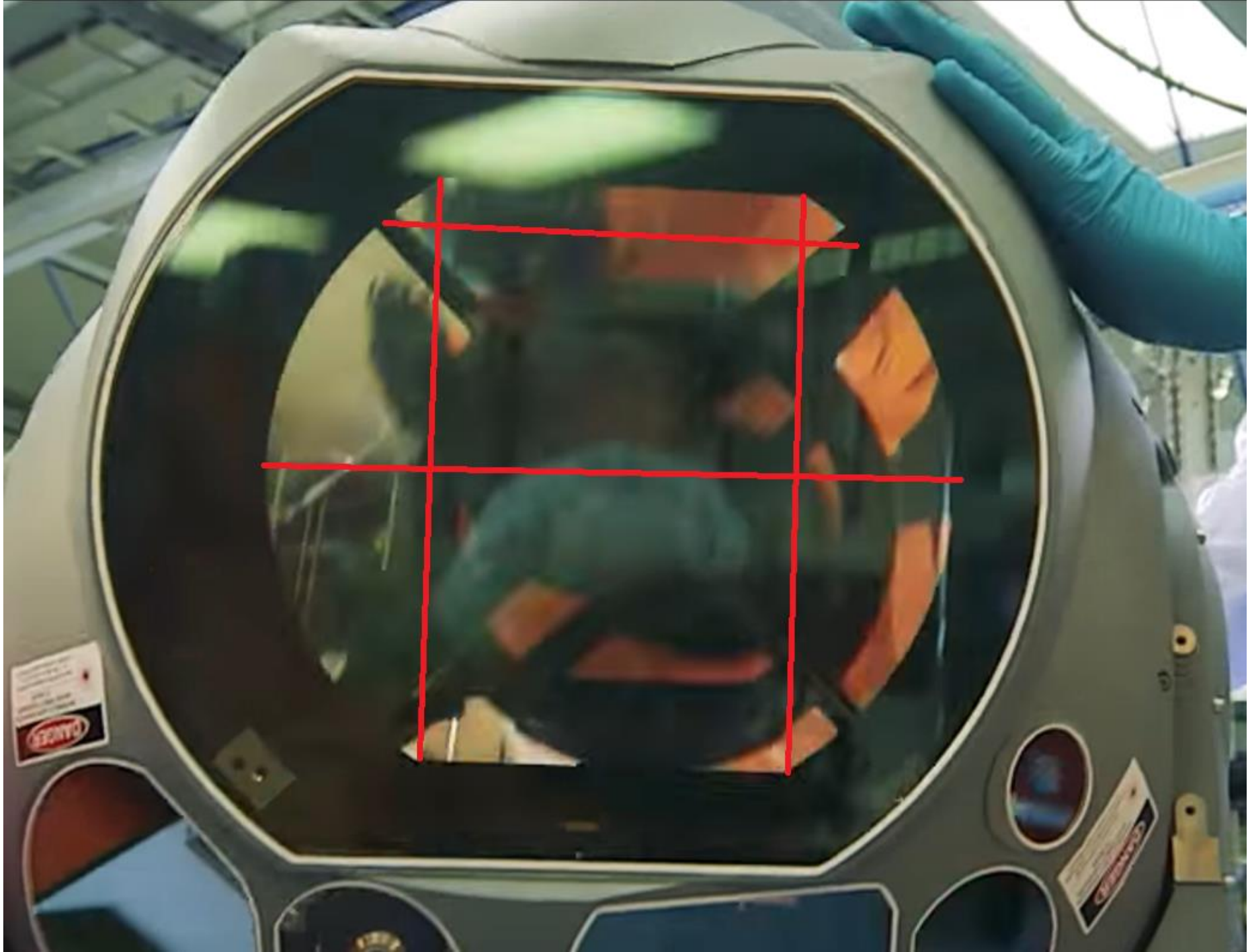
MTS-B mirror and aperture Shape.

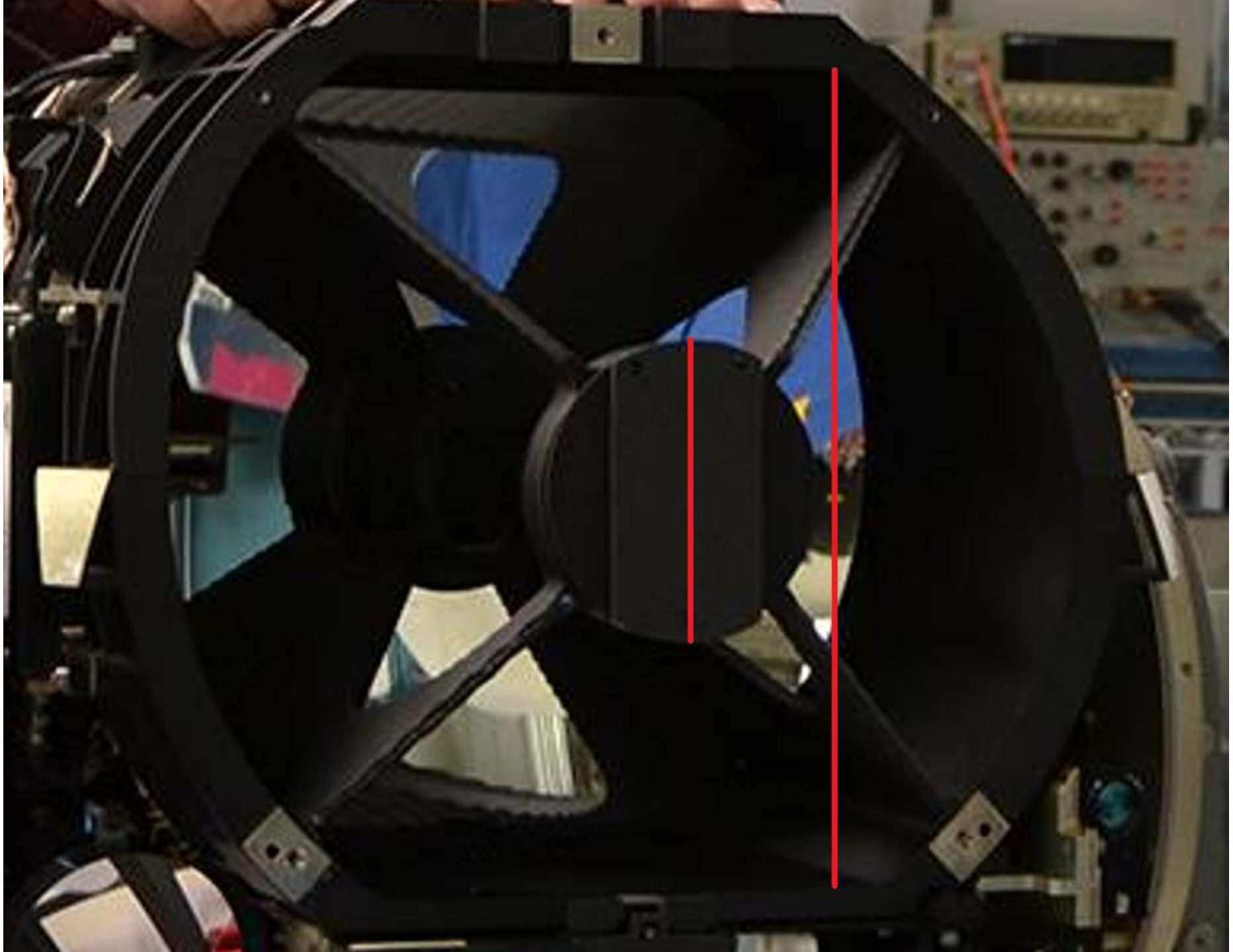
https://www.youtube.com/watch?v=QugrRRxirC0&t=12s

Measurements for proportions only.

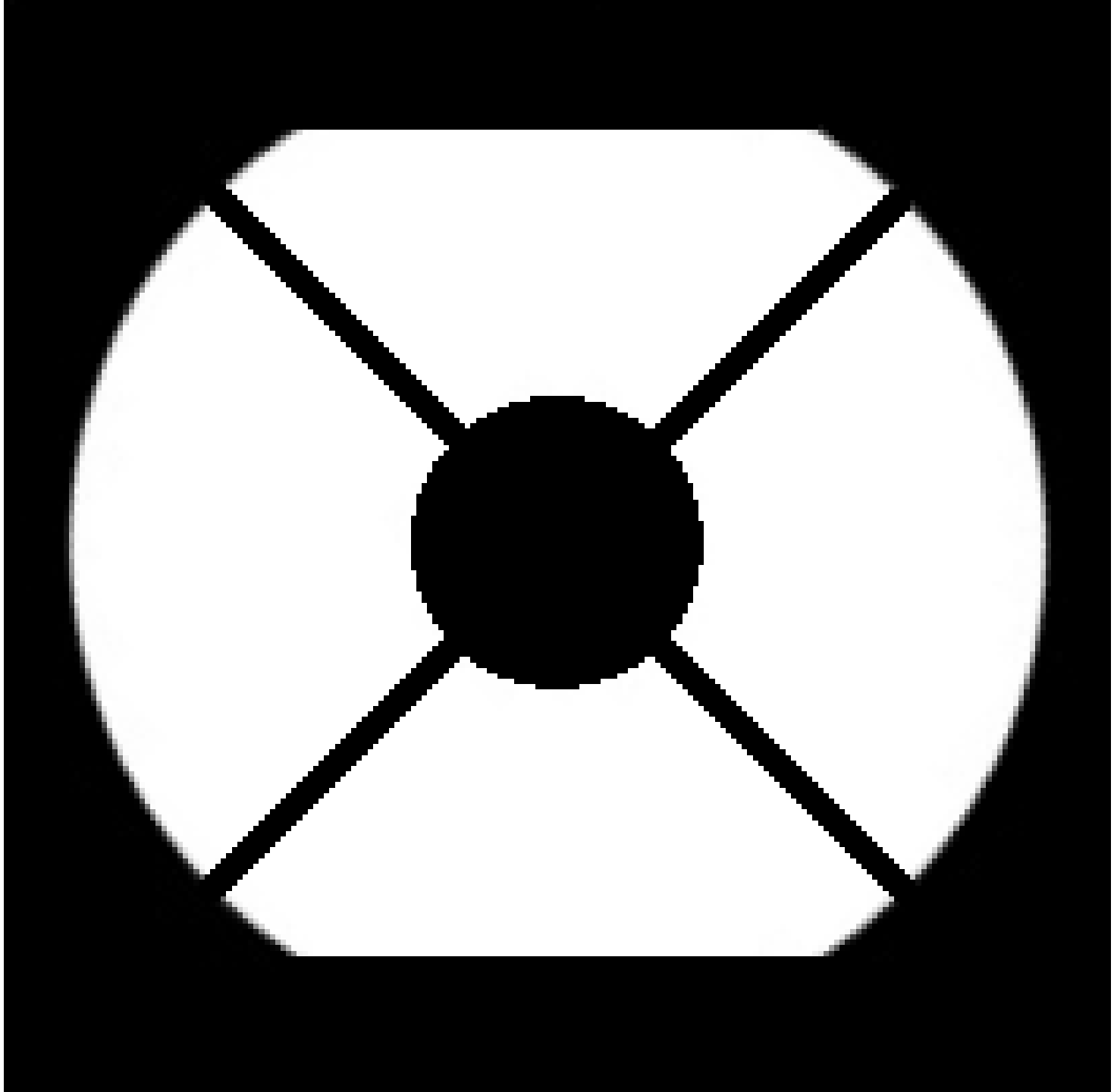
Measurements for proportions only.



Measurements for proportions only. In this image, the mirror seems to be a snug fit to the aperture and housing.



Derived diffraction mask depicting the aperture, spider vanes, and central obstruction, in proportion to the measurements taken.

