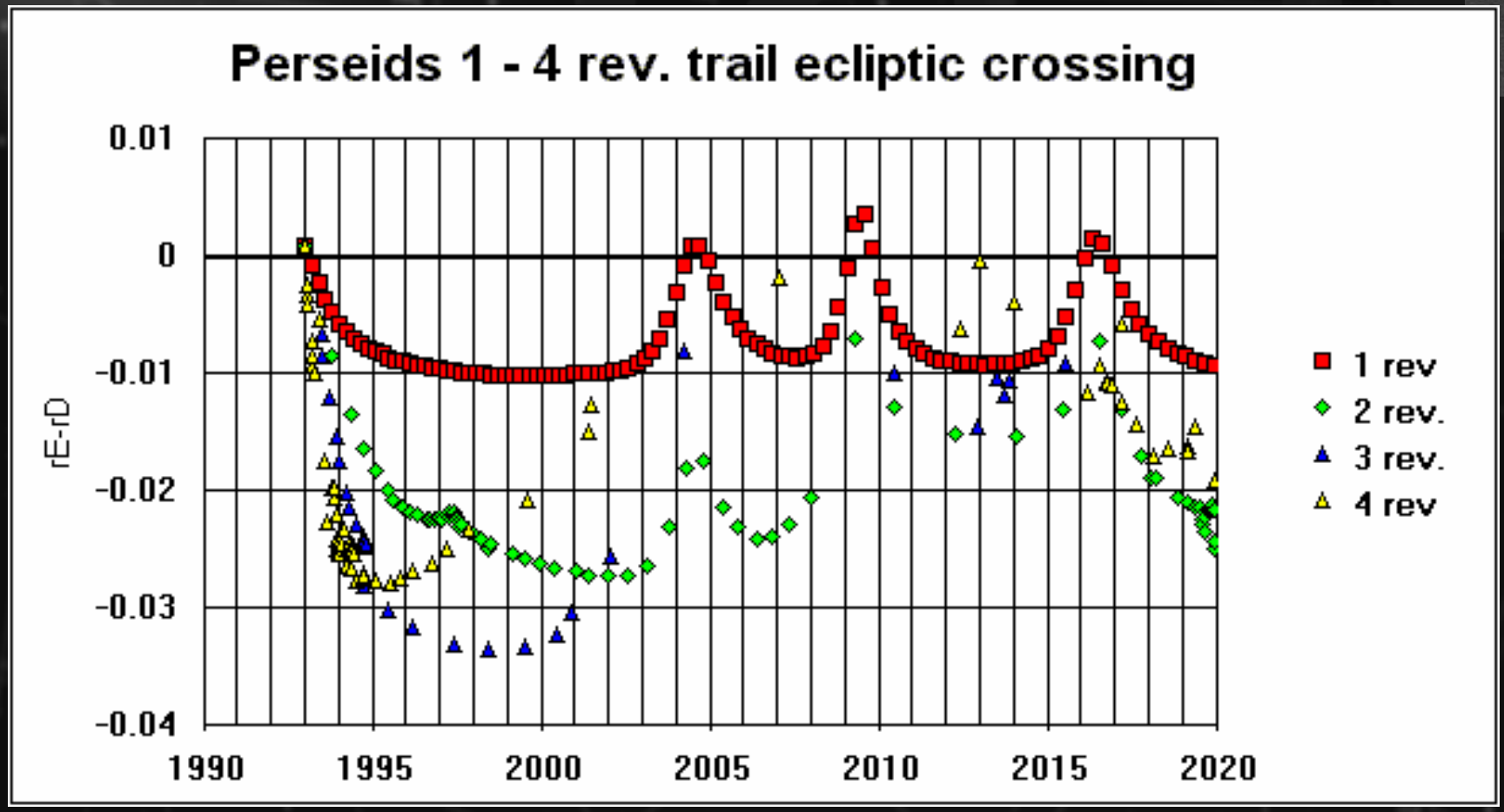


And now history of the one perseid maximum…



Due to good intersection geometry we suspected enhanced perseid activity at 2004. Some authors predicted ZHR's even larger than 1000!

And now history of the one perseid maximum…



Jeremie Vaubaillon pointed that this maximum can be slighty dissapointed for visual observers. Activity could be high, but meteors will be rather faint..

August 10 2004 – begin of the annual astronomical camp in Ostrowik Observatory, 40km south of Warsaw

As every year, we organised summer astronomical camp i Ostrowik station of the Warsaw Uniwersity Observatory. Due to favourite perseid prediction and moon phase we decided that this camp will held from 10 to 19 of August 2004

We planned to observe with al. Available methods including visual, photo, video and telescopic. Escpecially for this maximum two automated rotating shutters was created. On the image above you can see myself creating one of these units.

APOLLO, PHAETHON and TOUTATIS – rotatnig shutters used during this campaign

August 10 2004 – begin of the annual astronomical camp in Ostrowik Observatory, 40km south of Warsaw

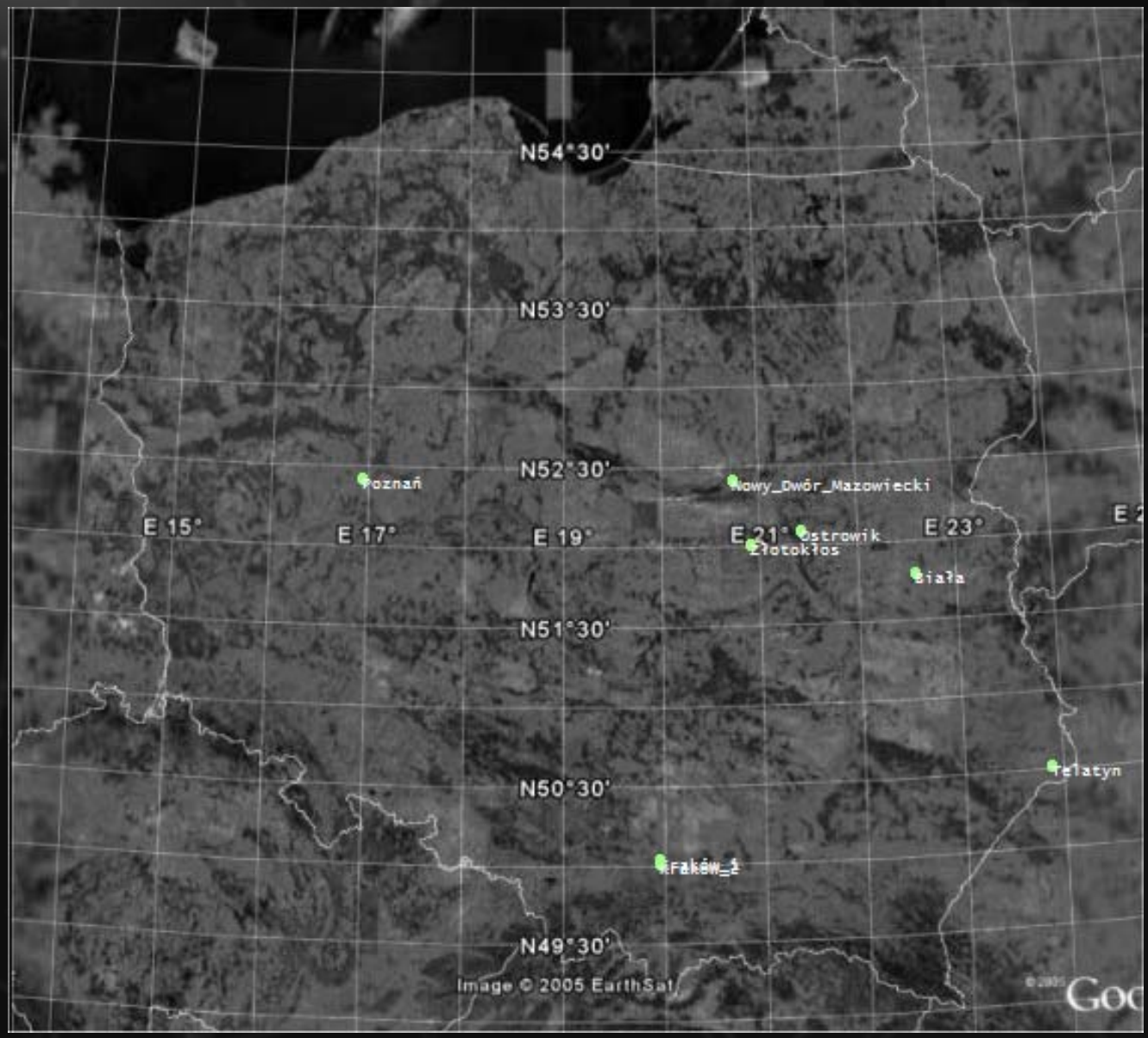
Video equipment at Ostrowik. We had three non intensified CCTV camers with 4 and 8 mm lenses this time at the station. All data were initially reduced by MetRec software.

August 10 2004 – begin of the annual astronomical camp in Ostrowik Observatory, 40km south of Warsaw

We had group of very experienced visual and telescopic observers supported our works. Thanks to their efforts we were able to determine ZHR and mass index of the perseids.

We were ready for large activity, it is a case when the visual observations giving us real scientific data.

