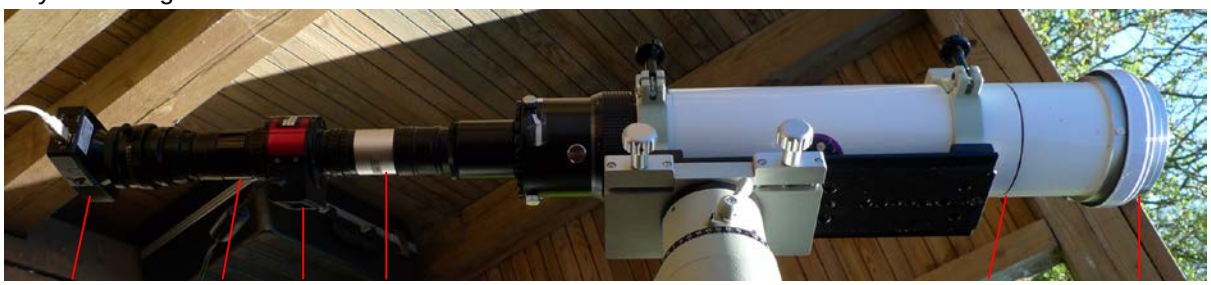
Introduction: This is part II of a back-to-back comparison between a Daystar Quantum SE and a Coronado SM60 solar H-alpha filter system (first part available at http://www.leif.org/mikael/coronado_daystar_showdown.pdf) . Two properties are of primary interest: contrast and resolution - both should be as high as possible!

Coronado configuration:

Daystar configuration:



Technical details:

Coronado: SM60 0.7Å with Tmax-tuner and BF10 rear filter. A 2x powermate is used to increase magnification. Diffraction limited resolution is 2.8 arcsec.

Daystar: Quantum SE 0.5Å with 100mm ERF filter. A Baader TZ4 (4x teleextender) is used[1] before the Daystar to achieve f/26[2] while an Astrophysics 0.67x reducer is placed between the Quantum SE and the camera to get a wider field of view. Diffraction limited resolution is 1.7 arcsec.

Both filters were used without detuning from 6562.8Å. Imaging is done with a Borg 100ED f/6.4 objective and a Skynyx 2-2M camera. The effective focal length for both setups is ~1500 mm resulting in an image scale of 0.6 arcsec/pixel.

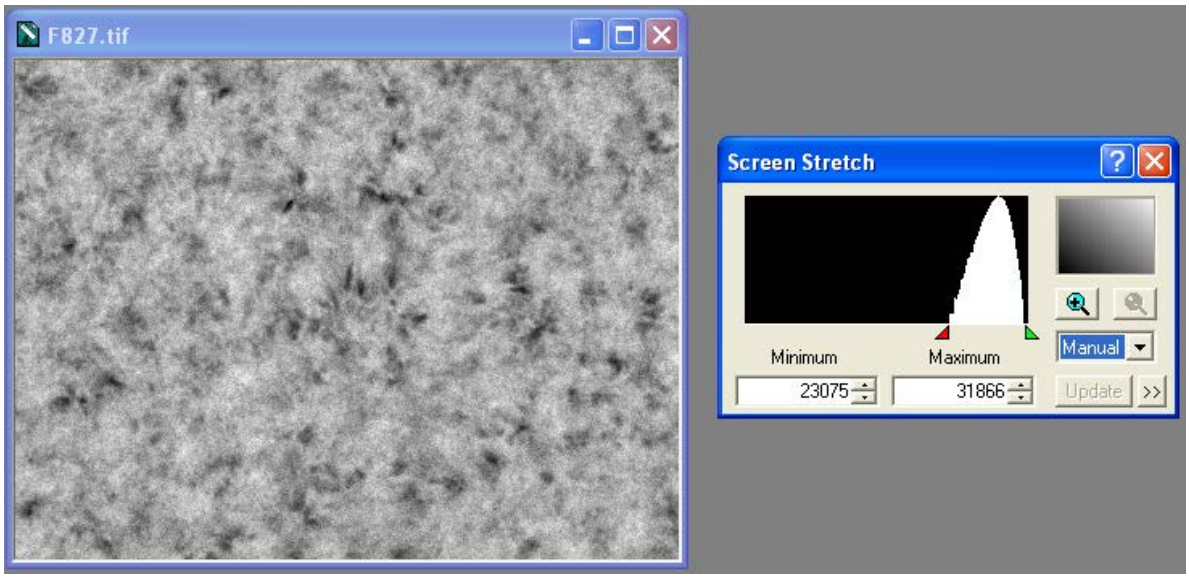
Acquisition is done using 1x1 binning and by adjusting the exposure time so that the peak pixel value is half of the maximum, then doing a 3000 image sequence. Several sequences were made

[1] TZ4 is located so that focal plane is 50 mm behind the front surface – this is 5mm from the optimal position and within the recommended range.

