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"Calculating video meteor positions in a narrow angle field with AIP4Win software - Comparison with the positions obtained by SPOSH cameras in a wide angle field"

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It all started there:

Two Perseid meteors in Lyra, captured with Watec / UFO Cap

on August 12th 2010

Why not try to do astrometry in the “standard” way?

SIGMA 28 mm f/1.8 DSLR lens

CS / Nikon adaptor

Watec 902 H2-U

The site and time of observations

Mt. Parnon, Greece (altitude 1,420 m) in August 2010, during the SPOSH campaign in Greece.

Method

First, we produced .bmp files for all the video frames using freeware software.

By visual inspection of the .bmp files we chose those with the best quality, in which the meteor trail was clear enough for astrometry calculations.

We picked three frames for each meteor.

Then we opened the .bmp files with the AIP4WIN software included in the "Handbook of Astronomical Image Processing" (Berry & Burnell 2006) and initiated the astrometry processing operation.

The images were astrometrically reduced using standard techniques, based on our previous experience from asteroid astrometry reductions (Tsamis 2011).

As a reference star catalog we used Guide Star Catalog 1.1, included in the MegaStar software.

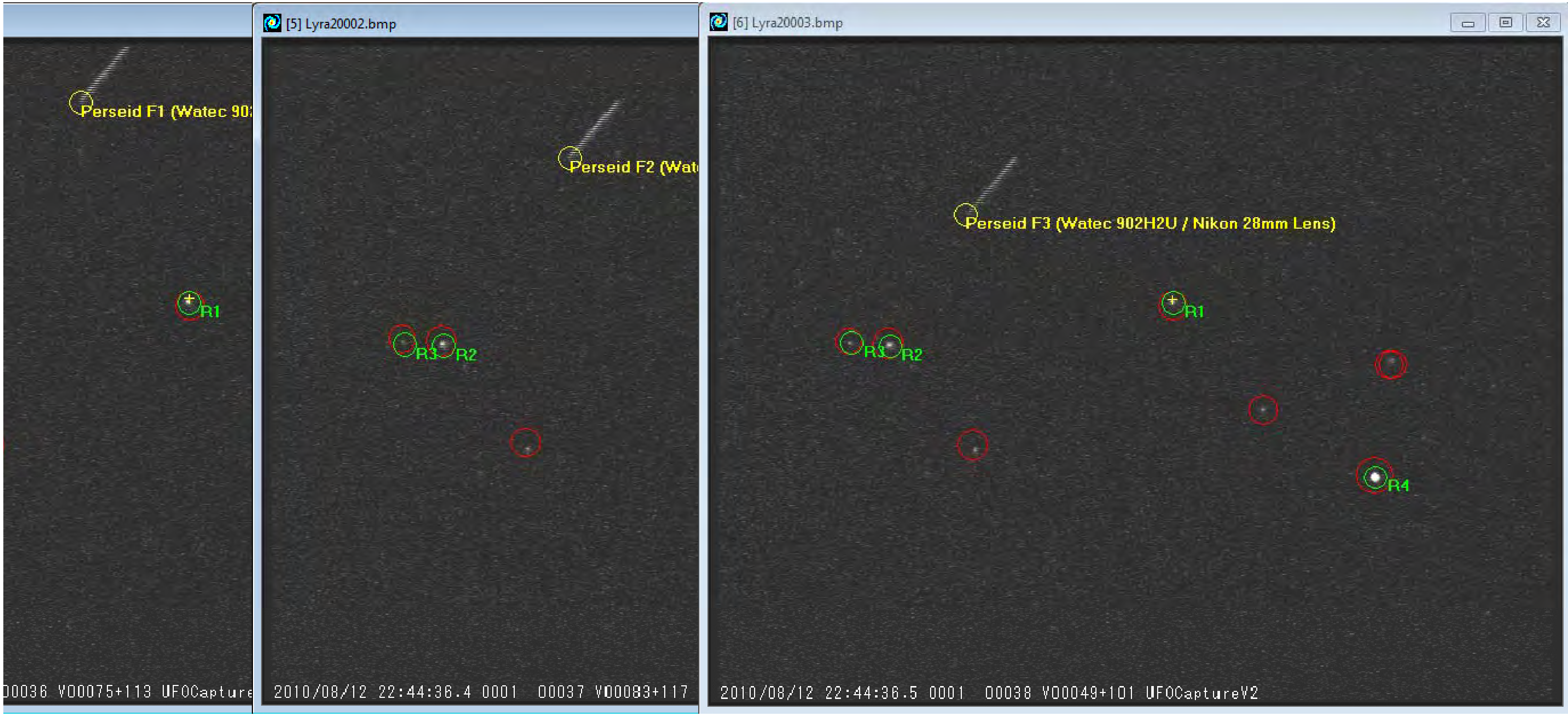
Fig 5: Astrometry targets and reference stars for Meteor_1