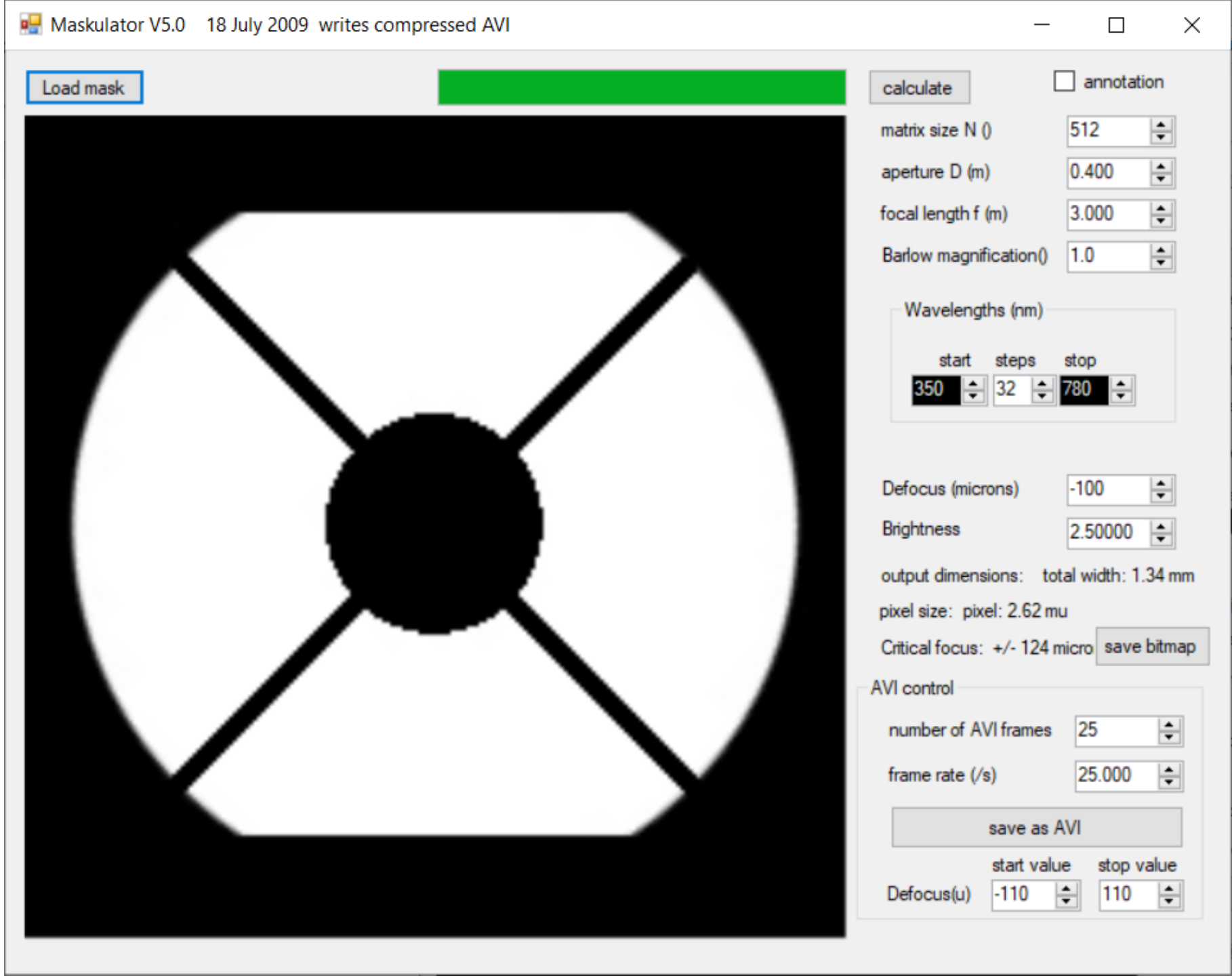


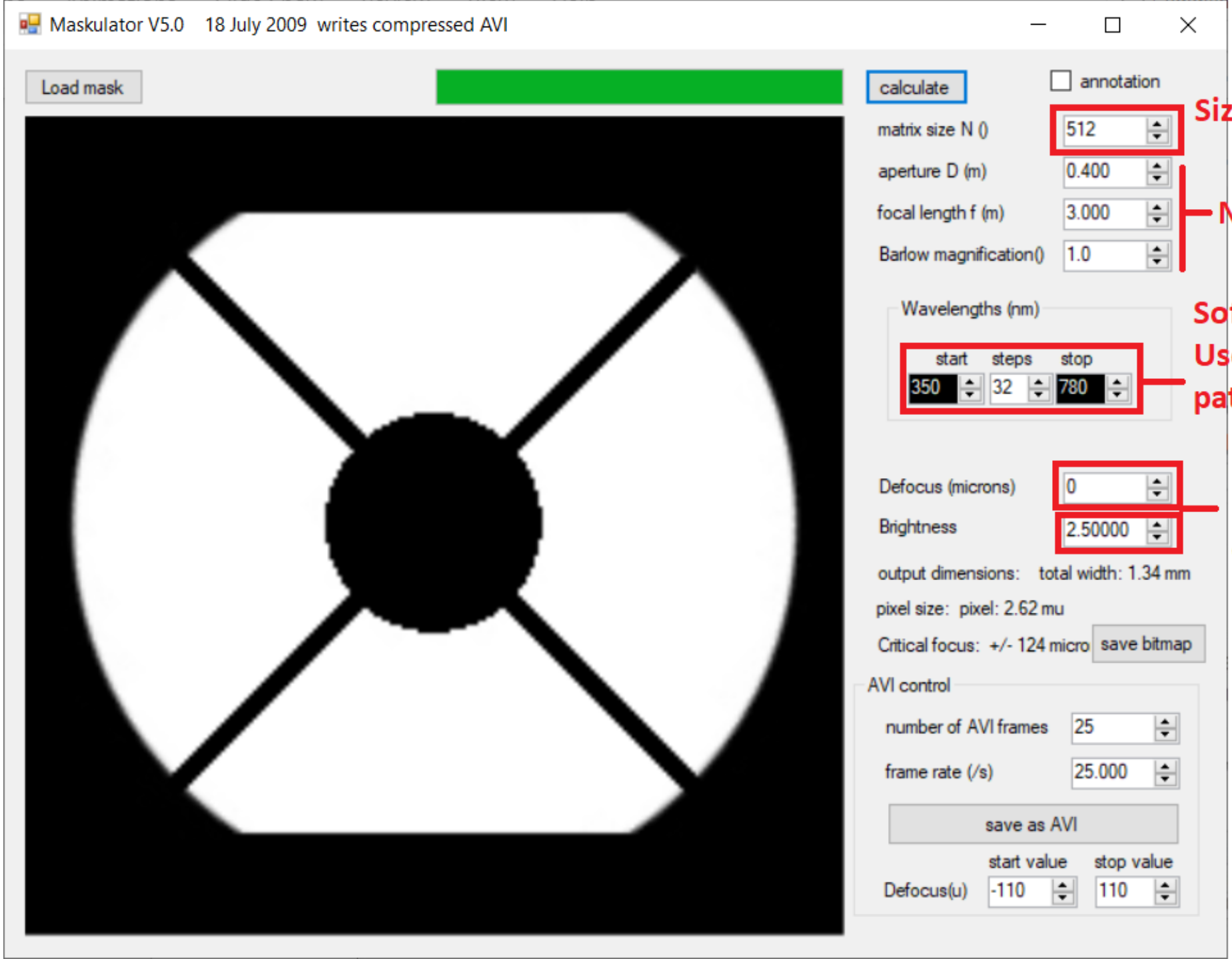
In order to produce the diffraction pattern, the astrophotography software Maskulator v5.0 is used in conjunction with FFTW library 3.3.5 64bits.

http://www.njnoordhoek.com/?p=376

https://www.fftw.org/install/windows.html

(just extract the library to the same folder as Maskulator and replace the older library).





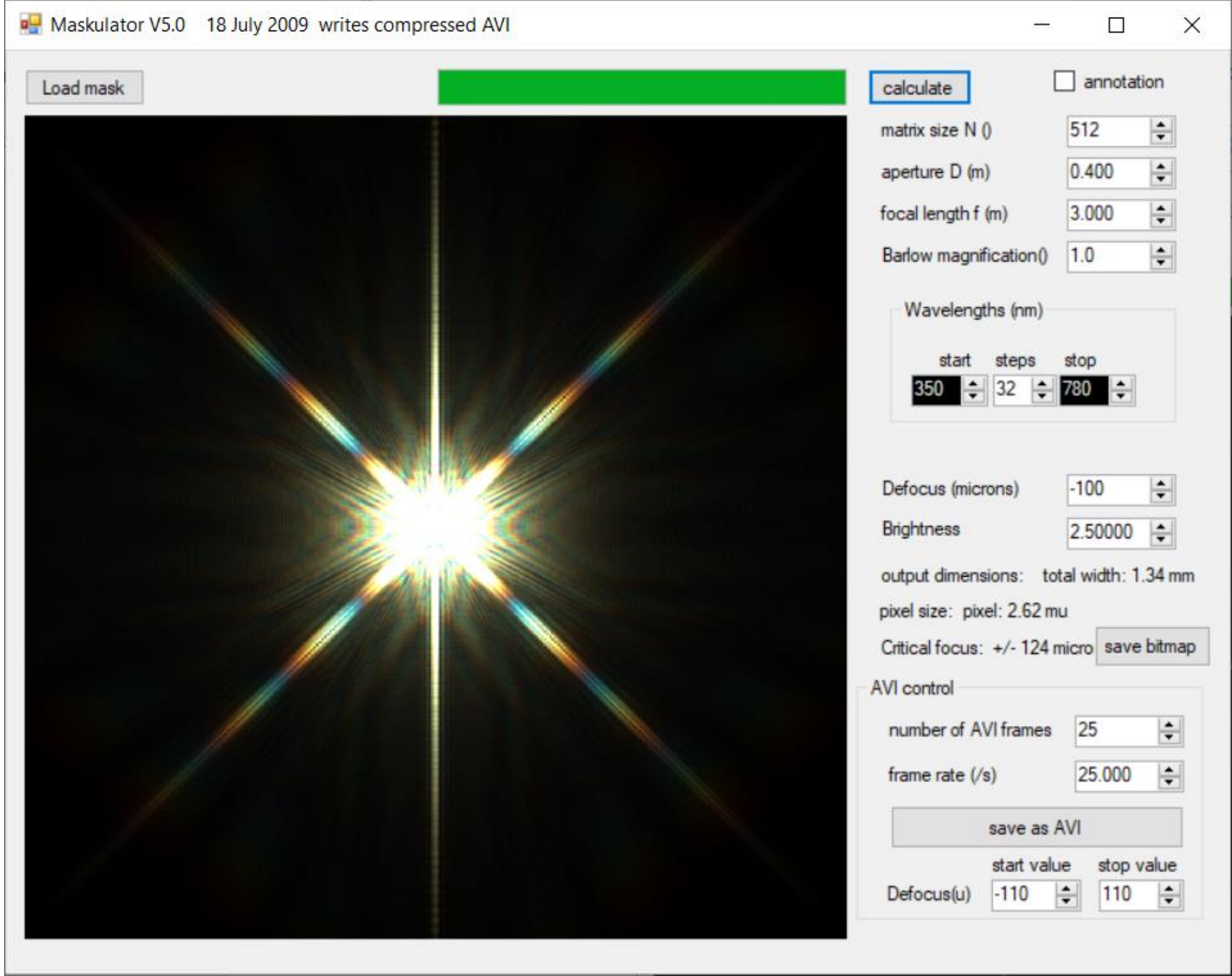
Size of final image

No effect on results

Software locked range.
Used for producing the rainbow pattern

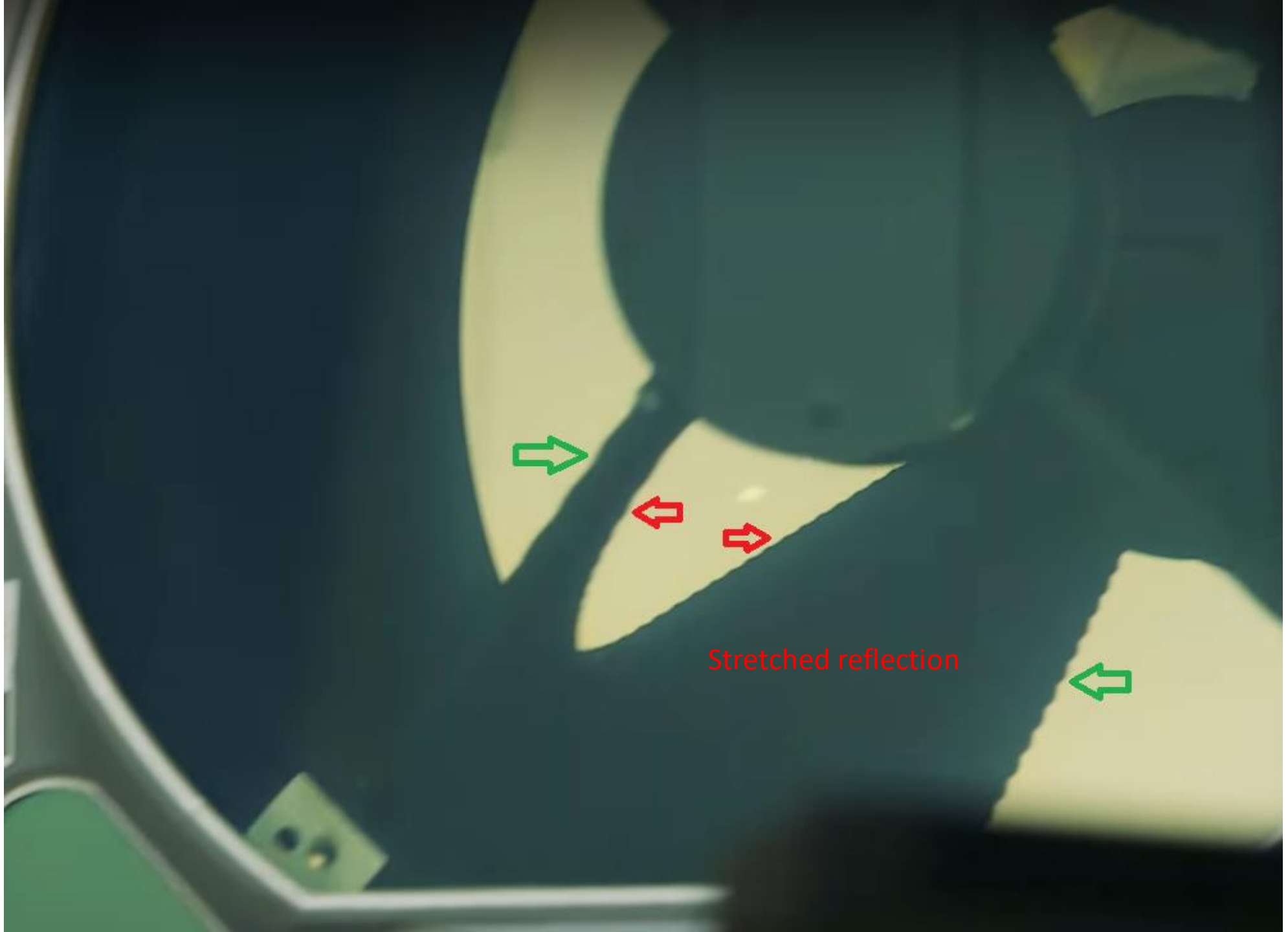
Used for tweaking the diffraction pattern.

Generated diffraction pattern. It becomes clear it does not match the features in the Chandelier shape. However, a review of the MTS-B housing shows that the spider vanes are actually apodizing.