Polish Fireball Network at the summer 2004 has eight active fireball stations



Polish Fireball Network at the summer 2004 has eight active fireball stations

Stations workind during this maximum were equiped with:

80001 Ostrowik – 2 Tayama's and 1 Mintron Camera with 8mm and 4mm lenses respectively

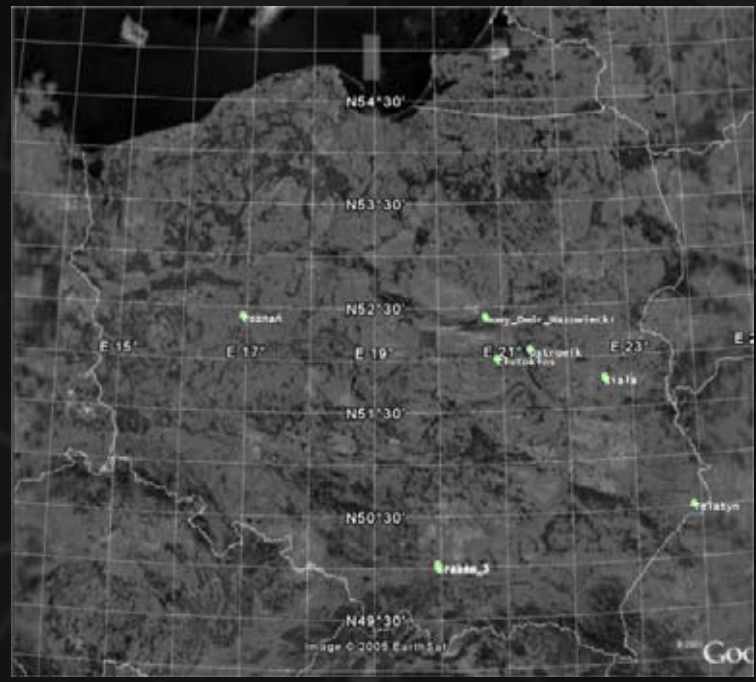
80003 Złotokłos – The same equipment as above

80005 Poznan – several types of CCTV's with 4mm lenses

80006 Kraków 1 – 2 Mintron's with 4mm

80007 Kraków 2 – 1 Mintron/4mm

80010 Telatyn – 1 Mintron /4mm



Polish Fireball Network at the summer 2004 has eight active fireball stations

Photographic stations were equiped with:

80001 Ostrowik:

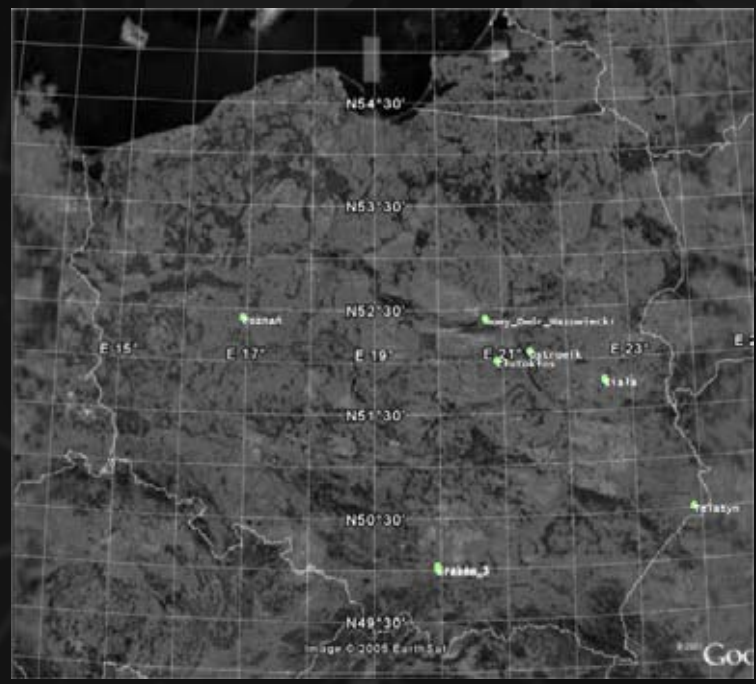
- PHAETHON w. 4x1.4/50mm analog camera
- TOUTATIS w. 2x2.8/28 analog camera

80015 Biała:

- APOLLO w. 2x 2.8/28mm analog camera

80010 Nowy Dwór Mazowiecki:

- PHAETHON w. 4x1.4/50mm analog camera (10/11 08 2004 only)



First observations were done at 10/11 08 2004

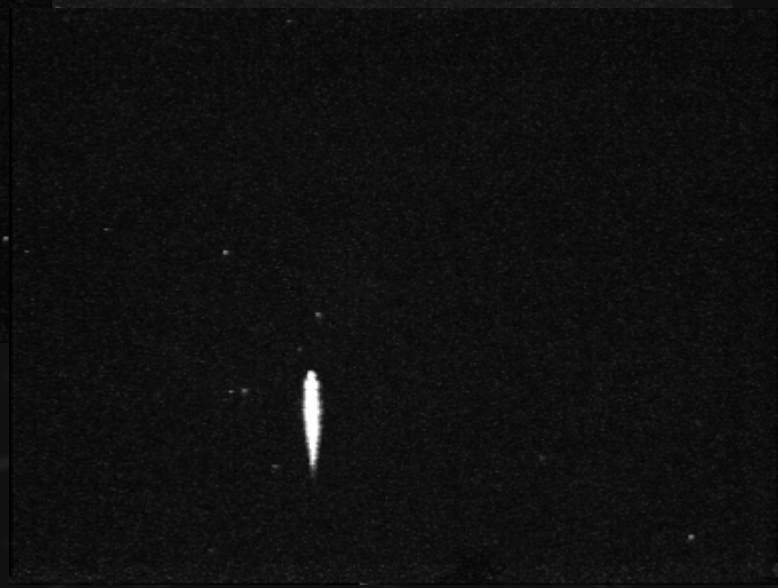
We had very clear weather during this night in Poland. Limiting magnitude reaches +6.0 on suburban areas and +6.8 on Ostrowik station.

Image presents one of photographic fireball obtained at Nowy Dwor station by 1.4/50 analog Canon FD camera with rotating shutter.

Gropup at Ostrovik observed mostly by video cameras

And off course visually..

Some examples from Ostrowik 8mm cameras



Gropup at Ostrovik observed mostly by video cameras

And off course visually..

And from 4mm..

11/12 08 2004 – Ostrowik

-3 magnitude Perseid fireball known from the WGN cover ☺(A.Olech)

11/12 08 2004 – Ostrowik

-1 magnitude Perseid catched by 1.4/50 camera with rotating shutter (P.Zoladek)

11/12 08 2004 – Ostrowik

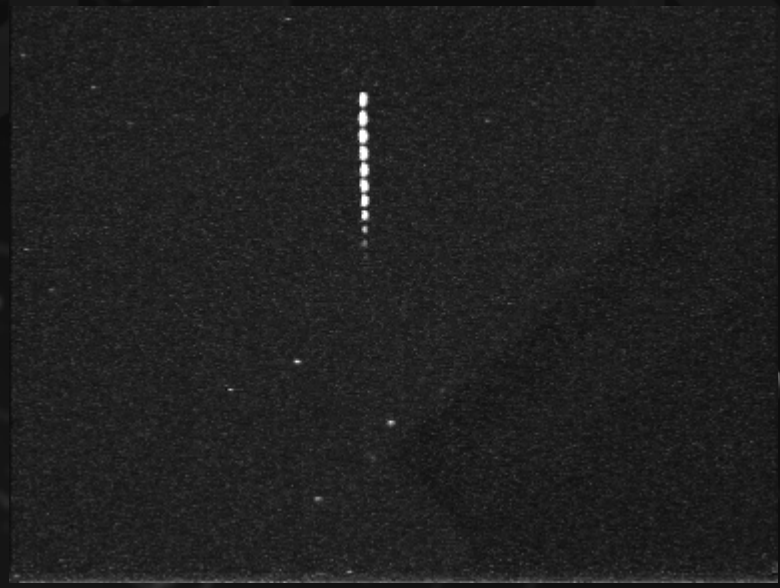
Another -1 magnitude Perseid catched by 1.4/50 camera with rotating shutter (slightly out of focus) (P.Zoladek)

11/12 08 2004 – Ostrowik

11/12 08 2004 – another stations

11/12 08 2004 – another stations

12/13 08 2004 – Perseids were still very active



Some curiosities..

Statistics for video cameras

Polish Automated Video Observations (PAVO) – Perseids 2004

PFN	PAVO	09/10	10/11	11/12	12/13
PFN01 Ostrowik	PAV01	4.7	6.2	6.9	7.1
PFN01 Ostrowik	PAV02	---	6.3	7.0	7.0
PFN01 Ostrowik	PAV10	4.7	6.0	6.7	6.6
PFN03 Zlotoklos	PAV04	5.4	5.0	6.8	6.7
PFN03 Zlotoklos	PAV03	5.1	---	6.8	6.7
PFN03 Zlotoklos	PAV09	5.5	7.0	6.9	7.1
PFN05 Poznan	PAV05	7.9	9.5	7.2	5.1
PFN05 Poznan	PAV11	---	5.1	6.1	5.7
PFN05 Poznan	PAV12	---	---	4.5	---
PFN05 Poznan	PAV13	---	---	2.3	---
PFN06 Krakow1	PAV06	---	6.2	6.2	---
PFN06 Krakow1	PAV07	---	6.1	6.0	---
PFN07 Krakow2	PAV08	---	3.1	3.1	---
PFN10 Telatyn	PAV12	---	---	3.5	3.6
TOTAL	PAVO	33	61	80	55

10/11 08 2004 –	364	meteors recorded
11/12 08 2004 –	1209	meteors recorded
12/13 08 2004 -	402	meteors recorded
Summary:	1975	single station events

Double events identification

Video data

All data observed during one night

Photographic data

XY Photographic Measurements

AstroRecord 3.0

DOUBLE EVENTS SELECTION

IMOgena ID Software

Double events identification – how we do it ☺?

STEP 1: Selection of meteors from one particular night

80001	PAV10	AFN	69
80001	PAV01	AFQ	98
80001	PAV02	AFW	64
80003	PAV09	AIX	169
80003	PAV04	AIY	88
80003	PAV03	AIZ	89
80005	PAV05	AMG	130
80005	PAV11	AMH	76
80005	PAV12	AMI	10
80005	PAV12	AMJ	31
80005	PAV13	AMK	19
80006	PAV06	APR	179
80006	PAV07	APS	75
80007	PAV08	ARQ	72
80010	PAV12	ARV	40

1209 meteors found

Double events identification – how we do it ☺?

