Current status of POLISH FIREBALL NETWORK

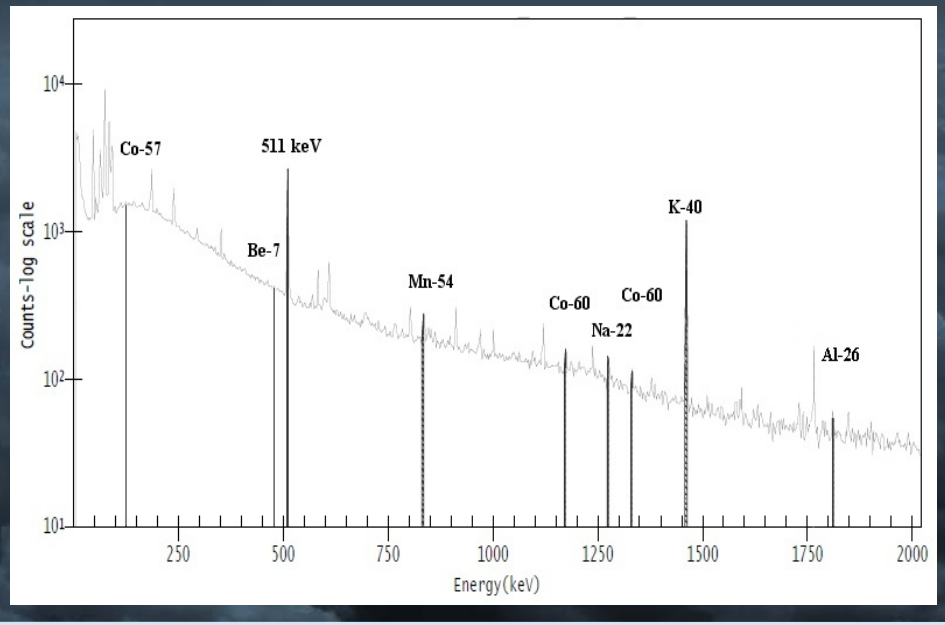
M. Wiśniewski[1,2], P. Żołądek[1], A. Olech[1,3],
Z. Tyminski[1,4], R. Rudawska[5] M. Maciejewski[1], K. Fietkiewicz[1],
M. Myszkiewicz[1], M. P. Gawroński[1,6], M. Gozdalski[1]

(1) Polish Fireball Network, Comets and Meteors Workshop,
ul. Bartycka 18, 00-716 Warsaw, Poland
(2) Central Office of Measures, ul. Elektoralna 2, 00-139 Warsaw, Poland
(3) Nicolaus Copernicus Astronomical Center, ul. Bartycka 18, 00-716 Warsaw, Poland
(4) National Centre of Nuclear Research RC POLATOM, Soltan 7, Otwock-Świerk, Poland
(5) ESA European Space Research and Technology Centre,
NL-2201 AZ Noordwijk, the Netherlands
(6) Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University,
Grudziądzka 5, 87-100 Toruń, Poland

POLISH FIREBALL NETWORK

Since 2004

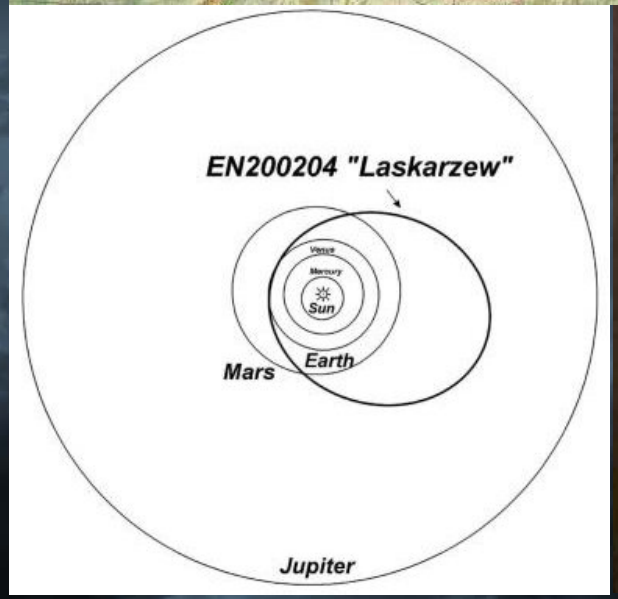
Goals


Counts-log scale
Energy(keV)
Co-57
511 keV
Be-7
Mn-54
Co-60
Co-60
Na-22
K-40
Al-26

Leonids 2002

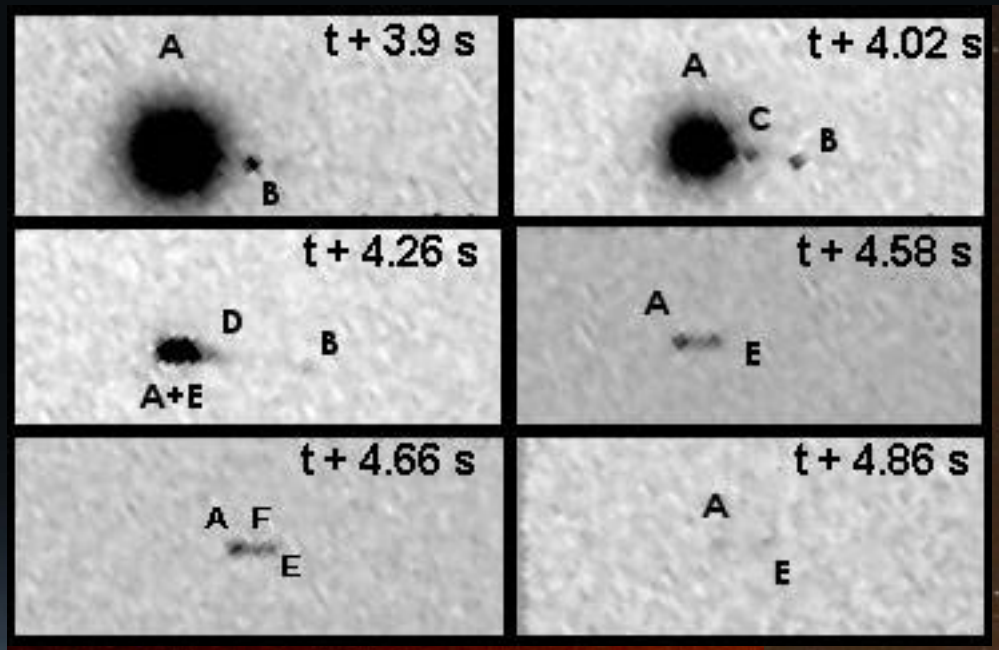
Wiśniewski et al. (2003) WGN 31, 33-34

EN200204 Łaskarzew fireball

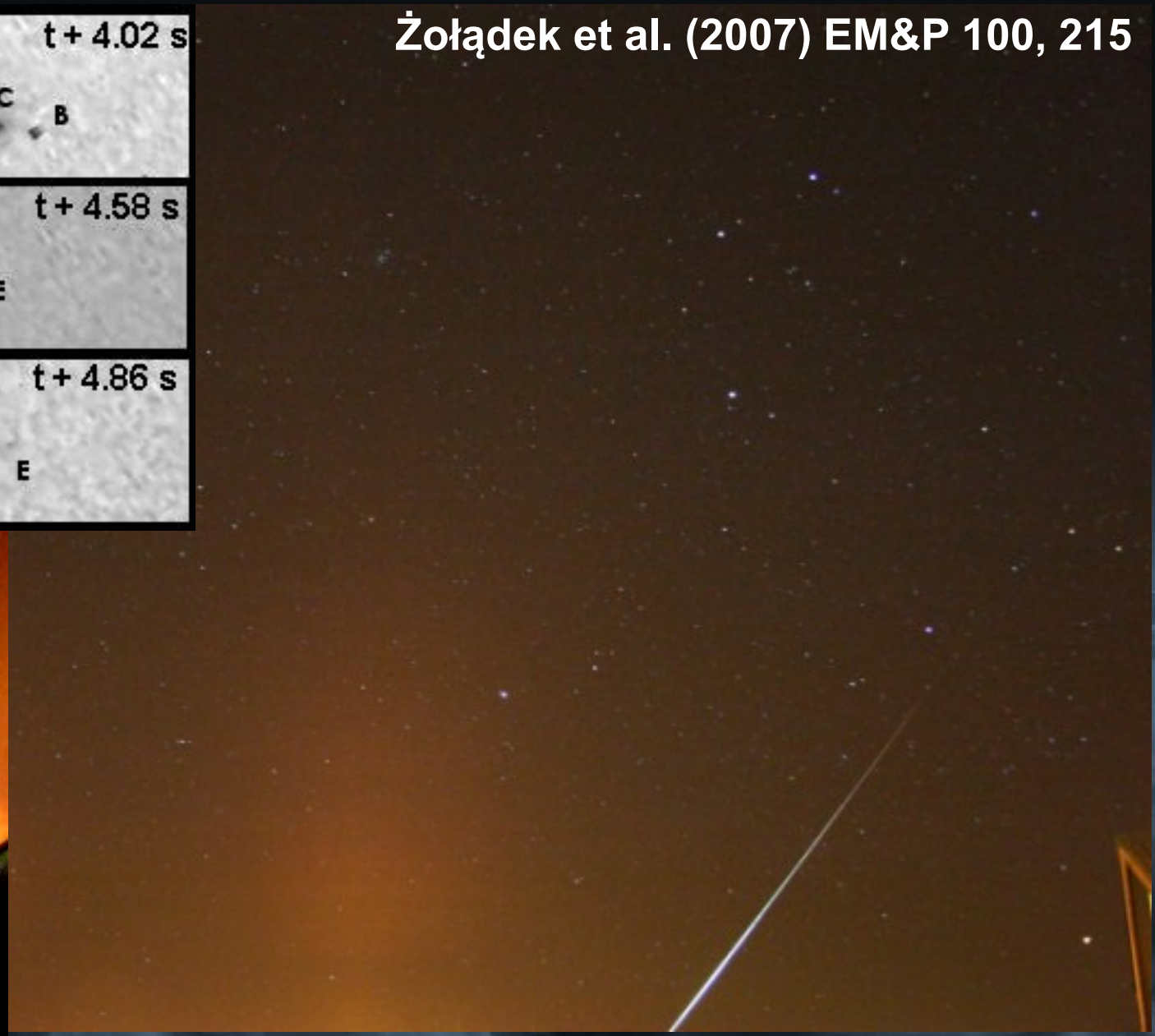


Spurny, Olech, Kędzierski (2004) WGN, 32, 48

PF030405a Krzeszowice fireball



Żołądek et al. (2007) EM&P 100, 215



PF191012 Myszyniec - highest Orionid

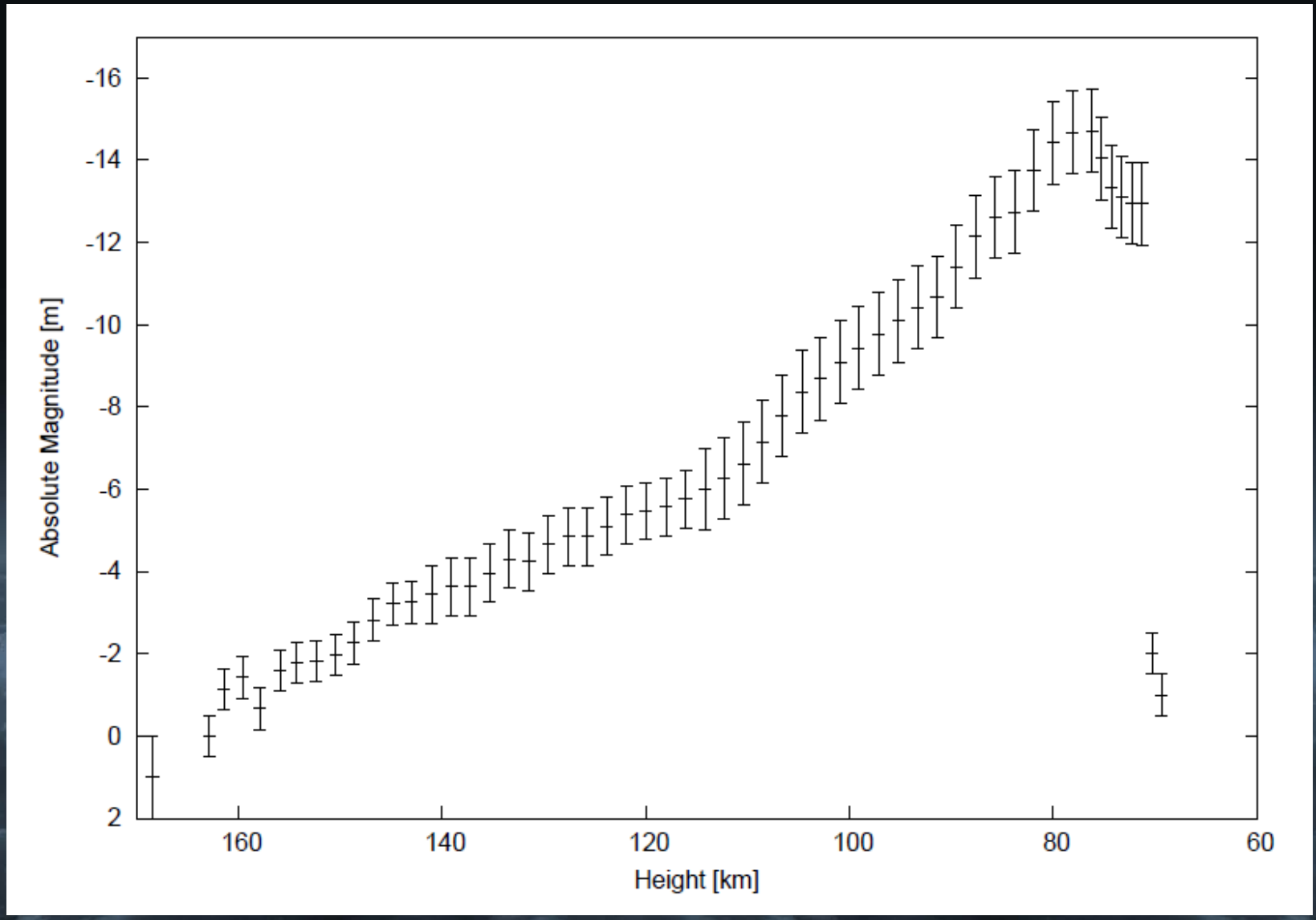
Olech et al. (2013) A&A 557, A89

PF191012 Myszyniec - highest Orionid

Code	Site	Longitude [°]	Latitude [°]	Elev. [m]	Camera	Lens	Remarks
PFN42	Błonie	20.6223 E	52.1888 N	86	Tayama C3102-01A1	Computar 4 mm f/1.2	flash saturated
PFN32	Chełm	23.4982 E	51.1355 N	194	Mintron MTV-12V8HC	Computar 3.8 mm f/0.8	end not detected
PFN06	Kraków	19.9425 E	50.0216 N	250	Mintron MTV-23X11C	Ernitec 4 mm f/1.2	low altitude
PFN38	Podgórzyn	15.6817 E	50.8328 N	369	Tayama C3102-01A1	Computar 4 mm f/1.2	low altitude
PFN43	Siedlce	22.2833 E	52.2015 N	152	Canon EOS 350D	Samyang 8 mm f/3.5	photo with shutter
PFN20	Urzędów	22.1456 E	50.9947 N	210	Tayama C3102-01A1	Ernitec 4 mm f/1.2	short path