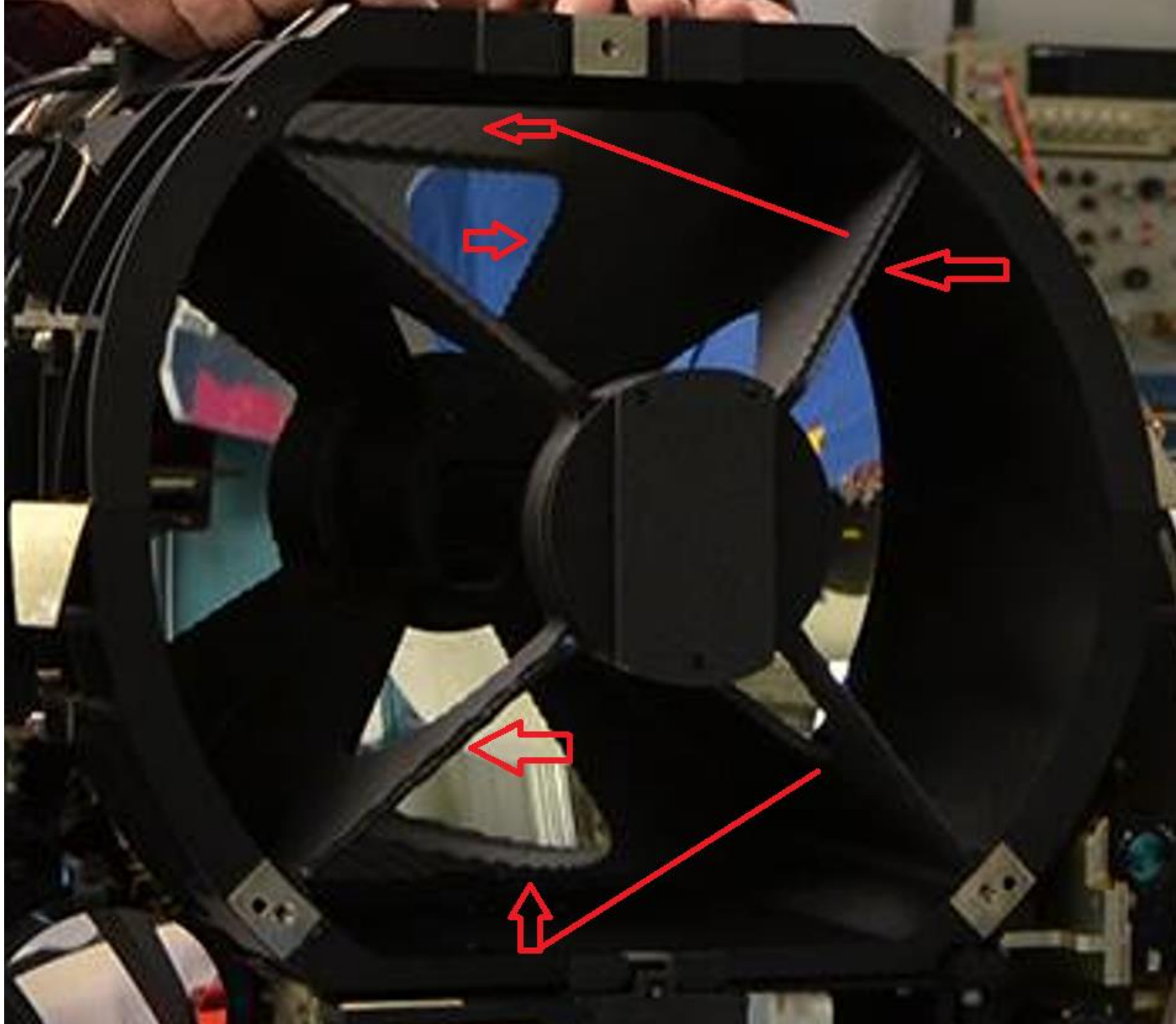
Apodizing spider vanes showing their wavy pattern on the outer and inner edges.

https://www.youtube.com/watch?v=QugrRRxirC0&t=17s

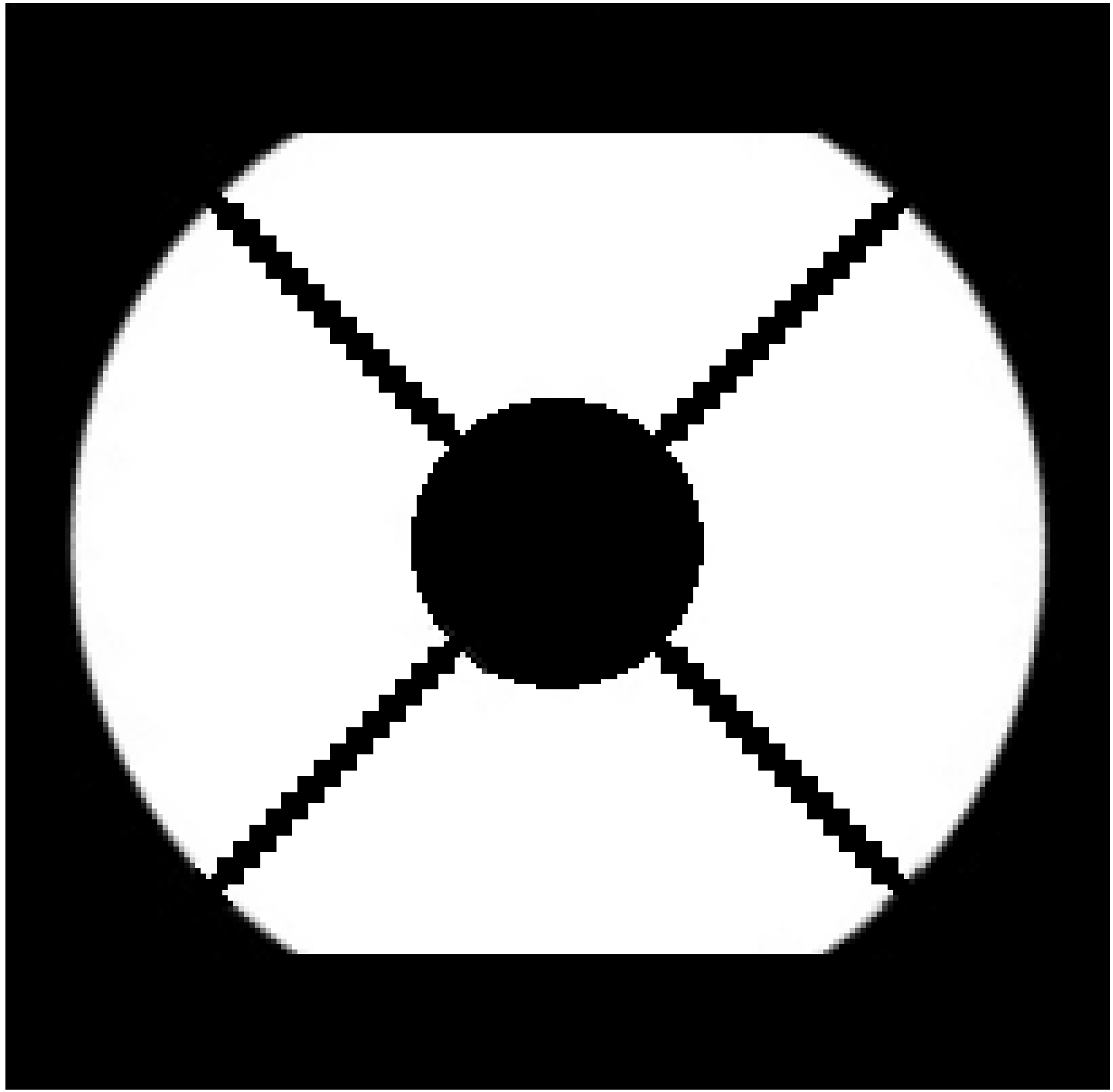


Confirmation apodizing spider vanes are being used.

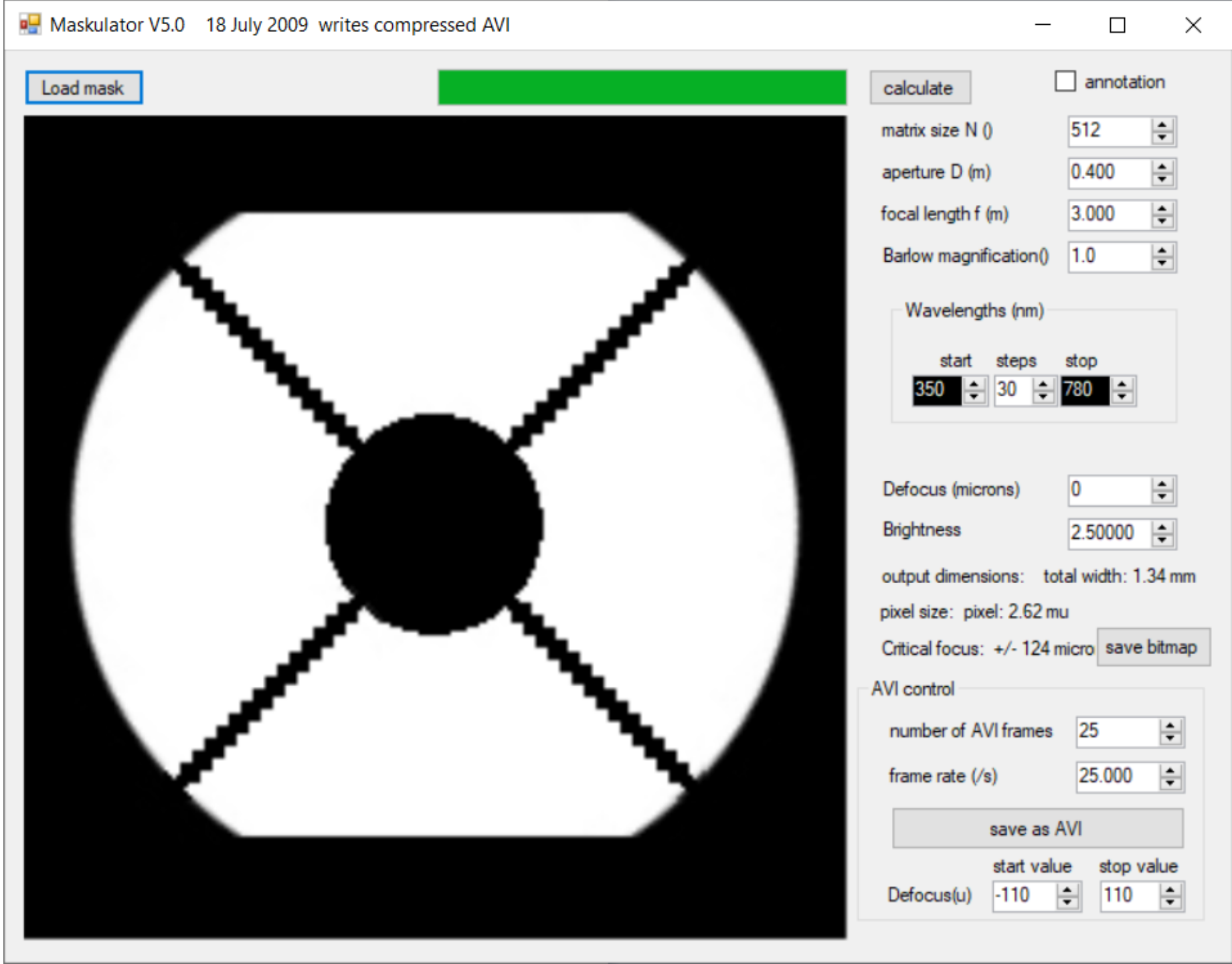
https://scontent.flye1-1.fna.fbcdn.net/v/t31.18172-8/12748027_1198978620130670_8658559703421352438_o.jpg?_nc_cat=103&ccb=1-7&_nc_sid=c2f564&_nc_ohc=Hhk8jpf17QwAX9fZe2A&_nc_ht=scontent.flye1-1.fna&oh=00_AfDMfN6t83irmolqT4BUa3R0E6uAIeJ-s4JiEpq09tFbfw&oe=65CA25AF



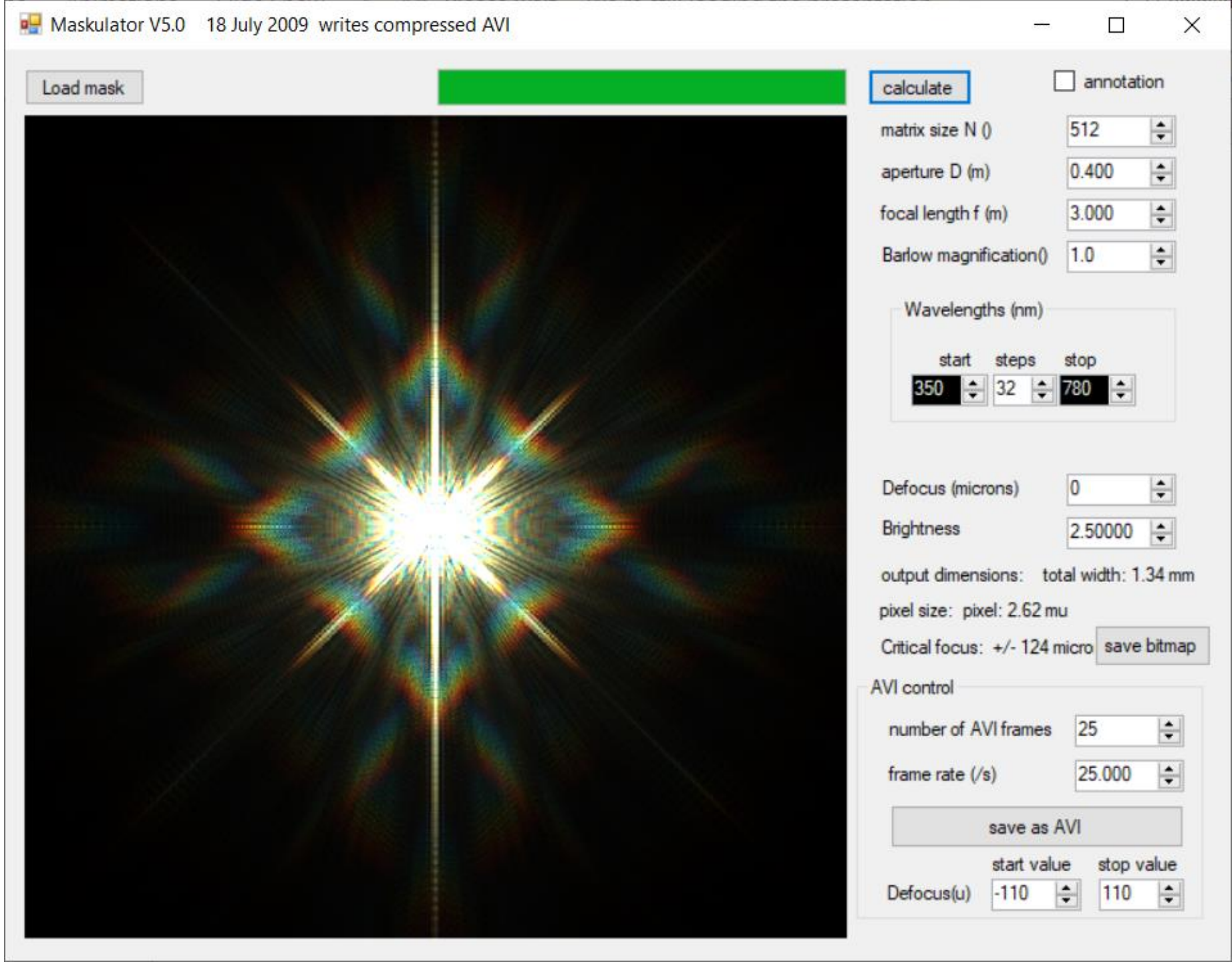
Updated diffraction mask with a wavy pattern similar to the pictures.



