Seeing Monitor Software

Installation and user manual

May 18th, 2015 revision

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1 Software installation

1.1 File copy

Just open the USB stick, and start **Setup_seeinMonitor.exe**, please follow instructions.

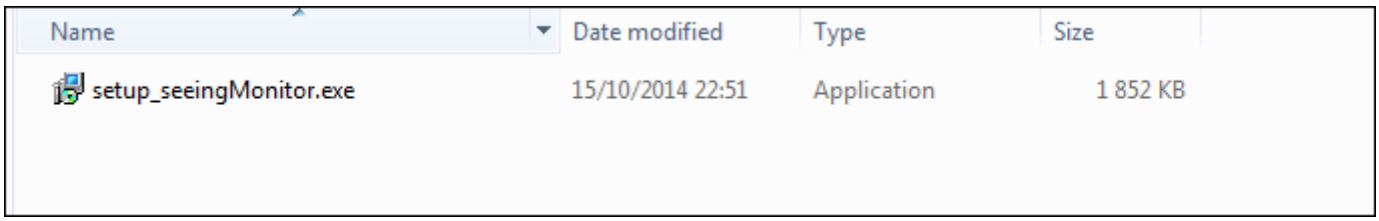


Fig. 1

Camera drivers must be installed and the camera shall be DirectShow compliant otherwise this software will not get images from the camera and will simply not work.

Important notice: this version of the software requires user/operator to attend the telescope the whole night. This is not a software that does all the process of starting up and running measurement the whole night and closing measurement session in an unattended fashion.

It is possible to overcome this, but please contact us for more information.

1.2 First time software startup and basic settings

The dongle key shall be present all the time when the software runs and of course, during startup.

On startup, here is how looks like the software.

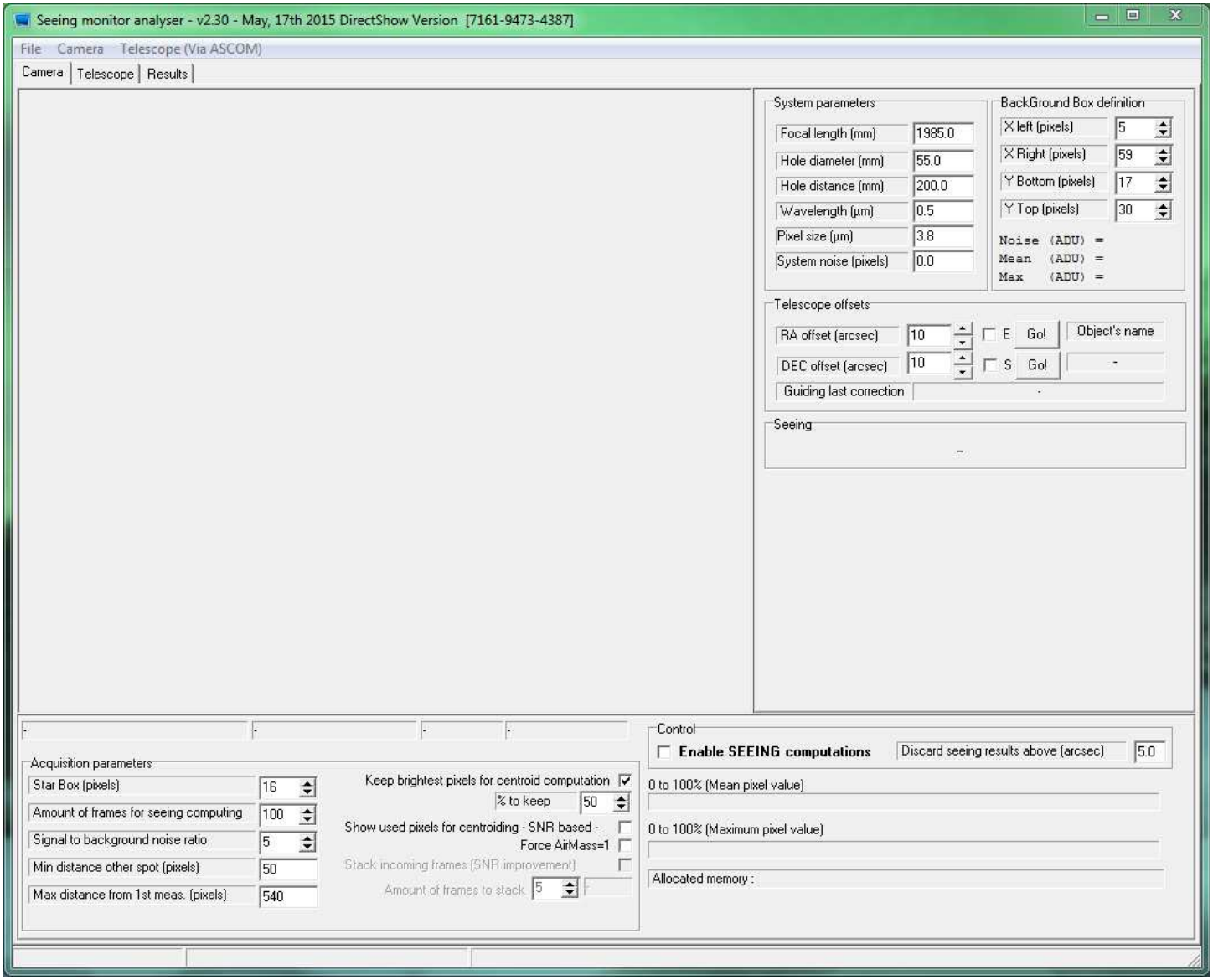


Fig. 2 *Main's software panels*

Set up the system parameters, as follows, according to your telescope, home diameter and separation.

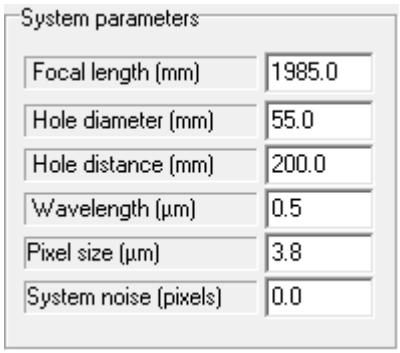


Fig. 3

It is strongly advised to get good measurement accuracy, to get a maximum sampling rate per pixel of your camera of 0.5 arcscec/pixel. In this documentation, a camera with pixels size of 3.75 µm and 1985 mm focal length has been used leading to sampling rate of 0.39 arcsec/pixel, which is a proper sampling rate for the experiment.

Then setup this group box with these figures, this is a small part of the image dedicated to compute noise and background level.

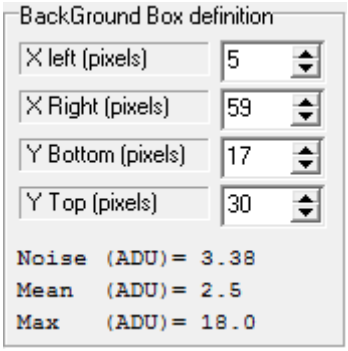


Fig. 4

To connect a camera follow this menu and all Directshow™ cameras that are recognized and operable in your system are listed here:

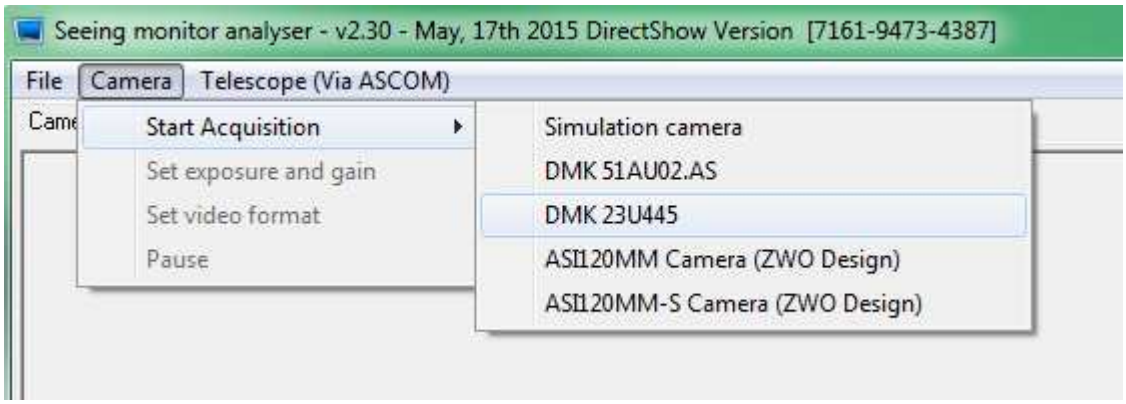


Fig. 5

Select the camera that see the two images of a star for seeing measurement.

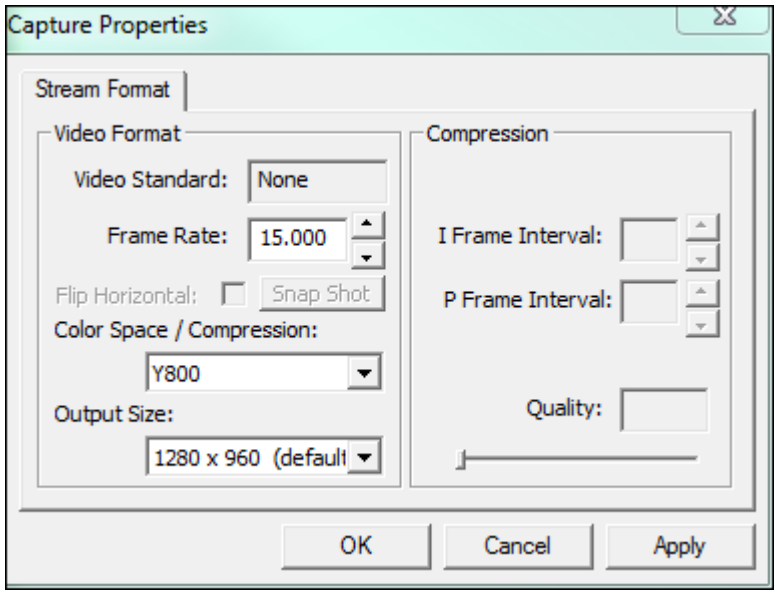


Fig. 6 *Directshow camera setup panel*

In **Capture Properties**, select monochrome codecs, such as Y800, and frame rate of 15 frames per second (fps), this is the highest available for this camera.

Measurements can be achieved up to 50 fps, and this is strongly advised not use not more than 20 ms exposure time, and set the highest frame rate possible. If longer exposures is used, seeing measurement might not be valid. So seeing measurement requires bright stars, such as magnitude 1 to 2, because of the 55 mm hole diameter and the very long F/ ratio (i.e. F/35 to F/50).

2 Hardware installation

2.1 Optical setup, pointing considerations

If the Alcor-System's mask has been purchased, on delivery the tunable prism are set so that the Prism performs a minimum deviation of the optical beam, and the two white arrow indicate the position of the minimum deviation.