Olech et al. (2013) A&A 557, A89

PF191012 Myszyniec - highest Orionid



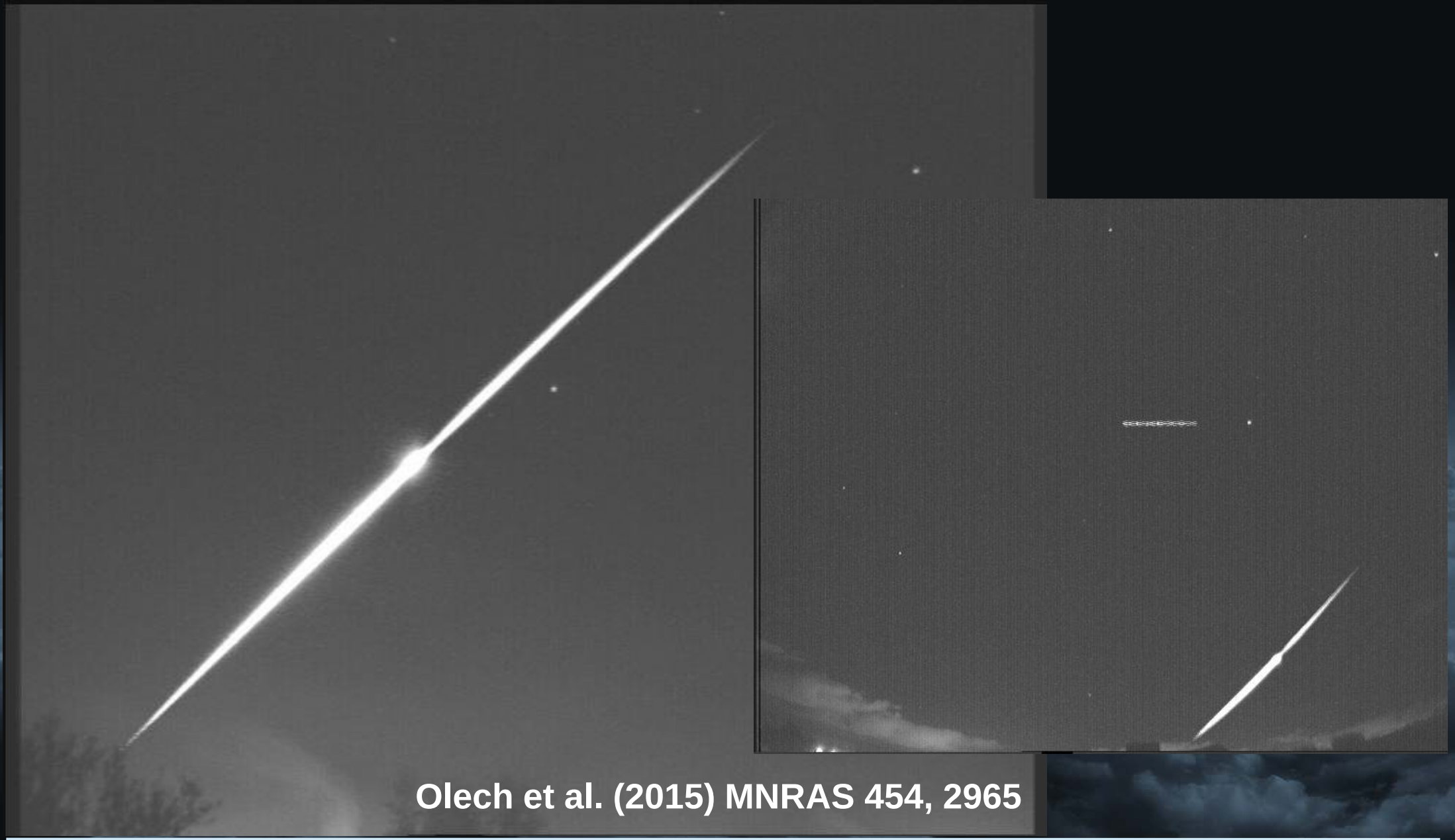
Olech et al. (2013) A&A 557, A89

PF191012 Myszyniec - highest Orionid

2012 Oct 19, T = $00^h23^m12^s \pm 1^s$ UT			
Atmospheric trajectory data			
	Beginning	**Max. light**	**Terminal**
Height [km]	168.4 ± 0.6	77.7 ± 1.0	69.4 ± 0.6
Long. [°E]	22.336 ± 0.005	21.186 ± 0.020	21.040 ± 0.002
Lat. [°N]	52.865 ± 0.004	53.385 ± 0.010	53.463 ± 0.007
Abs. mag	1.5 ± 1.0	−14.7 ± 1.0	−1.0 ± 0.5
Slope [°]	42.4 ± 0.5	41.5 ± 0.5	41.4 ± 0.6
Duration [s]		2.19 ± 0.04	
Length [km]		148.4 ± 0.8	
Stations		Siedlce, Błonie, Chełm	
Radiant data (J2000.0)			
	Observed	**Geocentric**	**Heliocentric**
RA [°]	92.71 ± 0.13	93.00 ± 0.06	—
Decl. [°]	15.08 ± 0.09	14.89 ± 0.14	—
Vel. [km/s]	68.0 ± 0.7	66.89 ± 0.76	41.51 ± 0.82

Olech et al. (2013) A&A 557, A89

PF131010 Ciechanow fireball



Olech et al. (2015) MNRAS 454, 2965

PF131010 Ciechanow fireball

Code	Site	Longitude [°]	Latitude [°]	Elevation [m]	Camera	Lens
PFN13	Toruń	18.6209 E	53.0252 N	65	Siemens CCBB1320-MC	Ernitec 4 mm f/1.2
PFN24	Gniewowo	18.3042 E	54.5779 N	130	Siemens CCBB1320-MC	Ernitec 4 mm f/1.2
PFN32	Chełm	23.4982 E	51.1355 N	194	Mintron 12V8HC-EX	VM2312 2.3-6 mm 4 mm
PFN37	Nowe Miasto Lubawskie	19.5922 E	53.4349 N	95	Tayama C3102-01A1	Computar 4 mm f/1.2
PFN38	Podgórzyn	15.6817 E	50.8328 N	360	Tayama C3102-01A4	Evatar 3.5-8 mm 4 mm

2010 October 13, $T = 02{:}52{:}32 \pm 2.0$ s UT

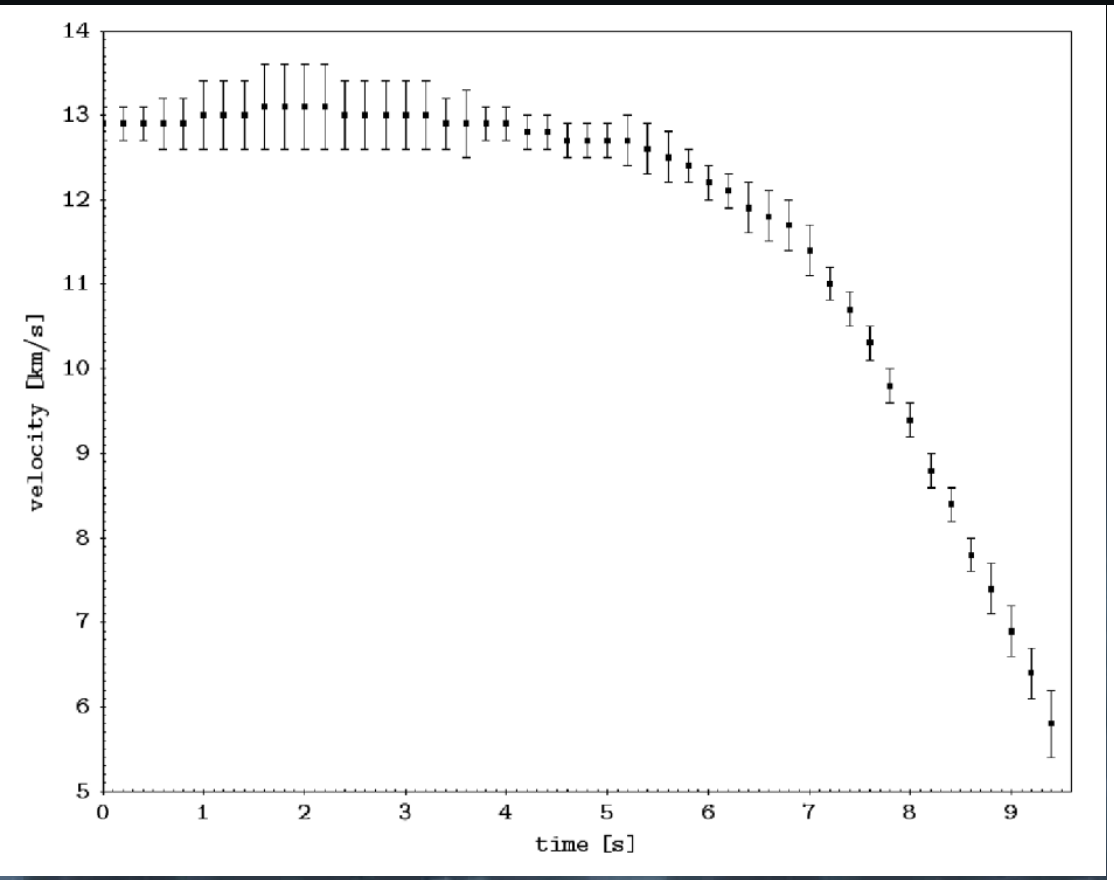
Atmospheric trajectory data

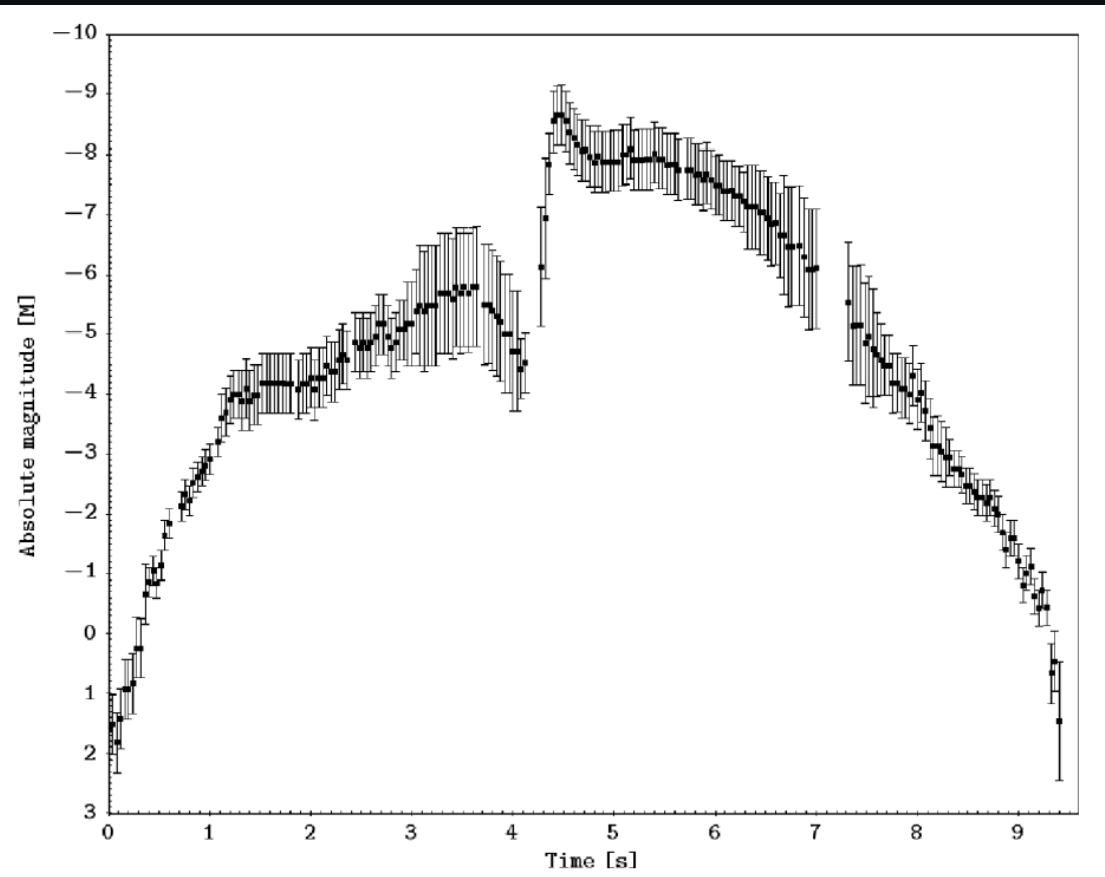
	Beginning	Maximum light	Terminal
Velocity [km s^{-1}]	12.9 ± 0.2	12.7 ± 0.2	5.8 ± 0.2
Height [km]	82.5 ± 0.3	54.4 ± 0.1	29.3 ± 0.1
Longitude [°E]	19.901 ± 0.001	20.622 ± 0.002	21.275 ± 0.005
Latitude [°N]	52.831 ± 0.002	52.902 ± 0.001	52.962 ± 0.002
Absolute magnitude	-1.6 ± 0.5	-8.6 ± 0.5	1.5 ± 1.0
Slope [°]	29.2 ± 0.1	28.8 ± 0.1	28.4 ± 0.1
Duration	9.4 s		
Length	110.5 ± 0.8 km		
Stations	Nowe Miasto Lubawskie, Gniewowo, Podgórzyn, Chełm, Toruń		