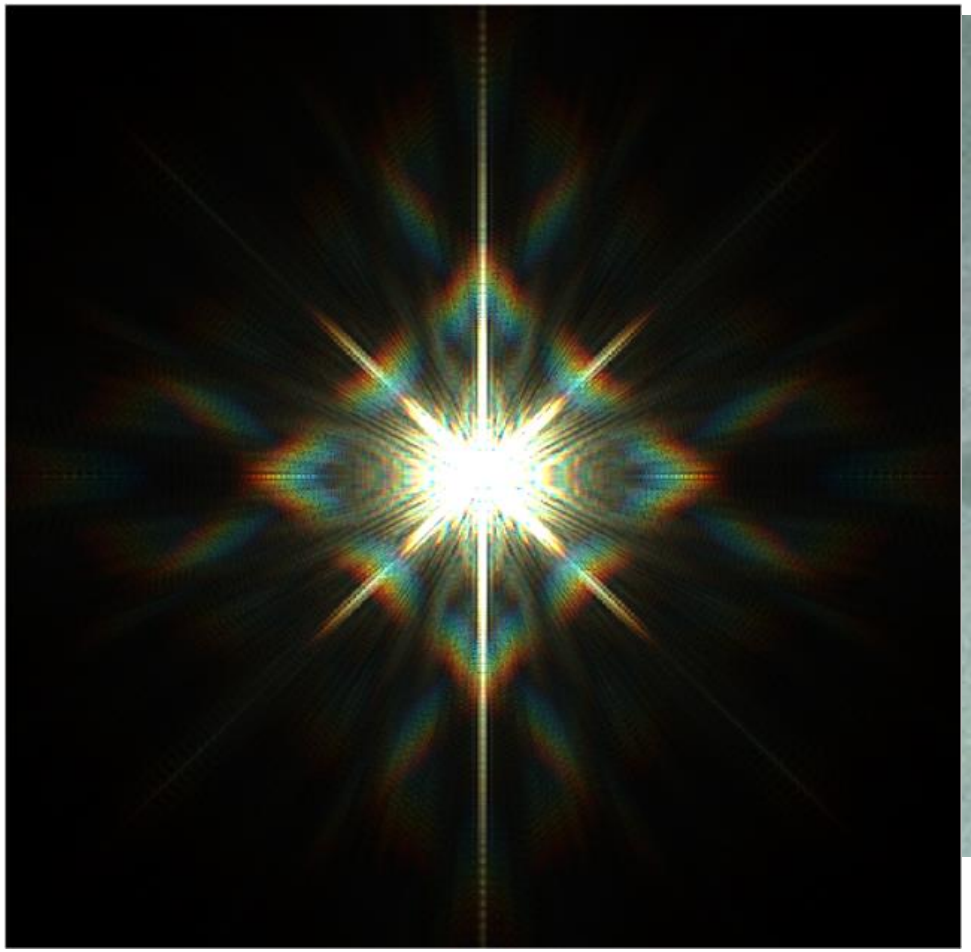
To demonstrate the effect of the apodization, the new diffraction mask was loaded in the software.

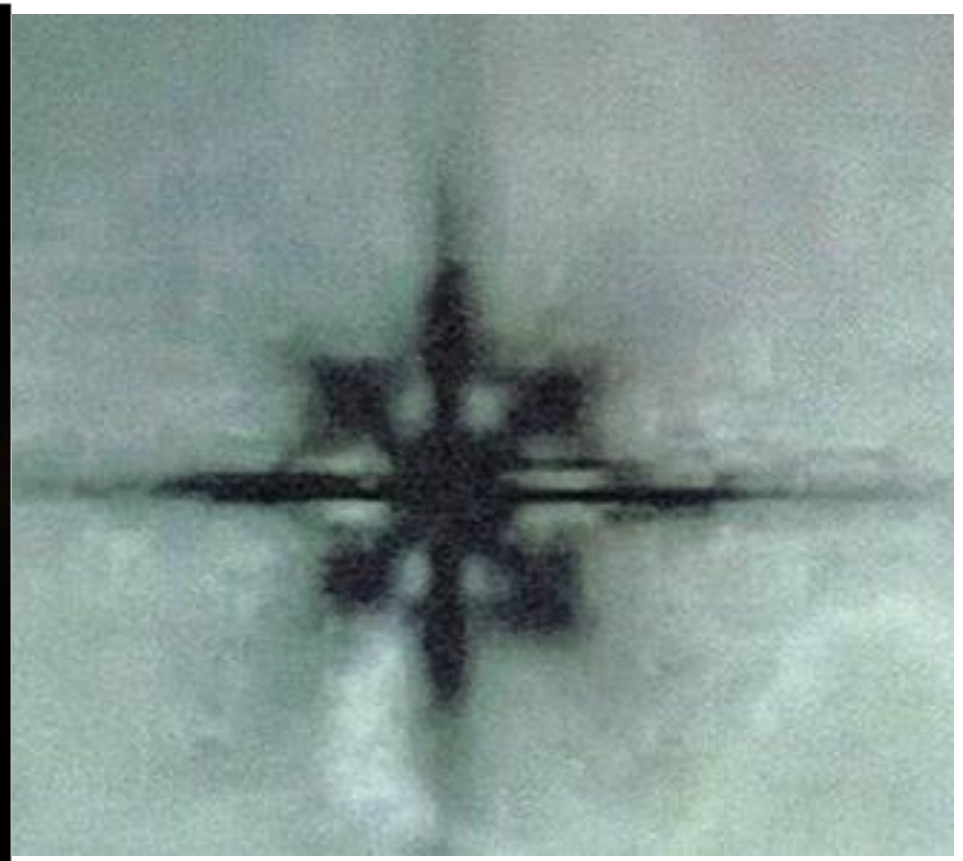


Generated diffraction pattern with the parameters as shown. Now the diffraction pattern more closely resembles the Chandelier.



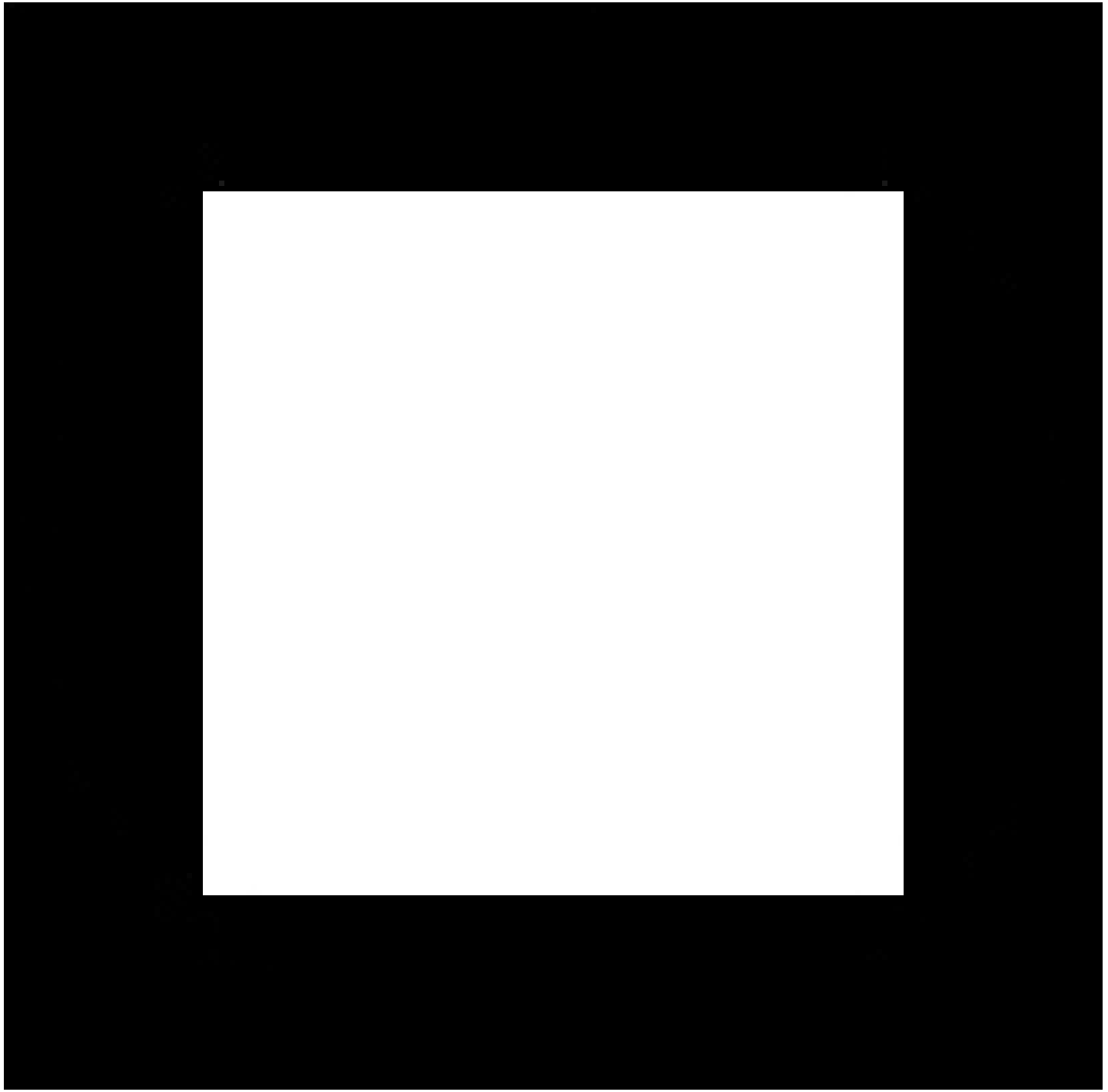
The comparison between the Chandelier image and the generated diffraction pattern shows remarkable similarity; however, the lack of horizontal spikes suggest that there is another source of diffraction in the optical path. The shape of the central part is also rounder in the reference image, whilst it is oblong in the produced diffraction due to the shape of the aperture.



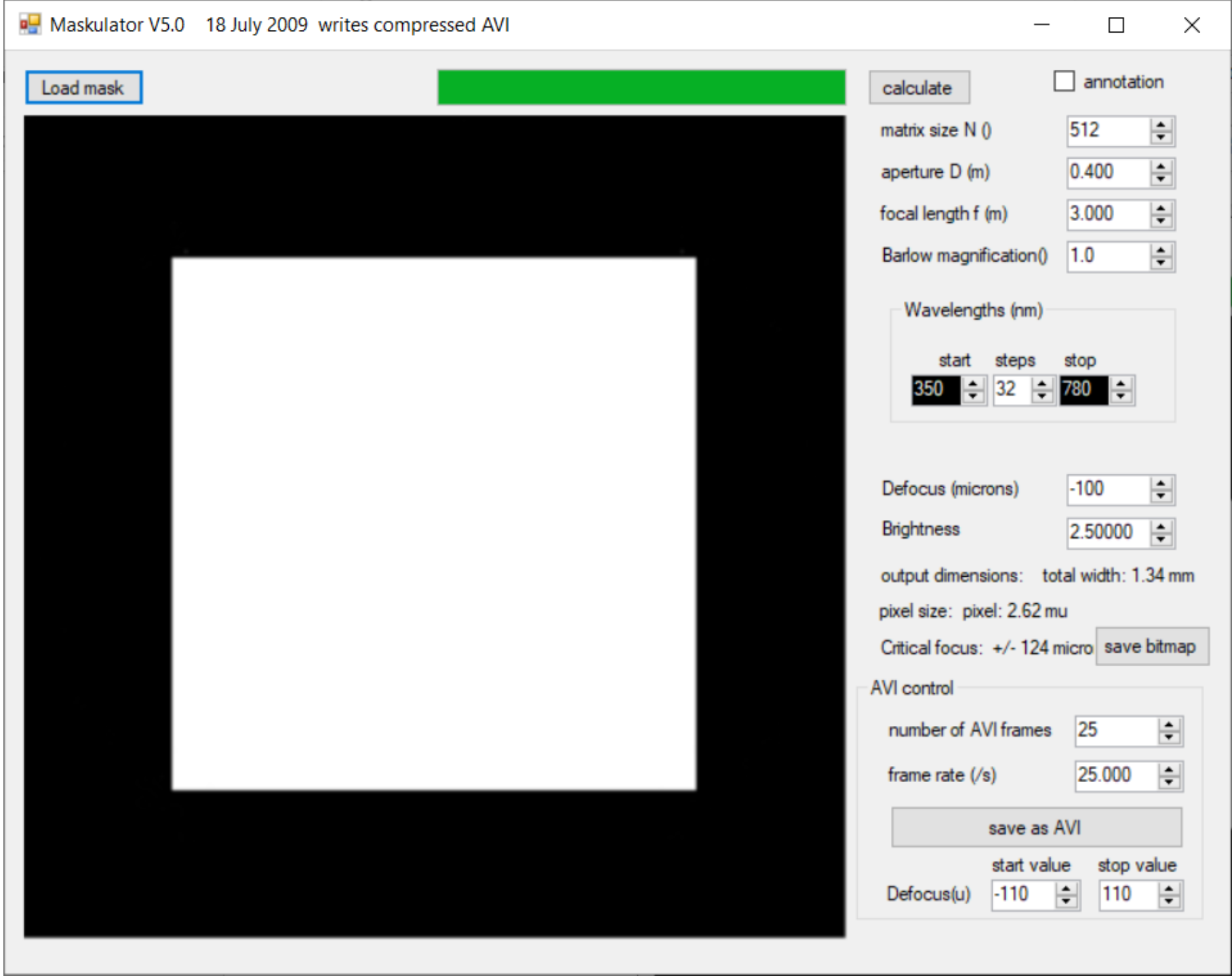


An additional diffraction mask to account for the horizontal spikes was created, assuming the instrument uses a mechanical square iris in front of the sensor to control the depth of field.