[2] this is just below the recommended value of f/30. I found that increasing the f ratio to f/33 using an aperture mask does not improve the image contrast measurably.

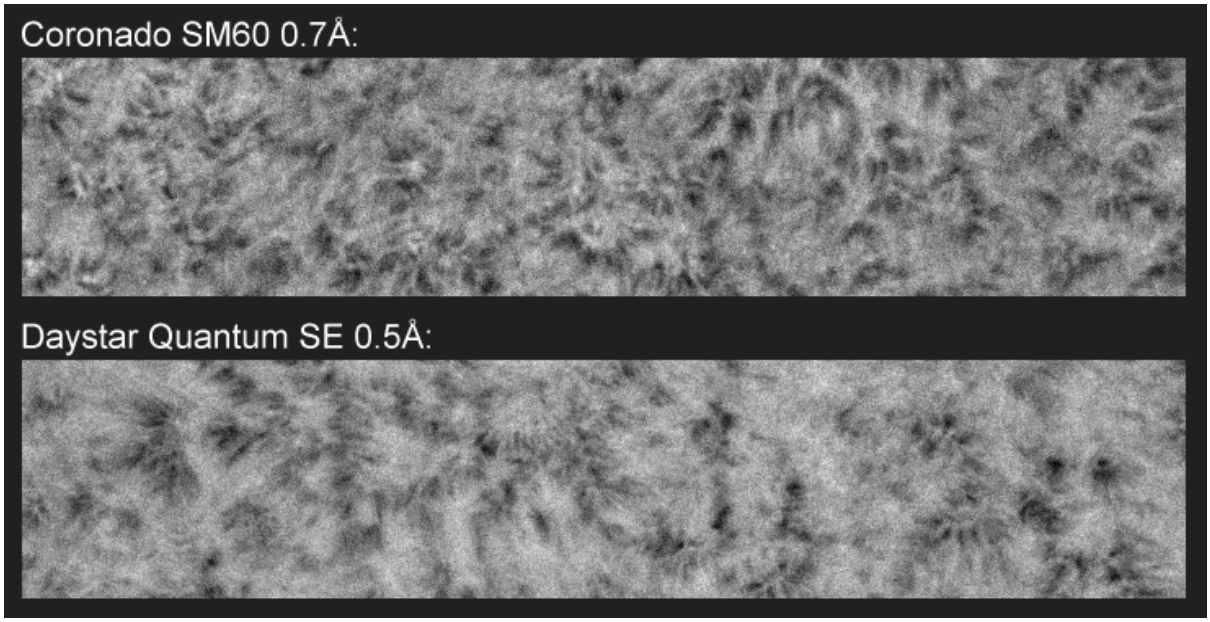
with each filter. The interval between comparison images is ~45 minutes due to the time it took to re-configure the setup. Hence, individual features cannot be directly compared. Instead, a large swath of indistinct chromosphere is analyzed – hence I am relying on the fact that the statistics of variations contained herein do not vary significantly over time.

Processing: Registax 5.0 was used to find the sharpest image in each sequence. This image was cropped to contain only a large swath of indistinct chromosphere. Large scale brightness variations (limb darkening, vignetting etc.) were removed using a background flattening filter. An example is shown below:

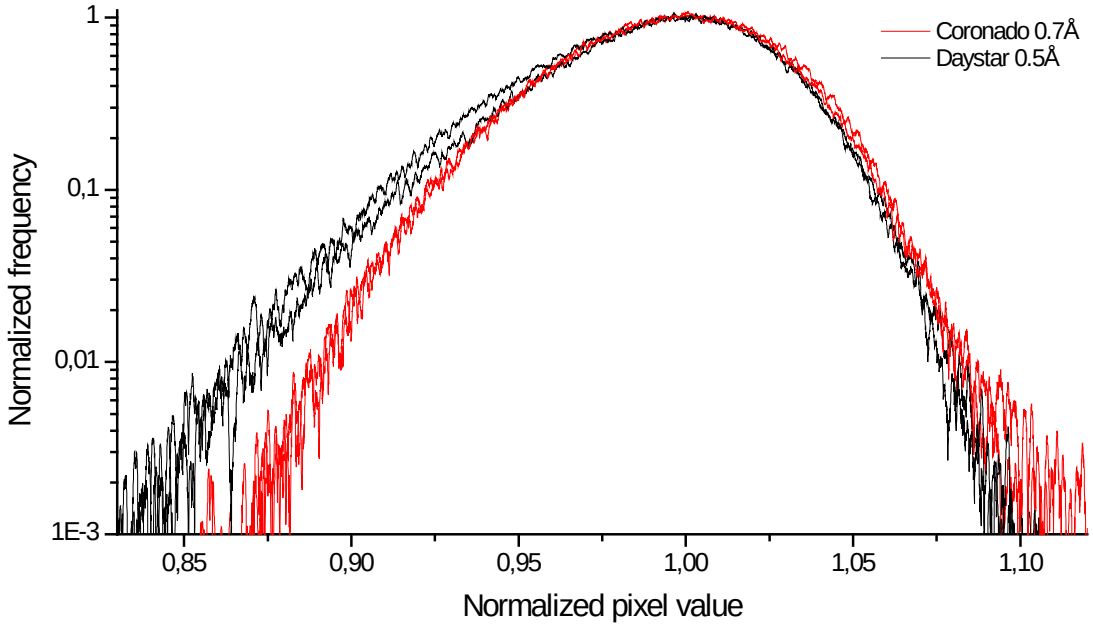


The histogram plot at right from the Maxim DL screen stretch tool reveals the maximum and minimum pixel values, and hence a contrast = (max-min)/max can be derived. In this case it is 28%.

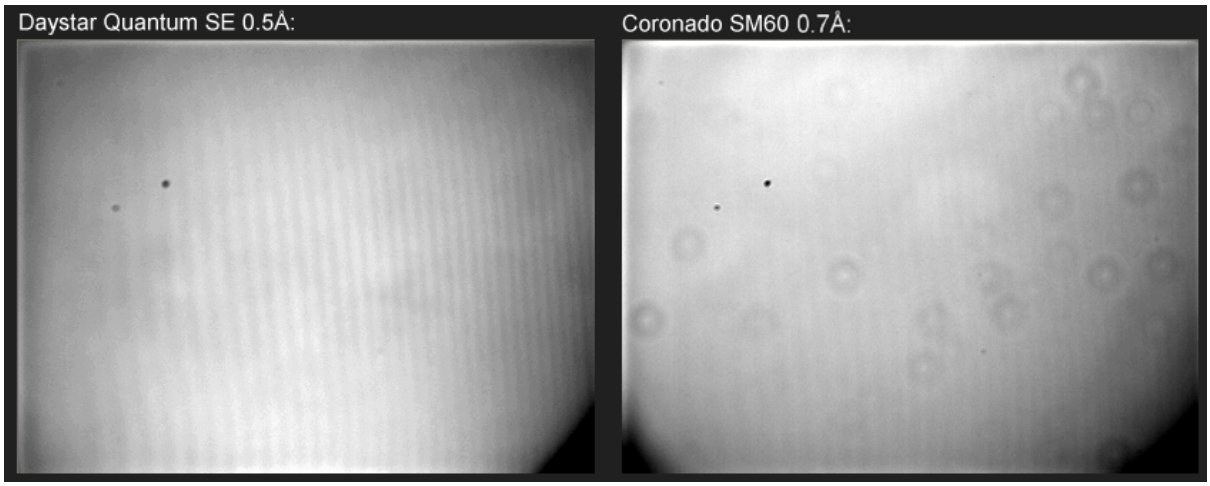
Chromosphere appearance: The chromosphere appeared subtly different for the two filter systems; see an example below. I do not know why but I suspect that the differing filter bandwidth (0.7Å vs. 0.5Å) has something to do with it.



Contrast results: Measurements from several imaging runs over several days are quite reproducible and show that Daystar contrast is 27-28% while Coronado contrast is 24-25%. Increasing the Daystar f ratio to 33 did not lead to larger contrast. The histogram function is plotted in detail below for each filter (for two images of indistinct chromospheric regions). The functions have been normalized to the peak value to aid in visualizing differences in shape. It is clear that Daystar 0.5Å generally reveals more dark regions and fewer bright regions than the Coronado 0.7Å filter. Again, I suspect that this has something to do with the difference in bandwidth.