Radiant data (J2000.0)

	Observed	Geocentric	Heliocentric
Right ascension [°]	19.93 ± 0.24	6.17 ± 0.36	–
Declination [°]	17.68 ± 0.04	0.41 ± 0.42	–
Velocity [km s^{-1}]	12.9 ± 0.2	6.9 ± 0.3	32.2 ± 0.3

PF131010 Ciechanow fireball





Olech et al. (2015) MNRAS 454, 2965

PF131010 Ciechanow fireball

Olech et al. (2015) MNRAS 454, 2965

PF131010 Ciechanow fireball

Olech et al. (2015) MNRAS 454, 2965

PF131010 Ciechanow fireball

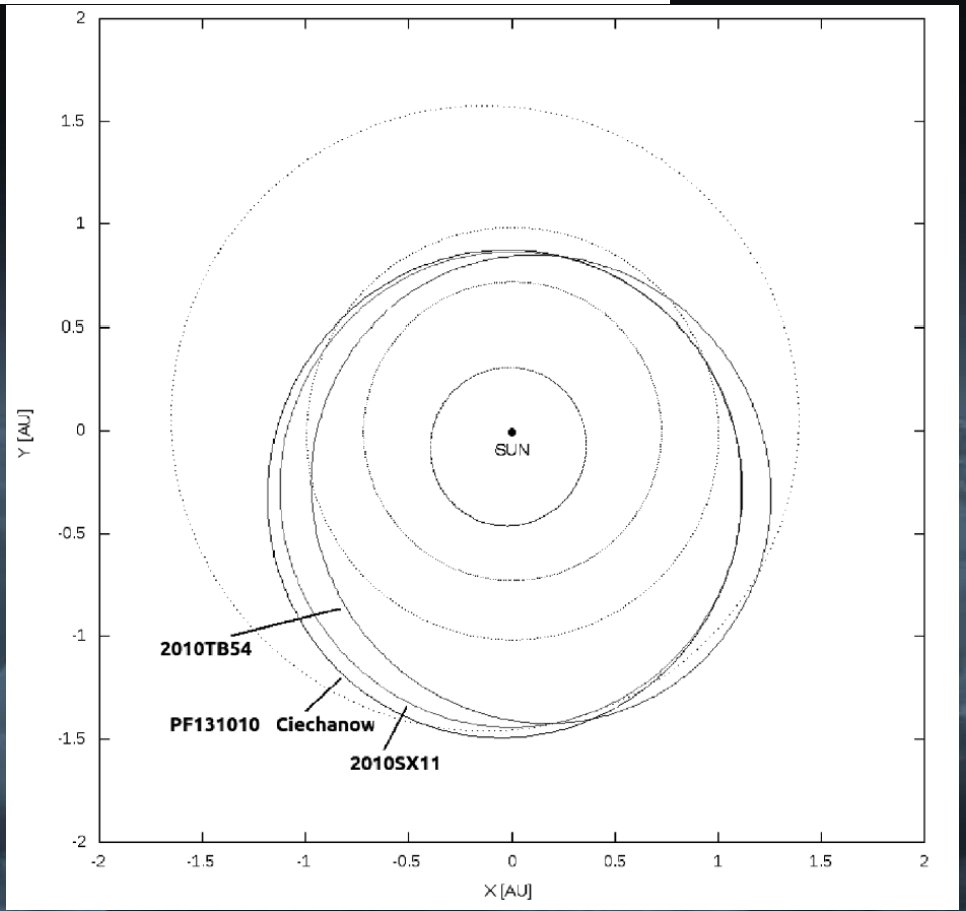
Olech et al. (2015) MNRAS 454, 2965

PF131010 Ciechanow fireball

	$1/a$ [1/au]	e	q [au]	ω [°]	Ω [°]	i [°]	P [yr]	D_D
PF131010	0.837(3)	0.263(3)	0.880(3)	64.14(82)	19.5248(1)	0.45(5)	1.304(10)	–
2010 TB54	0.8680(3)	0.2791(3)	0.8308(2)	82.566(4)	14.2330(3)	6.62(1)	1.2366(7)	0.058
2010 SX11	0.8703(3)	0.2495(2)	0.8703(3)	266.873(4)	182.524(1)	5.17(1)	1.2487(5)	0.043

PF131010 2010 Oct 13 02:52 UT

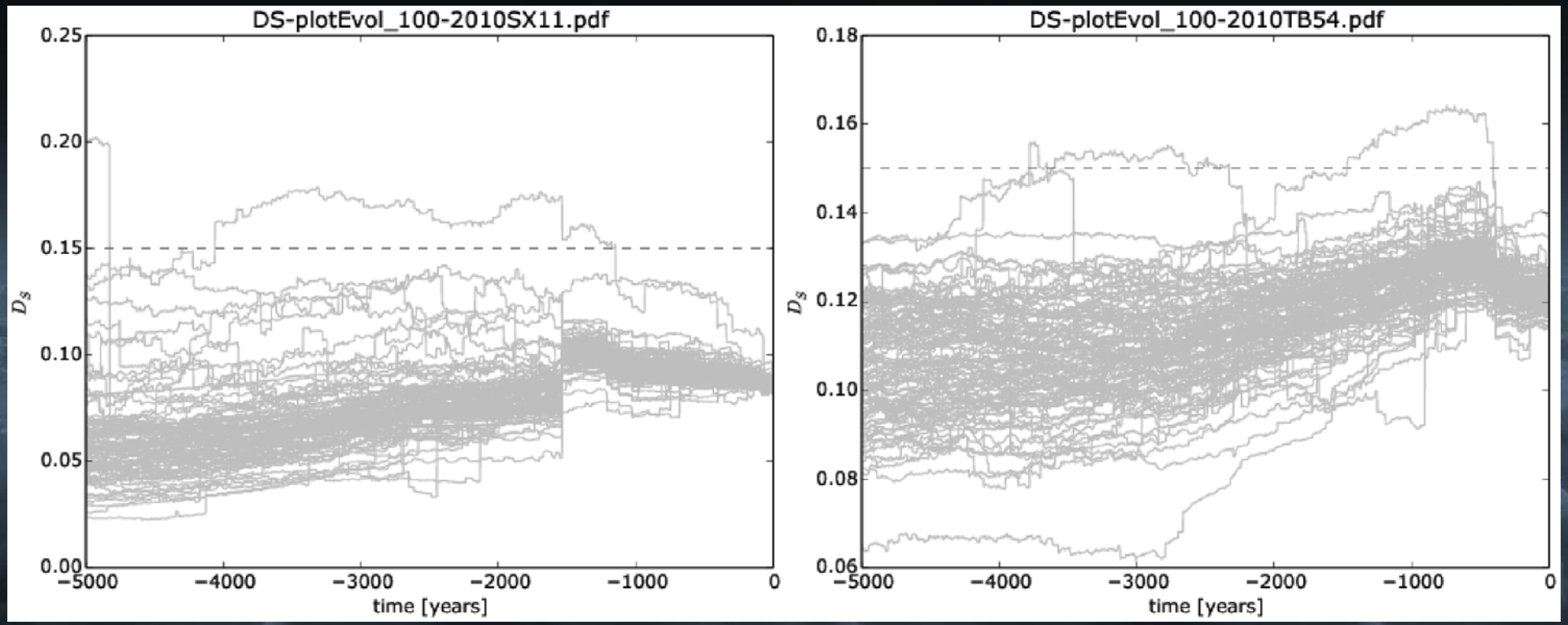
2010 TB54 2010 Oct 13 14:14 UT 0.016 au 29 m
2010 SX11 2010 Oct 11 13.10 UT 0.025 au 73 m



Olech et al. (2015) MNRAS 454, 2965

PF131010 Ciechanow fireball

	$1/a$ [1/au]	e	q [au]	ω [°]	Ω [°]	i [°]	P [yr]	D_D
PF131010	0.837(3)	0.263(3)	0.880(3)	64.14(82)	19.5248(1)	0.45(5)	1.304(10)	–
2010 TB54	0.8680(3)	0.2791(3)	0.8308(2)	82.566(4)	14.2330(3)	6.62(1)	1.2366(7)	0.058
2010 SX11	0.8703(3)	0.2495(2)	0.8703(3)	266.873(4)	182.524(1)	5.17(1)	1.2487(5)	0.043