STEP 2: Displaying meteors in the short time periods (sorting all data by time of occurence)

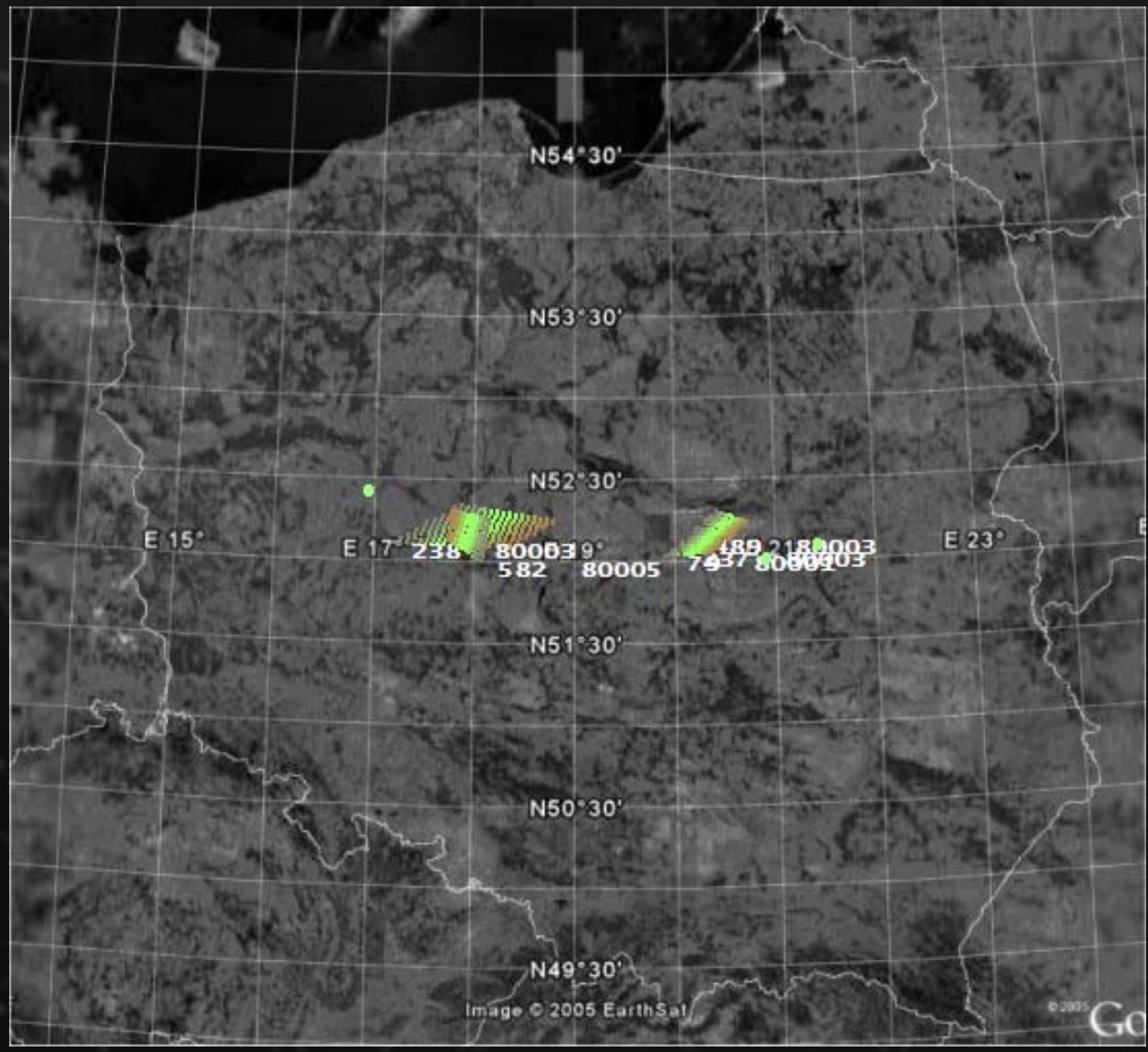
No	PFN	Pavo	h	m	s	v	m	acc	length
237	80003	PAVO9	20	1	50	29	-0.8	1	5.830294
489	80003	PAVO3	20	1	55	26	-1.9	2	2.074619
79	80001	PAVO1	20	2	19	25	-1.3	1	16.17203
238	80003	PAVO9	20	2	24	15	-0.1	1	8.009852
582	80005	PAVO5	20	2	30	20	1.3	1	11.1602

Double events identification – how we do it ☺?

STEP 3:

Drawing planes including meteorid trajectory.

If for two or more meteors we have very similar times of occurence and planes including meteor trajectory and station intersets we assume that we have double event



Double events identification – how we do it ☺?

Finnaly:

We have list of double events created by IMOgena ID

IMOGENA ID double station meteor search
report for night: 2004 8 10

Event	1								
2	80001	PAVO1	19	52	5	25	-1.4	1	21.81052
50	80003	PAVO9	19	52	8	30	0.7	1	19.18134
Event	2 +								
52	80003	PAVO9	19	55	20	9	1.0	2	1.071507
149	80005	PAVO5	19	55	31	18	1.3	1	11.8085
Event	3 +								
56	80003	PAVO9	20	23	35	20	0.9	1	12.10507
217	80006	PAVO6	20	23	35	10	1.5	1	5.830378
Event	4 -								
57	80003	PAVO9	20	28	42	14	1.1	1	7.142061
218	80006	PAVO6	20	28	42	14	1.4	1	7.202409
Event	5 -								
58	80003	PAVO9	20	33	46	14	1	1	12.11328
150	80005	PAVO5	20	33	49	16	0.7	1	15.73715
Event	6 -								
4	80001	PAVO1	21	5	22	20	1.3	1	3.230917
63	80003	PAVO9	21	5	25	27	1.8	2	2.142255
Event	7 -								
66	80003	PAVO9	21	29	26	17	1.2	1	7.927025
152	80005	PAVO5	21	29	29	12	1.1	1	6.473425
226	80006	PAVO6	21	29	26	8	1.4	2	0.9977618

Trajectory and orbit calculations

All trajestory and data calulations are done using methods described by Zdenek Ceplecha on 1987

DATA SELECTION

Due to comparatively low resolution of the video system we must apply strict selection for the resuting data:

-Every double event has calculated planes intersections angle. We usually reject data with Qab < 10 degrees

-We can select events using errors of the radiant position too

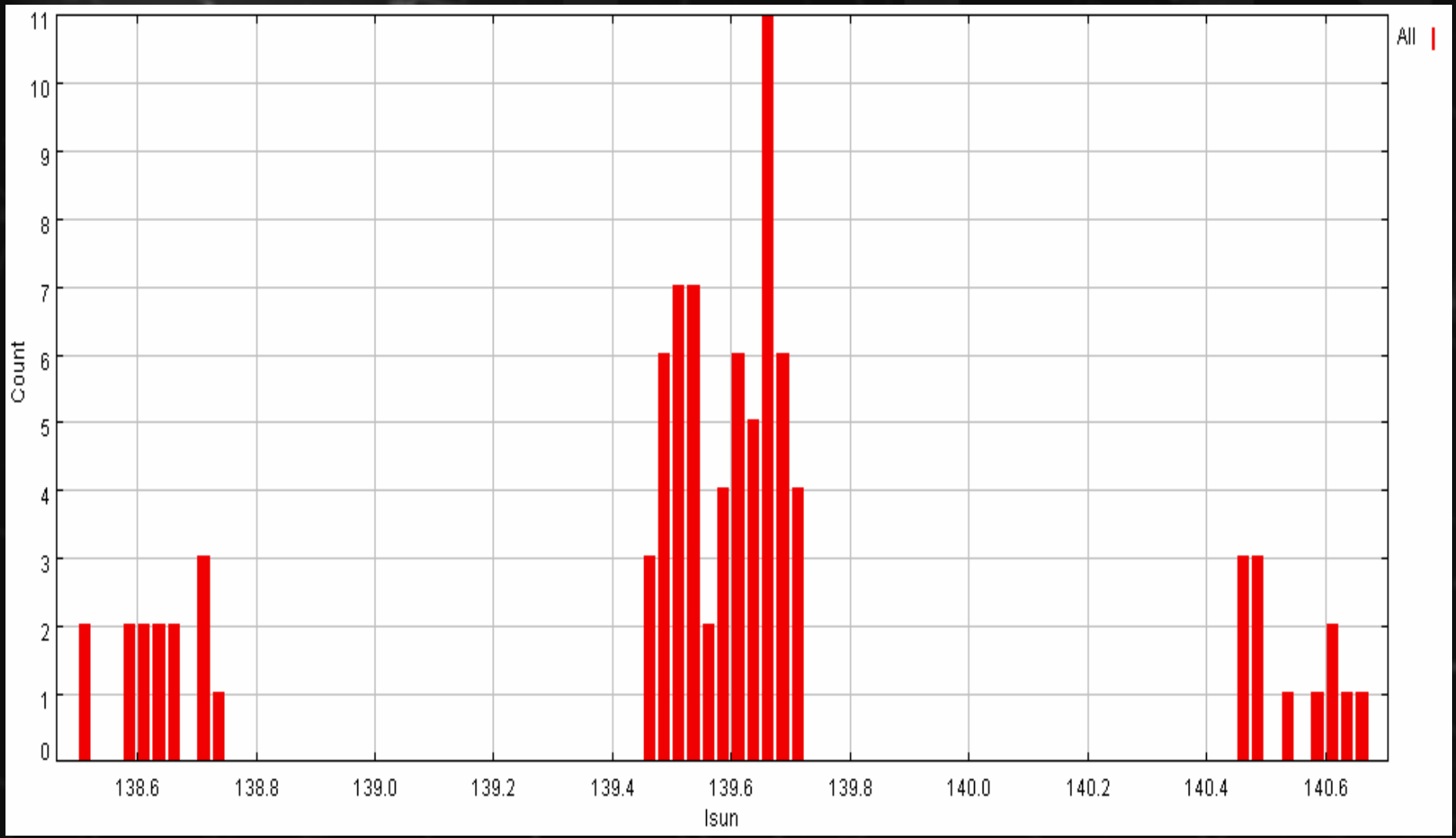
PFN Catalog

We created ASCII catalog with 71 columns describing time,trajectory and orbital data (and it's errors)