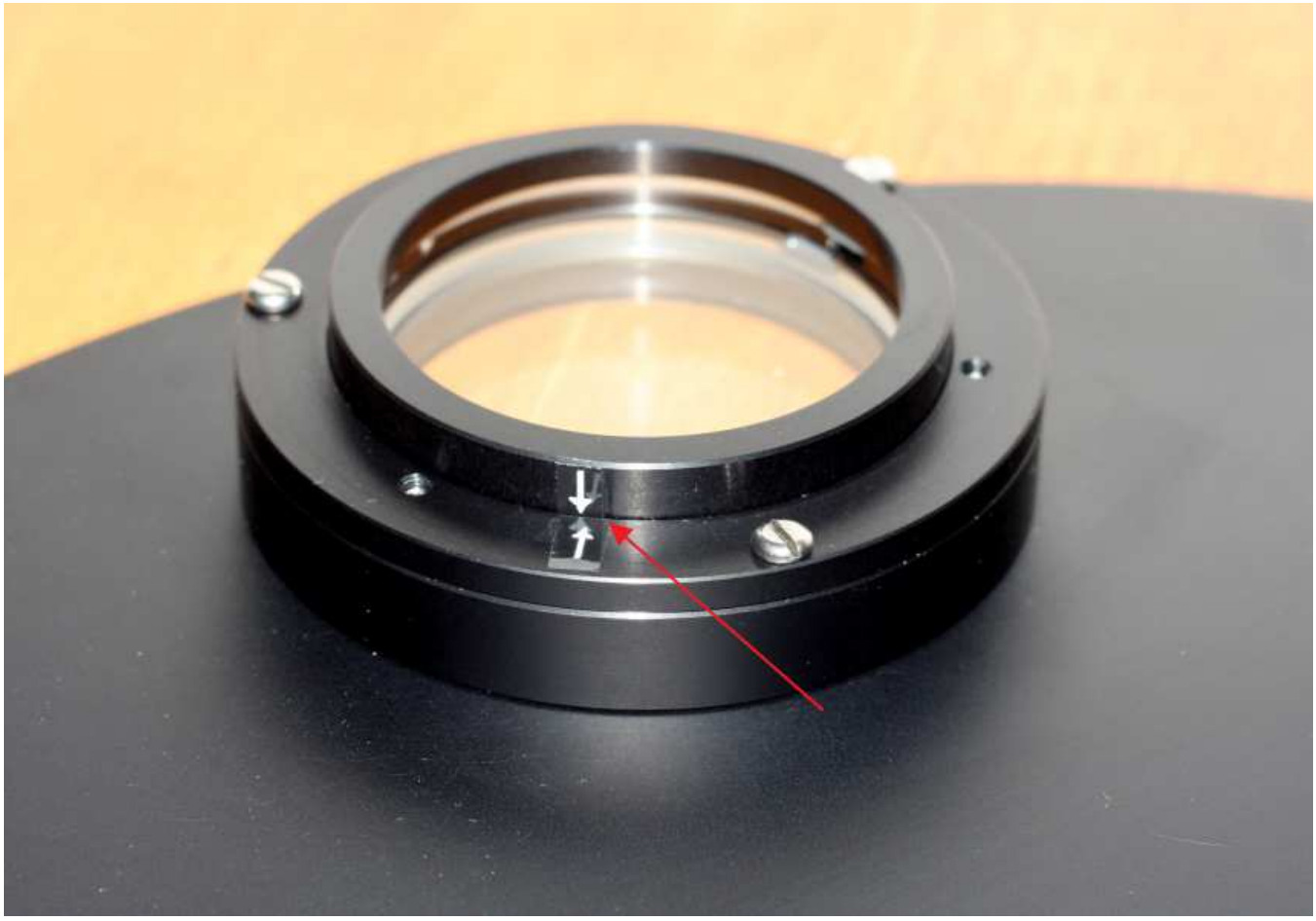


Fig. 7 *ALCOR SYSTEM deviation tunable prism*

The star separation can be increased/ decreased by un-screwing the three small crews (red arrows), and rotating the upper part of the prism's holder.

Fig. 8 *ALCOR SYSTEM deviation tunable prism : how to adjust beam deflection*

It is recommended to look at the image at the telescope to assess the star separation while rotating the prism.
Rotate in a very slow and smooth fashion.
Do not get the star image with too much distance, because it will quickly exits the field of view of your camera, and the portion of star that is deflected will be too much distorted (spectral elongation).

In the next image star separation is 200 pixels, so this is 1arcmin and 18 arcsec of separation. This is a good setup.

Since the field of view of this camera is 8.3' x 6.2', good pointing accuracy of the mount shall be achieved (so meaning good polar alignment and mount with pointing model enabled).

Also good focus has to be performed so that the star have the sharpest/smallest shape, and most of the time the airy disk is visible on good seeing conditions, such as follows with a 10'' telescope and 1982 mm focal length.

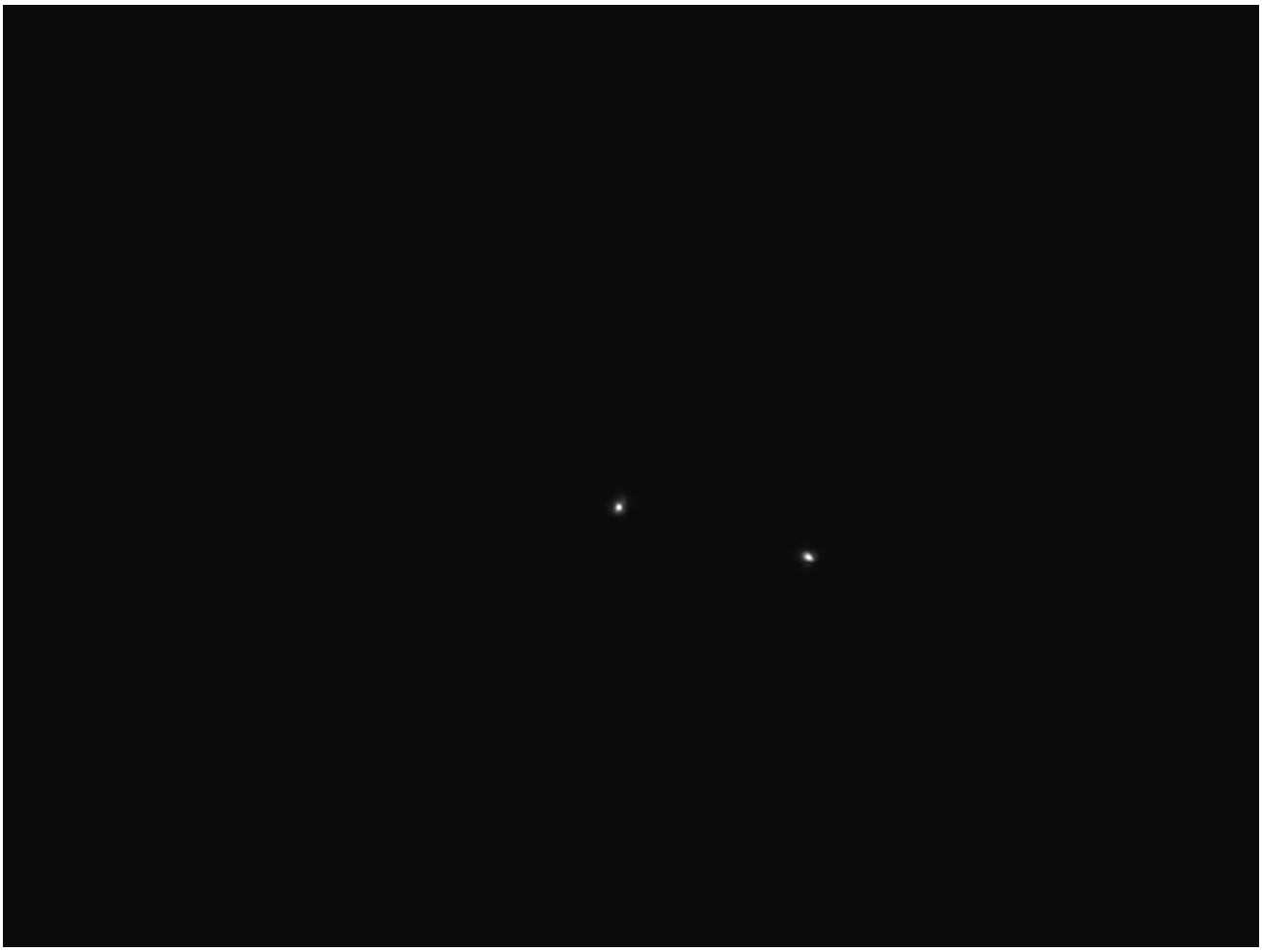


Fig. 9 *Two images of a single star*

Fig. 10 *Complete mask on top of a 10'' RC telescope*

Pointing requirements to get the star to be used for measurement, can be difficult/challenging to center in the camera. Either a flip mirror can be used or setting up an electronic finder on telescope piggy back. This can be used such as shown hereafter. This is an image from a 1/1.8'' Sony CCD camera combined with a 100 mm focal length lens.

Fig. 11 *Camera and 100 mm focal lens on piggy-back of the same 10'' RC telescope from previous picture*

This provides a field of view of 4°x3° and in this case, the red arrow indicate where the user must put the star to get the double star image into the seeing monitor measurement camera that has a much smaller field of view. This is achieved with the PRISM+ software suite.

The star visible in the next image is 14 Gam Lyra.

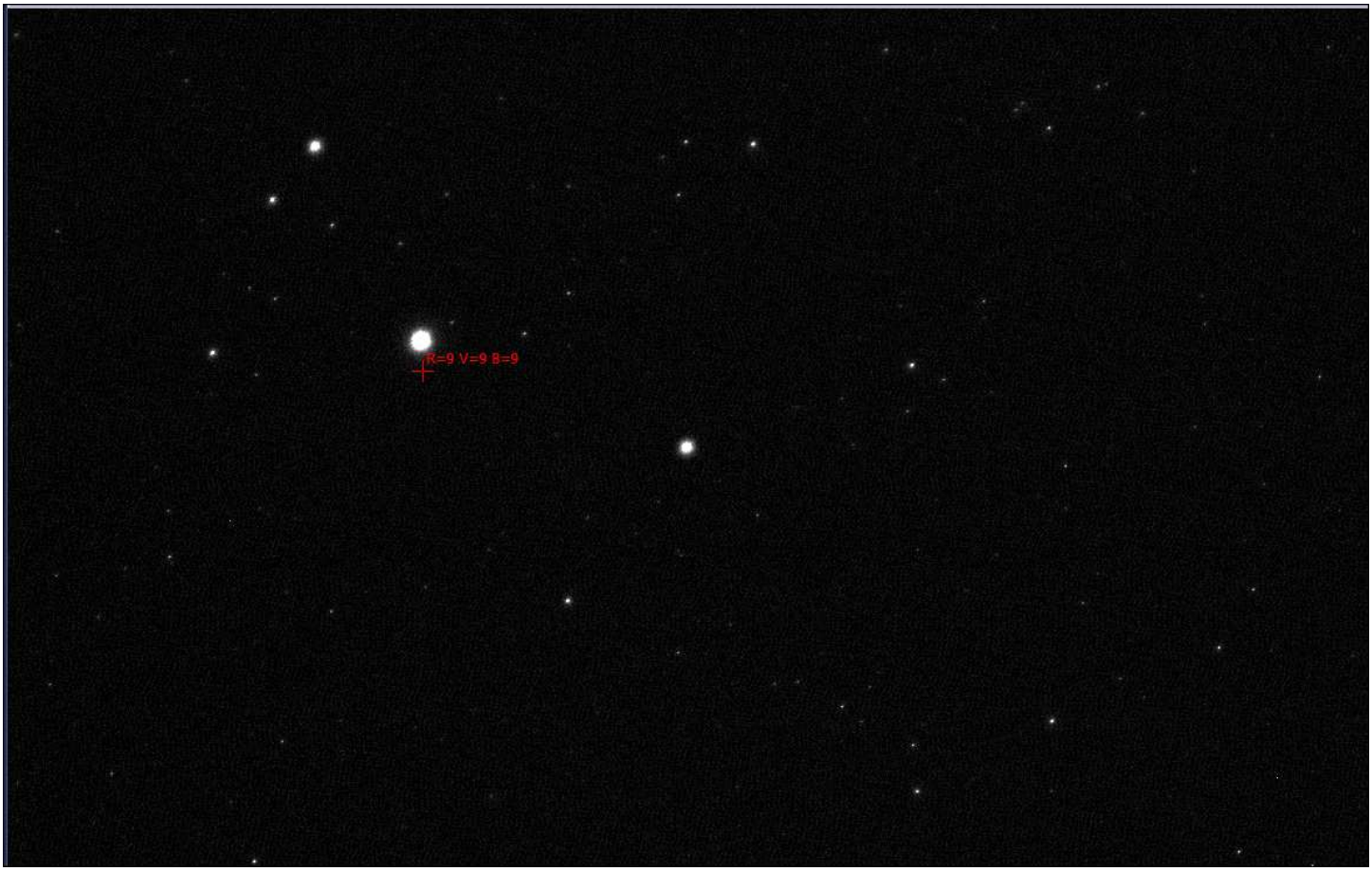


Fig. 12 *Example of electronic camera viewfinder*

This is a magnitude 3.2 star and is the faintest star that can be used for a 55 mm diameter hole and 1982 mm focal length. The exposure time is 1/65s and gain set to the maximum of the camera.