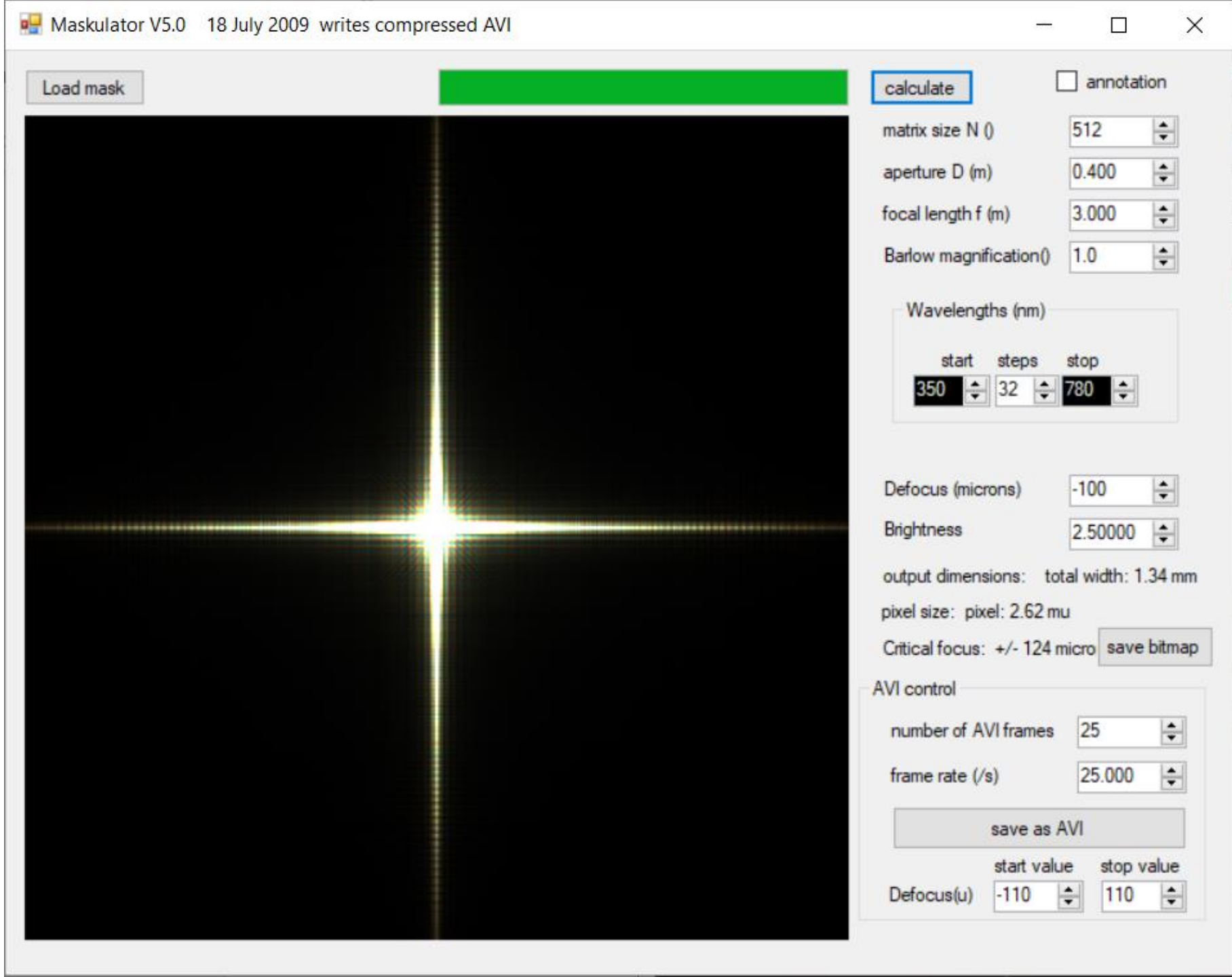
Image below is illustrative only.



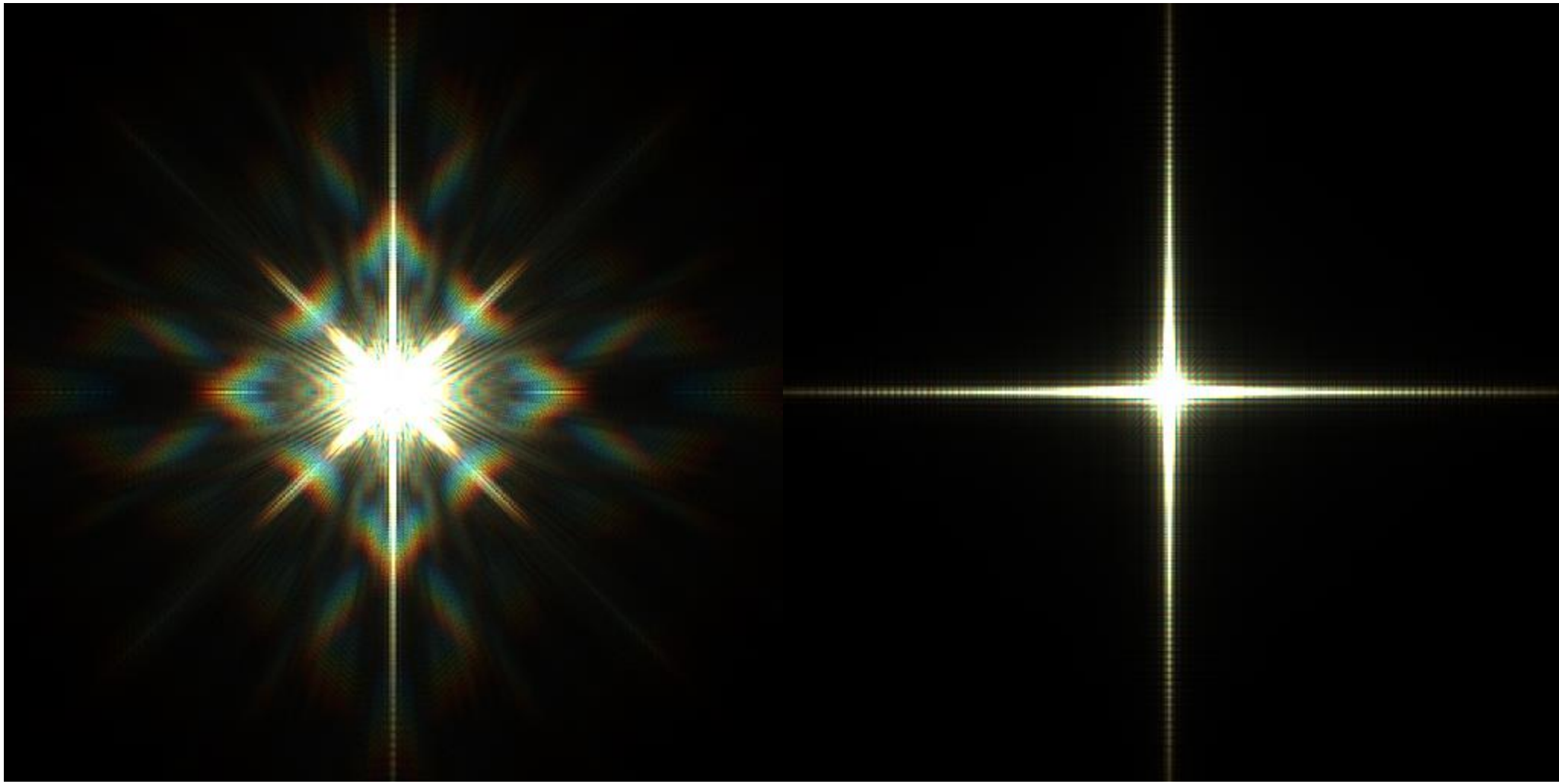
Additional diffraction mask.



Generated diffraction pattern with the parameters as shown for the square iris.

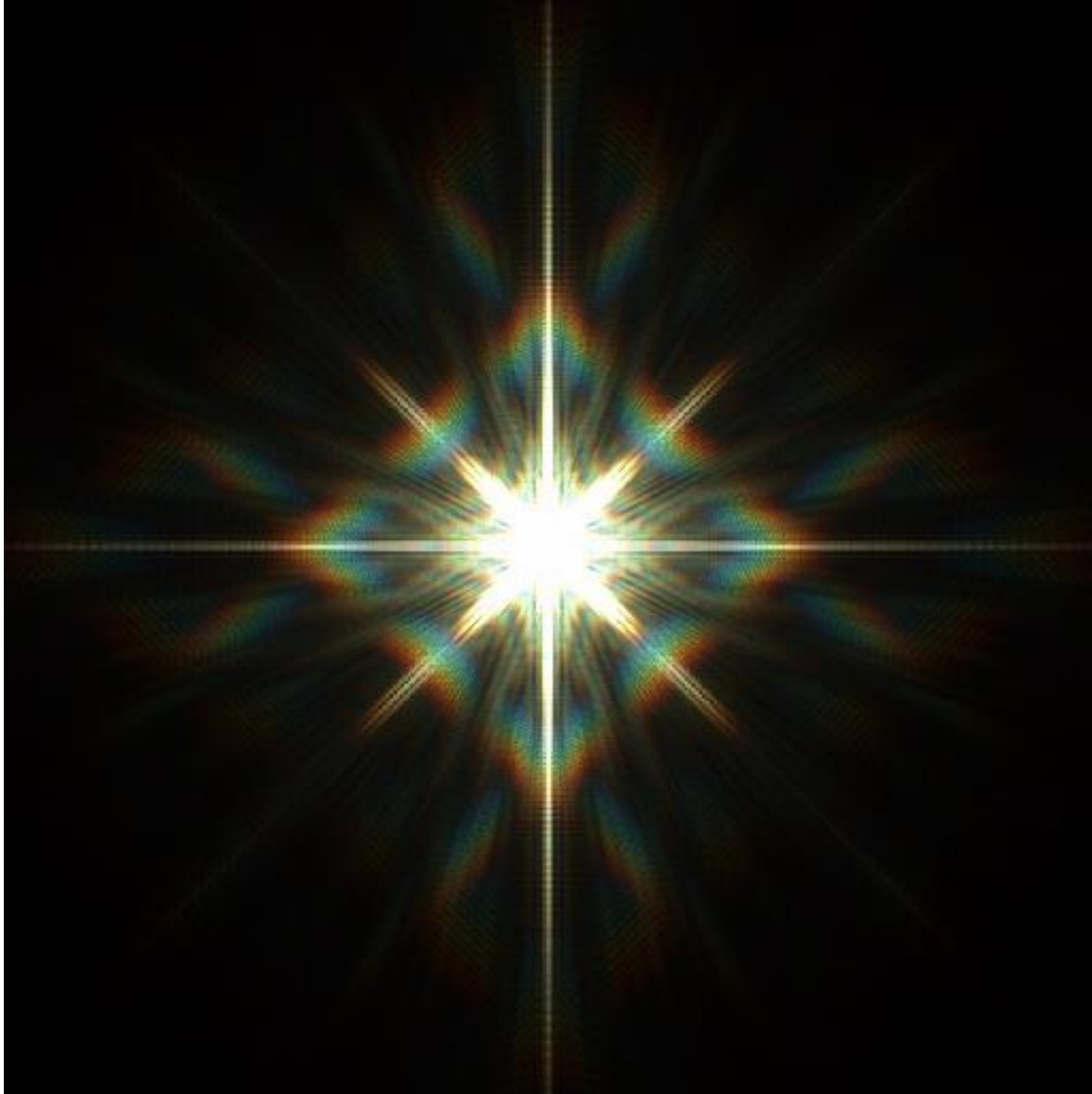


The constructive interference between both diffraction patterns would reinforce the vertical spikes, and add the missing horizontal spikes, as intended.