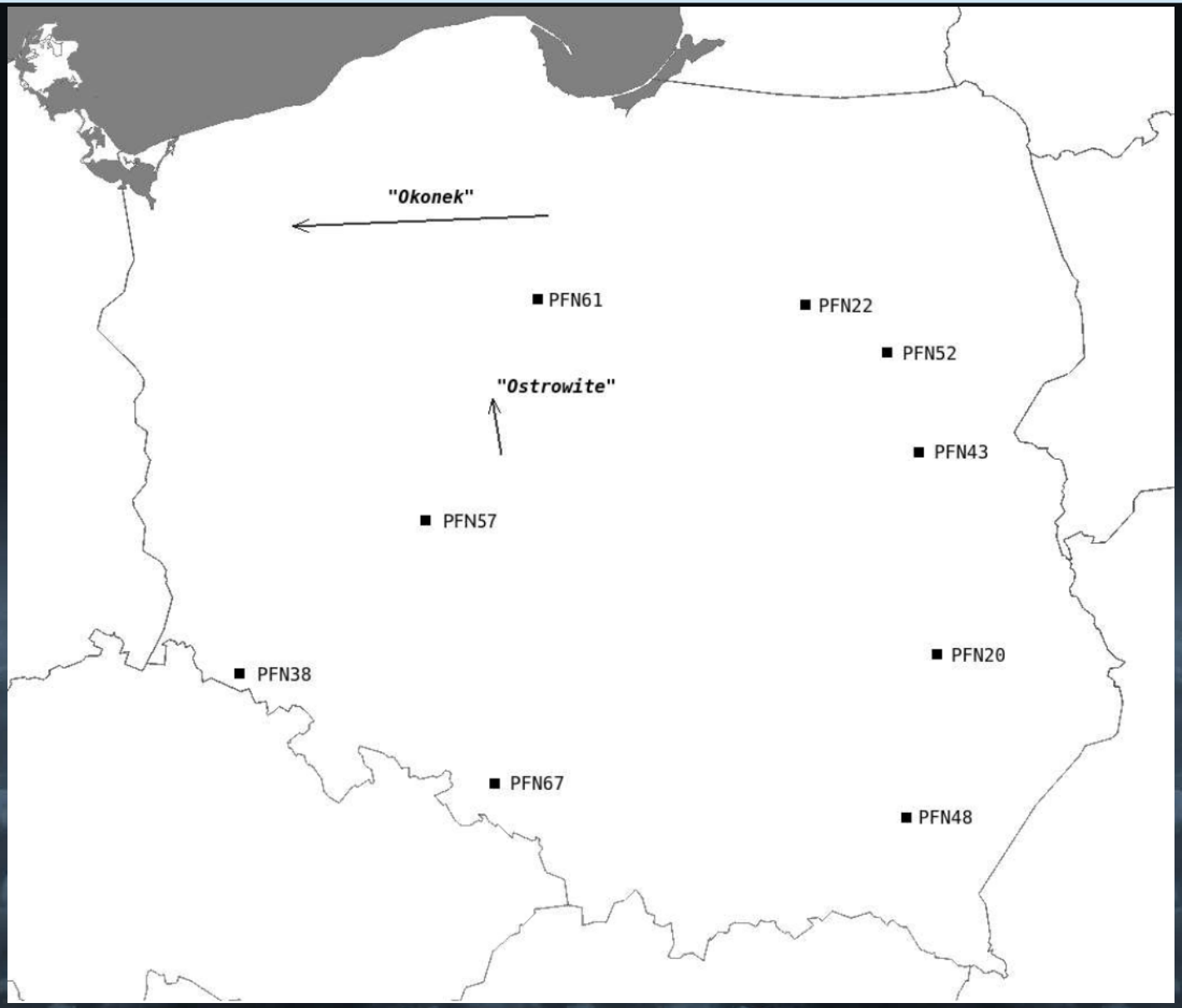
Olech et al. (2015) MNRAS 454, 2965

2015 Southern Taurid fireballs

2015 Southern Taurid fireballs

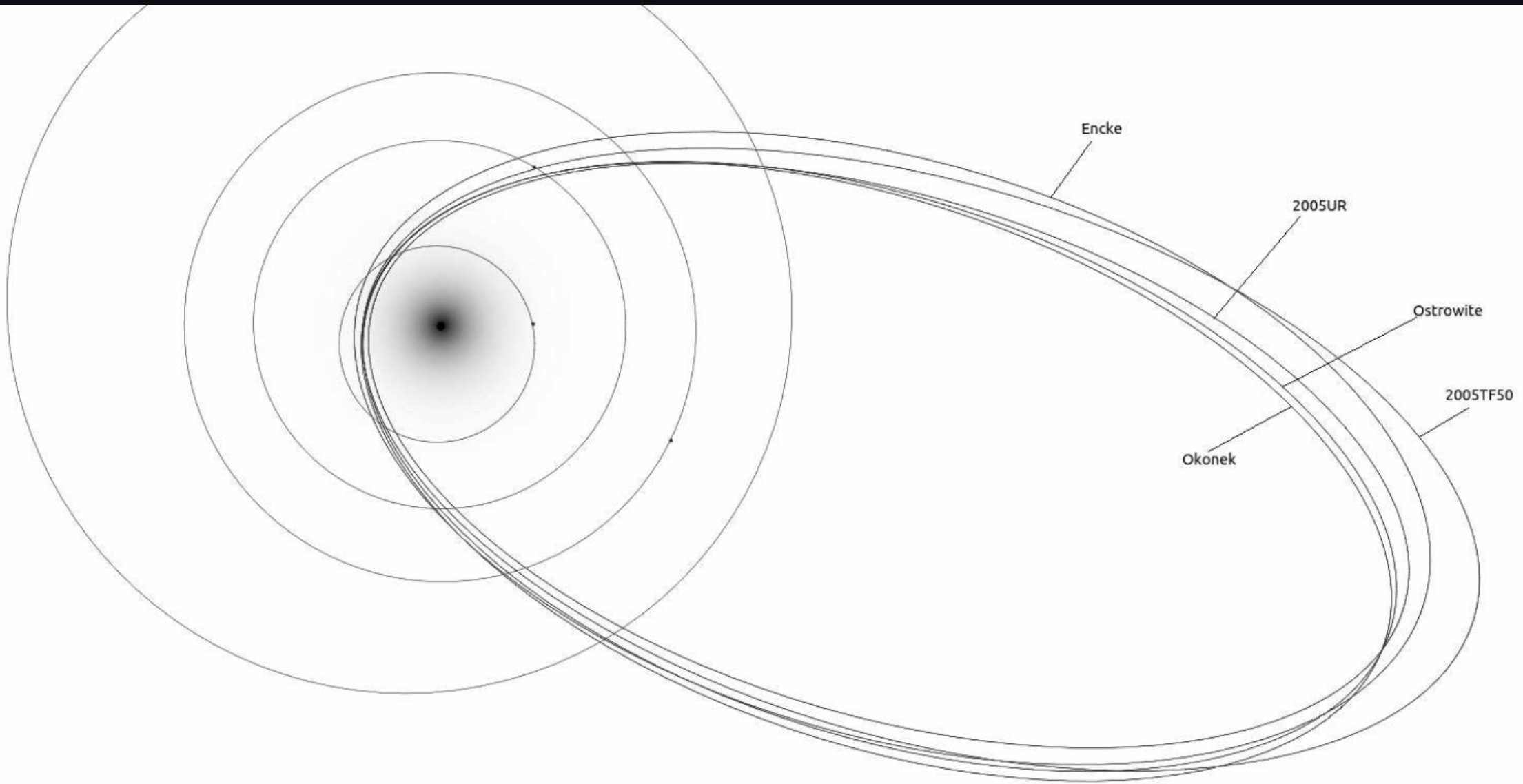
Olech et al. (2016) MNRAS

2015 Southern Taurid fireballs



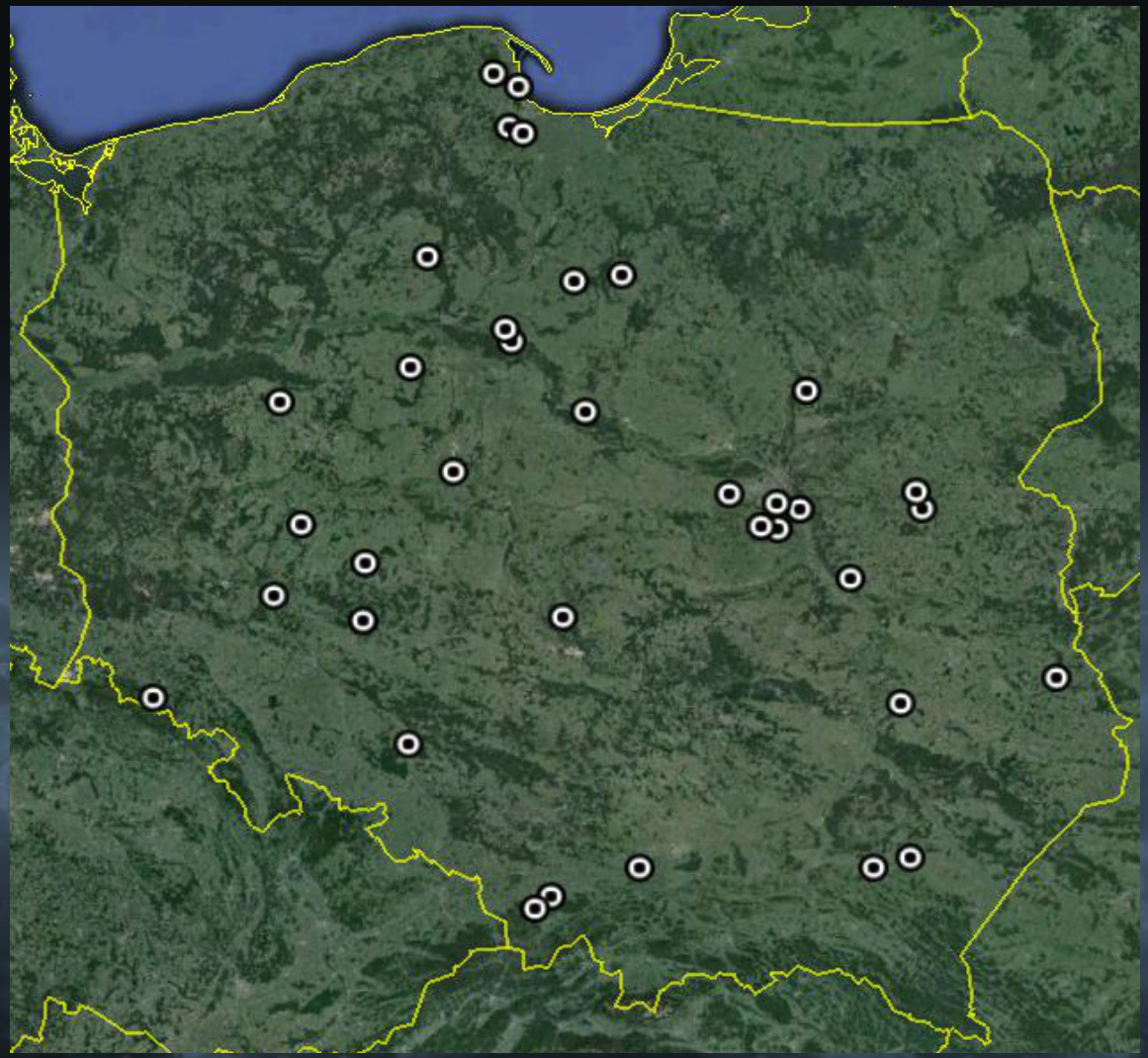
Olech et al. (2016) MNRAS

2015 Southern Taurid fireballs



Olech et al. (2016) MNRAS

Status of PFN



The network consists of 40 continuously working stations with nearly 80 sensitive CCTV video and digital cameras.

Low cost analog video camera (PFN 1.0)

Tayama C3102-01A1
768x576 pix
25/50 fps 8 bit
F1.2 4mm lens
FOV 66x50 degrees
5’/pix
Interlaced
real resolution
~480x288 pix
10’/(2 pix)

Sensitive analog video cameras (PFN 2.0)

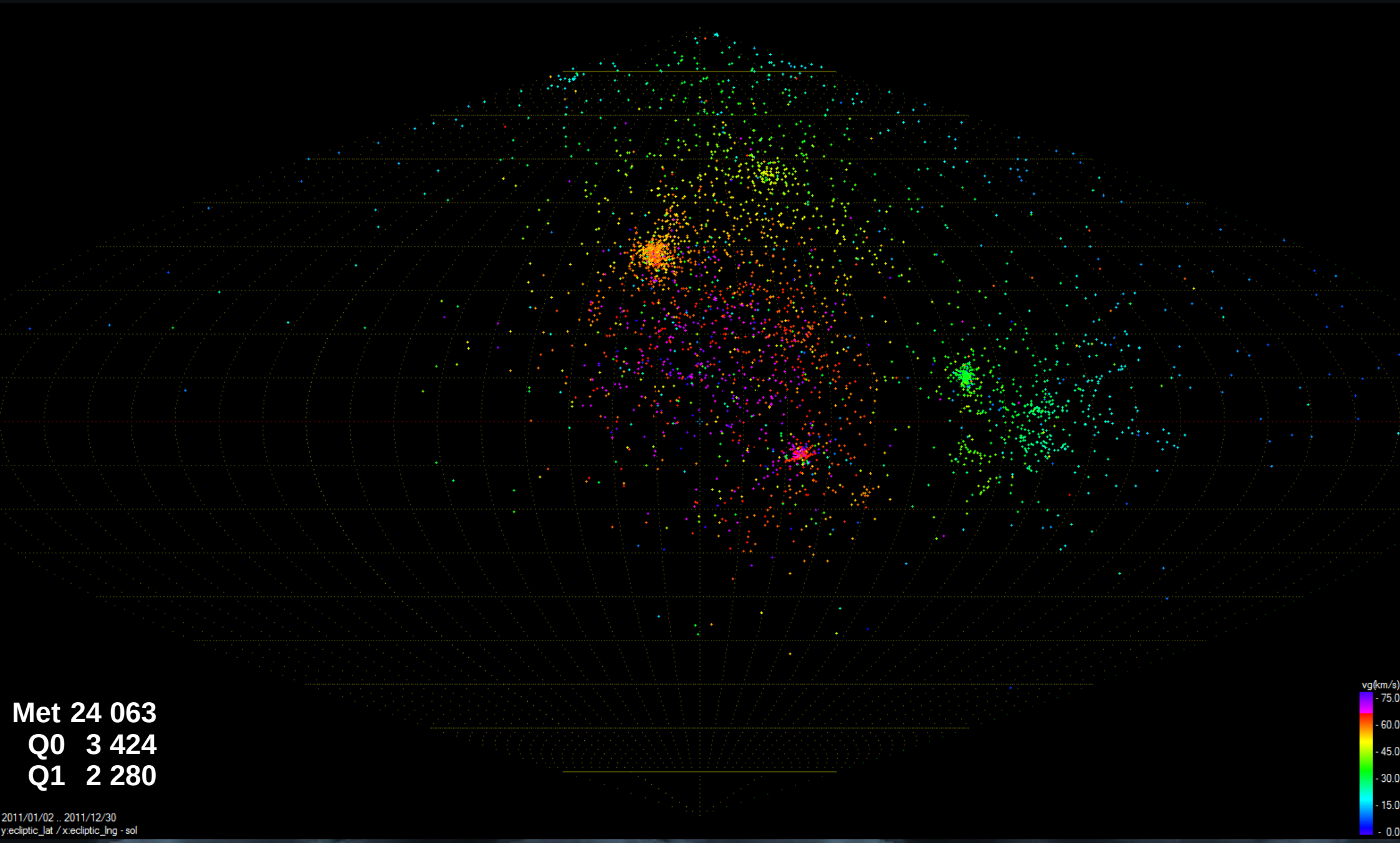
Mintron 12v6
768x576 pix
25/50 fps 8 bit
F0,8 6mm to 12 mm lens
FOV <66x50 degrees
<5’/pix
Interlaced
real resolution
~768x288 pix

Digital HD cameras (PFN 2.0)

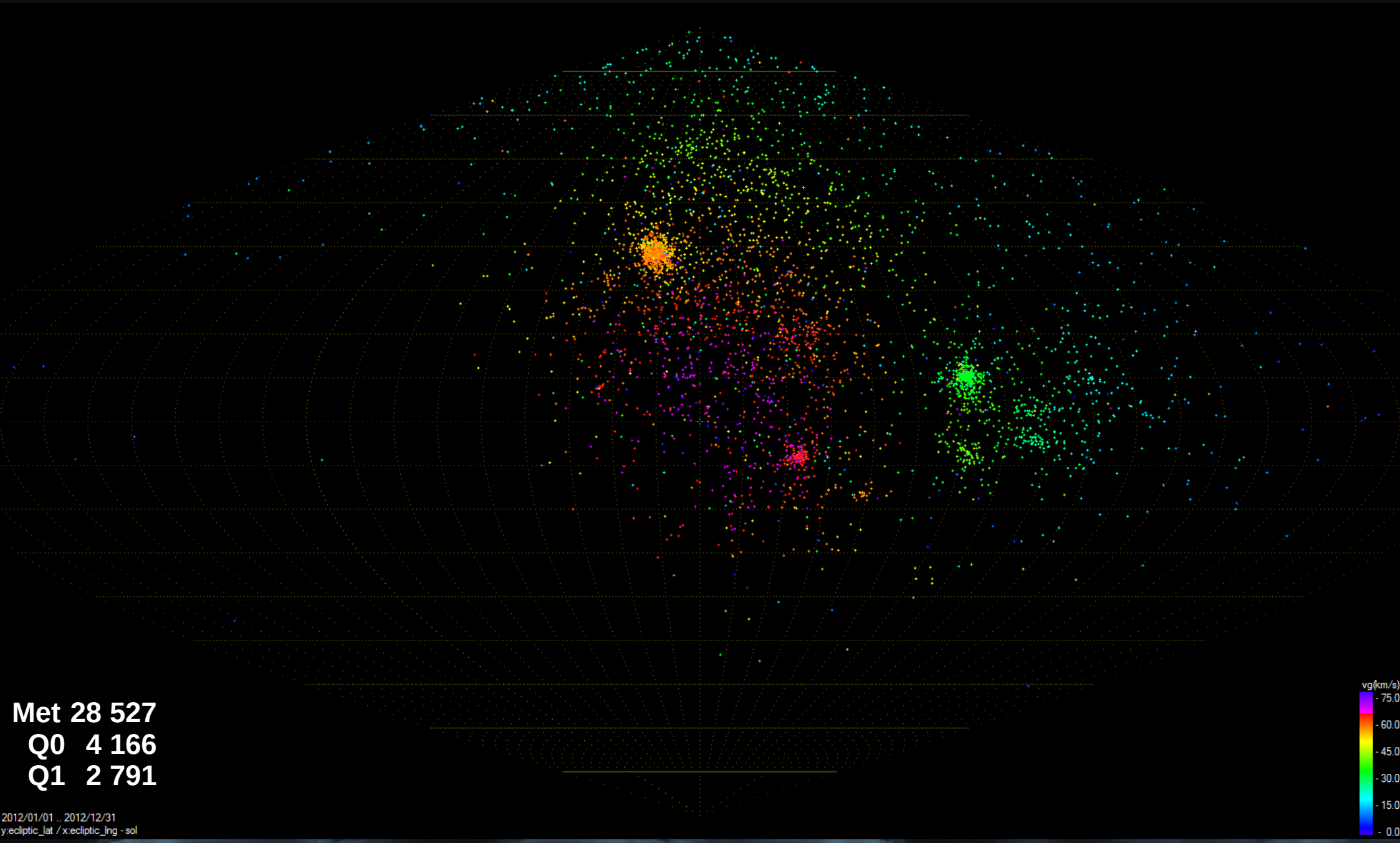
DMK 33GX 236
1920 x 1200 pixels
50/25 fps 8/12 bit
F1.2 2.4mm lens
FOV 130x80 deg
4’/pixel
progressive