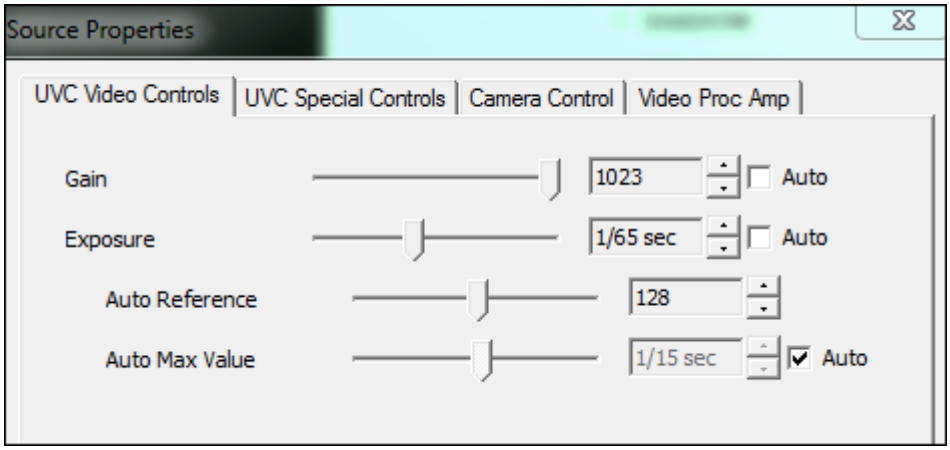


Fig. 13

So, do not use fainter stars than magnitude, say 2.5. Since there are plenty of those, it is possible to get one. The software does air mass correction to display zenith seeing, but selected star must always be above 45° of elevation with respect to the horizon.

Another way to center the star to measure, is to use a flip mirror, an eyepiece, and a viewfinder that is aligned properly to the telescope.

Fig. 14 *Flip mirror and eyepiece for field centering*

Finally do not forget to have a mount able to track accurately the star. Typically, in a field of 8x6 arcmin, the "double star image" shall stay inside the field for half of an hour. The software can track and correct the mount if your mount is ASCOM compliant (see section below in this documentation).

2.2 First steps

Once the star (and its deflected image) is selected and centered, seeing measurements can start.

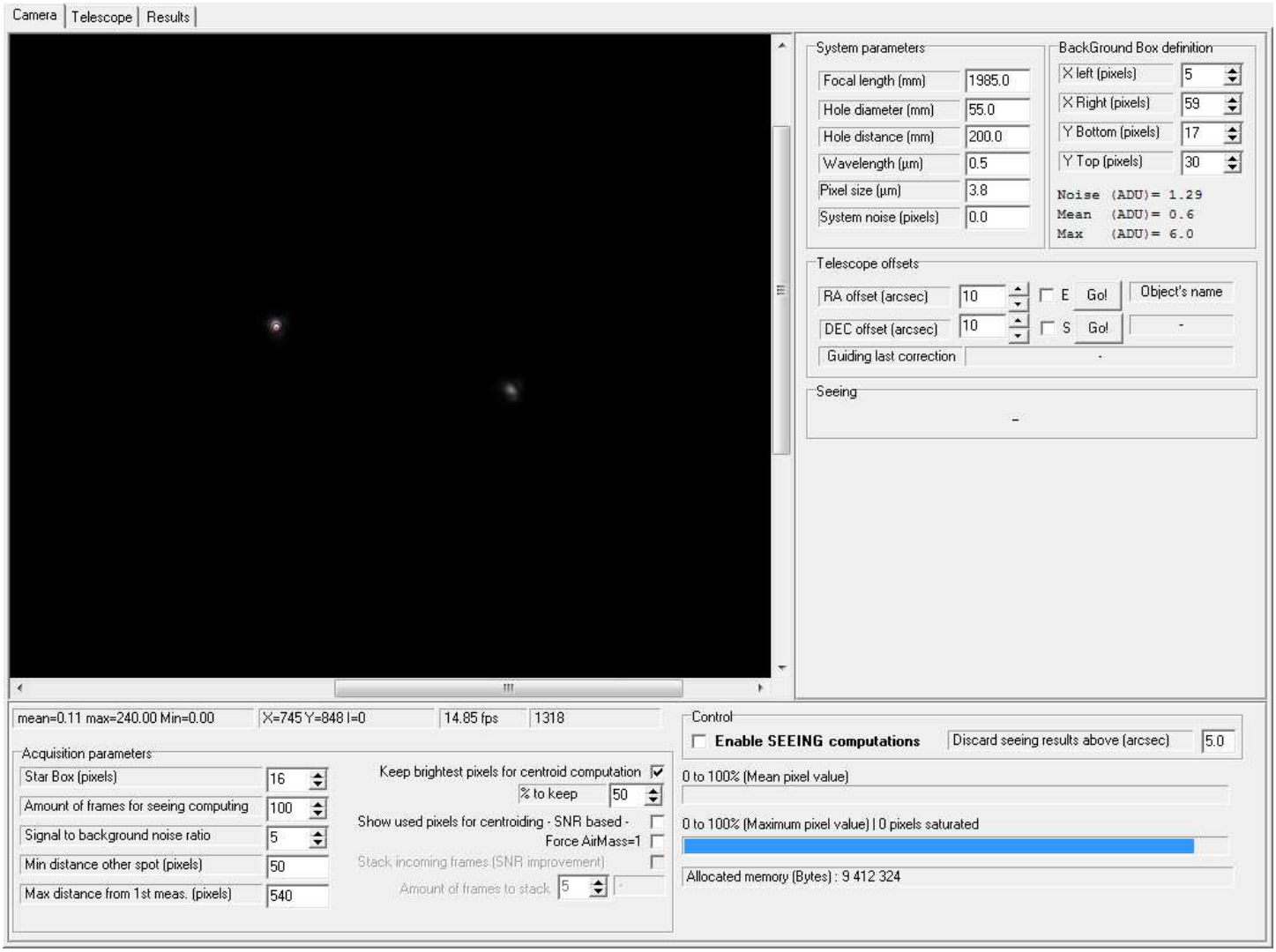


Fig. 15 *Checking star saturation level*

First, pay attention that the exposure time is not too high, and that the two dots does not saturate. Performing measurement with saturated star images will lead to inaccurate seeing measurements, so this is an important point.

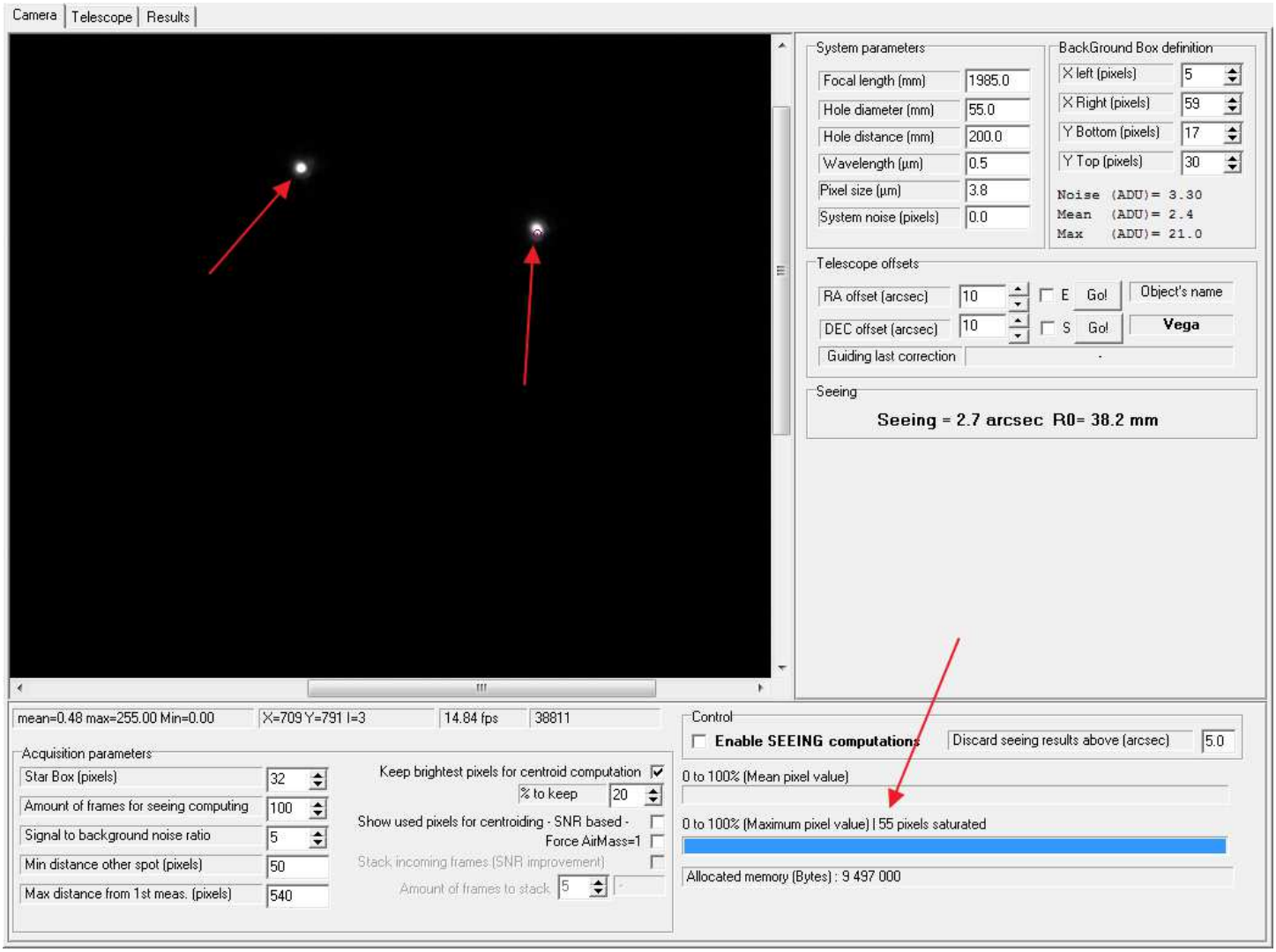


Fig. 16 *Checking star saturation level*

The blue bar indicates the dynamic range used and the number of saturated pixels. Keep this value to 0 saturated pixels, (or sometime can be 1 to 5 because of scintillation).This is achieved by changing the exposure time and/or the gain of the camera.

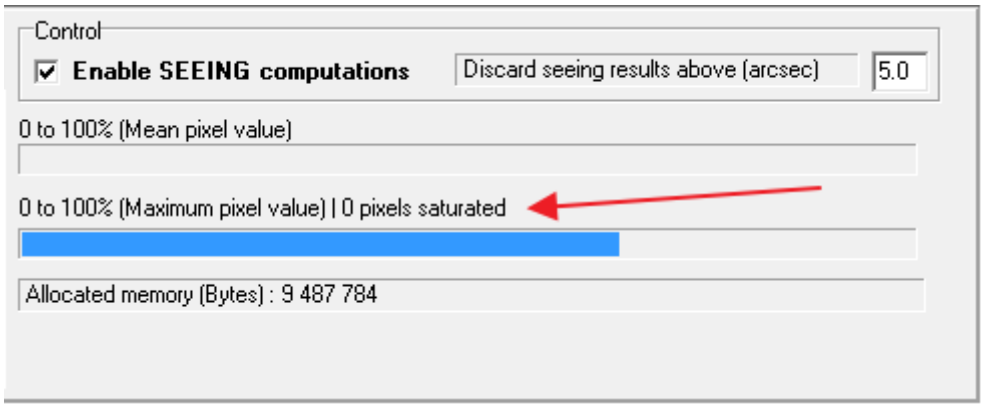


Fig. 17 *Checking star saturation level*

Then the seeing measurement can be turned on.

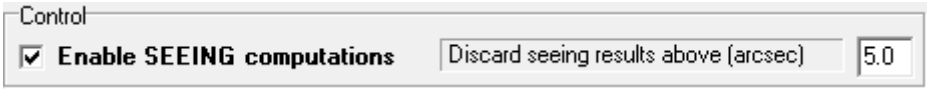


Fig. 18

If the shape and the light level of the star images is correct, a red and yellow square appear. These square defines where the centroiding is going to take place.