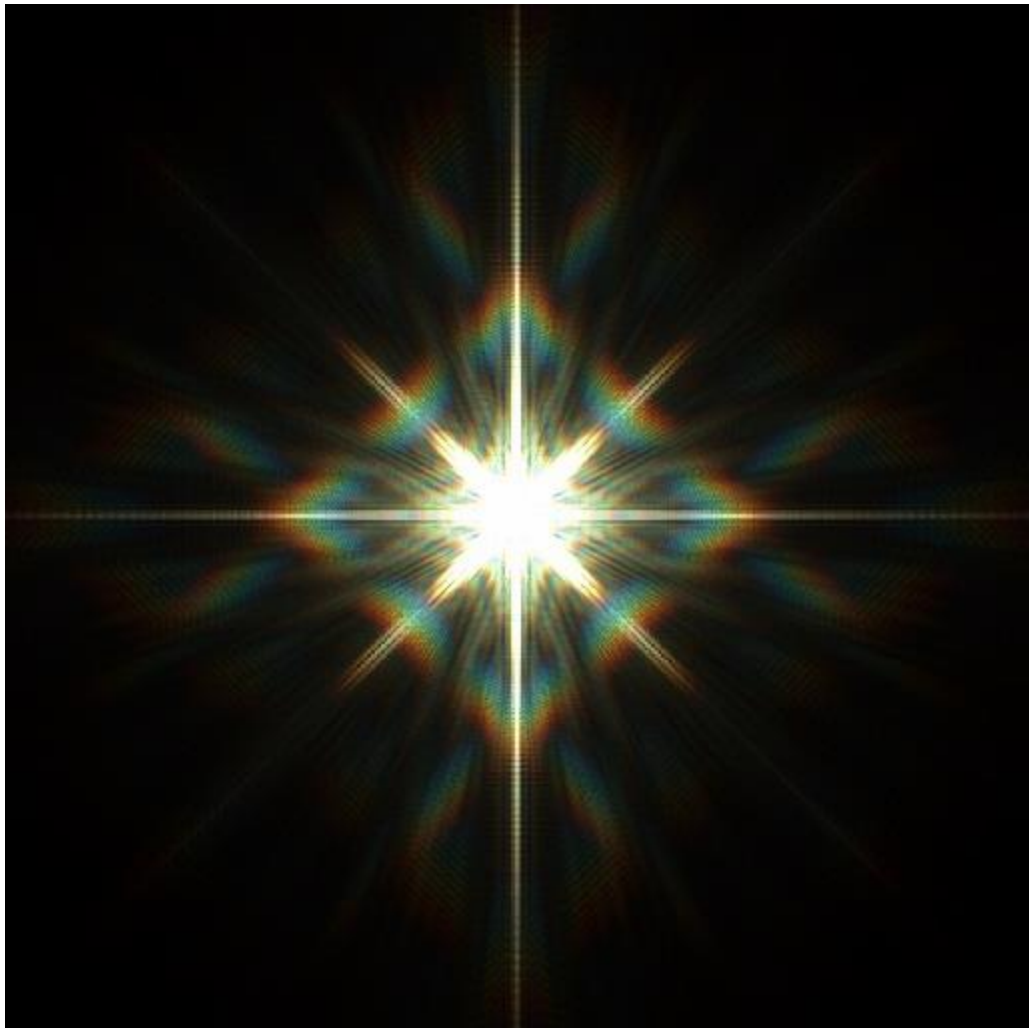


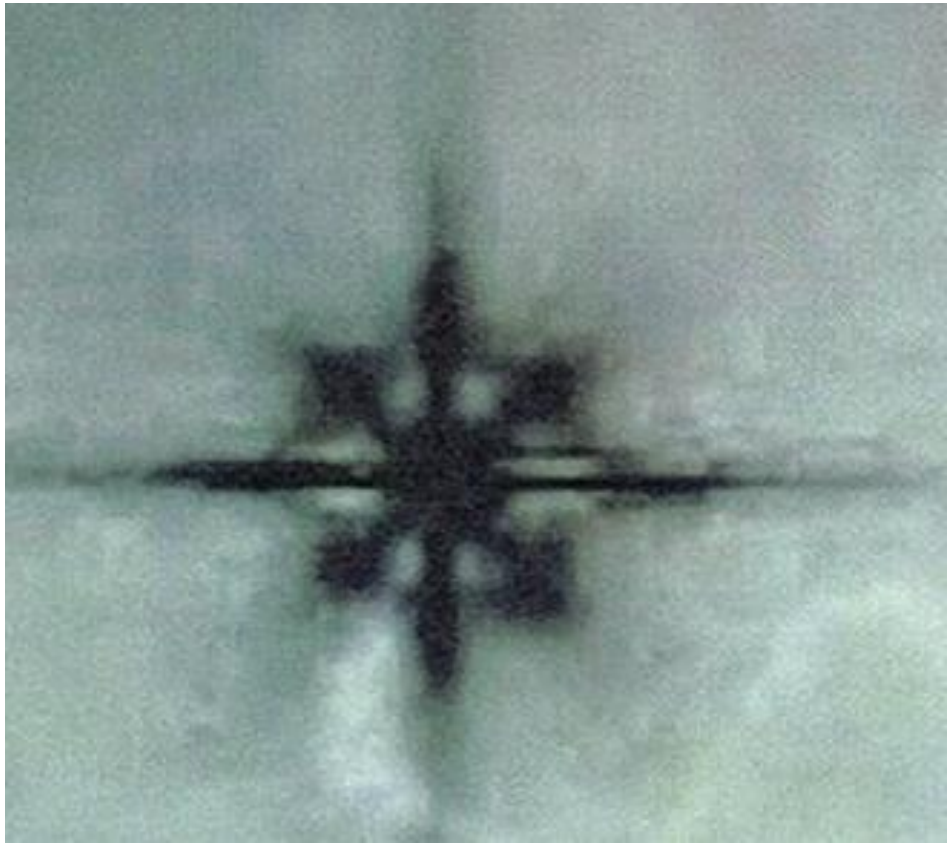
Both diffraction patterns were stacked in DeepSkyStacker 5.1.5 to produce the final combined diffraction pattern, assuming constructive interference.

http://deepskystacker.free.fr/



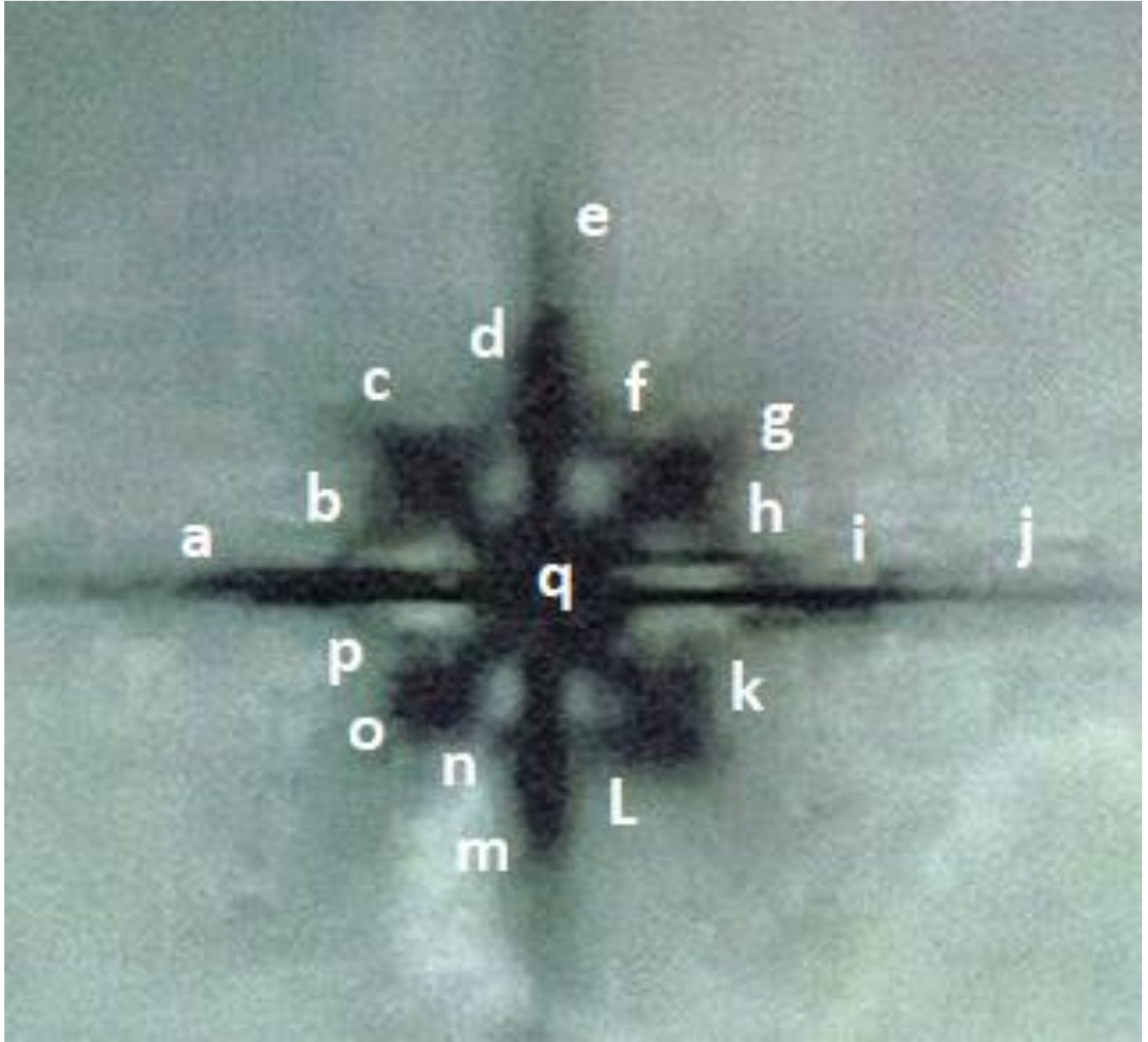
The comparison between the Chandelier image and the combined diffraction pattern produces a better match than the previous case. The missing horizontal spikes are now produced, and the shape of the central part is closer to the reference image.



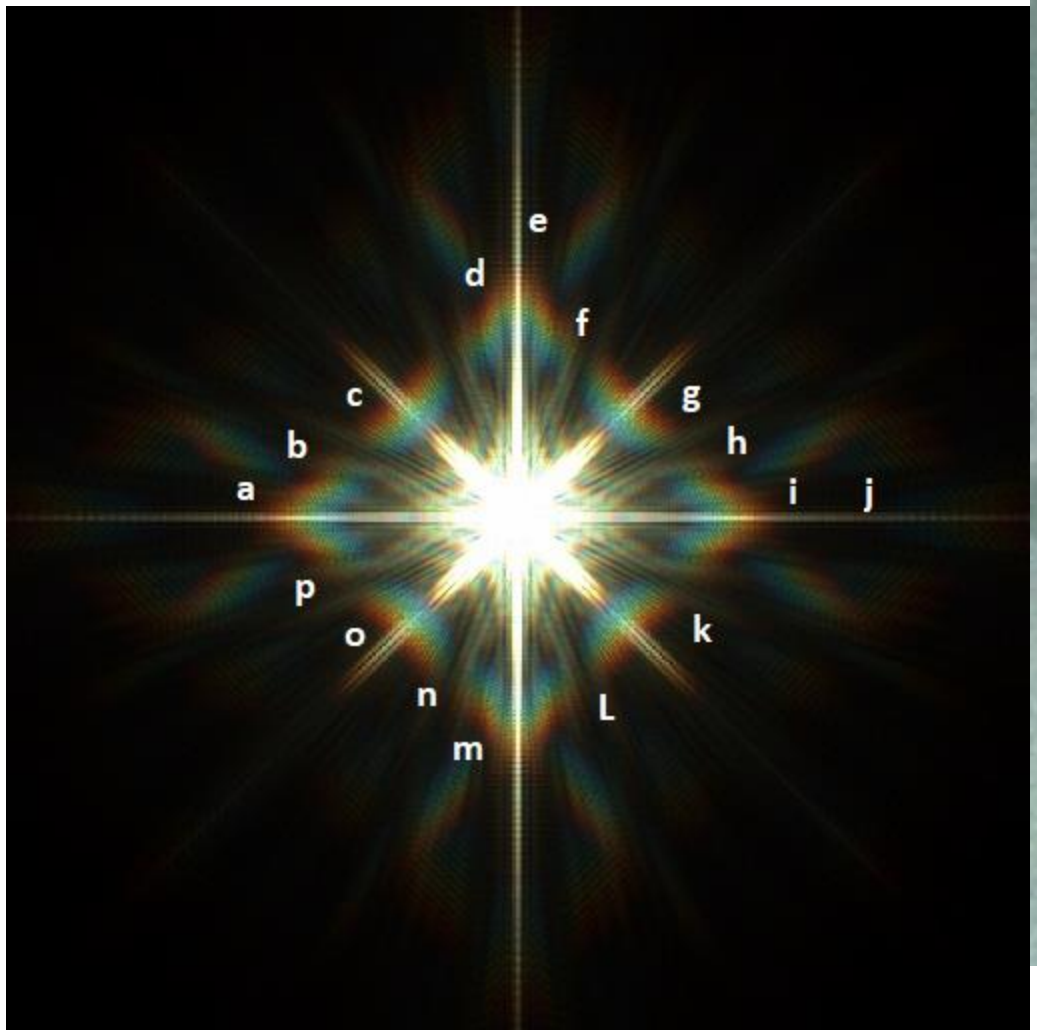


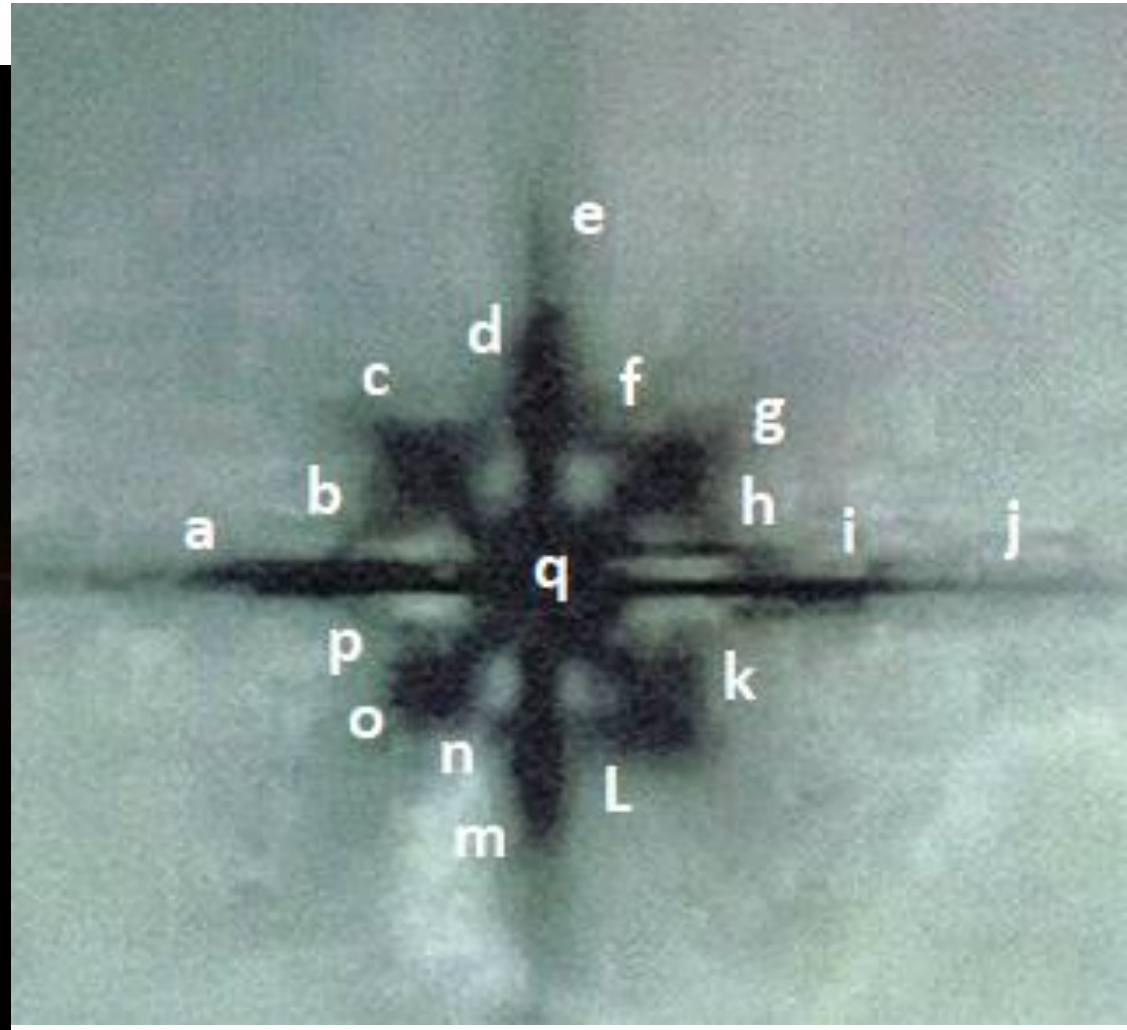
Regions of interest for comparison with the produced diffraction pattern:

a, i – Horizontal feather (aigrette)
b, p – Faint arc
c, g, k, o – Diagonal arrow-like shape
d, m – Vertical feather (aigrette)
e – Vertical spike
f, L – Horizontal line (artifact?)
h – Disconnected horizontal line (artifact?)
j – Horizontal spike
n, p - Gap
q – Circular central region



In respect to the Chandelier image, 'a' (feather) is more elongated; 'b' (arc) is a close match; 'c' (arrow) is a very good match; 'd' (feather) is a very good match; 'e' (spike) is a good match; 'f' seems horizontal; 'g' (arrow) is close; 'h' (horizontal line) is a possible match; 'i' (feather) is more elongated; 'j' (spike) is a very good match; 'k' (arrow) is close; 'L' seems horizontal; 'm' (feather) is a good match; 'n' (gap) is a good match; 'o' is close; 'p' (arc and gap) is a good match; 'q' is a good match.