Digital HD cameras (PFN 2.0)

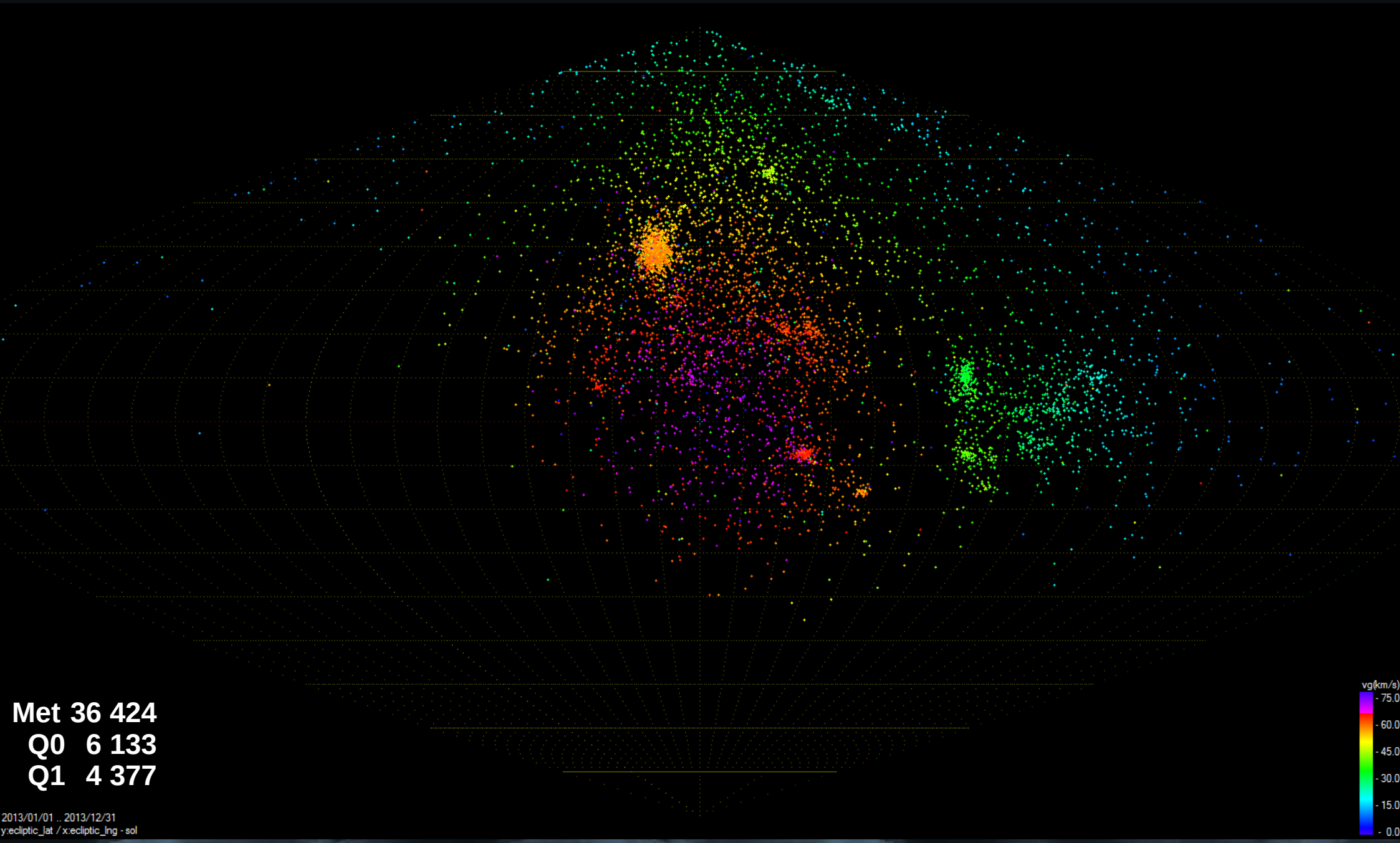
2011


Met 24 063
Q0 3 424
Q1 2 280
2011/01/02 .. 2011/12/30
y:ecliptic_lat / x:ecliptic_lng - sol
vg(km/s)
75.0
60.0
45.0
30.0
15.0
0.0

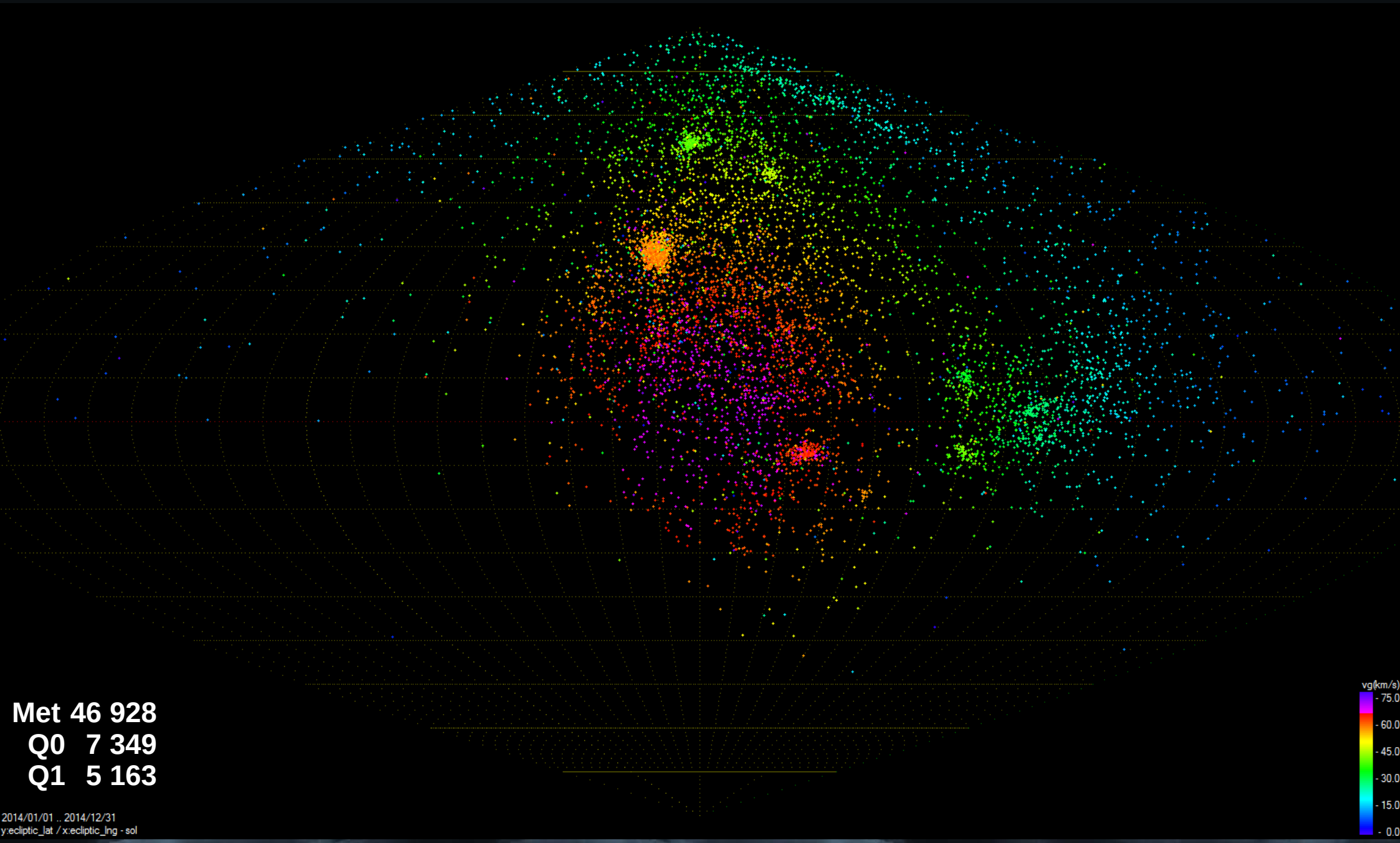
2012


Met 28 527
Q0 4 166
Q1 2 791
2012/01/01 .. 2012/12/31
y:ecliptic_lat / x:ecliptic_lng - sol
vg(km/s)
75.0
60.0
45.0
30.0
15.0
0.0

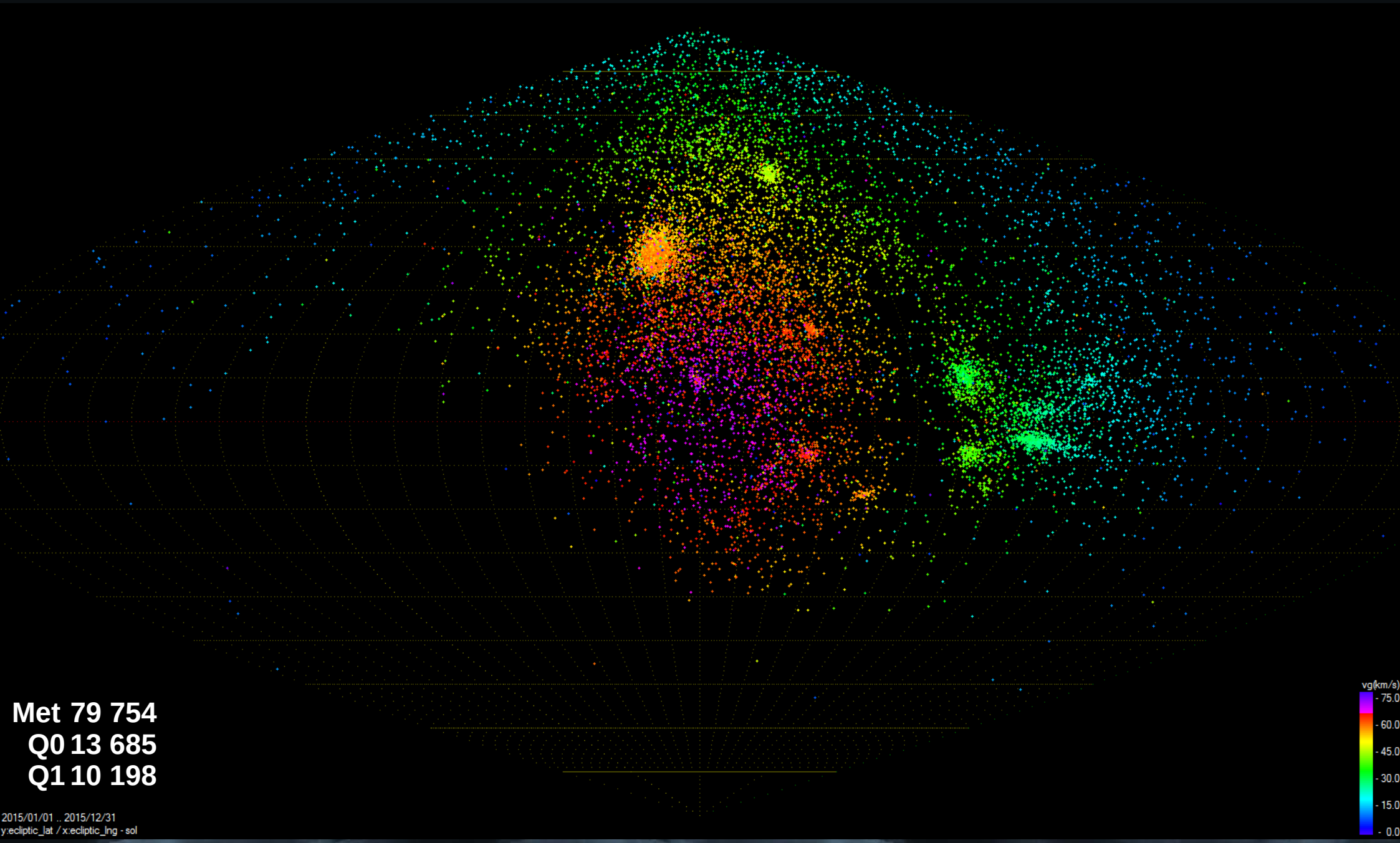
2013


Met 36 424
Q0 6 133
Q1 4 377
2013/01/01 .. 2013/12/31
y:ecliptic_lat / x:ecliptic_lng - sol
vg(km/s)
75.0
60.0
45.0
30.0
15.0
0.0