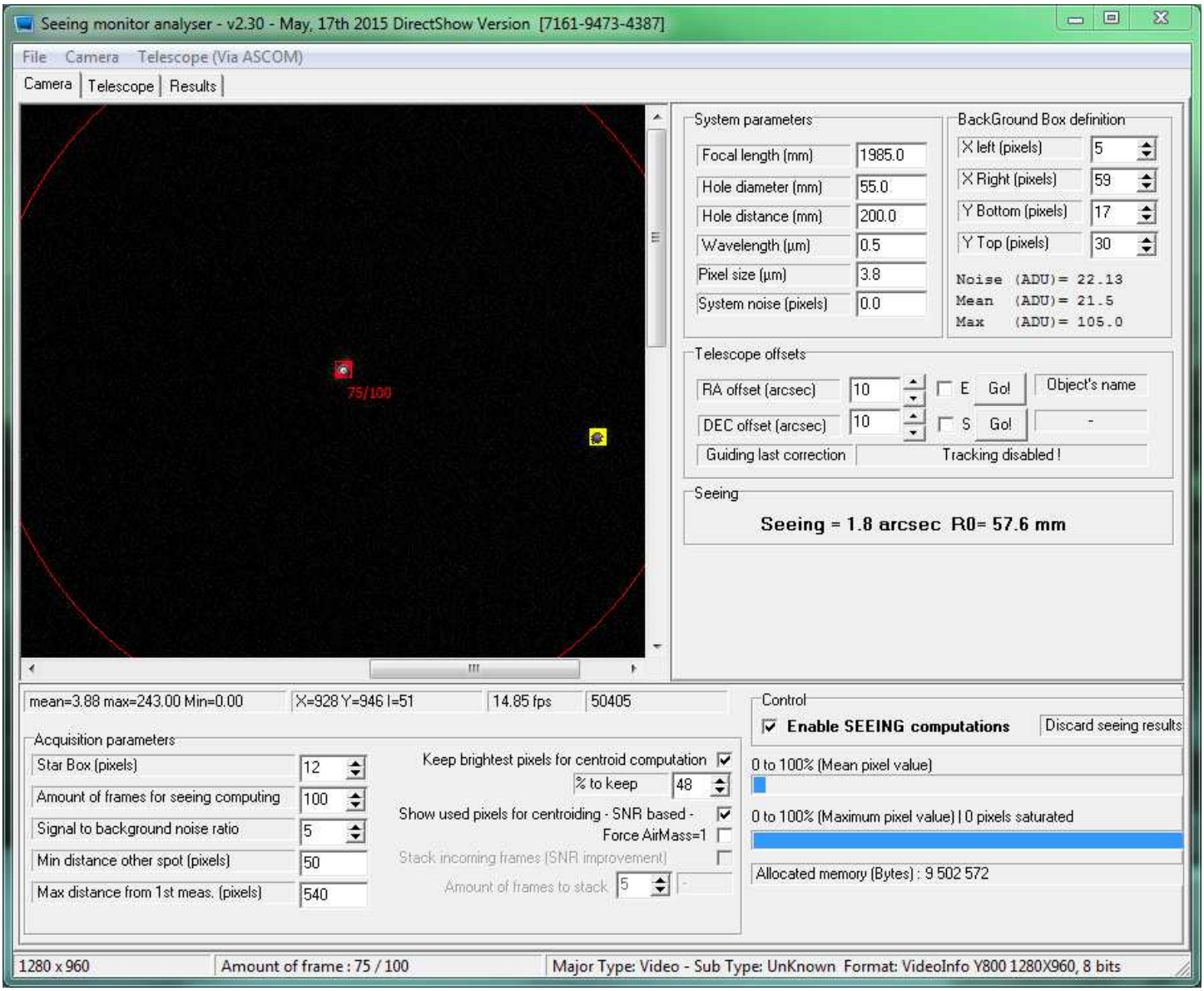


Fig. 19 *Running Software*

It is possible to adjust the size of the box (**Star Box** field), and this must be adjusted so that all the light of star is inside the square and not too large to border the star shape. This is an important figure, and if set too large can impact measurement by lowering seeing figures!

The amount of frames to be acquired to perform valid seeing measurement shall be set to 50 at least, even 100 to 500 can be selected. The frame rate of the camera is so fast nowadays, that this is not an issue anymore. If the number of frame is too low, measurements will exhibit a lot of noise.

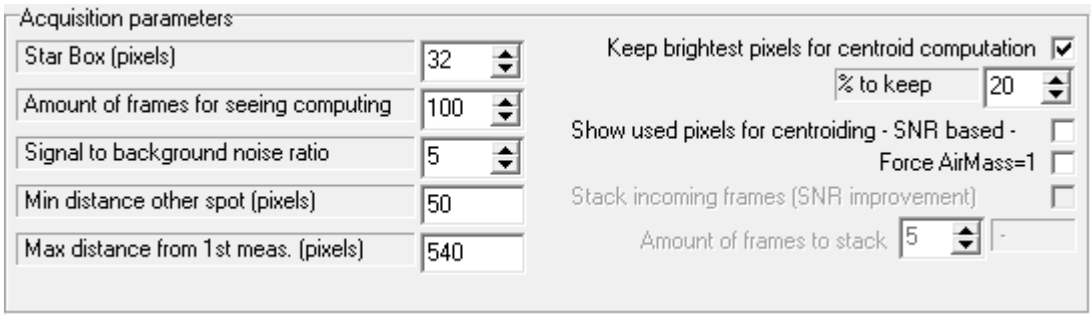


Fig. 20 *Main software setup for star image extraction and centroiding*

Leave **signal to background noise ratio** to 5. The large red circle is defined by the 540 pixel radius in this documentation, tells, that nothing outside this circle will be searched as the second image of the star. So select a diameter to enclose the two images of the star. The **Min distance**, set that nothing will be seek inside as a second image of the star. Those figures are not paramount for the experiment and are just to avoid the software picks up spurious spots from cosmic ray impacting the sensor, for instance.

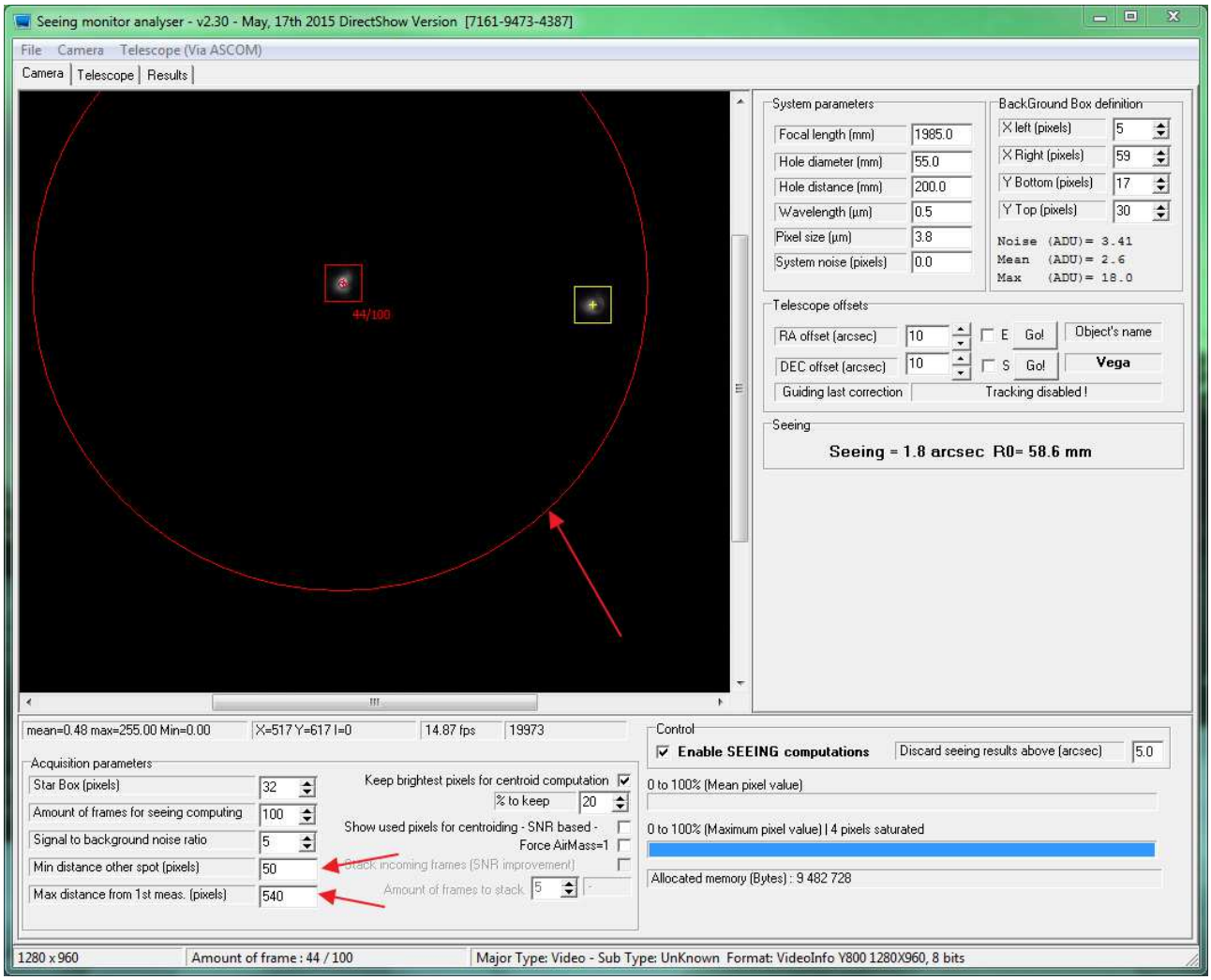


Fig. 21 *Inclusion / exclusion areas*

Another powerful feature, is to keep only the brightest pixels in the box, making centroiding more robust. Also the used pixel, that are above the Signal to background noise ratio" can be displayed.

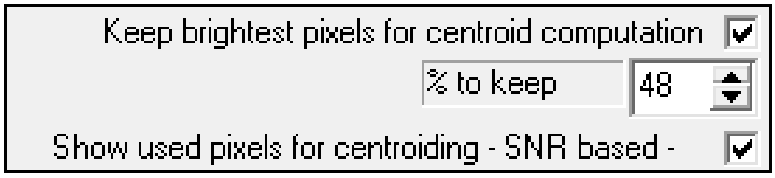


Fig. 22 *Enhancing centroiding*

Colored pixels are not unused pixels for centroiding.