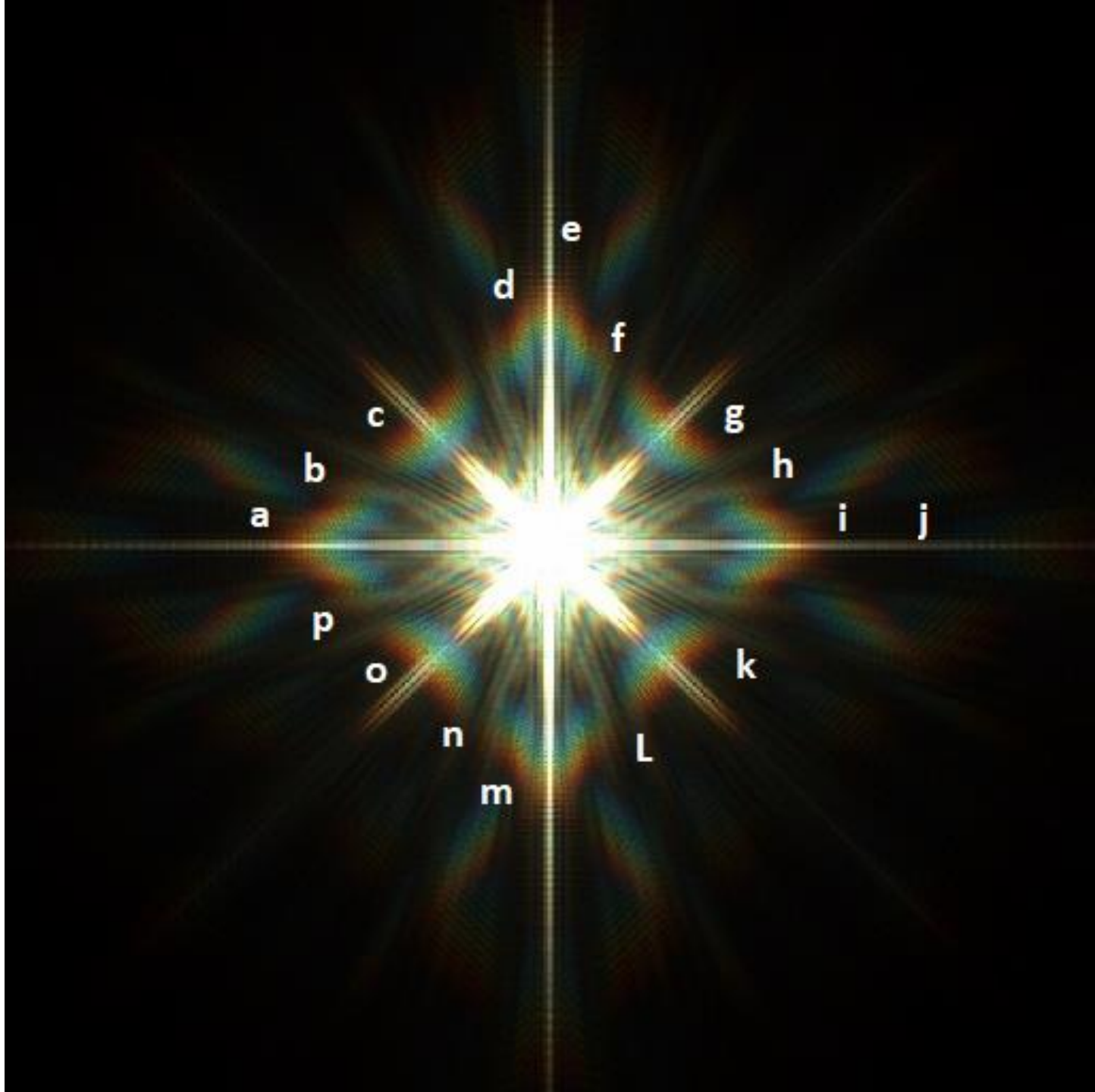


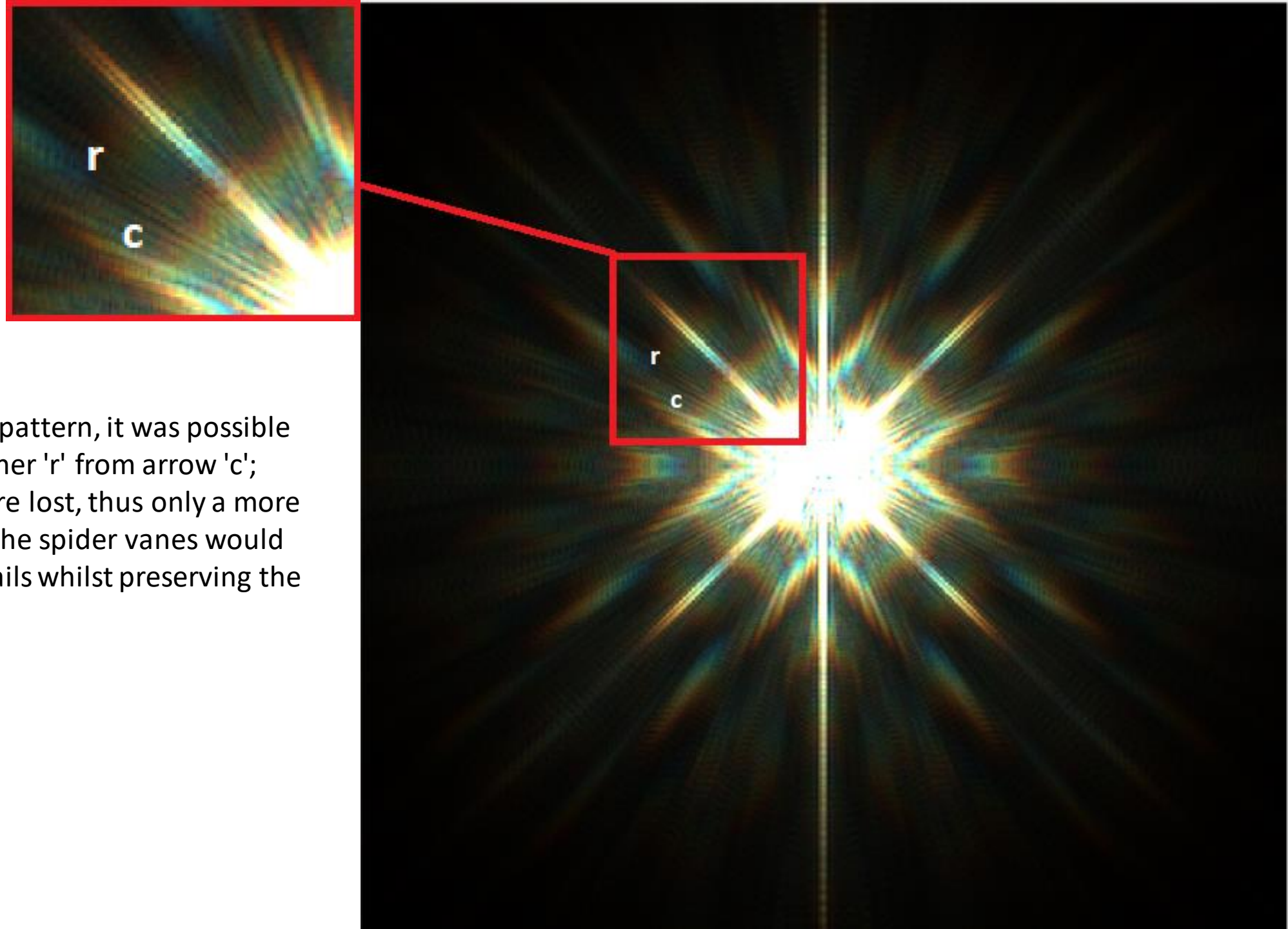
In order for the diffraction pattern to match the Chandelier more closely, the "arrow" 'c' should have a feather around the spike. The arrows are produced by the apodization spider vanes, thus a more precise apodization in the diffraction mask should bring up the missing details.

The horizontal feathers (a, i) are more elongated in the Chandelier image, possibly superimposed with another feather. Those feathers are produced by the apodizing spider vanes, and would change if the profile was more detailed.

The vertical feathers (d, m) are already a very good match to the Chandelier image, thus any changes to the apodizing spider vanes would affect these features too, indicating that the apodizing pattern along the vanes is probably irregular, and not necessarily symmetrical between faces and between vanes.

Revisiting the vanes image shows that the pattern is irregular within a vane, and between top and bottom vanes.

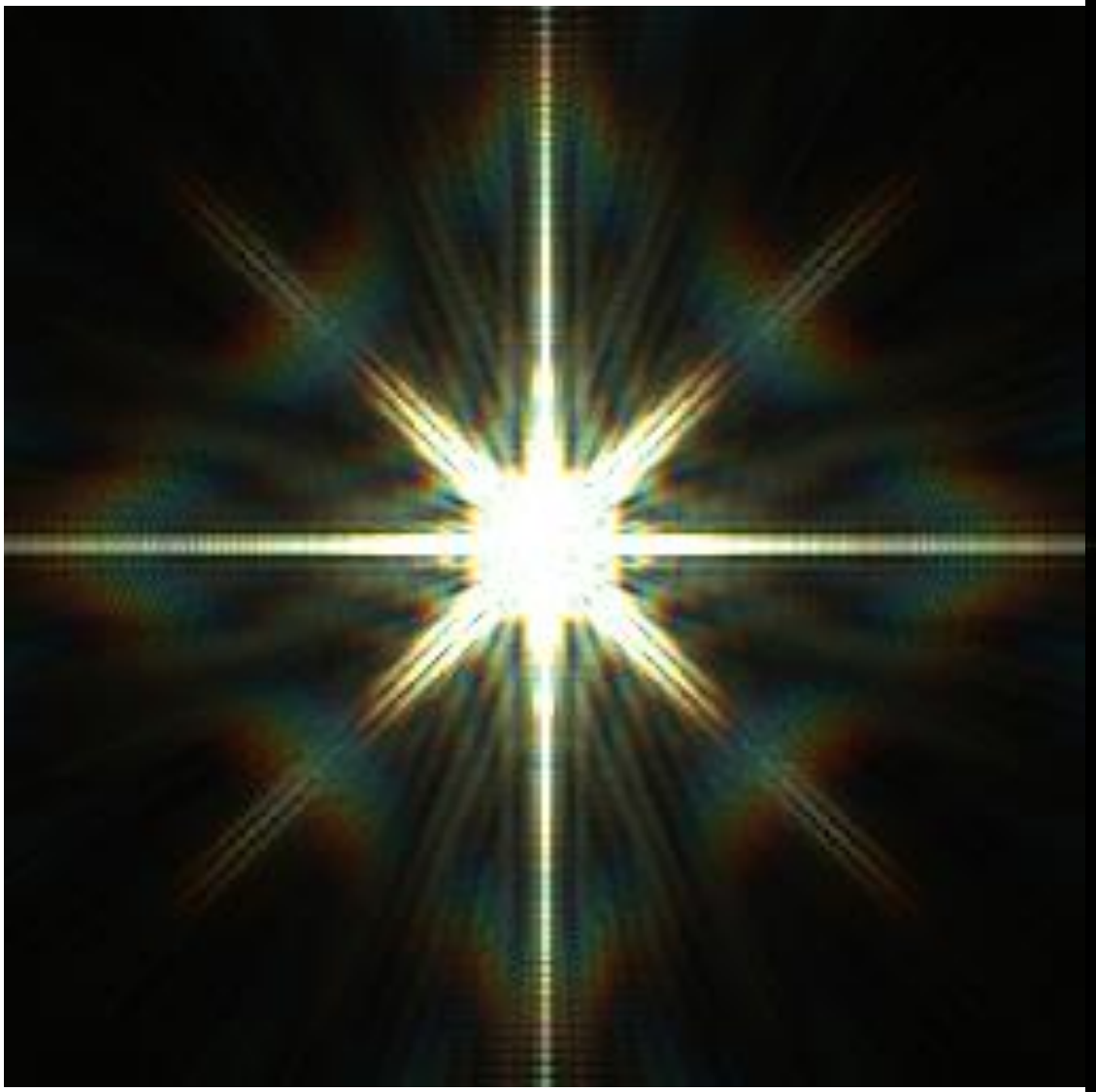


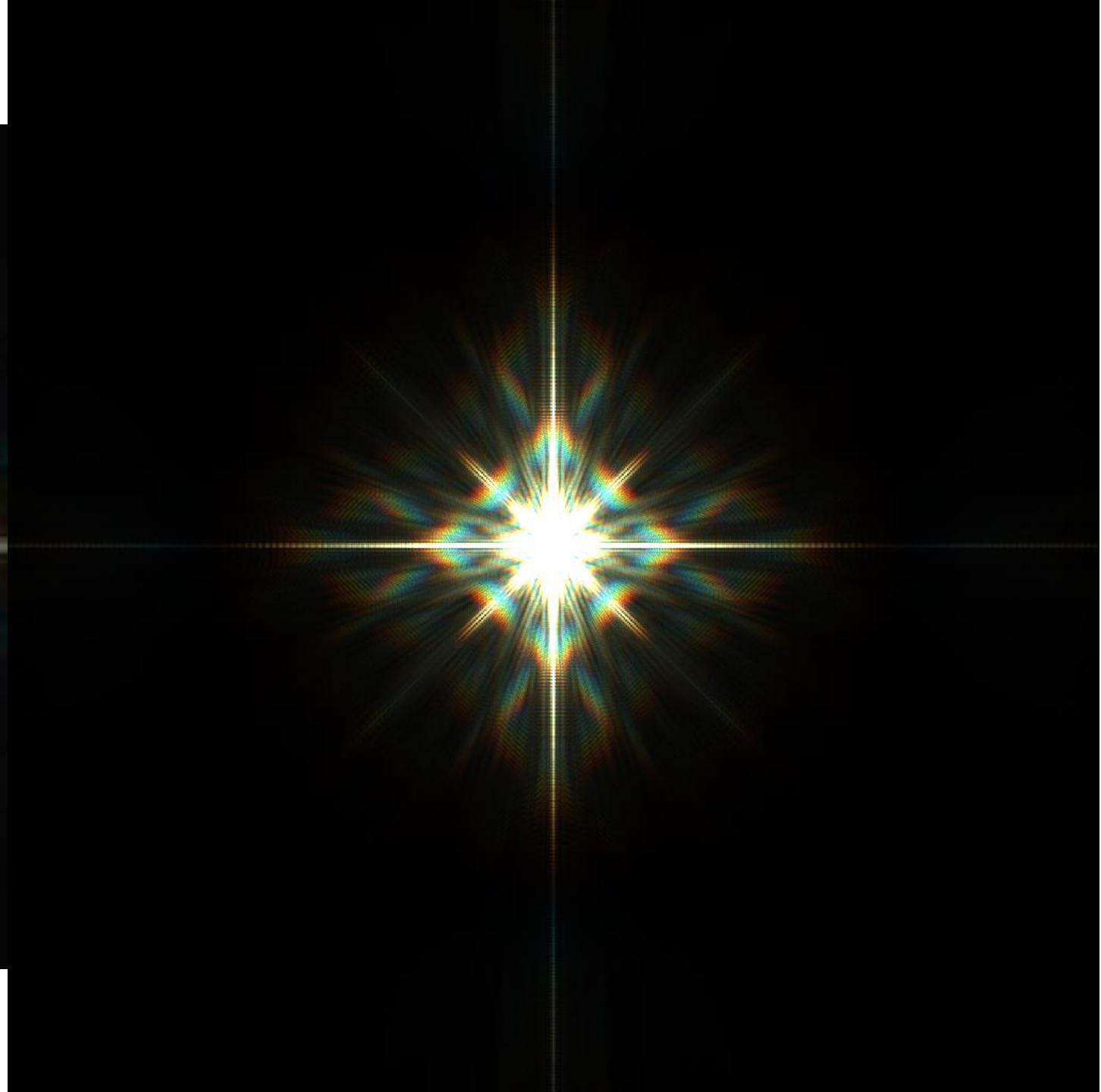


By modifying the apodizing pattern, it was possible to produce the missing feather 'r' from arrow 'c'; however, other features were lost, thus only a more accurate representation of the spider vanes would bring up all the missing details whilst preserving the details already uncovered.