Captured at 2010/08/12 UT 21:45:01

As reference stars for the astrometric calculations for Meteor_1 we used alpha, delta, epsilon and zeta Lyrae.

Fig 5: Astrometry targets and reference stars for Meteor_2

Captured at 2010/08/12 UT 22:44:36



As reference stars for the astrometric calculations for Meteor_2 we used alpha, gamma, delta and lamda Lyrae.

Astronomical Image Processing Astrometry Tool

Target object(s): **Perseid F2 (Watec 902H2U / Nikon 28mm Lens)**

REFERENCE STARS

MegaStar

Coordinates direct from the catalog.

Coordinate epoch: 2000.0

Ref #	RAS hh mm ss.sss	DEC +dd mm ss.ss	Mcat	X pixels	Y pixels	Mpho	RArms arcsec	DErms arcsec
R1	18 54 34.401	+36 59 47.94	09.60	390.402	225.492	15.98	+0.833	-1.874
R2	18 58 56.538	+32 41 22.53	03.20	151.229	263.050	15.86	-13.020	+29.272
R3	19 00 00.746	+32 08 44.08	04.90	118.069	262.253	17.50	+11.736	-26.385
R4	18 36 56.335	+38 47 01.54	00.10	561.696	378.696	14.18	+0.451	-1.013

TARGET OBJECT(S)

Target name or number	X pixels	Y pixels	Mpho	RA hh mm ss.sss	DEC +dd mm ss.ss	Mag
Perseid F2 (W	258.082	098.052	16.55	19 08 27.064	+35 34 15.47	08.09

ASTROMETRIC SOLUTION

Top left pixel: (0, 0)

Plate center X: 360.00 [pixels]

Plate center Y: 288.00 [pixels]

PA of +Y axis: 66.05 [degrees]

Plate center RA: 18 50 47.834

Plate center DEC: +36 03 20.17

Focal length: 28.2616

Residual in RA: 017.555 [arcsec rms]

Residual in DEC: 039.466 [arcsec rms]