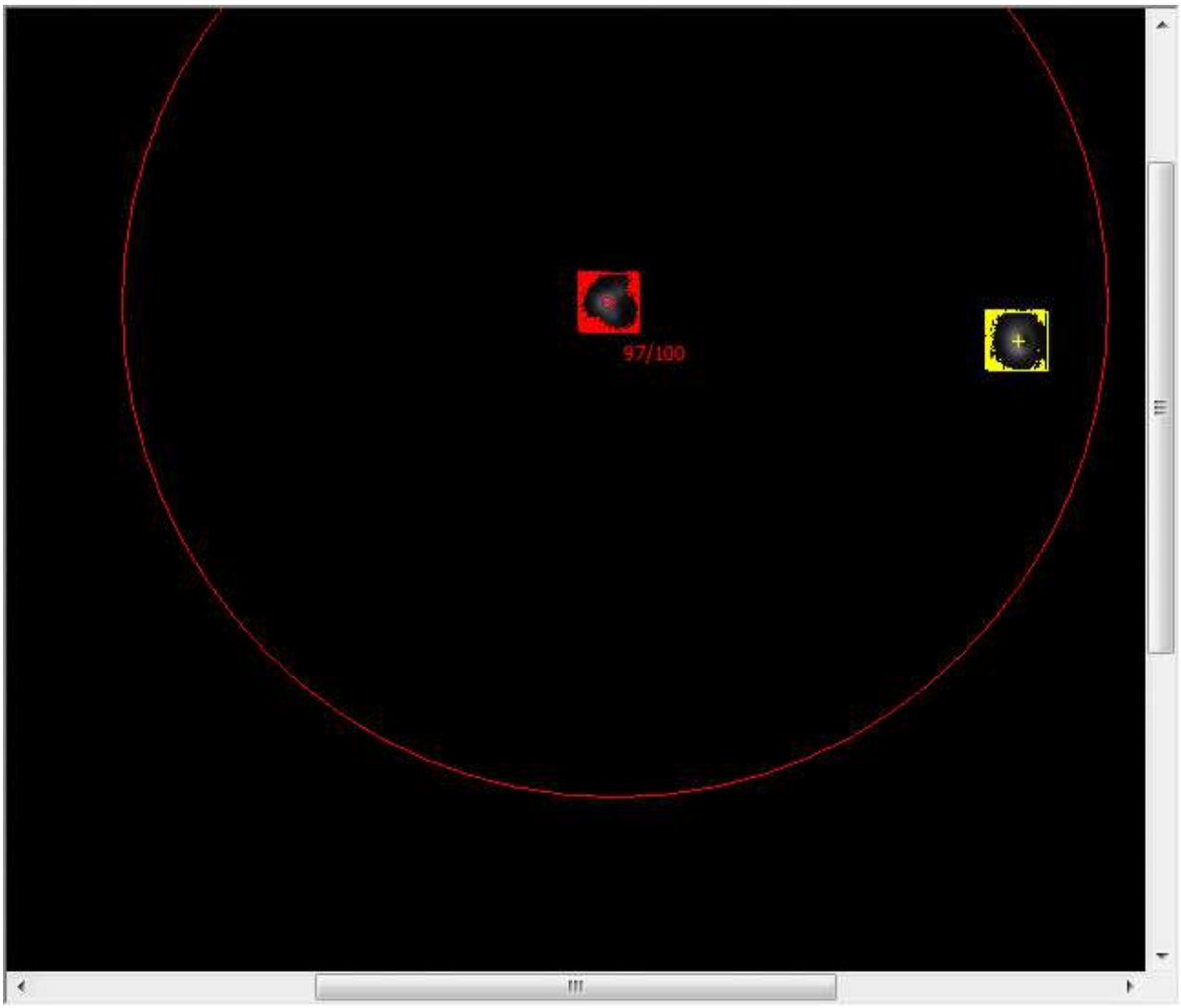


Fig. 23 *Displaying unused pixels*

The seeing figure is computed at the star elevation, and then computed as if it was at zenith position according to the current star elevation and air-mass by the means of a mathematical formula.

The telescope tab shows list of stars sorted from highest elevation to lowest elevation.

If the telescope's mount is not an ASCOM compliant mount and/or this software not connected to it, the user MUST have to click on the star' list to tell the software which star is been used for the measurement, and thus compute the proper air mass and perform zenith correction.

Say, the telescope is aimed at GAMMA CAS, the user shall click on GAMMA CAS star name on the list:

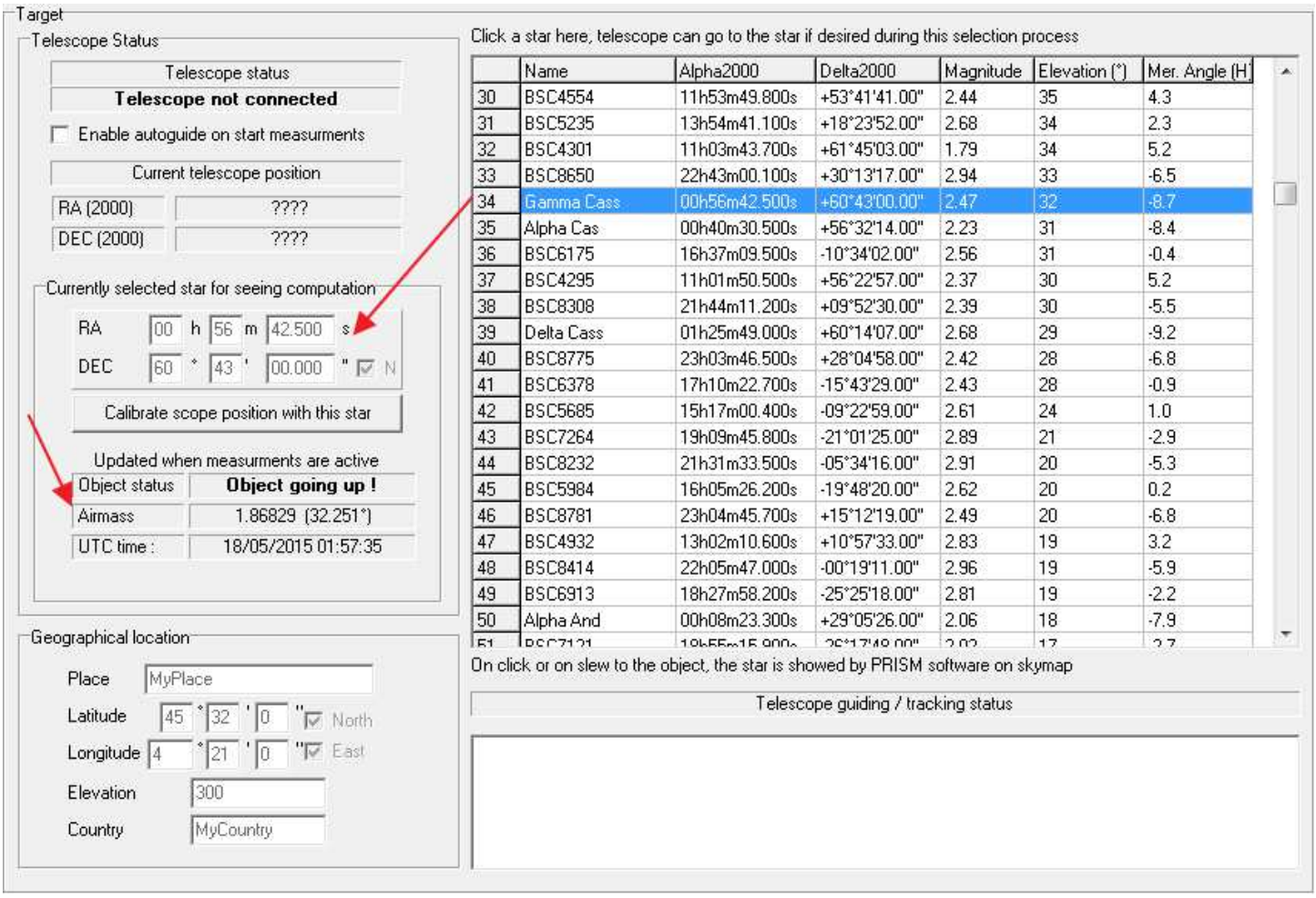


Fig. 24

The correct air mass will be computed accordingly to the star used for measurement. Warning, selecting a new star will delete all previous measurements from the result plot.
Otherwise, the user can check the “Force AirMass=1” and the software will not do this air mass correction, but awareness has to be about this feature!

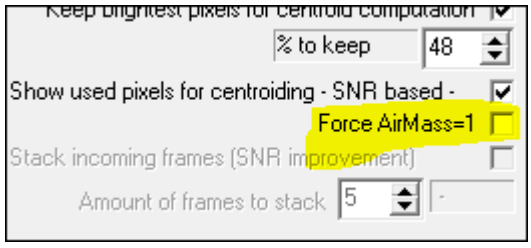


Fig. 25

After a while, measurement curve builds up, and data can be saved into a text file, or plot can be pasted …

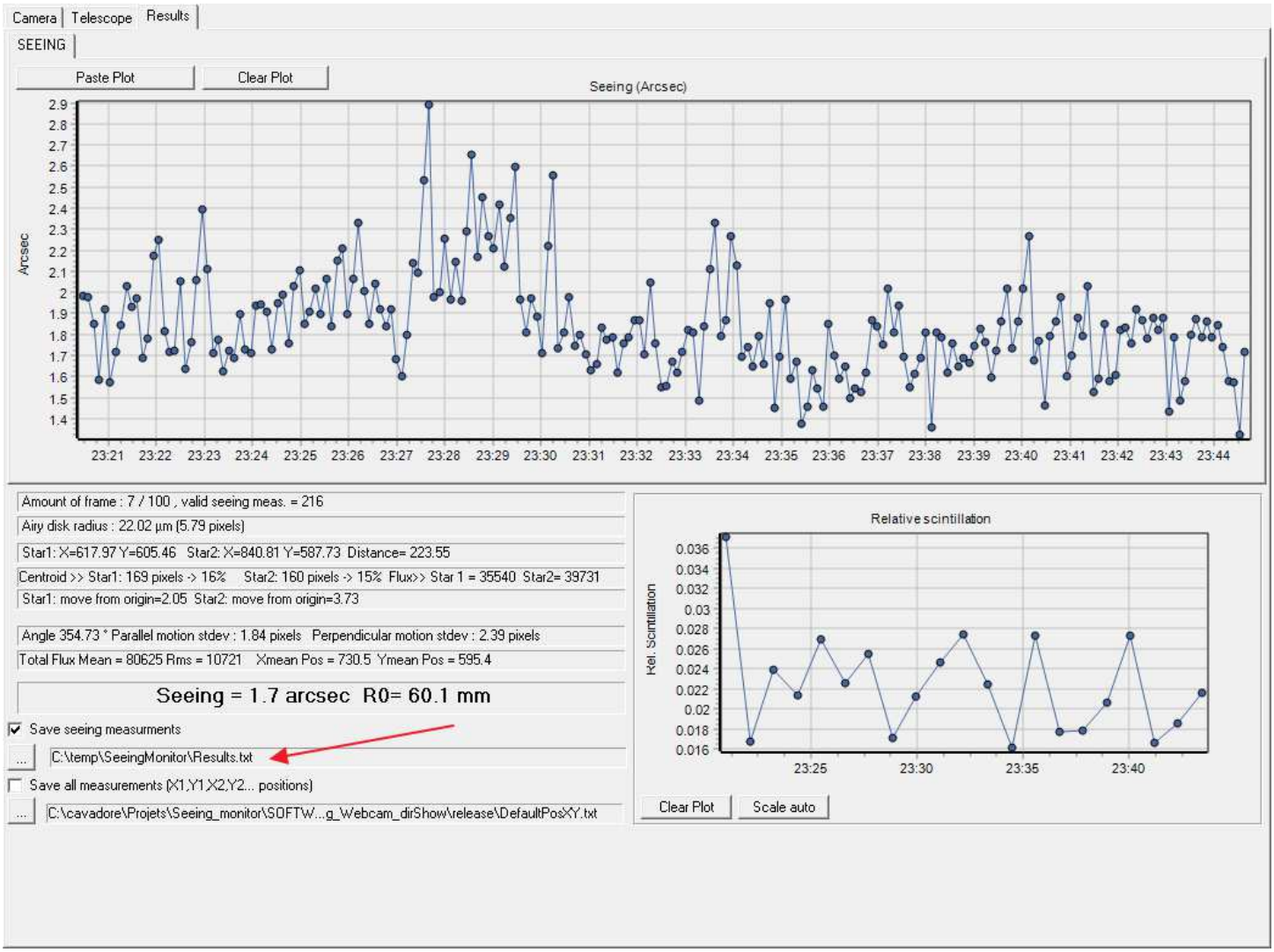


Fig. 26

After some hours, actual seeing fluctuation can be seen.