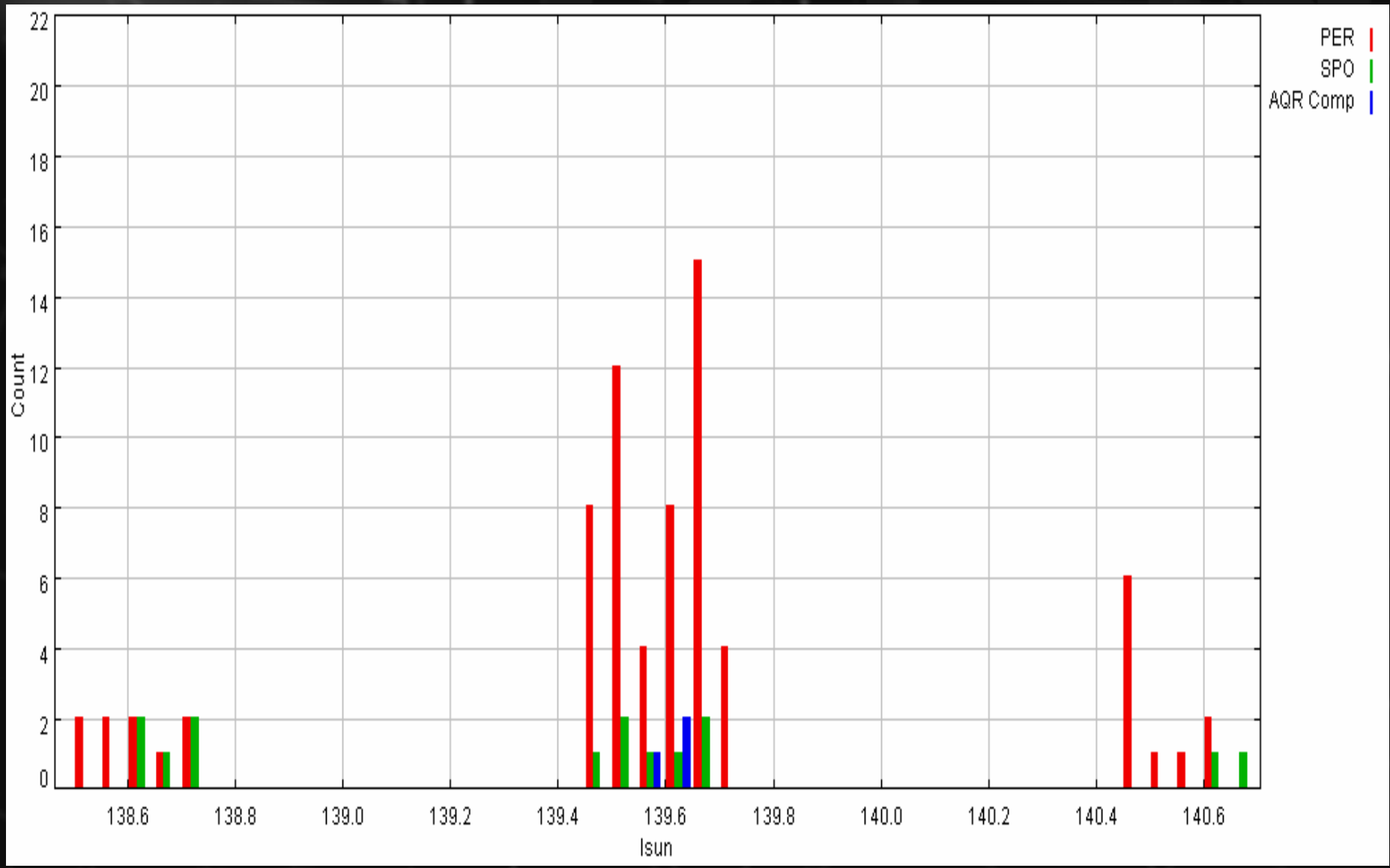
Table Browser for 1: PFN.txt

	Name	Qab	y	m	d	h	m	s	dl	rad_alfa	drad_alfa	rad_delta	drad_delta	
1	20040010PFN195520	79	2004	0	10	19	55	20	2,12132	49,01276	6,20351	59,51353	2,17517	5
2	20040010PFN202335	55	2004	0	10	20	23	35	0,	43,16099	1,00544	60,77271	1,09073	5
3	20040810PFN215917	80	2004	8	10	21	59	17	2,08167	44,79467	0,64421	53,26769	0,49386	5
4	20040810PFN220036	88	2004	8	10	22	0	36	2,12132	47,089	2,86895	56,14123	2,06136	6
5	20040810PFN222220	66	2004	8	10	22	22	20	0,70711	43,55318	0,61997	54,66214	0,84739	5
6	20040810PFN224412	13	2004	8	10	22	44	12	6,36396	23,983	1,04628	1,40787	1,63129	6
7	20040810PFN233001	11	2004	8	10	23	30	1	7,07107	23,34592	6,15699	26,87001	5,31584	6
8	20040810PFN233032	66	2004	8	10	23	30	32	2,08167	46,01095	0,0001	57,98585	0,0001	6
9	20040810PFN234453	61	2004	8	10	23	44	53	2,82843	61,7806	1,88296	39,51337	0,60928	5
10	20040811PFN000615	87	2004	8	11	0	6	15	0,	41,93805	4,28584	64,79652	1,4057	5
11	20040811PFN010047	78	2004	8	11	1	0	47	2,82843	41,09409	3,48866	56,44601	2,21406	6
12	20040811PFN010251	85	2004	8	11	1	2	51	2,82843	47,67575	2,86777	58,75752	1,96529	6
13	20040811PFN012305	49	2004	8	11	1	23	5	2,82843	316,82819	0,98553	-2,21109	0,29595	2
14	20040811PFN013838	34	2004	8	11	1	38	38	5,65685	39,21337	0,8989	15,44948	1,67192	6
15	20040811PFN195609	81	2004	8	11	19	56	3	4,24264	45,68212	4,13762	59,83986	0,87326	5
16	20040811PFN200224	83	2004	8	11	20	2	24	4,24264	43,86449	0,61573	57,83177	0,3706	6
17	20040811PFN200506	79	2004	8	11	20	5	6	0,70711	45,46616	1,33183	57,2818	0,66121	6
18	20040811PFN200951	16	2004	8	11	20	9	51	8,48528	41,50129	2,76198	59,49695	0,91312	5
19	20040811PFN201058	17	2004	8	11	20	10	58	7,77817	42,9061	3,85413	58,35686	1,83662	5
20	20040811PFN203501	64	2004	8	11	20	35	0	37,47666	46,69017	1,6592	62,66364	3,11614	5
21	20040011PFN203040	17	2004	0	11	20	30	40	9,19239	42,72010	3,96210	57,54507	0,5126	5
22	20040011PFN204303	60	2004	0	11	20	43	3	2,12132	39,14192	1,60990	53,96374	2,11645	5
23	20040011PFN204317	23	2004	0	11	20	43	3	9,09949	62,94651	0,42621	60,26404	1,09000	3
24	20040811PFN205622	20	2004	8	11	20	56	36	9,89949	48,8812	1,02842	57,76663	0,4186	5
25	20040811PFN210201	17	2004	8	11	21	2	1	9,89949	44,34013	1,54969	59,44862	0,35197	5
26	20040811PFN210220	62	2004	8	11	21	2	23	2,12132	37,60883	0,72284	59,99364	0,57551	5
27	20040811PFN210437	48	2004	8	11	21	4	37	2,12132	46,53266	2,24388	55,17126	4,52743	6
28	20040811PFN210559	80	2004	8	11	21	5	59	4,94975	48,24817	0,7252	59,78581	0,47406	5
29	20040811PFN210621	27	2004	8	11	21	6	21	16,97056	282,60467	0,92474	22,4839	2,13317	1
30	20040811PFN211113	18	2004	8	11	21	11	13	9,19239	44,8729	1,98869	57,88128	0,16151	6
31	20040811PFN212645	16	2004	8	11	21	26	45	9,89949	42,8977	1,6642	58,64465	0,62923	6
32	20040811PFN212827	12	2004	8	11	21	28	27	3,53553	44,28833	3,16367	59,02137	2,09006	5
33	20040811PFN213710	18	2004	8	11	21	37	10	9,89949	48,54699	1,31561	56,59075	0,29069	5
34	20040811PFN213841	16	2004	8	11	21	38	41	9,89949	45,75962	6,67622	58,03795	1,82243	5
35	20040811PFN214223	54	2004	8	11	21	42	23	3,4641	46,03348	1,32123	61,04884	1,04018	5
36	20040811PFN214512	16	2004	8	11	21	45	12	2,82843	45,47828	7,10307	68,8345	3,15075	5