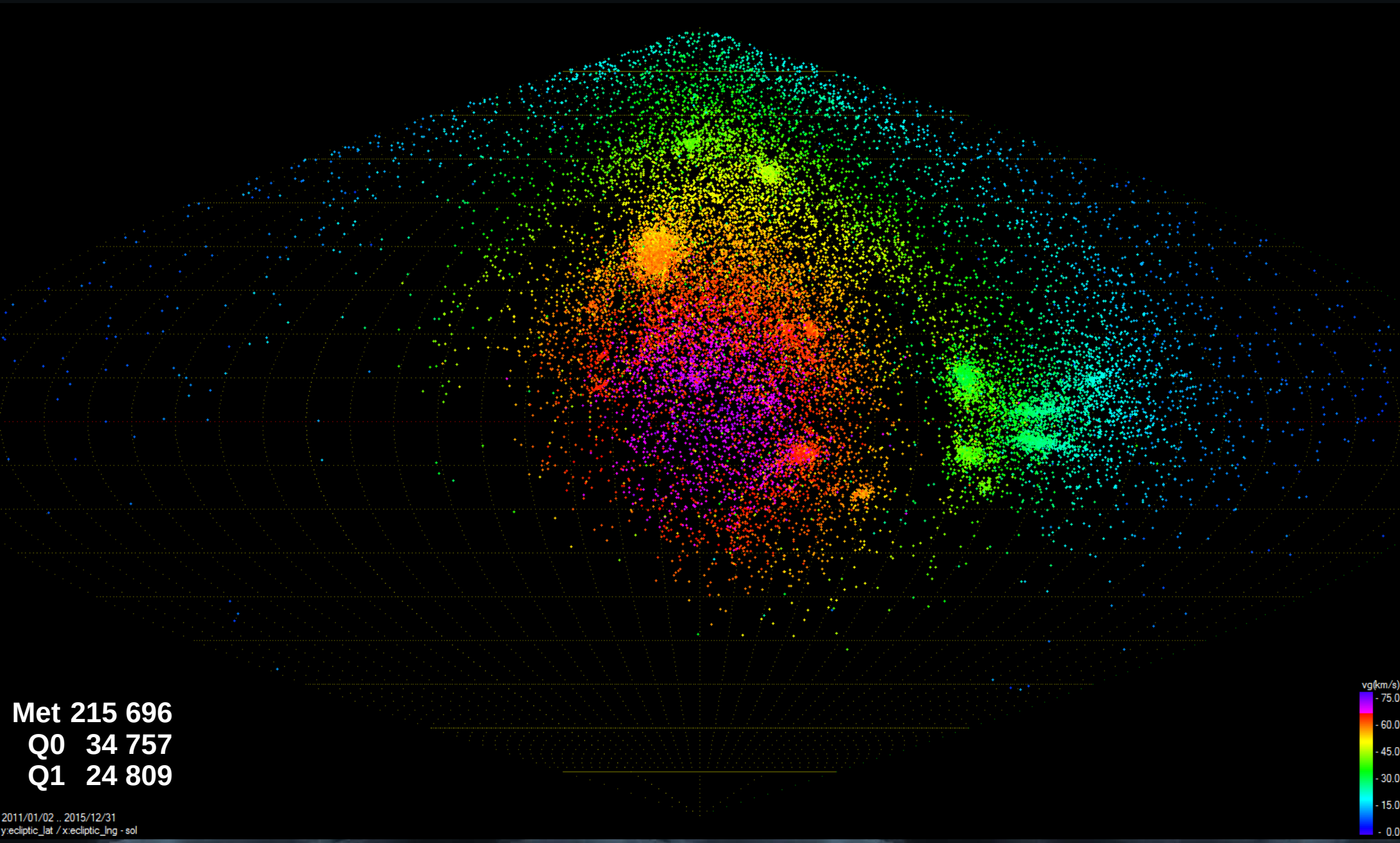
2014


Met 46 928
Q0 7 349
Q1 5 163
2014/01/01 .. 2014/12/31
y:ecliptic_lat / x:ecliptic_lng - sol
vg(km/s)
75.0
60.0
45.0
30.0
15.0
0.0

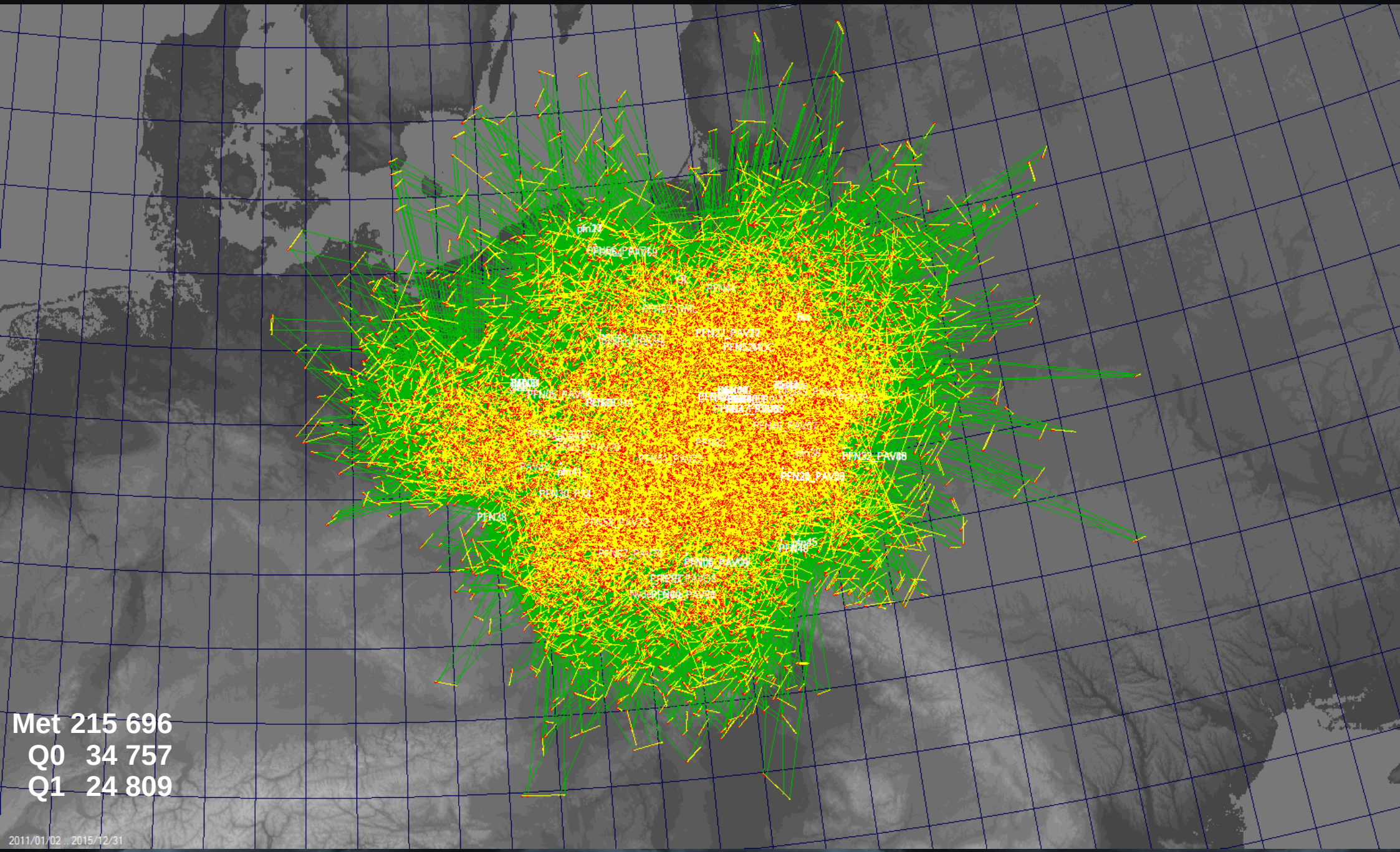
2015


Met 79 754
Q0 13 685
Q1 10 198
2015/01/01 .. 2015/12/31
y:ecliptic_lat / x:ecliptic_lng - sol
vg(km/s)
75.0
60.0
45.0
30.0
15.0
0.0

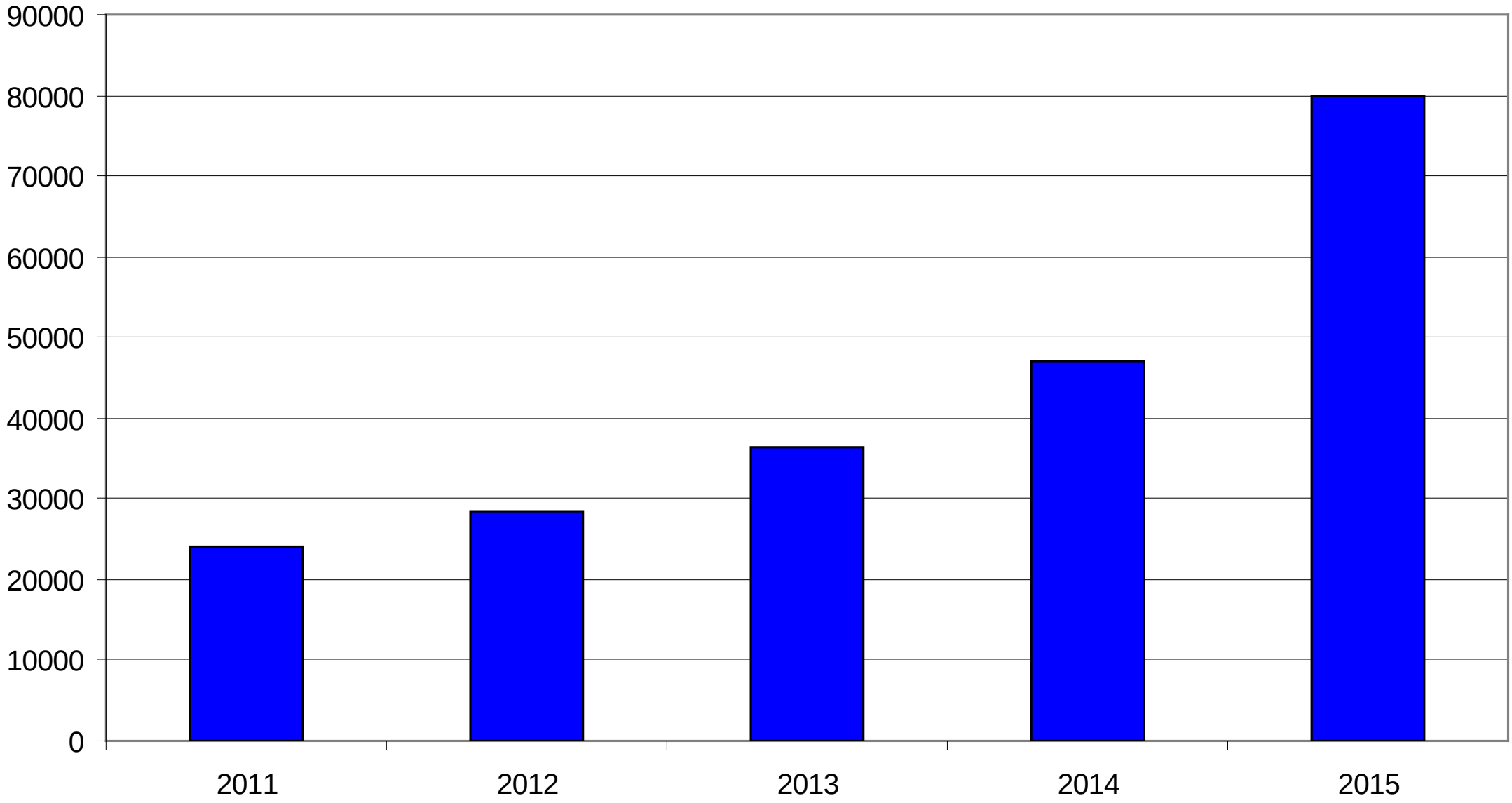
2011-2015


Met 215 696
Q0 34 757
Q1 24 809
2011/01/02 .. 2015/12/31
y:ecliptic_lat / x:ecliptic_lng - sol
vg(km/s)
75.0
60.0
45.0
30.0
15.0
0.0