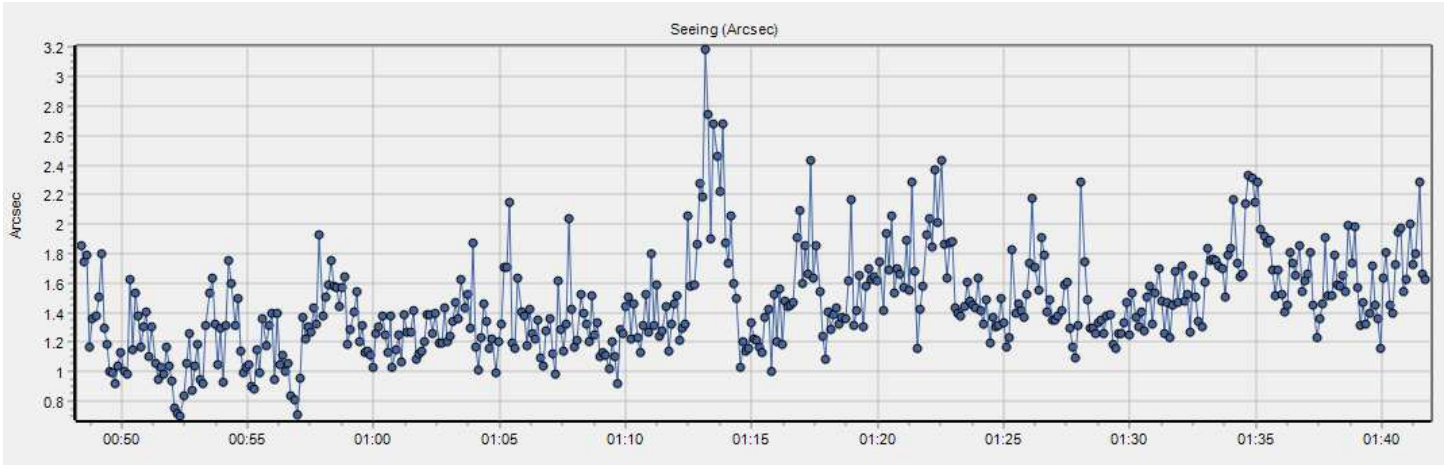


Fig. 27 *Resulting seeing plot*

The plot can be moved by right click and pan, can be zoomed and un-zoomed by selecting part of it with mouse right and left buttons.

3 Advanced operation with telescope controls using ASCOM

This is a very convenient feature, so we recommend to use an ASCOM compliant mount to operate the seeing monitor software with.

This will allow this software to interact with your telescope mount, for slewing toward stars to be used for seeing measurement, and perform autoguiding, avoiding the pair of star image to escape from the field, and causing measurement to halt.

Please check out here for more information about ASCOM : http://ascom-standards.org/

Your mount must be ASCOM capable and the ASCOM platform be installed as well as the mount ASCOM driver.

First setup ASCOM to your mount model

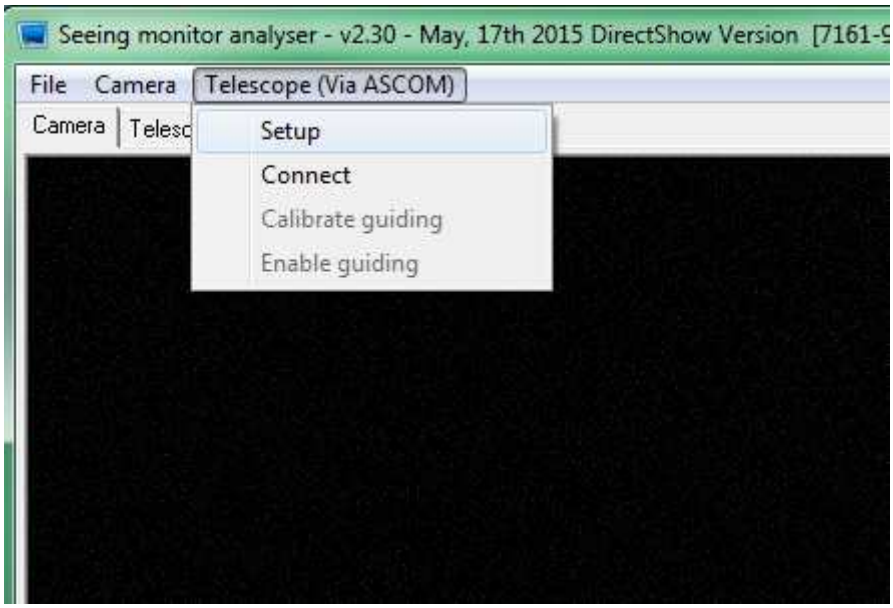


Fig. 28

In this sample the ASCOM mount system is MCMT II, but can be Astrophysics, ASA, Paramount, 10micron … mount. Select "**Properties**", set the right parameters for your mount and close this window.

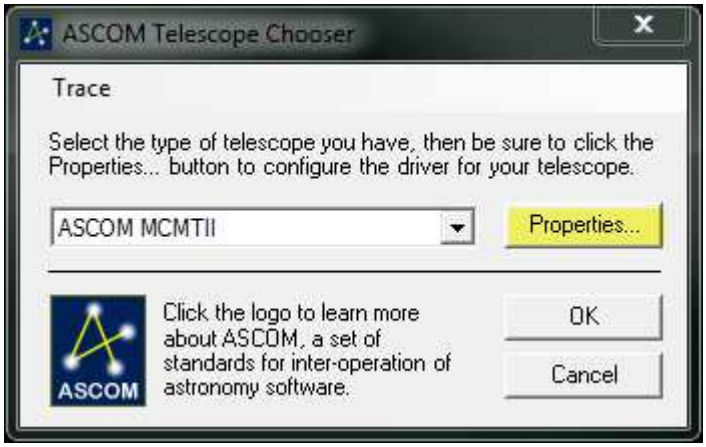


Fig. 29

Then do "**Connect**"

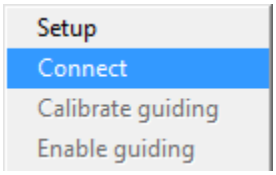


Fig. 30

The telescope status group box changes to "**Tracking**"

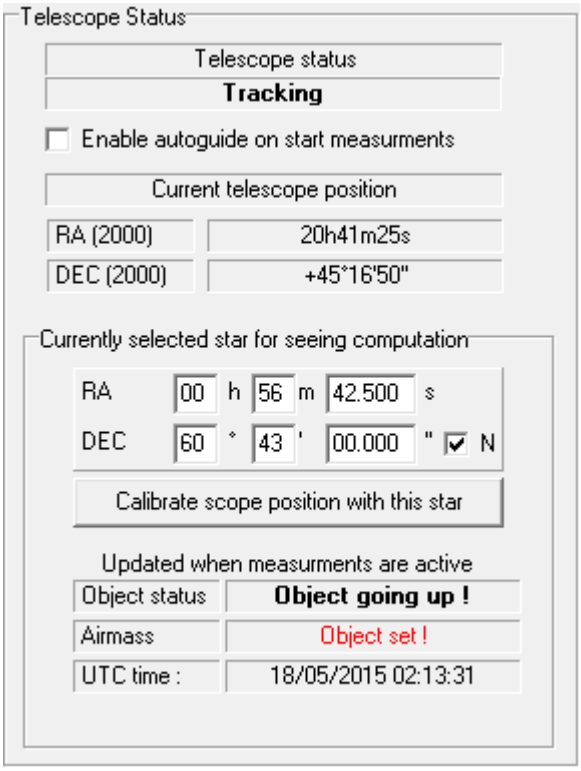
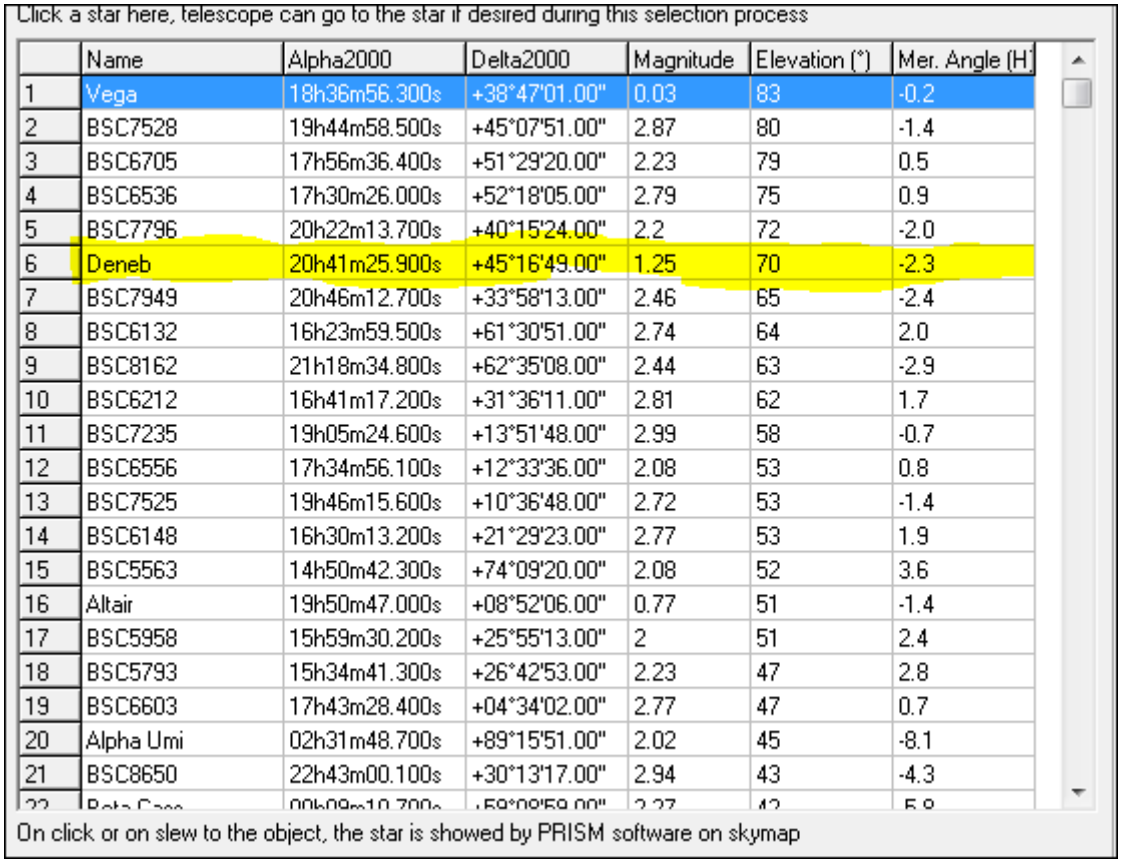


Fig. 31

Now, by clicking the star list, the telescope can slew to the star that has been selected. Warning, this is up to the user to take care of mount alignment and mount slewing performance to have the image of the two star inside the field of the camera. Either use an electronic camera finder, as explained above, or an eye finder to correct mount position to get the star you plan to measure.



	Name	Alpha2000	Delta2000	Magnitude	Elevation (°)	Mer. Angle (H
1	Vega	18h36m56.300s	+38°47'01.00"	0.03	83	-0.2
2	BSC7528	19h44m58.500s	+45°07'51.00"	2.87	80	-1.4
3	BSC6705	17h56m36.400s	+51°29'20.00"	2.23	79	0.5
4	BSC6536	17h30m26.000s	+52°18'05.00"	2.79	75	0.9
5	BSC7796	20h22m13.700s	+40°15'24.00"	2.2	72	-2.0
6	Deneb	20h41m25.900s	+45°16'49.00"	1.25	70	-2.3
7	BSC7949	20h46m12.700s	+33°58'13.00"	2.46	65	-2.4
8	BSC6132	16h23m59.500s	+61°30'51.00"	2.74	64	2.0
9	BSC8162	21h18m34.800s	+62°35'08.00"	2.44	63	-2.9
10	BSC6212	16h41m17.200s	+31°36'11.00"	2.81	62	1.7
11	BSC7235	19h05m24.600s	+13°51'48.00"	2.99	58	-0.7
12	BSC6556	17h34m56.100s	+12°33'36.00"	2.08	53	0.8
13	BSC7525	19h46m15.600s	+10°36'48.00"	2.72	53	-1.4
14	BSC6148	16h30m13.200s	+21°29'23.00"	2.77	53	1.9
15	BSC5563	14h50m42.300s	+74°09'20.00"	2.08	52	3.6
16	Altair	19h50m47.000s	+08°52'06.00"	0.77	51	-1.4
17	BSC5958	15h59m30.200s	+25°55'13.00"	2	51	2.4
18	BSC5793	15h34m41.300s	+26°42'53.00"	2.23	47	2.8
19	BSC6603	17h43m28.400s	+04°34'02.00"	2.77	47	0.7
20	Alpha Umi	02h31m48.700s	+89°15'51.00"	2.02	45	-8.1
21	BSC8650	22h43m00.100s	+30°13'17.00"	2.94	43	-4.3

Fig. 32

A message is displayed to warn the user that the telescope will slew to this location.