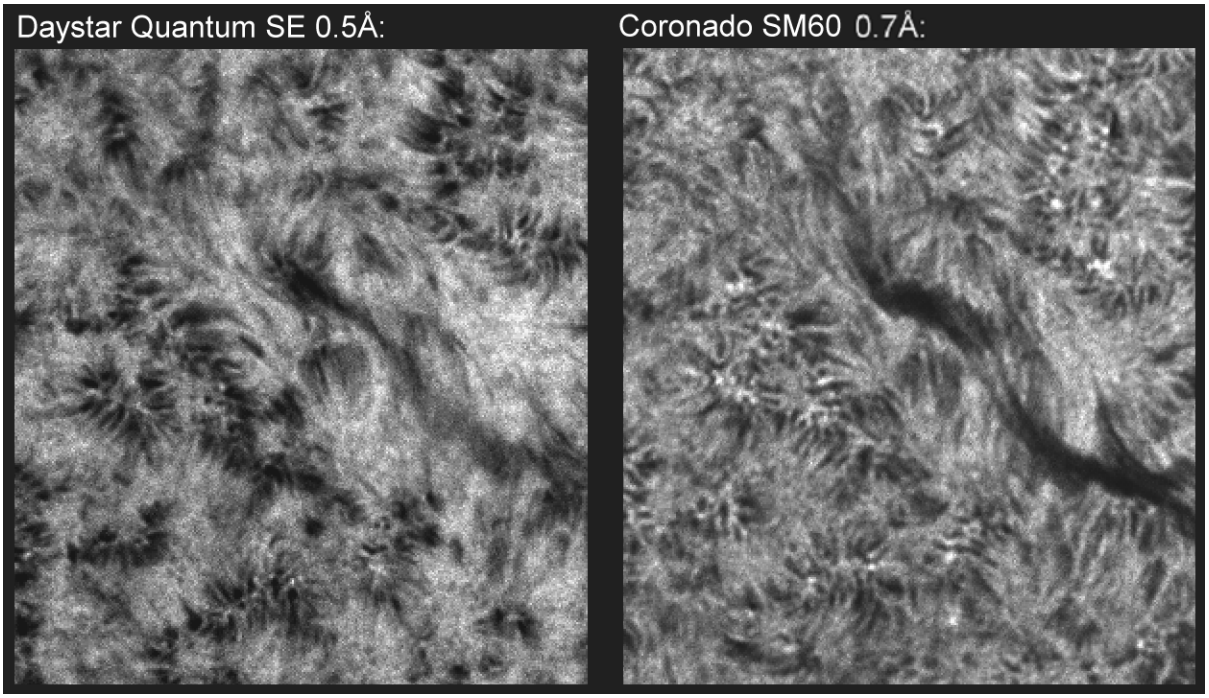
Newton rings were more prominent with the Daystar filter which is expected since the degree of coherence here is higher (smaller bandwidth). Examples using flat field images are shown below:



The peak-to-peak amplitude variation is 1.2% with Daystar and 0.5% with Coronado.

Stacked image comparison: stacked images were created using multipoint alignment and a stacksize limit of 60 out of 3000 frames. Identical wavelet processing was applied and the Coronado image was rotated slightly to better match the Daystar image. The images below are zoomed and cropped to reveal details in the same filament structure (remember: individual details cannot be

compared due to the 45 minute time difference). Just looking at the brightness variations shows what I plotted in the histogram functions: Daystar reveals more 'darker' areas and fewer 'brighter' areas than Coronado. It is also clearly apparent that the Daystar image is considerably sharper – not surprising since the aperture here is 100mm as opposed to just 60mm with the Coronado.



Conclusion: in my experience, both filters deliver what they promise. Coronado is considerably easier to set up and use – no electrical requirements, no waiting to achieve correct temperature. In addition, the Daystar requires careful attention to f/ratio – with extra expense required for a tele-extender and various thread adapters to connect everything. However, the Daystar image is superior in terms of contrast and resolution – as it should be when comparing to a Coronado with larger bandwidth and smaller aperture. In this sense, my comparison is not really valid, but maybe others can use it to decide whether a 2-3 times larger investment for a solar filter system is worth it.