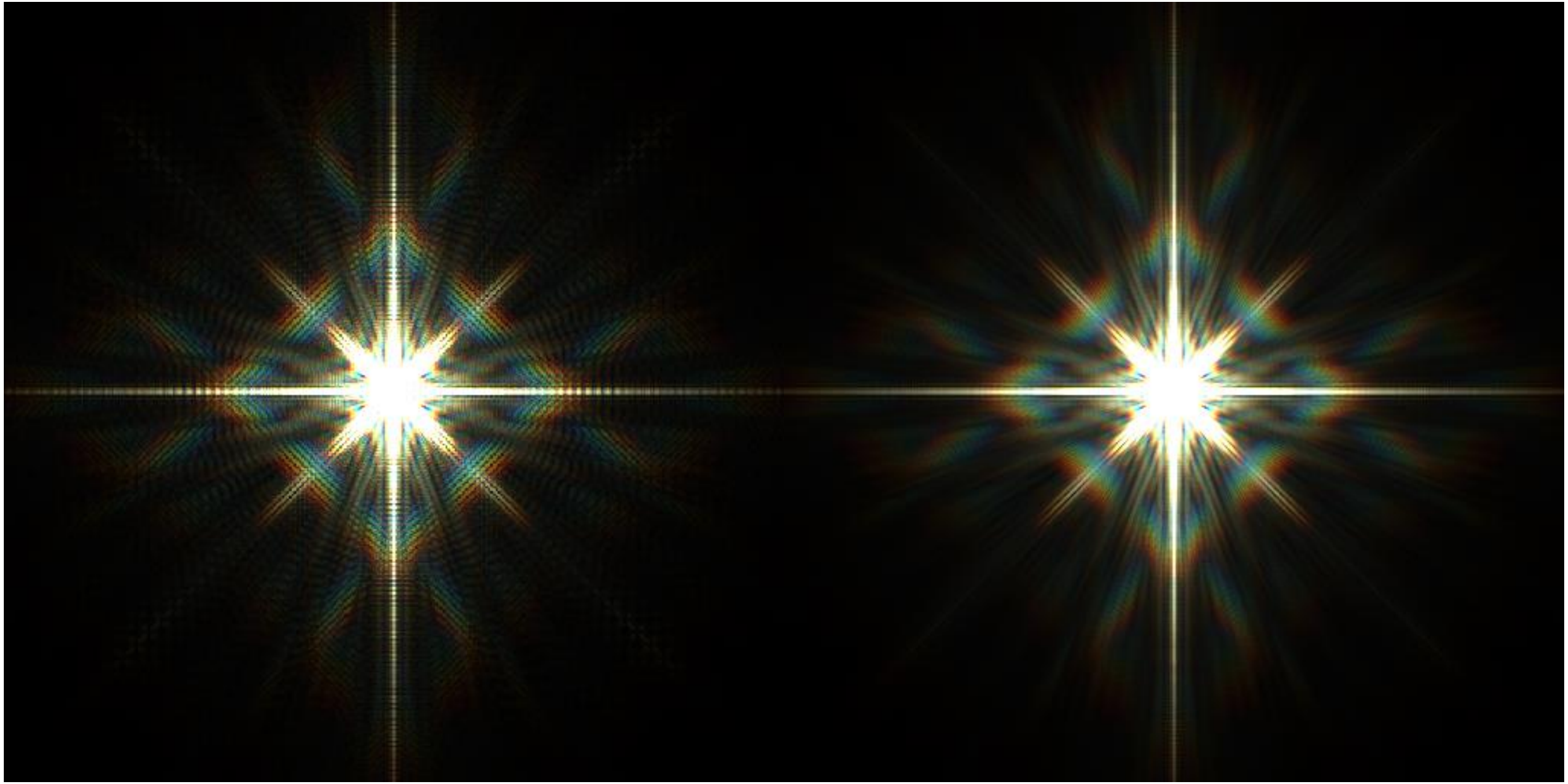
In conclusion, the "object" known as "Chandelier" is most likely a diffraction pattern caused by the instrument itself, instead of an extended object with that shape. The actual object presented itself as a bright point-like source of heat, small enough in proportion to the distance to the camera, to be obscured by the central region of the diffraction pattern.

Sensitivity check – Size 256px vs 1024px
Variation noted in level of detail, size 512px is used.

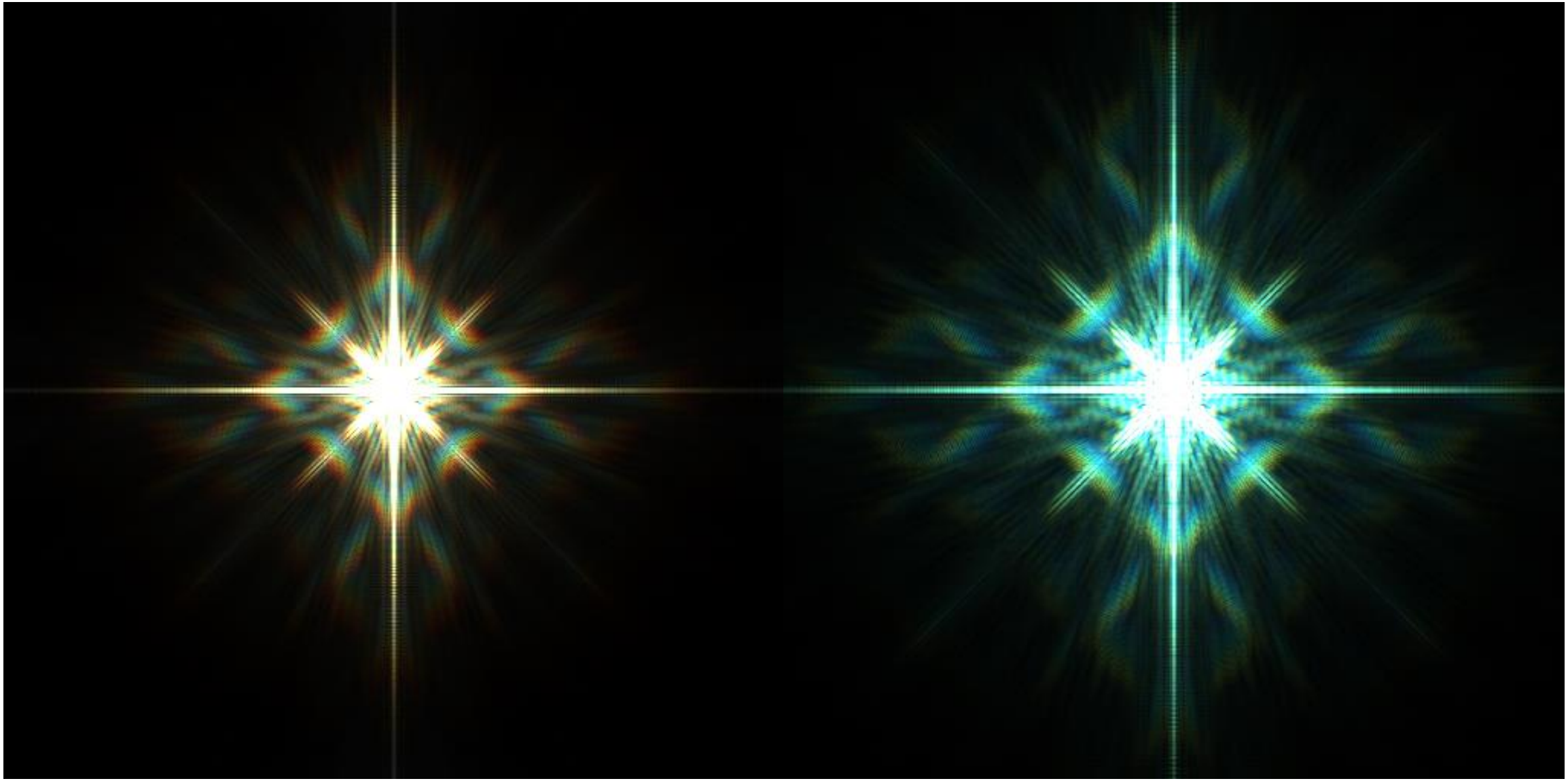




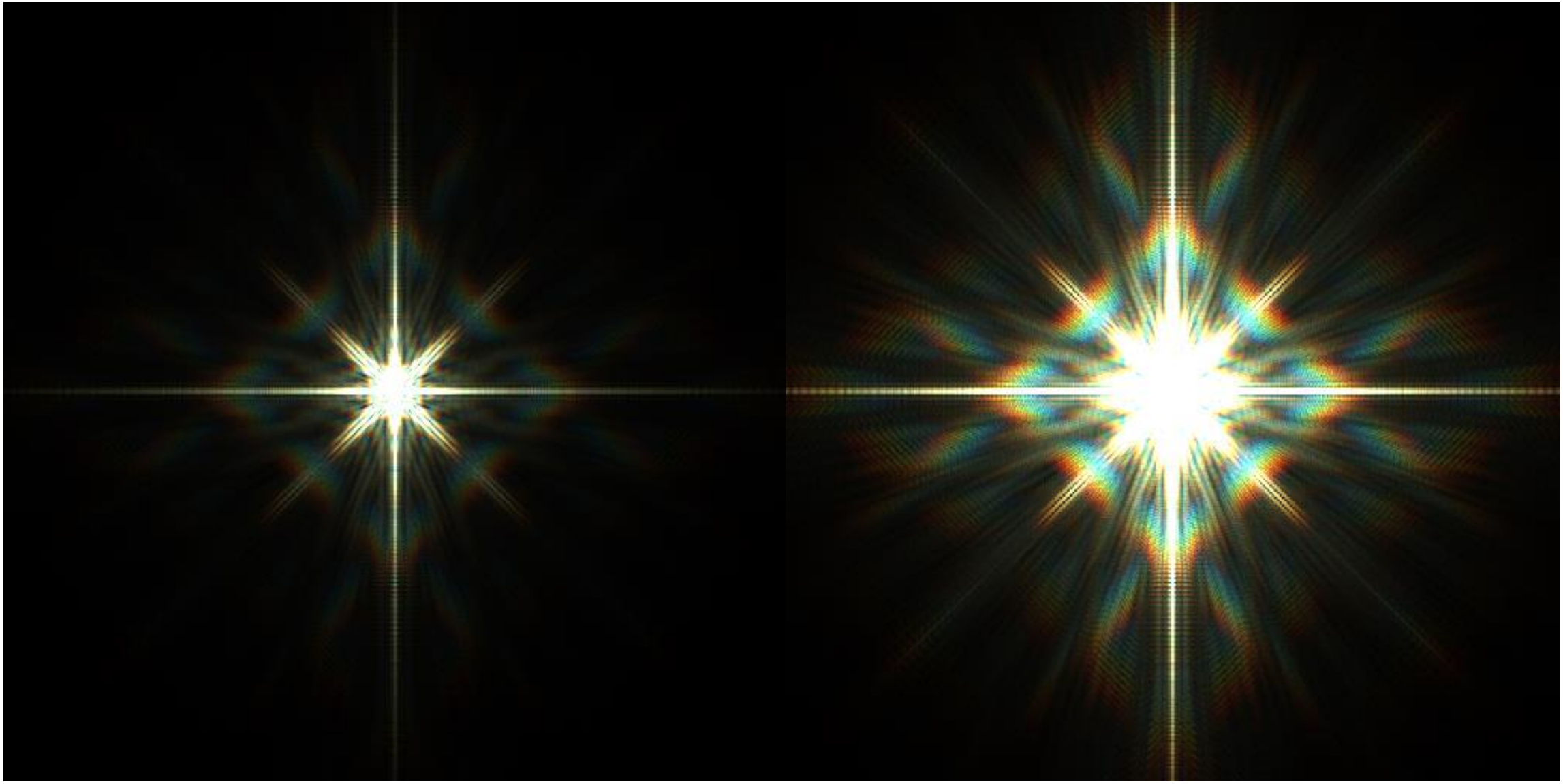
Sensitivity check – Wavelength Steps – 16 vs 64
Small variation noted, 32 steps used.



Sensitivity check – Wavelength Range – 468nm to 780nm vs 350nm to 585nm
Variation noted in colour only, 350nm to 780nm range used.



Sensitivity check – Brightness – 1.0 vs 5.0
Variation noted in apparent level of detail (screen calibration dependent), 2.5 used.



Sensitivity check – Focus– 0µm vs 200µm
Variation noted in fine detail, 0µm and 100µm used.