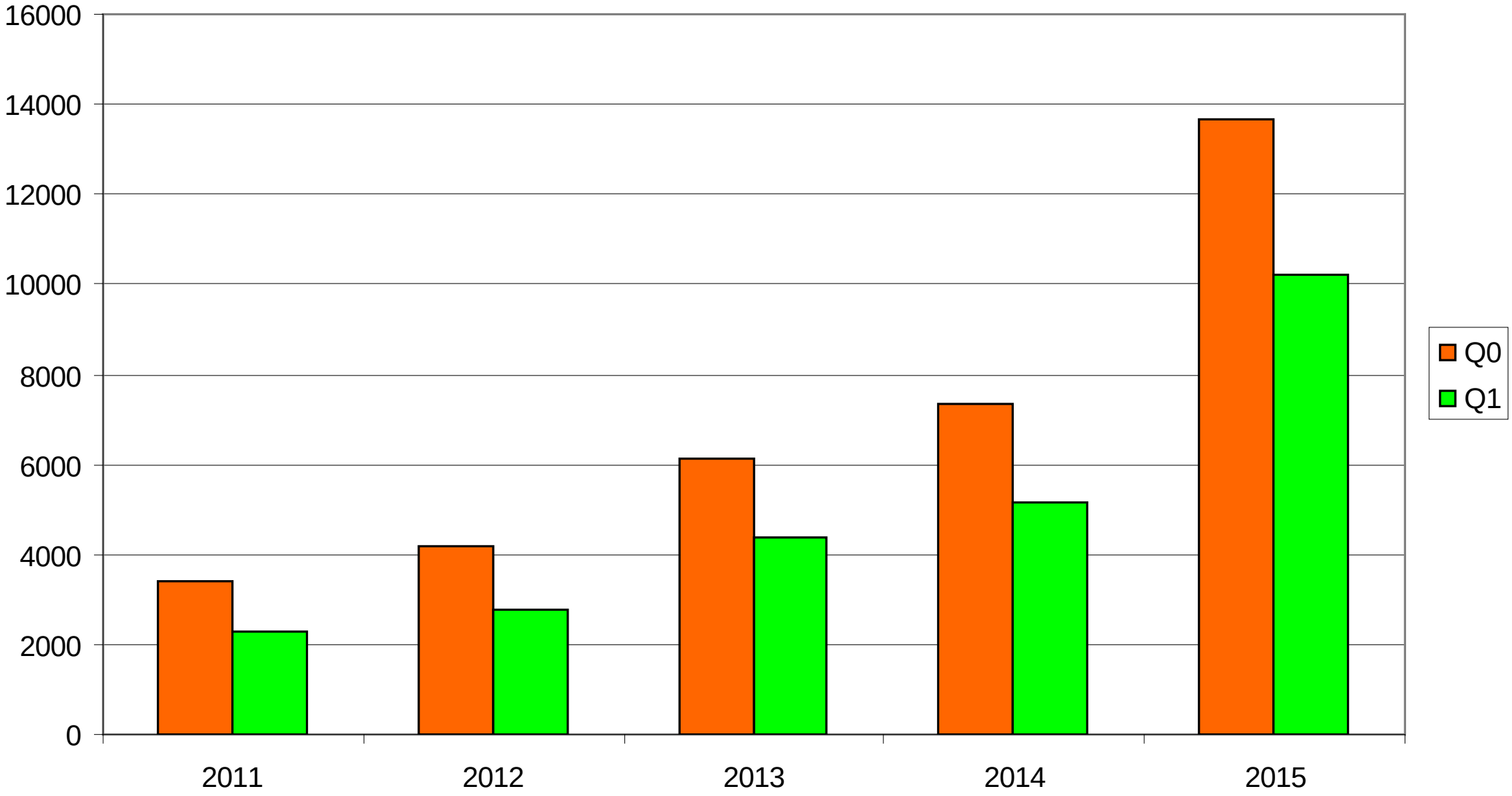
2011-2015



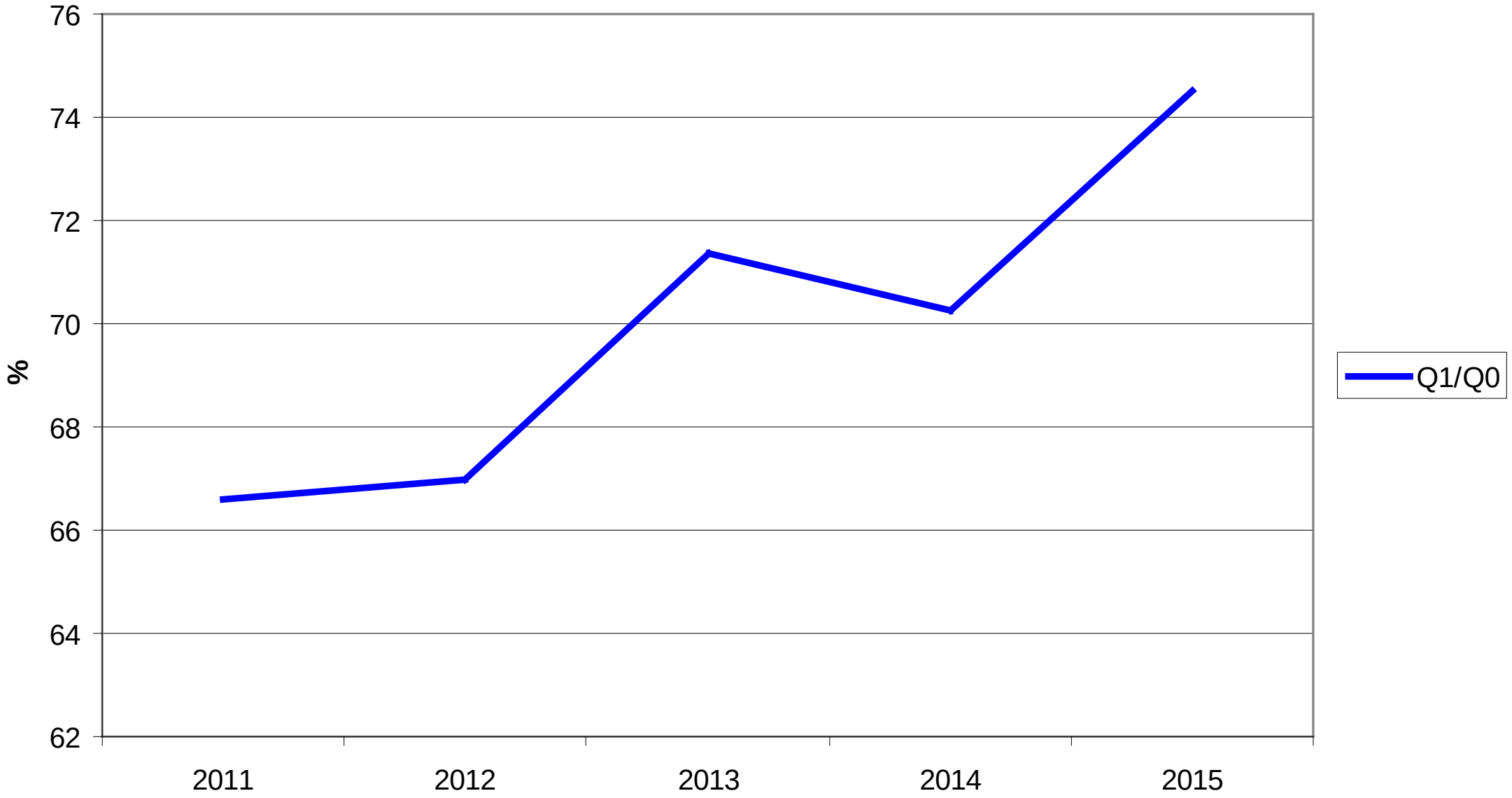
Number of recorded meteors



Number of calculated orbits (UFOorbits)



Quality of data (Q1/Q0)