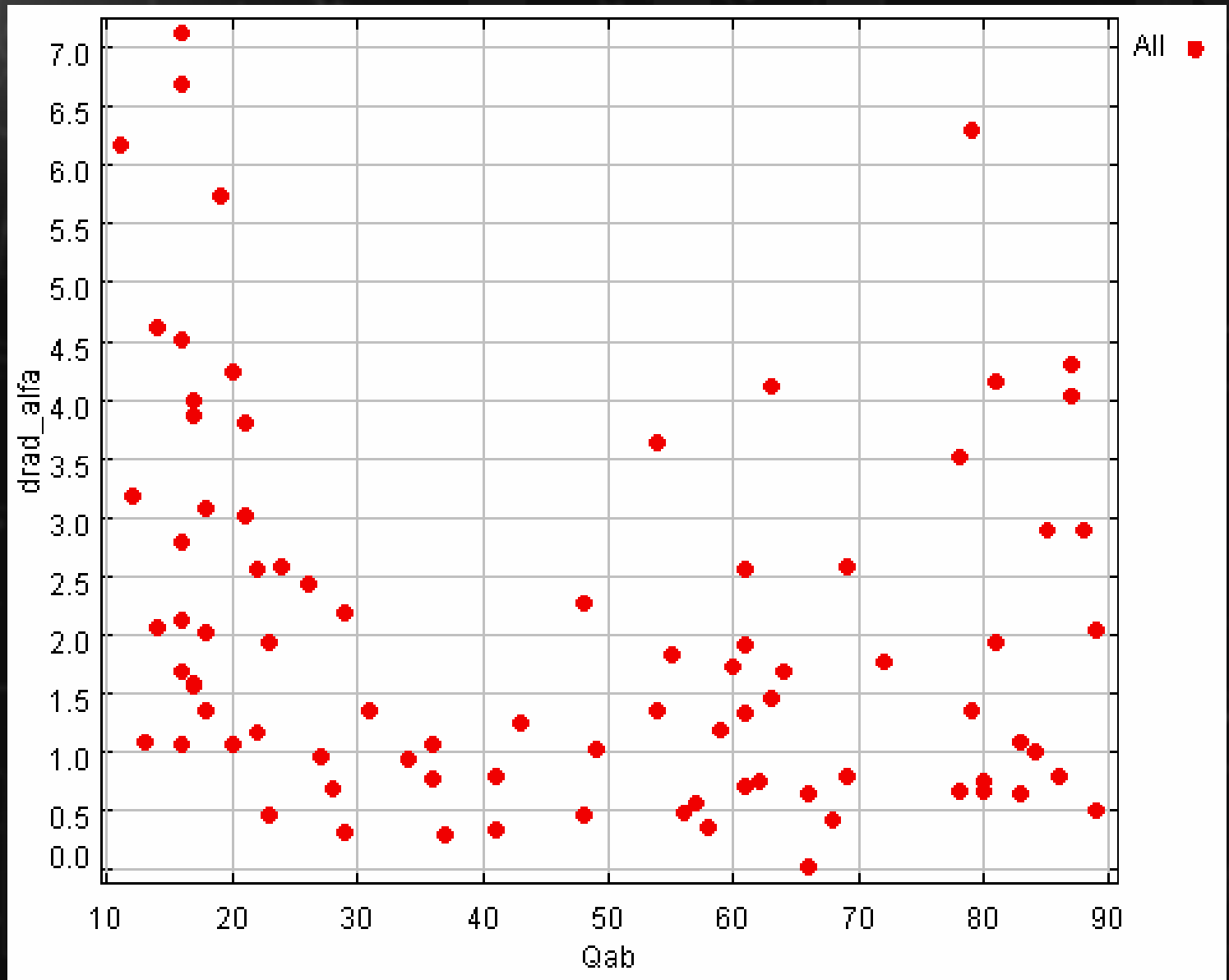
Number of double events



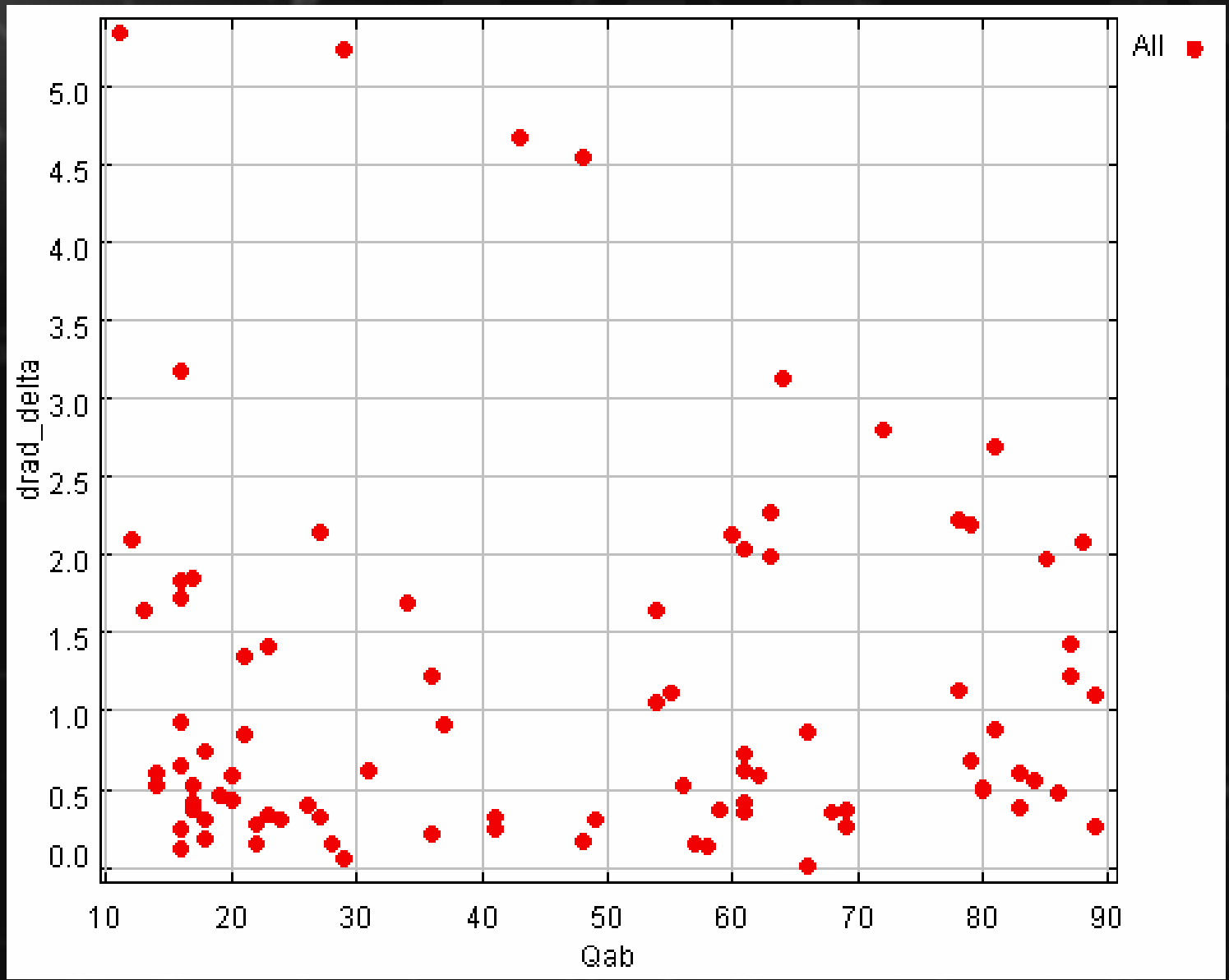
Number of double events



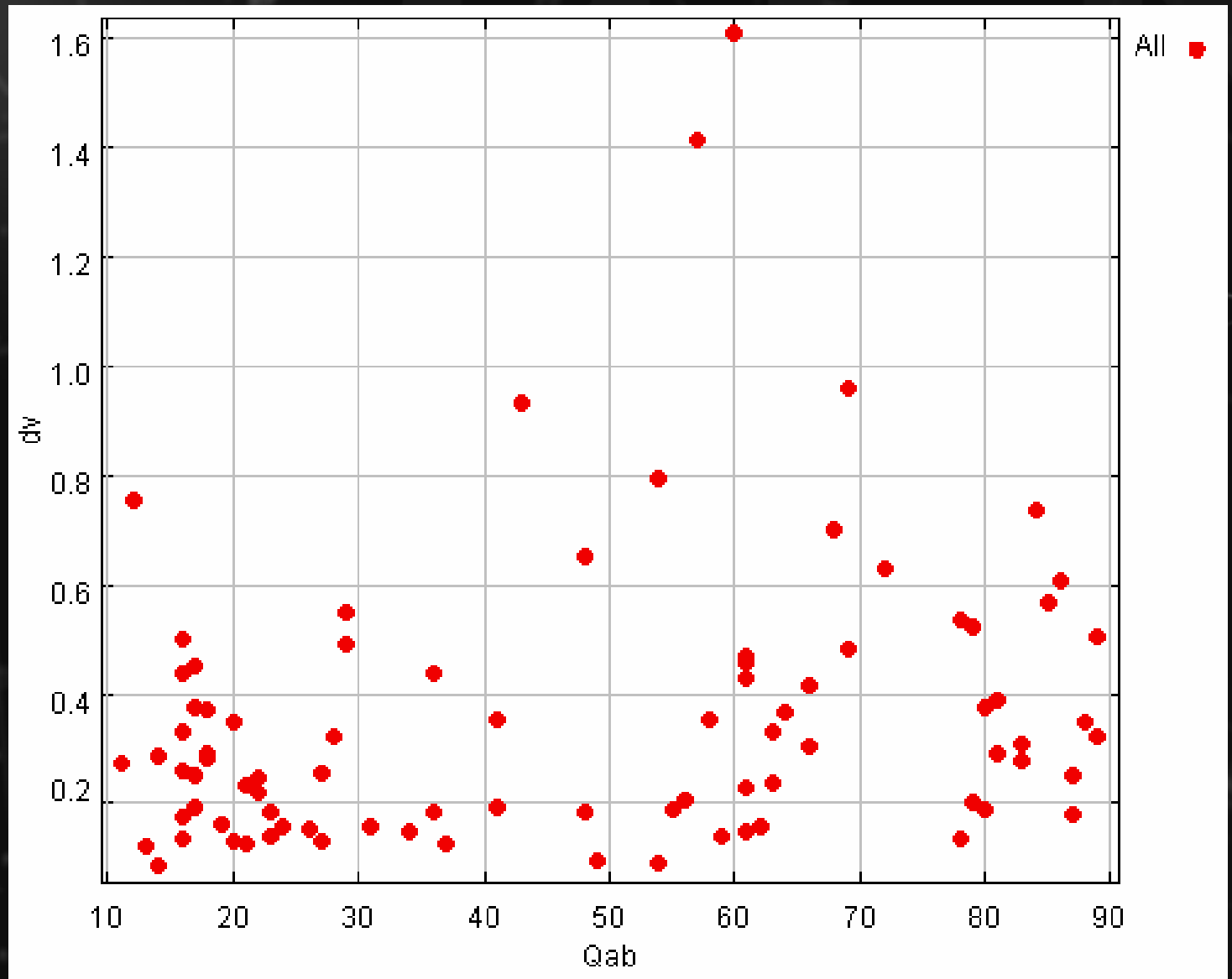
Errors


All
drad_alfa
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
10
20
30
40
50
60
70
80
90
Qab