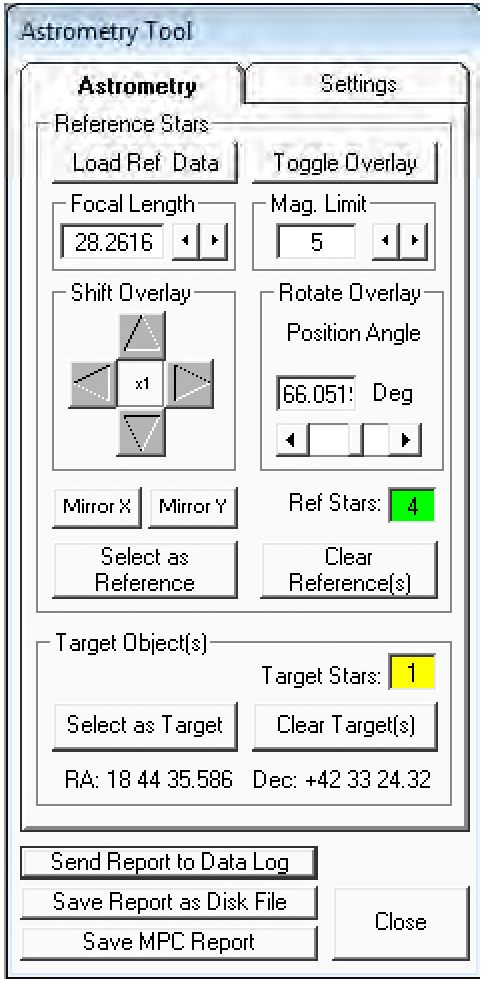
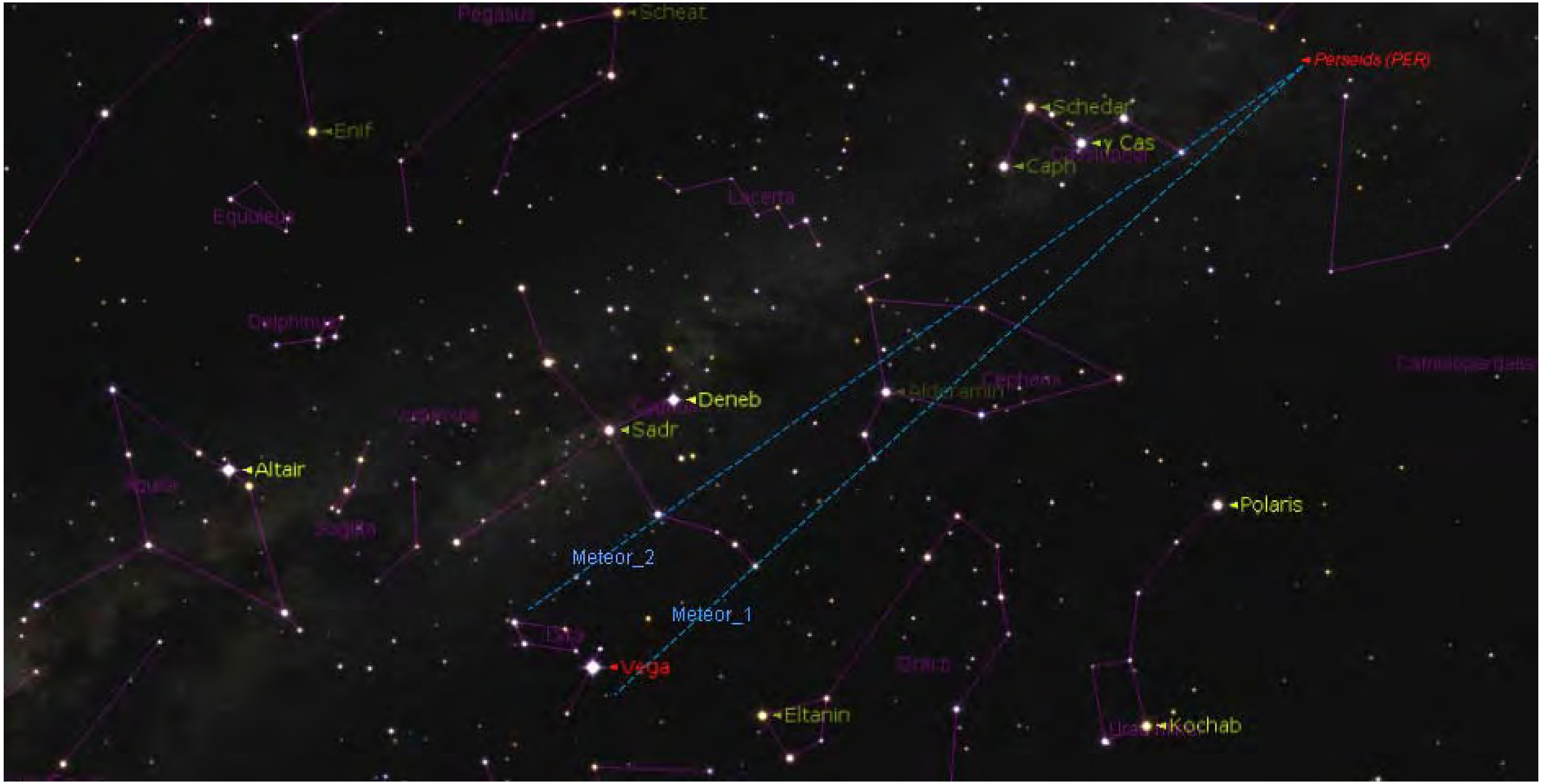


Table 3: A Full astrometry report for Meteor 2 (frame 2) in AIP4WIN


Pegasus
Scheat
Perseids (PER)
Enif
Schedar
γ Cas
Caph
Equuleus
Lacerta
Delphinus
Cepheus
Deneb
Sadr
Altair
Polaris
Meteor_2
Meteor_1
Vega
Eltanin
Kochab

AIP4WIN Astrometric Results

The astrometry with AIP4WIN produced the following results for the positions of Meteor 1 (table 1):