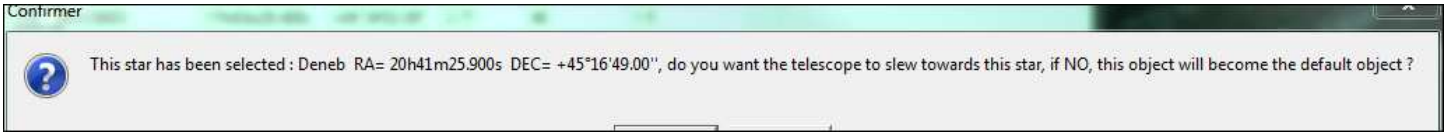


Fig. 33

To be able to perform guiding, the user needs to select "**Calibrate Guiding**"

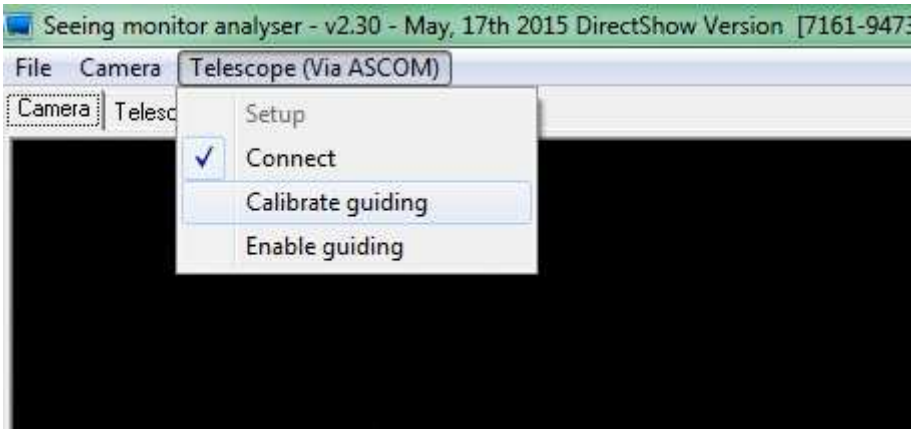


Fig. 34

A warning message is displayed, remove the two holes mask, or hide one hole.

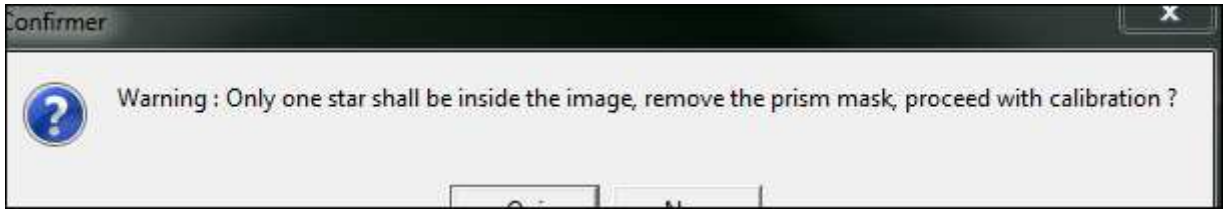


Fig. 35

Then ONLY one image of the star shall be visible to perform guiding calibration

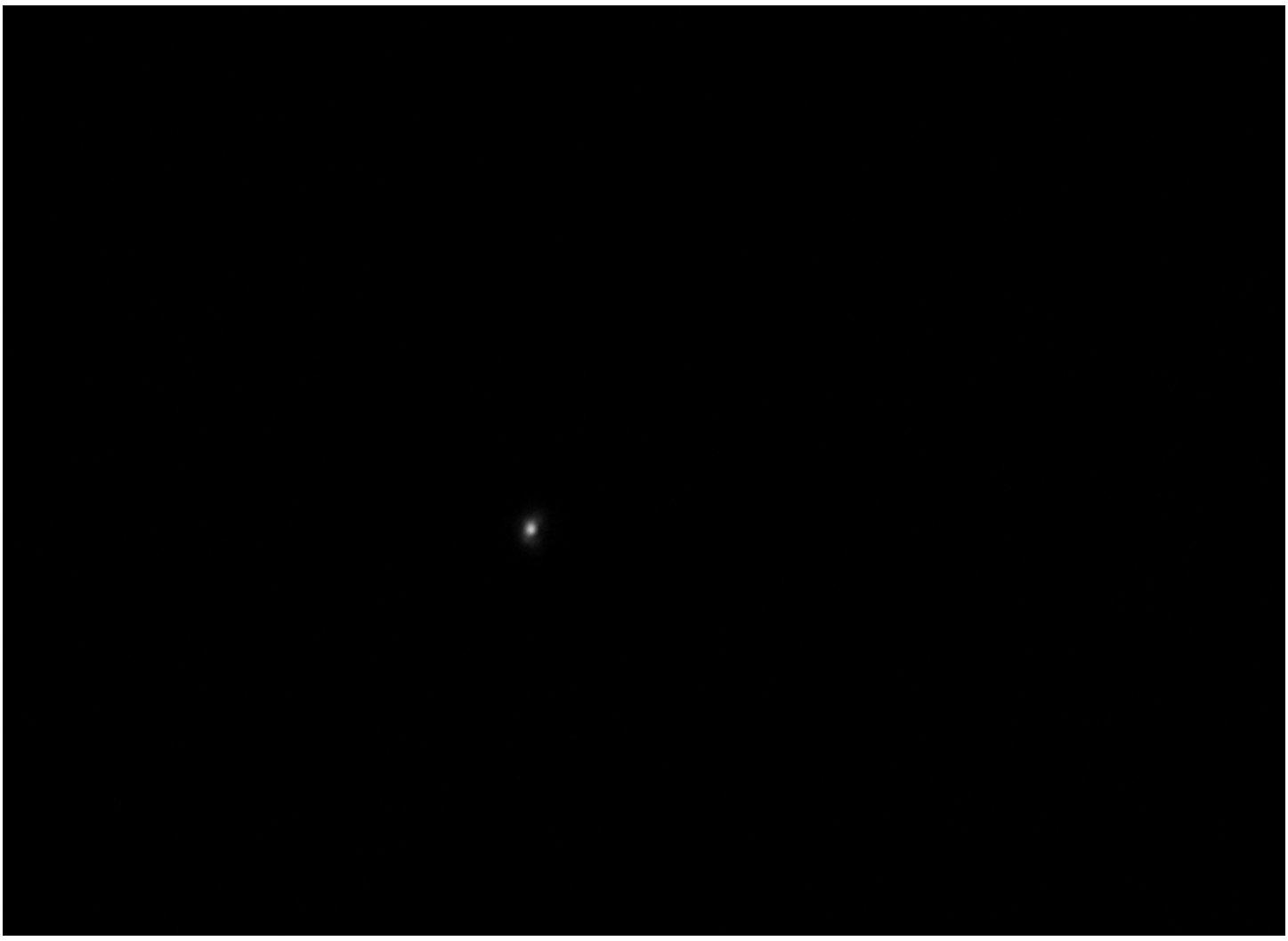


Fig. 36 *Single image of a star required for calibration*

Then enter calibration parameters, adjust time in seconds so that star moves by 200 to 500 pixel without exiting the image frame. ASCOM mount must support PULSEGUIDE capability. Check your mount user manual.

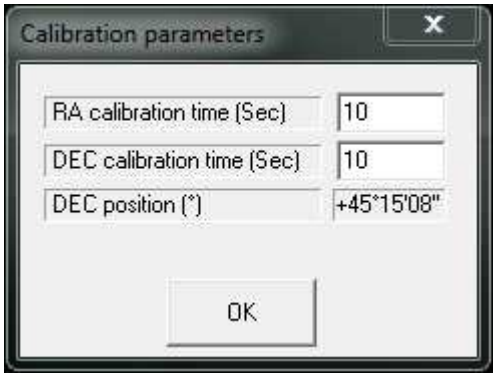


Fig. 37

Calibration takes place, and the star moves following a square or polygon shape.

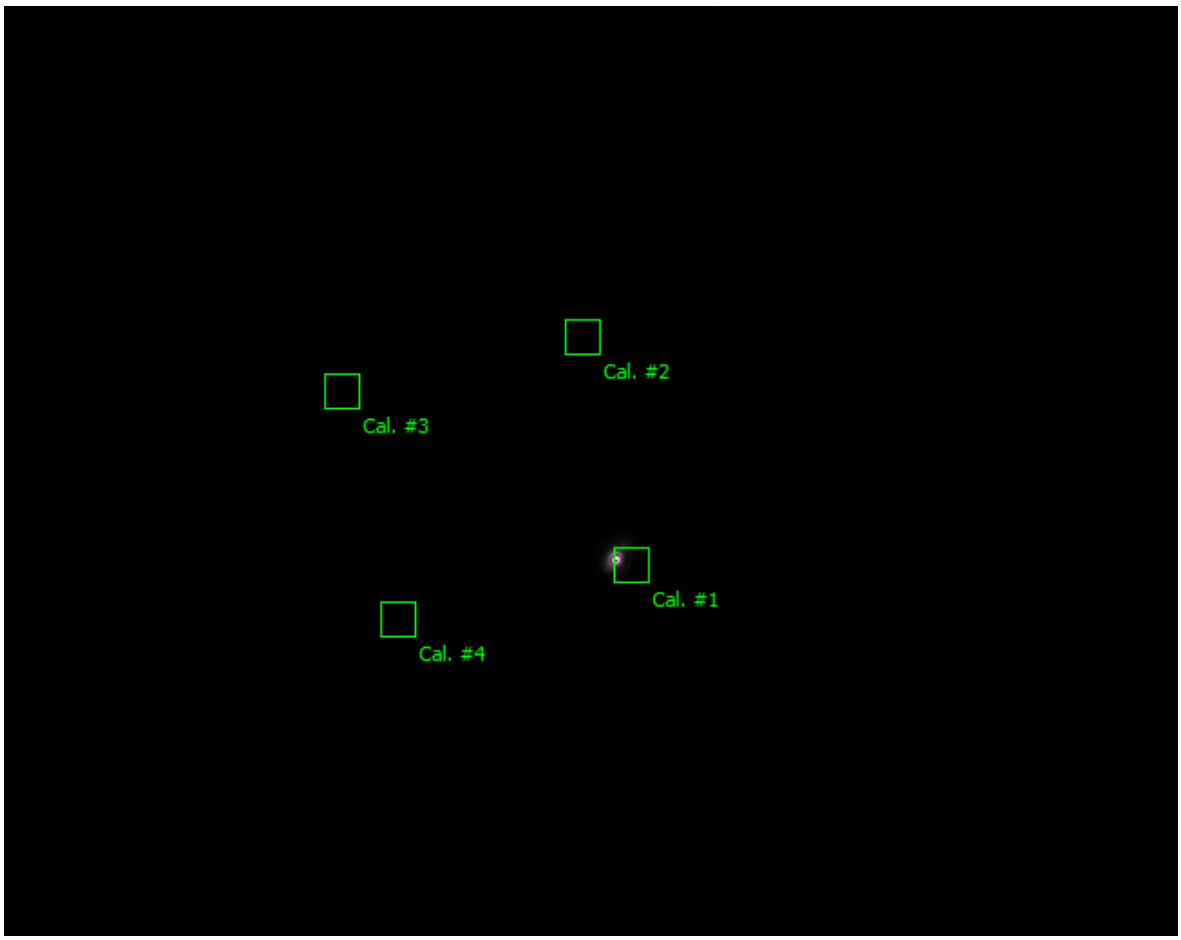


Fig. 38 *Guiding Calibration sequence*

Once completed a message pops up.
If successful the guiding can start by just checking this menu item.