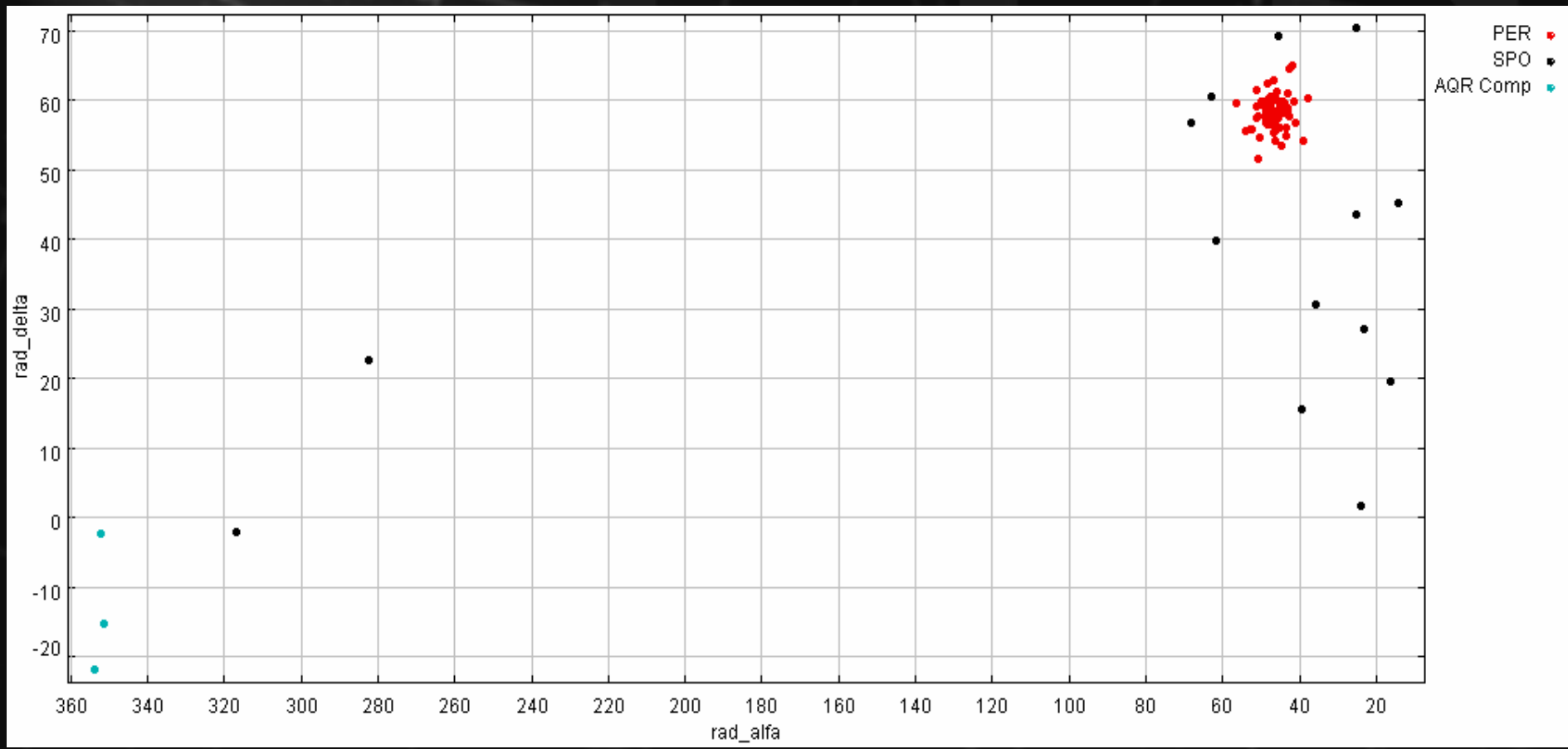
Errors


All
drad_delta
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
10
20
30
40
50
60
70
80
90
Qab

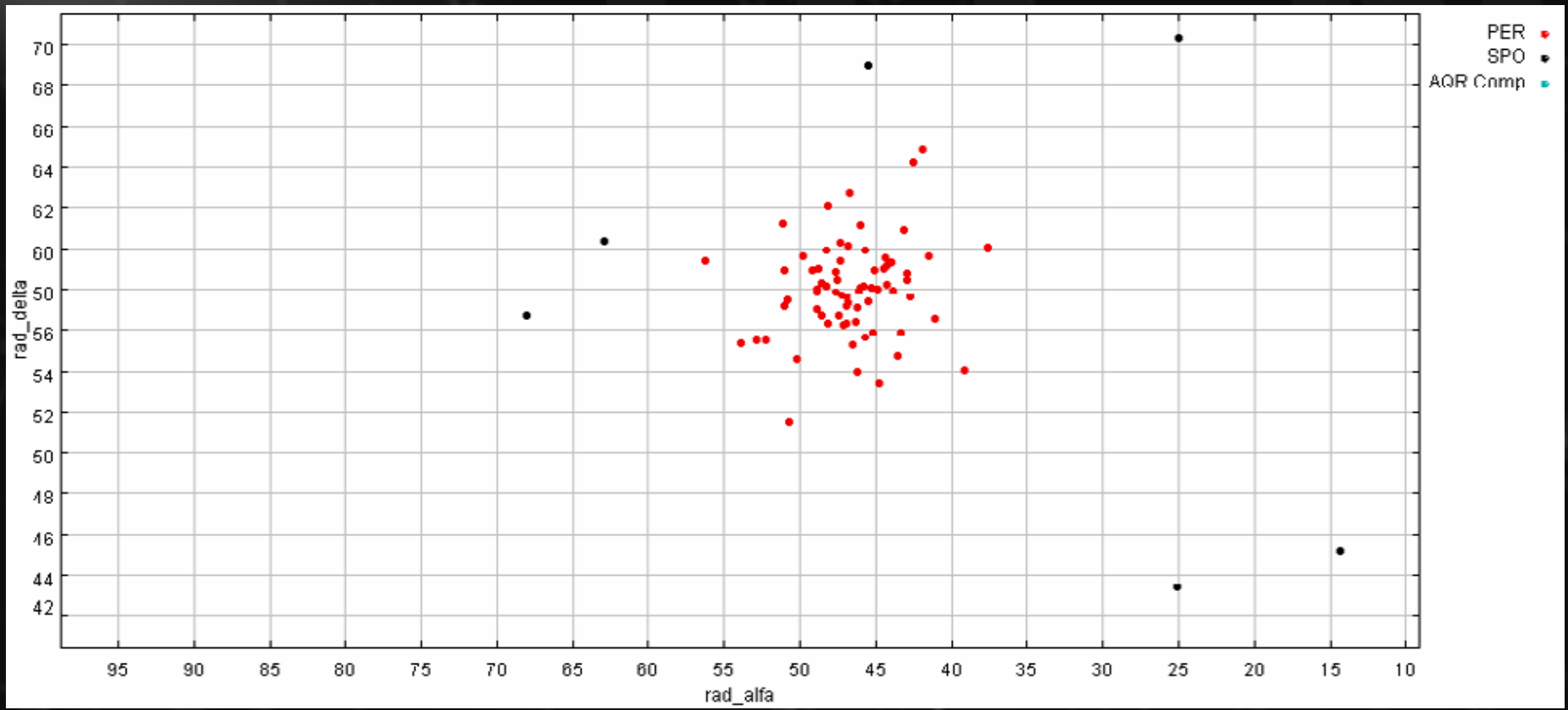
Errors



Individual radiants distribution



Individual radiants distribution for 11/12 08 2004

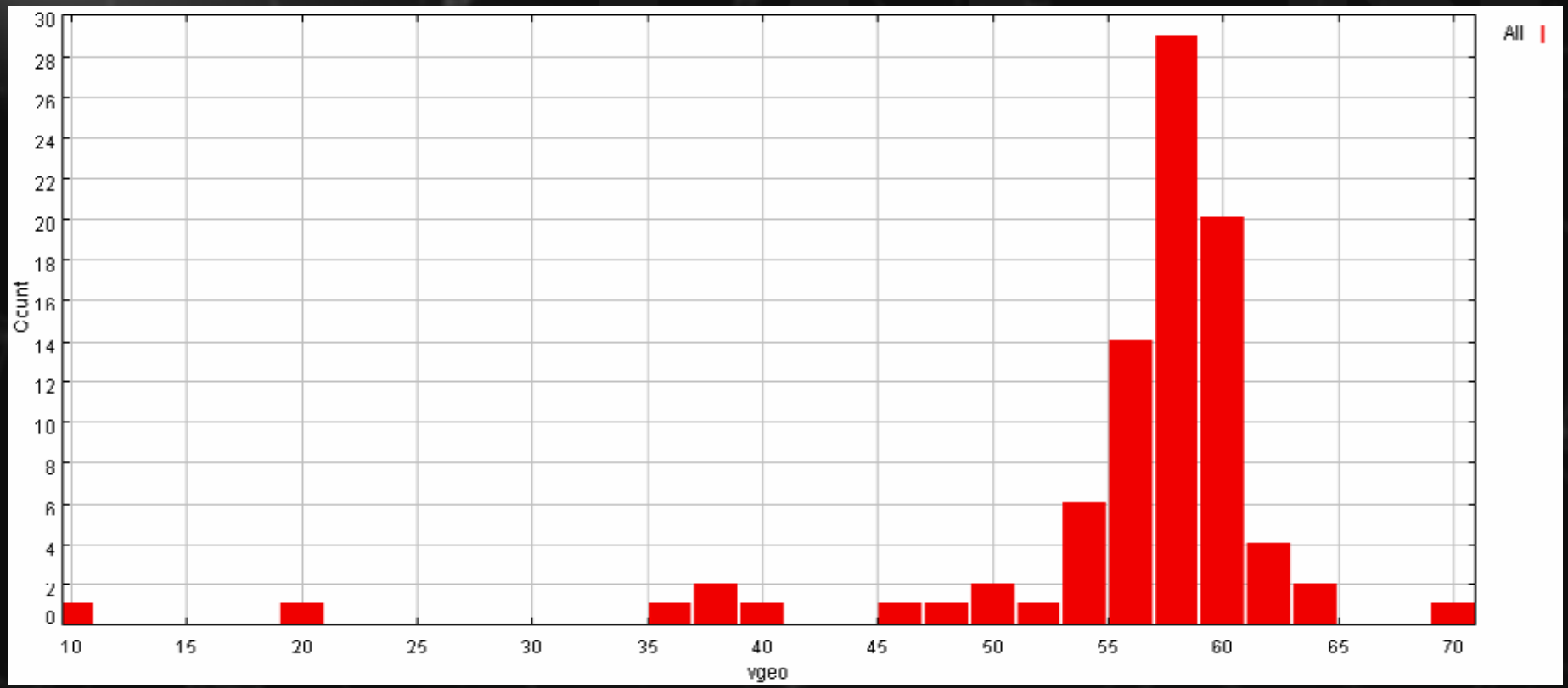


Mean geocentric radiant for above point is following:

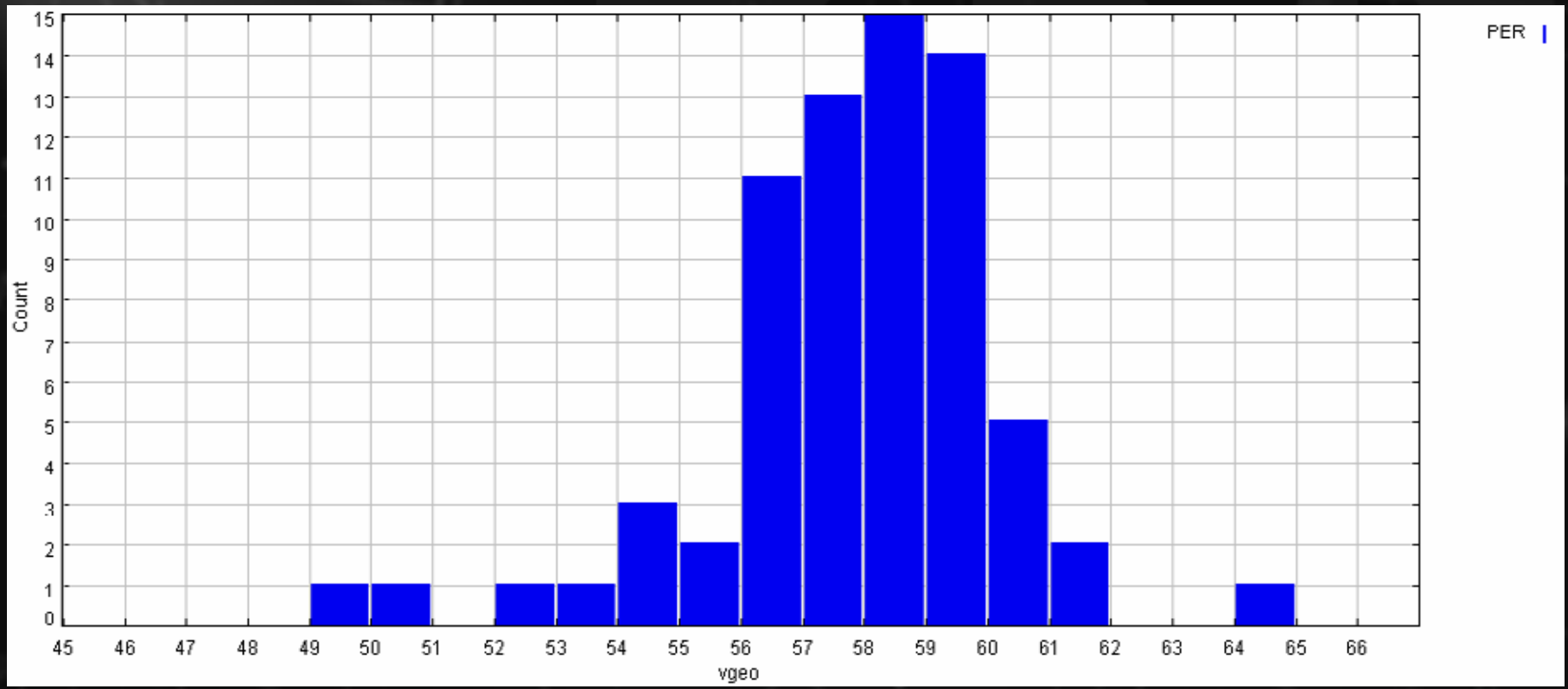
RA: 47.36 +- 3.22

Dec: 57.76 +- 2.31

Geocentric velocity distribution for whole dataset



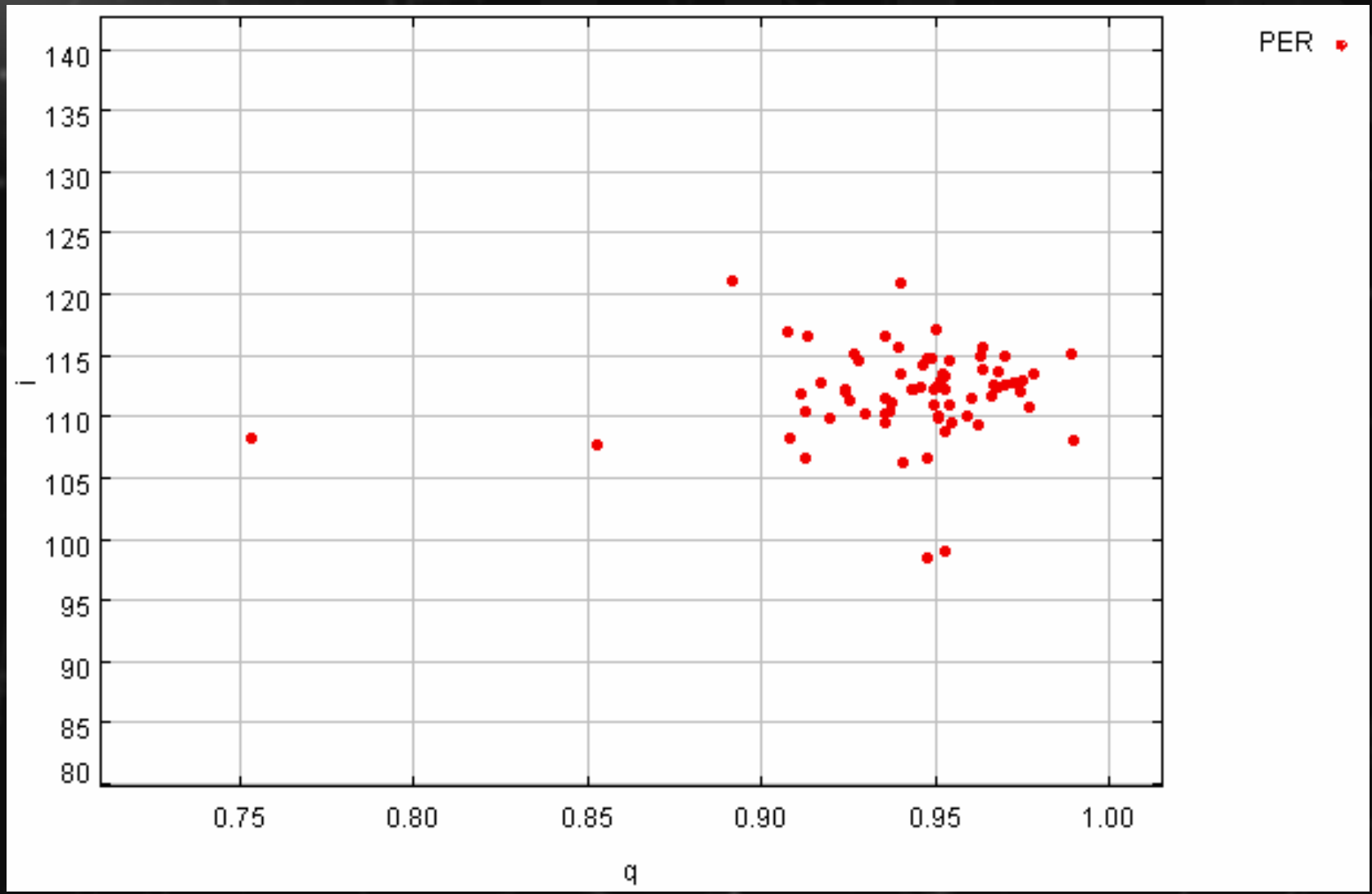
Geocentric velocity distribution for whole dataset



Mean geocentric velocity:

Vgeo = 57.86km/s +- 2.33

Inclination and perihelion distance



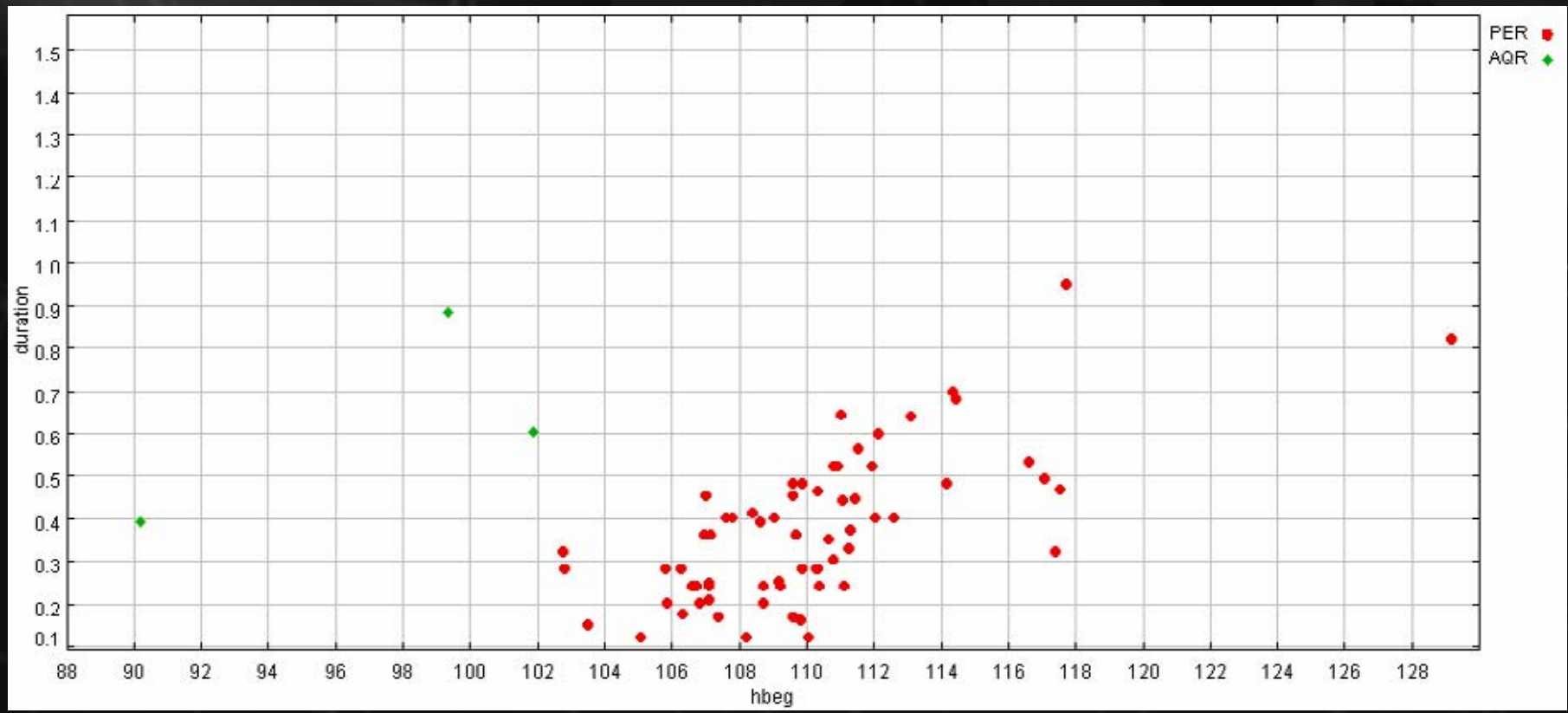
Mean perihelion distance: 0.94234 AU +- 0.0323