Frame	Time	Coordinates (RA, DEC)	
1	21hr 45min 05.00sec ± 1 sec	18 31 56.313	+41 37 50.39
2	21hr 45min 05.05sec ± 1 sec	18 30 16.801	+40 35 32.51
3	21hr 45min 05.10sec ± 1 sec	18 27 16.585	+39 36 17.10

Table 1: Astrometry position results for Meteor 1

and for Meteor 2 (table 2):

Frame	Time	Coordinates (RA, DEC)	
1	22hr 44min 36.40sec ± 1 sec	19 12 44.757	+36 01 06.86
2	22hr 44min 36.45sec ± 1 sec	19 08 27.064	+35 34 15.47
3	22hr 44min 36.50sec ± 1 sec	19 05 52.255	+34 31 39.95

Table 2: Astrometry position results for Meteor 2

N

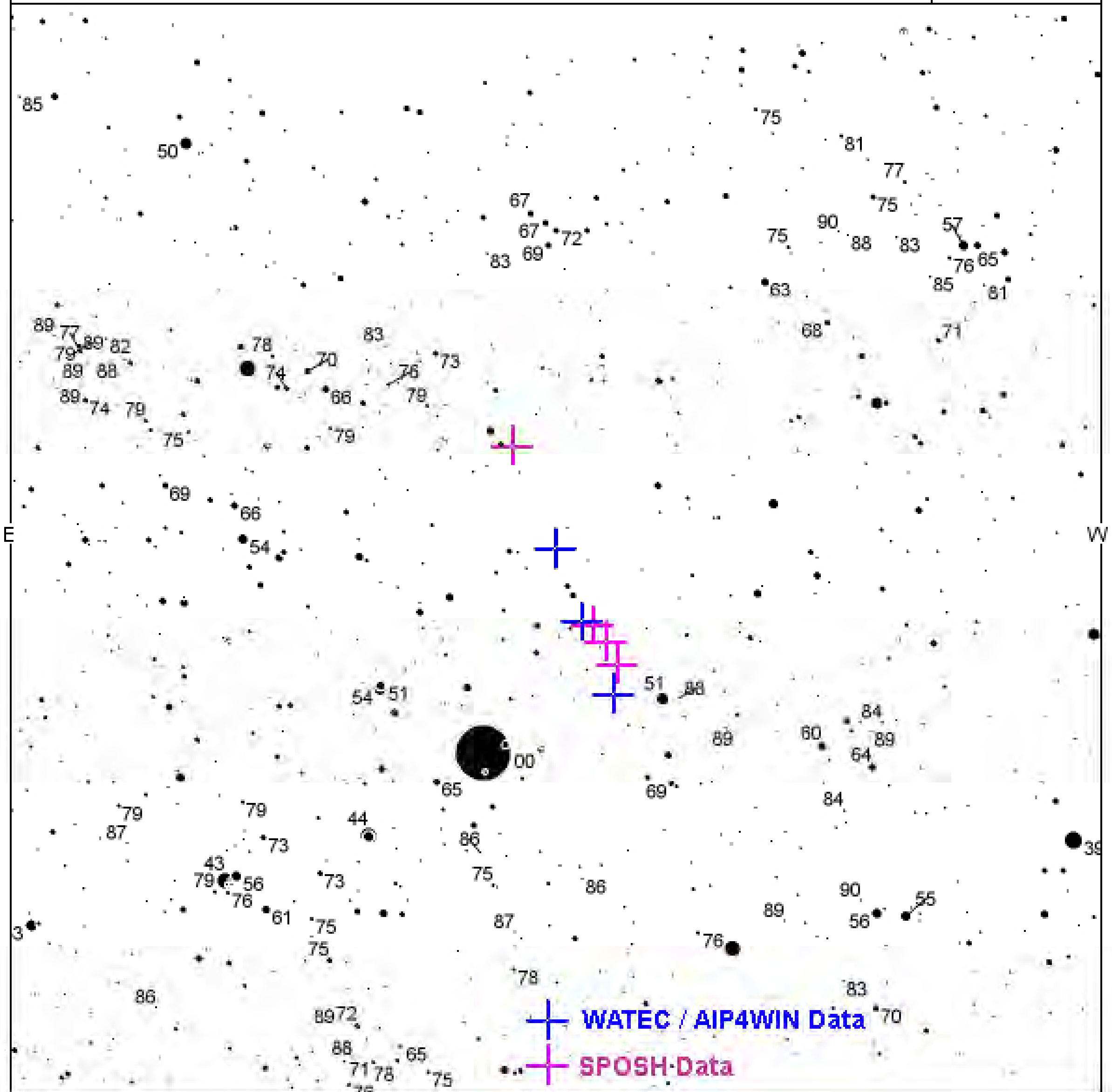
Magn:
Period:
Type:
Spec:

Positions of the Lyra_1 Meteor
20100812_214504_dpa

AAVSO
Chart

8809RF

E



W

FOV = 15.0°

Please use the photometry table for CCD observations.

http://www.aavso.org/usp/

S

Meteor_1 SPOSH Results

```
Calculated Orbit from Images 20100812_214505_dma.fits
 20100812_214504_dpa.fits
UTC Date and Time: 2010-08-12 21:45:05

                TRAJECTORY
--------------------------------------------

Starting Height: 113.59
Ending Height: 105.25
Length of Trail: 17.32
Angle of Attack: 26.56
Convergence Angle: 25.46

                   RADIANT
--------------------------------------------
Apparent Radiant:
RA     =        47.647635 deg +-0.19583109
dec    =        57.268799 deg +-0.094911612
Observed Velocity:
v_app =         58.123676 km/s +-1.5805512
Pre-atmospheric velocity:
v_inf =        59.1929 km/sec +-0.19583109

Geocentric Radiant:
RA     =        48.671684 deg +-0.19719608
dec    =        56.962650 deg +-0.094108231
Geocentric Velocity:
v_geo =         58.151761 km/s +-1.5852129

Heliocentric Velocity:
v_hel =         39.920265 km/s +-1.5275707

                   ORBIT
--------------------------------------------

Orbital Elements:
rp     =       0.94003691 AU +-0.00080288637
a      =        5.5714227 AU +-0.0015375618
ecc    =       0.83127525 deg +-0.42024737
inc    =        113.90662 deg +-0.22402975
lnode =         139.92513 deg +-1.4208847e-05
argp   =        147.21609 deg +-0.12390715
```

Meteor_2 SPOSH Results

```
Calculated Orbit from Images 20100812_224436_dma.fits
20100812_224435_dpa.fits
UTC Date and Time: 2010-08-12 22:44:36

                TRAJECTORY
--------------------------------------------

Starting Height: 113.43
Ending Height:    105.19
Length of Trail: 15.72
Angle of Attack: 28.69
Convergence Angle: 24.97

                   RADIANT
--------------------------------------------
Apparent Radiant:
RA     =        44.979950 deg +-0.15496794
dec    =        57.604688 deg +-0.10161045
Observed Velocity:
v_app =         50.833219 km/s +-0.49704262
Pre-atmospheric velocity:
v_inf =        52.0524 km/sec +-0.15496794

Geocentric Radiant:
RA     =        46.215676 deg +-0.16011865
dec    =        57.413607 deg +-0.10049634
Geocentric Velocity:
v_geo =         50.865322 km/s +-0.50305840

Heliocentric Velocity:
v_hel =         33.867090 km/s +-0.42591191

                   ORBIT
--------------------------------------------

Orbital Elements:
rp     =       0.91031035 AU +-0.0024535446
a      =        1.4647434 AU +-0.012791021
ecc    =       0.37851888 deg +-0.044400544
inc    =        107.19981 deg +-0.34803444
lnode =         139.96576 deg +-1.7973713e-05
argp   =        129.04064 deg +-0.36552227
```

Conclusions

We argue that the astrometric results for meteor derived in this way are <u>of good quality</u> since the value of the residuals in RA and DEC are not bad at all, since in most our observations the residuals in RA and DEC are around the values of 18 arcsec (rms) and 40 arcsec (rms), respectively.

This level of astrometric precision could be the strong point in using a good quality lens with a medium or narrow FOV and dedicated general astrometry software for meteor positions.

In contrast, wide angle lens are more vulnerable to geometrical distortions, especially at the edges of the FOV. On the other hand, many more meteors can be captured with a wide FOV.

Nevertheless, the weak point in this approach is <u>time consuming</u> step by step analysis of the data and the lack of automated astrometry and orbit calculation procedures, which can be found in modern video meteor recording and analysis software like METREC.

THANK YOU!

QUESTIONS ?