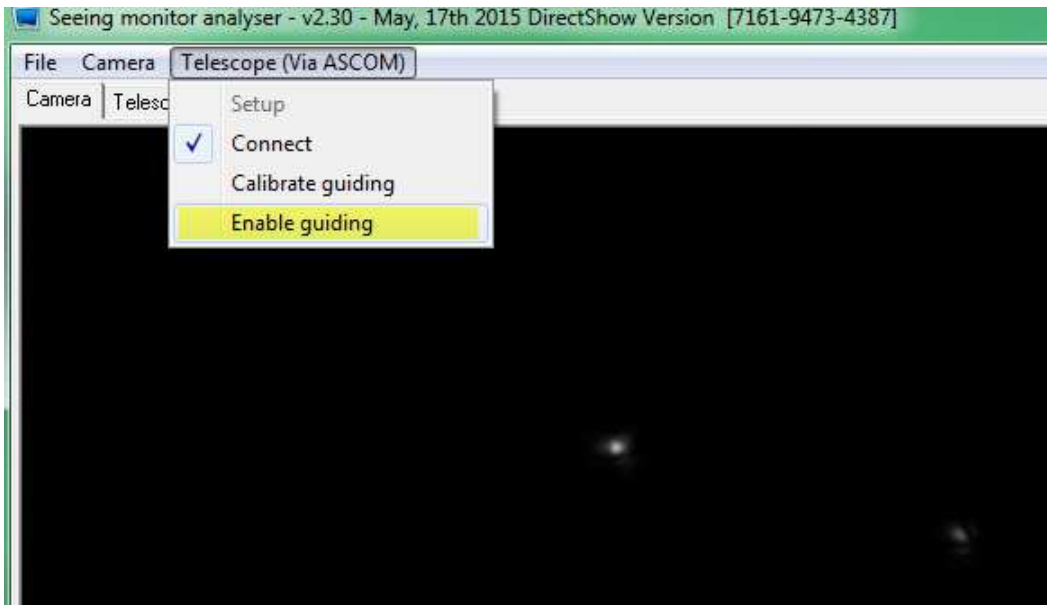


Fig. 39

During the measurement, a green indicator is displayed, the circle be the reference position and the line be the guiding error vector to be compensated.

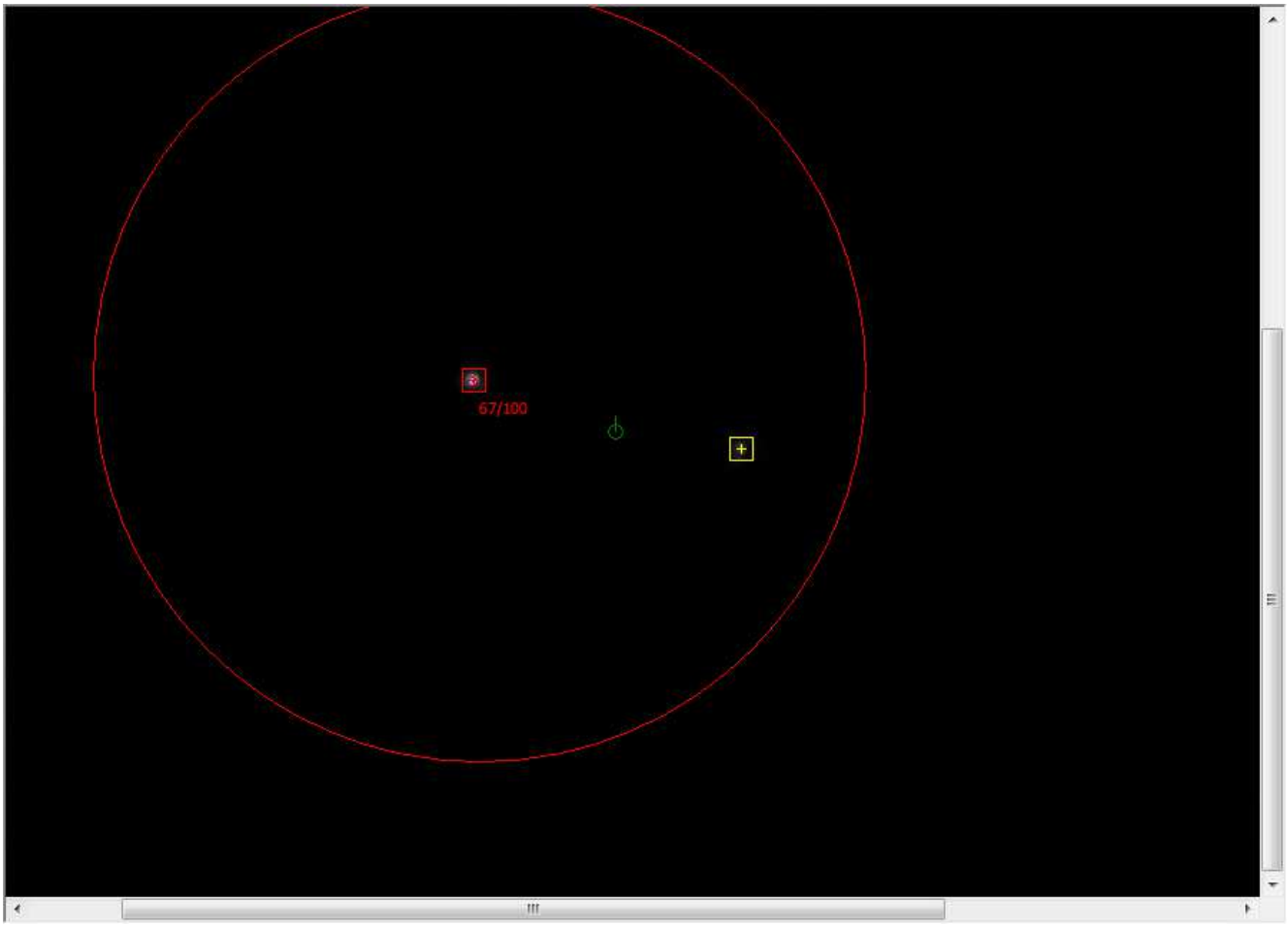


Fig. 40 *Guiding while measuring seeing*

If coming back to the telescope's tab, the status changes to "Guiding" and some guiding information is provided below the star list.

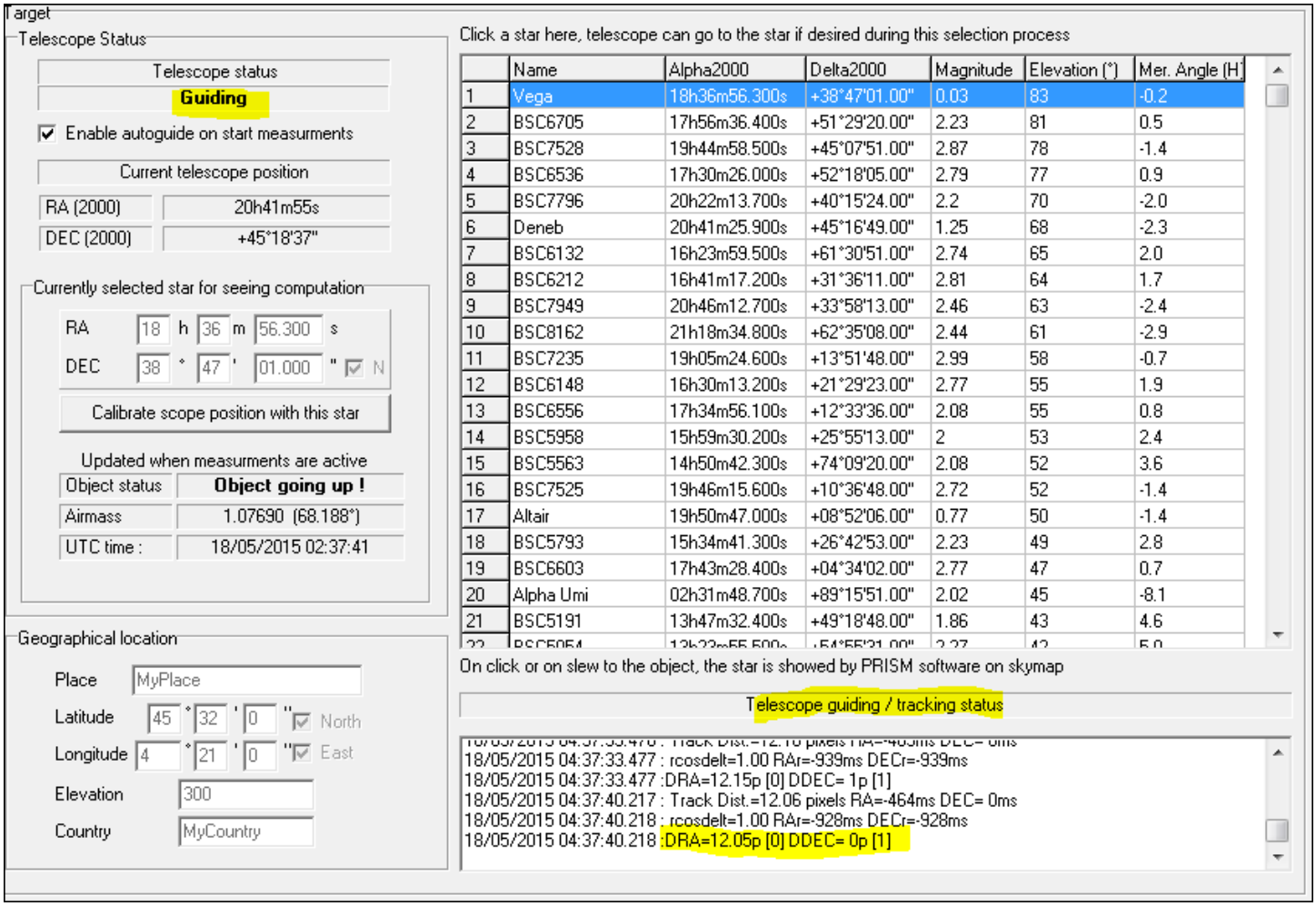


Fig. 41 *Guiding information*

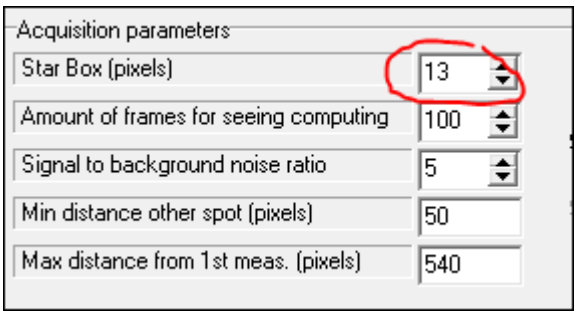
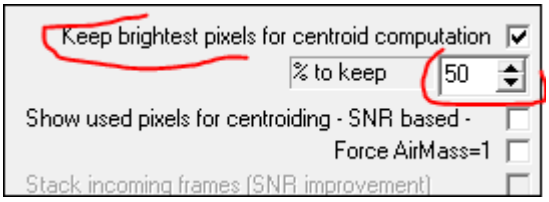
4 Troubleshooting

This will provide some hints about trouble shooting the system in case of failure to get seeing measurements.

Issue	There is a very significant signal level difference between the star and the prism deflected star image.
Cause	This can be due by using a prism that has no anti-reflection coating or dew can form into the prism's surface
Remedies	ALCOR-SYSTEM sells tunable prism set that has anti reflection coating or use an air dryer to remove dew
Issue	No seeing figure can be computed, the red and yellow square cannot be seen around the two images of the star.
Cause	Signal level is too low, or star shape is too distorted or fuzzy
Remedies	Increase exposure time and gain

	or perform a better focus, or be sure about the prism optical quality or check that not dawn or dusk is preventing from seeing stars

Issue	Measurement halts, and the two images of stars disappear after a while
Cause	Mount polar alignment is poor, or sidereal speed rate are
Remedies	Improve mount polar alignment, or perform tracking with an ASOM compliant mount or check sidereal speed rate

Issue	Seeing figures are incredibly low and unexpected (less than 1 arcsec !)
Cause	Exposure time too long, or **Star box** size set to high 
Remedies	Reduce exposure time, seek for another star that will be brighter or decrease **Star box** size or enable this feature 

5 Product terms of use

The use of this product is solely for monitoring the current sky turbulence levels, night and day, entertaining, educational or scientific purposes.

Use of this product involving people's lives is the responsibility of the user and in no way ALCOR SYSTEM will be held liable for injuries to persons or property theft as the use of this software and hardware described in this manual.

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