Mean inclination: 111.8 deg +- 3.67

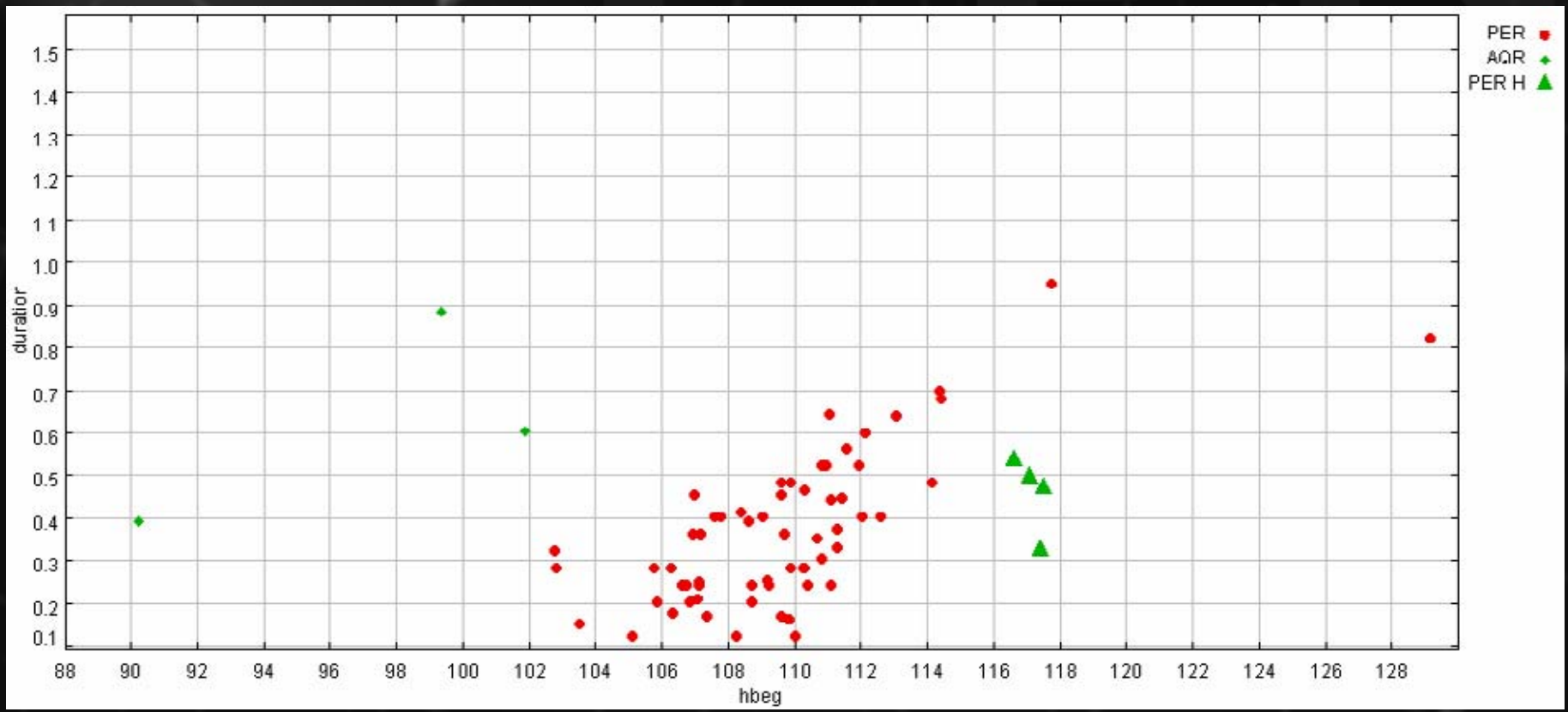
Summary:

Semimajor axis:	3.68 AU	
1/a:	0.13	+- 0.056
e:	0.882	+- 0.171
i:	111.8	+- 3.67
q:	0.94234	+- 0.0323
Ω:	139.601	+- 0.501
ω:	148.2	+- 8.9

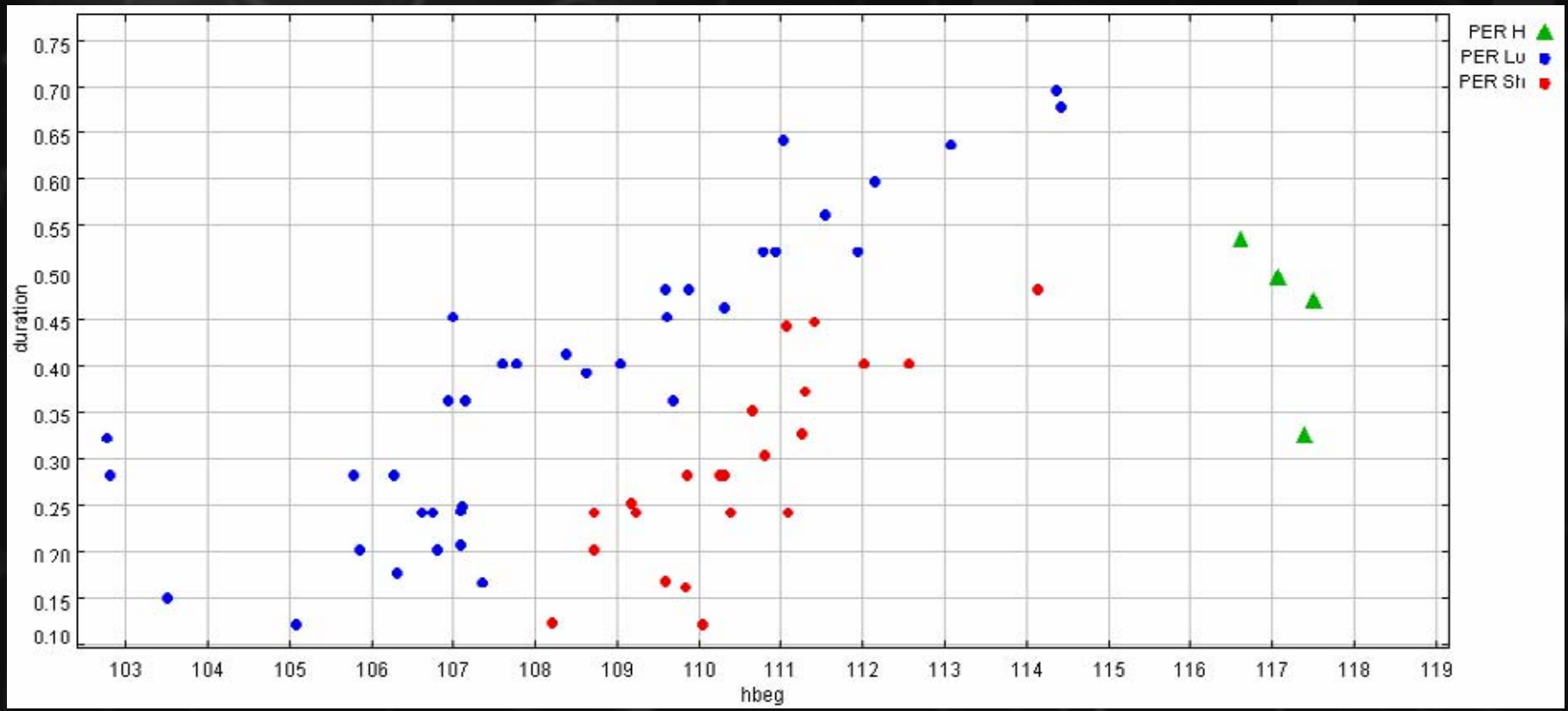
Duration of meteor and the begining height



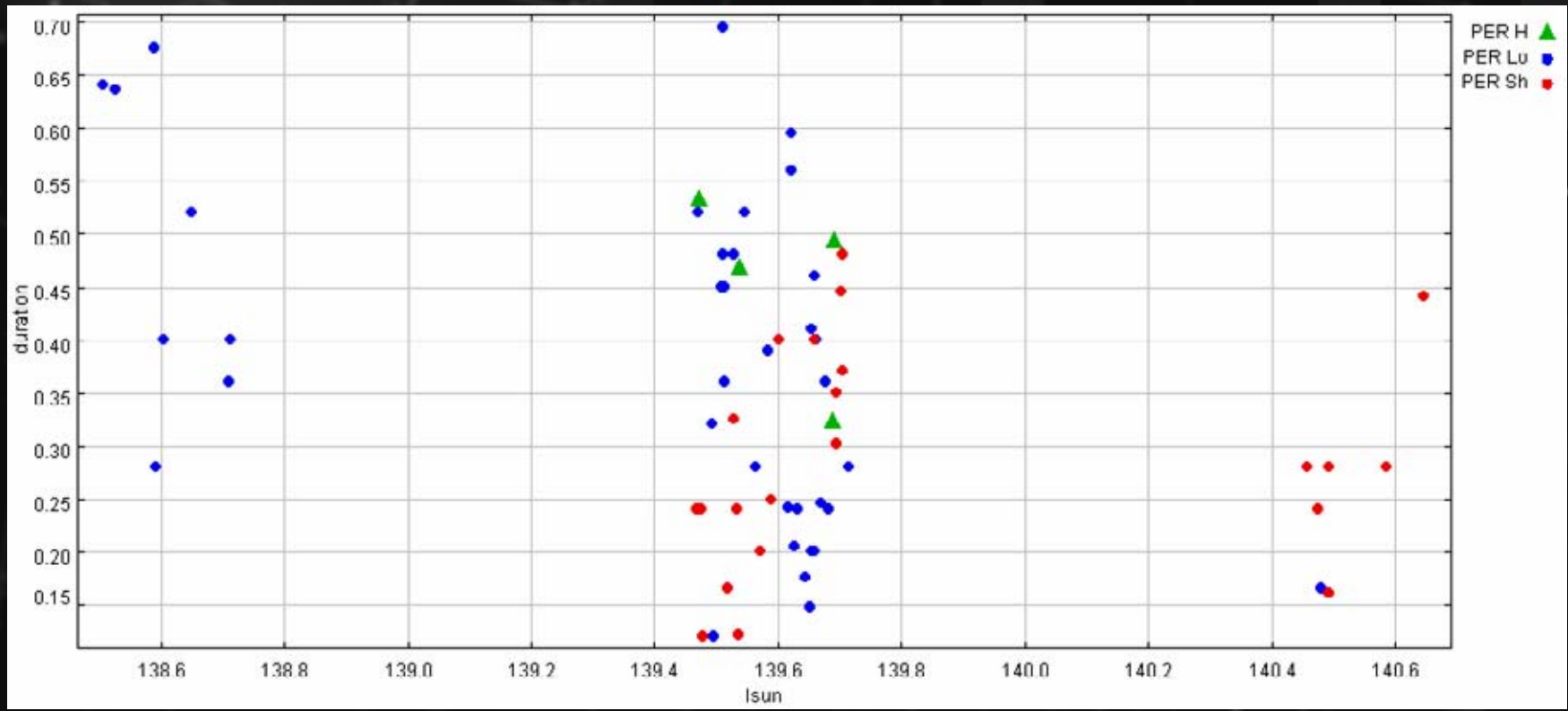
Duration of meteor and the begining height



Duration of meteor and the begining height



Duration of meteor and solar longitude



Duration of meteor and solar longitude