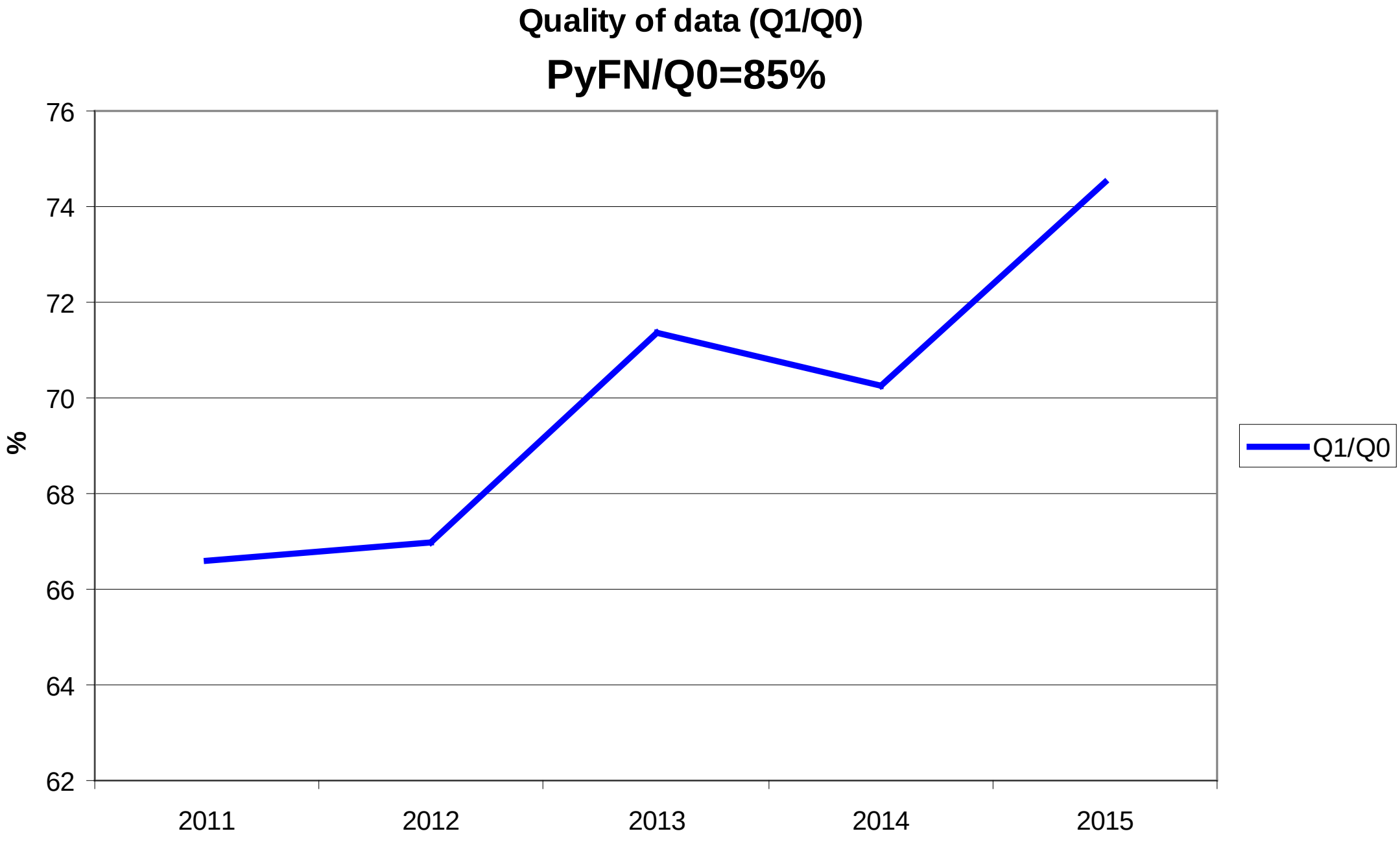


PyFN - multipurpose meteor software

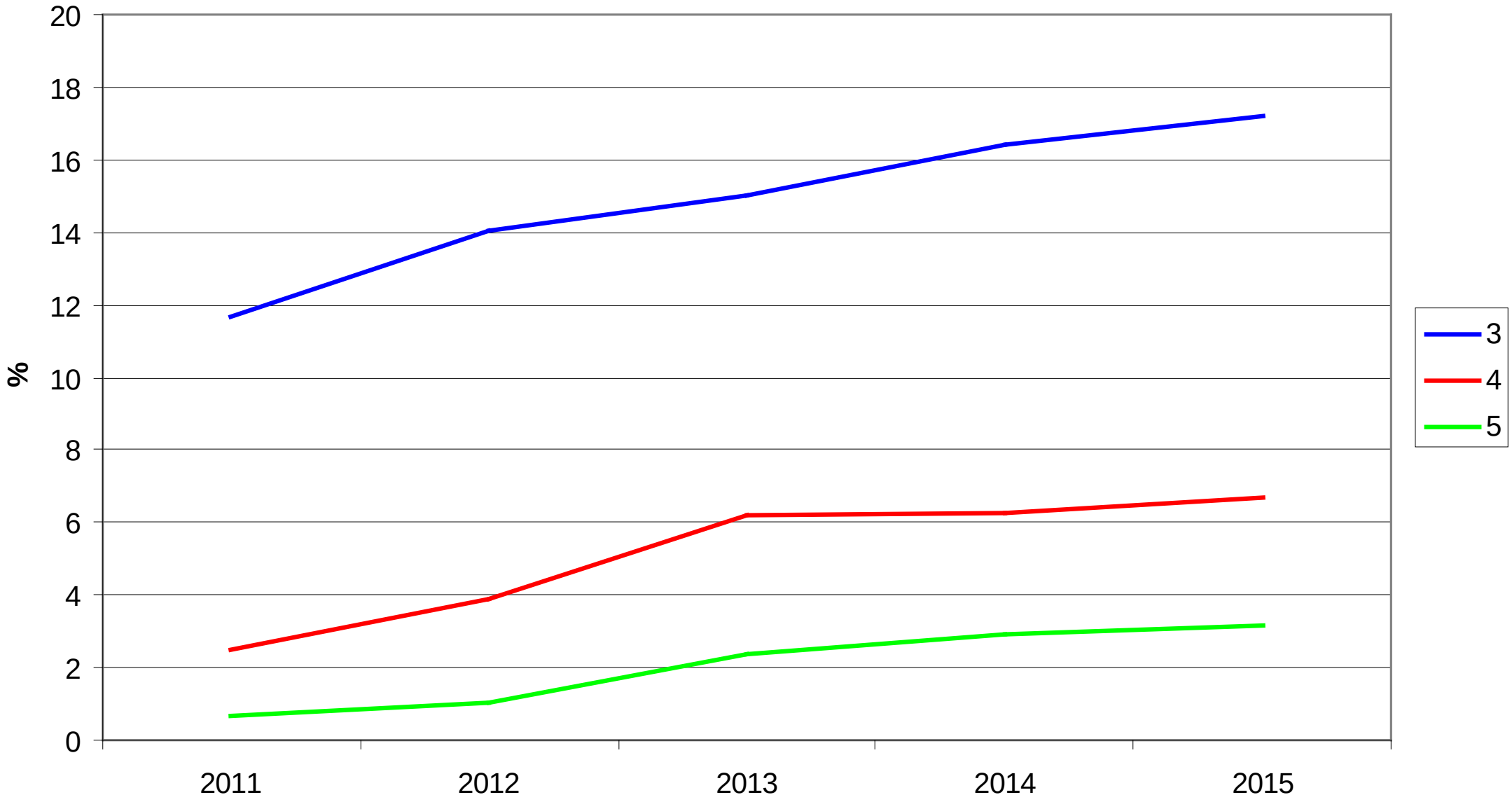
Ceplecha 1987

Visual inspection

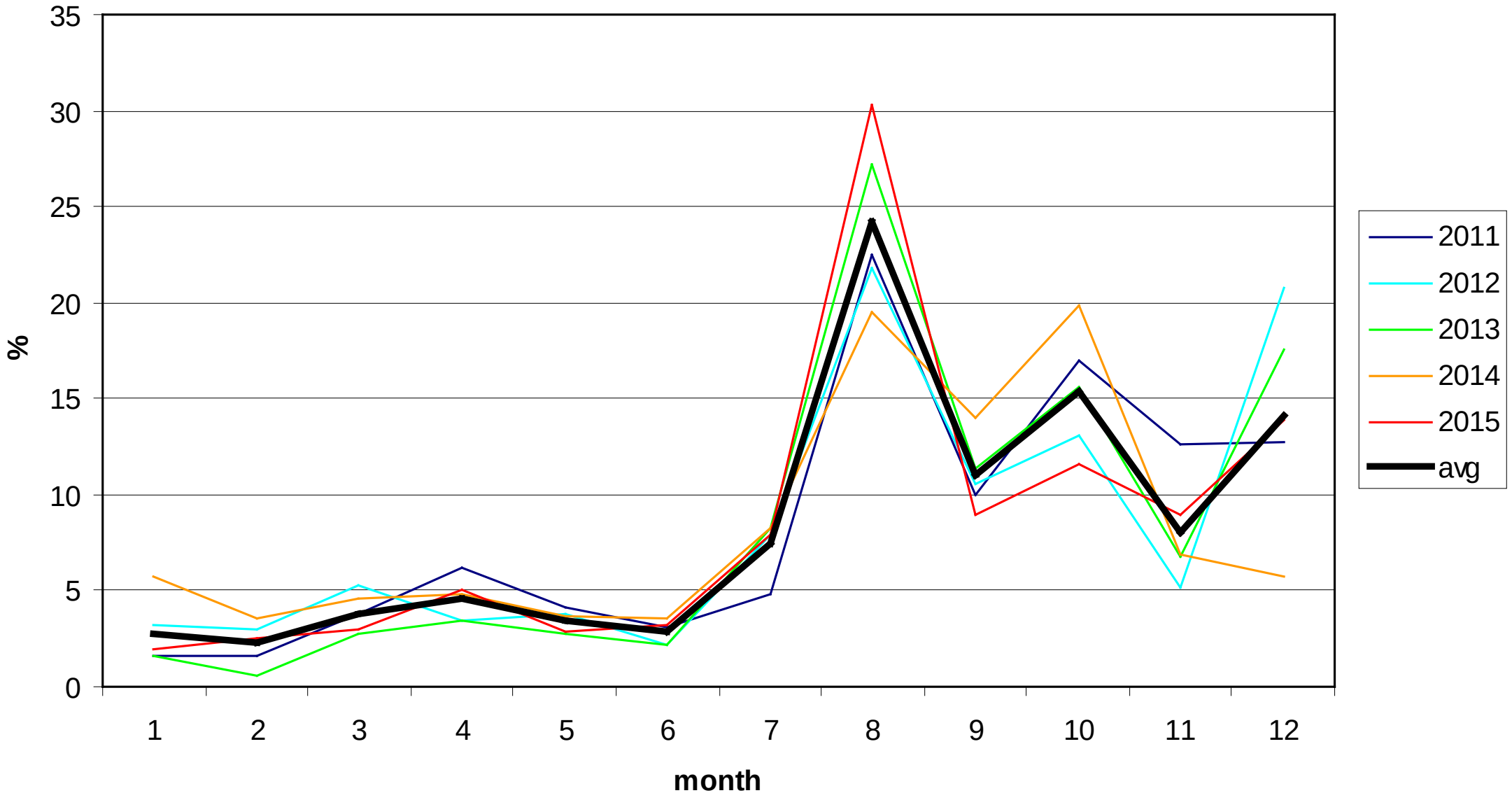
Manual removal of bad points


Quality of data (Q1/Q0)
PyFN/Q0=85%
76
74
72
70
68
66
64
62
%
2011
2012
2013
2014
2015
Q1/Q0

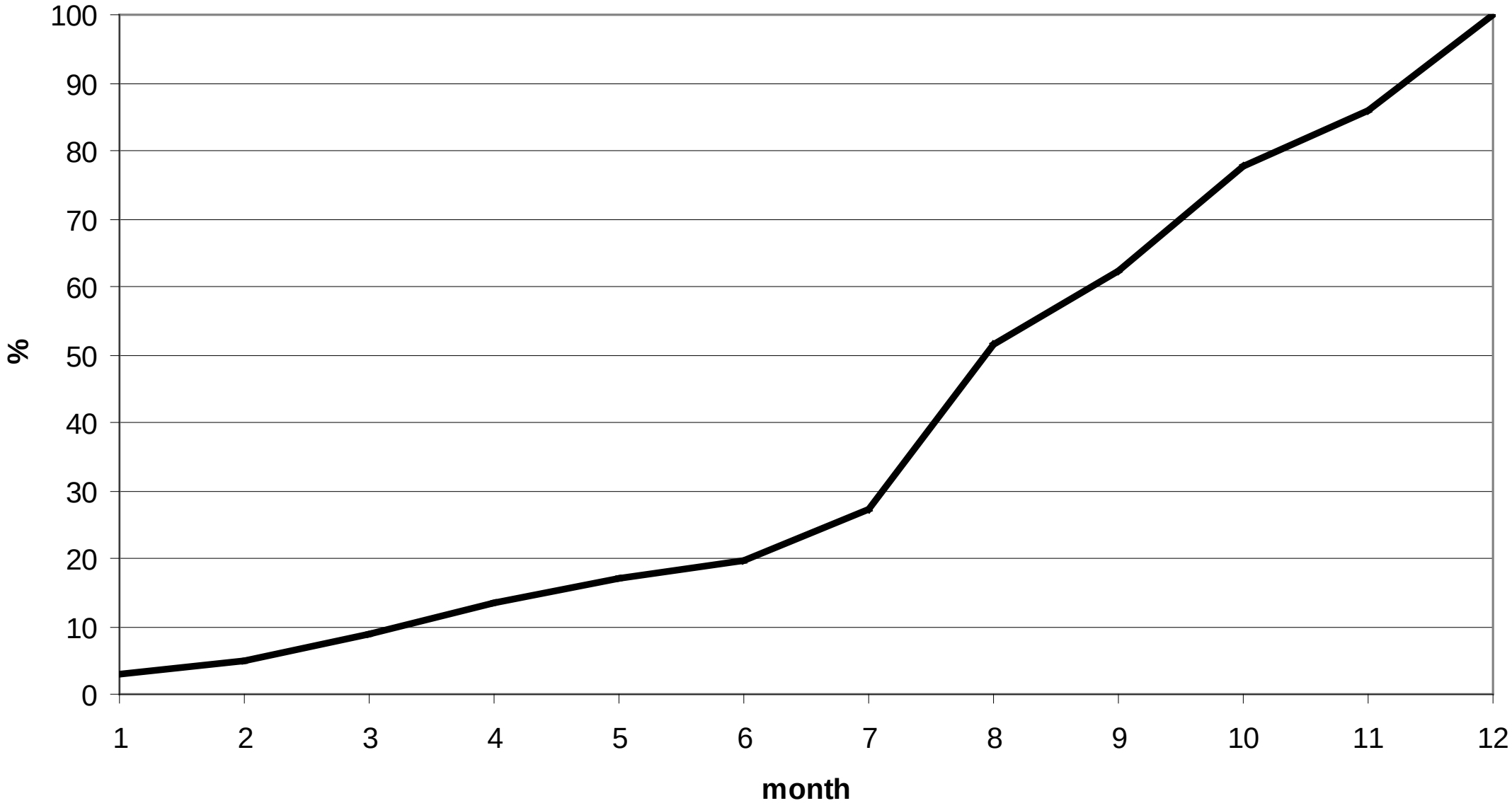
Multistation detections



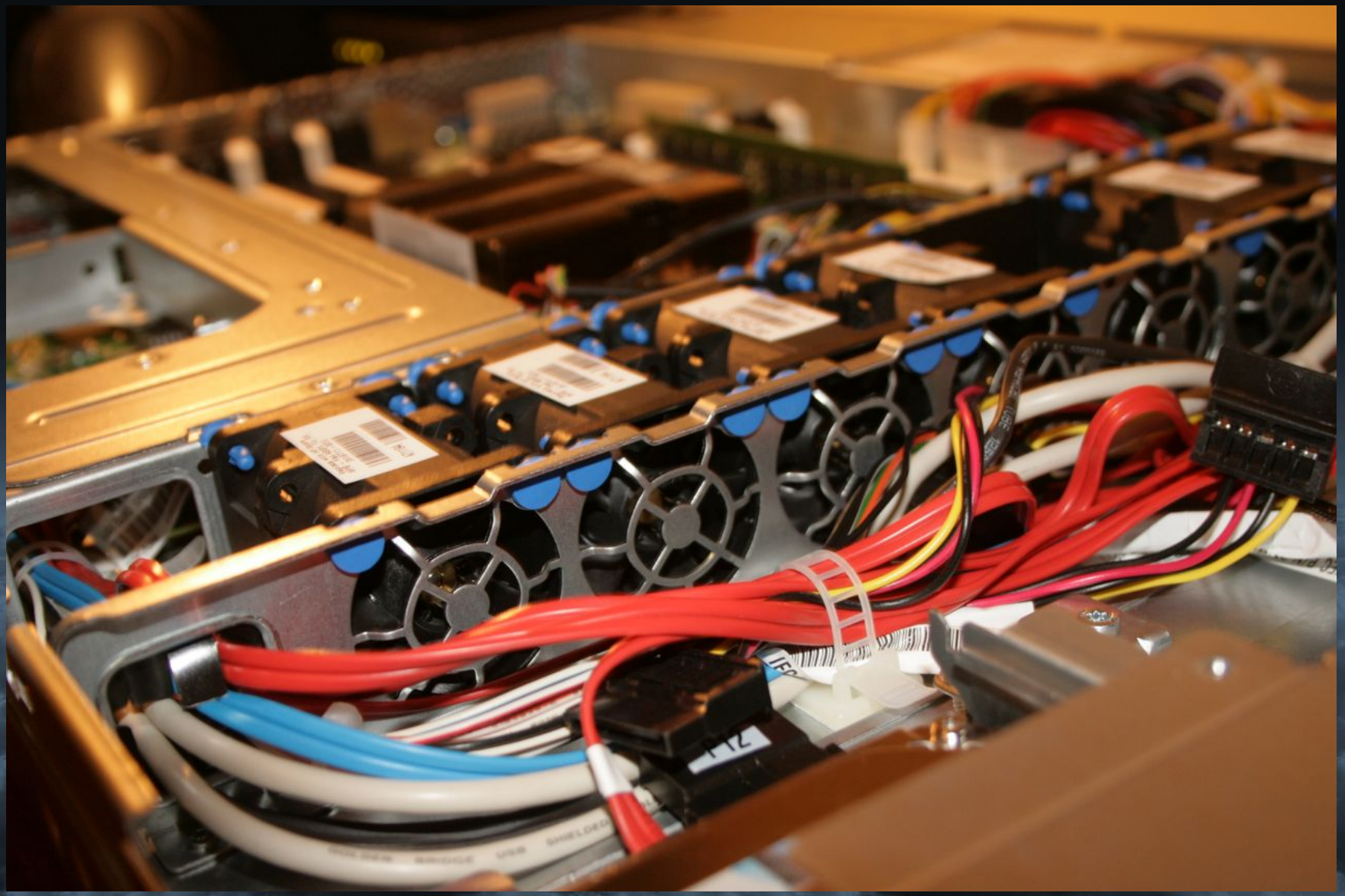
monthly distribution of data



Cumulative distribution of data

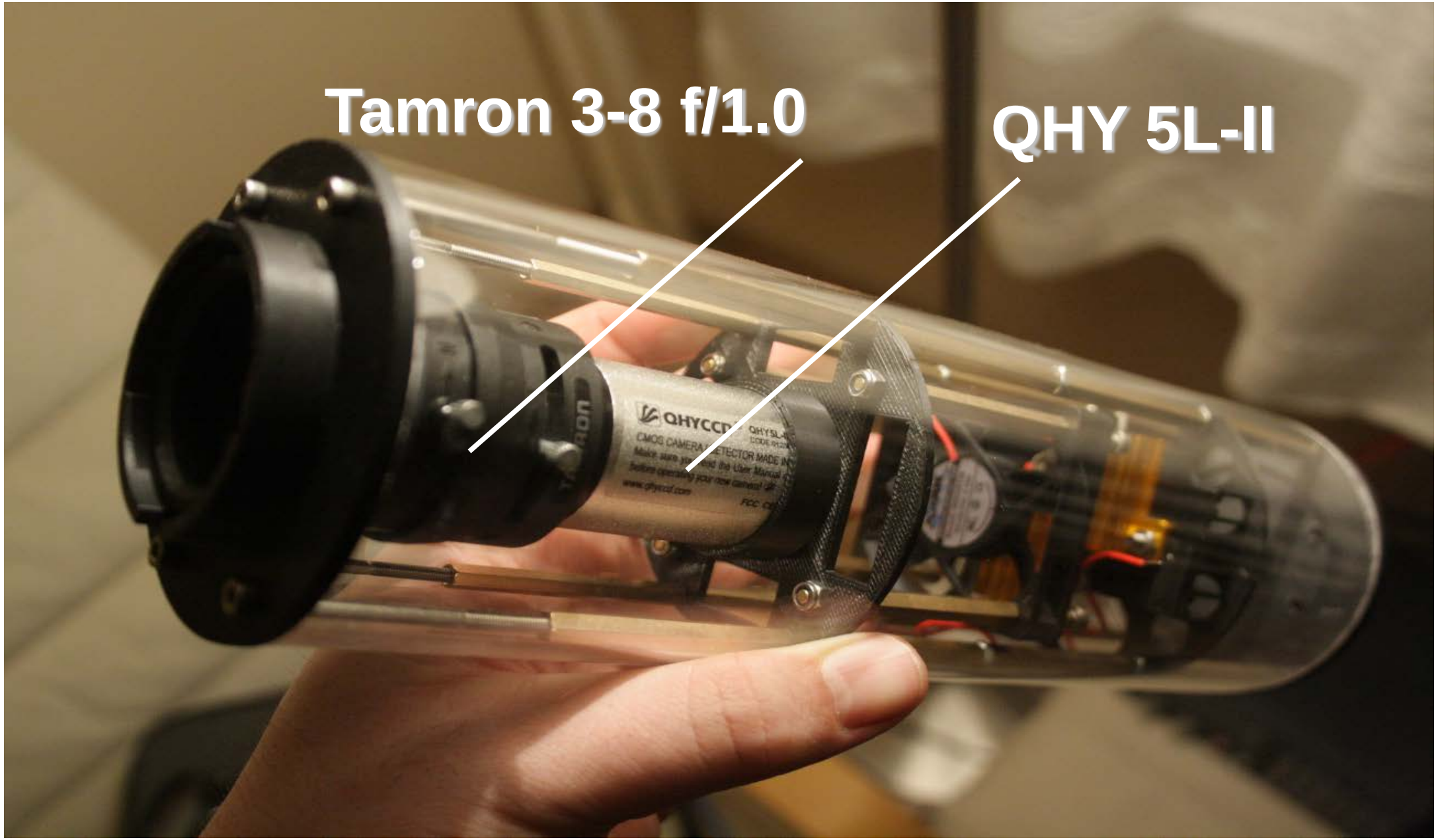


Second server



Software

CGMS2 – spectroscopy with QHY



Meteor spectra