SOAR/SAM-FP
Problem with residual rings in the data.
Example on SAMFP, April2017, 009-NGC3132

PhA

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Problem

Residual rings appear during the data reduction process, see Figs 1, 3, 4, 5 or 6 for instance.

Explanation

The finesse of the etalon is 18, thus the data cube has been obtained through a scanning sequence of 36 channels in order to cover a whole FSR. This scanning sequence is nevertheless slightly under-sampled, this could be seen for instance by the presence of residual rings on Fig 1. The moments (especially the FWHM) clearly show residual rings if we compute them from the re-phased data cube but these residual rings do not appear when we compute the moment from the raw (not-rephased) data cube (see Fig. 3) where the first panel shows the FWHM computed from the raw data cube and the second and third panels the one computed from rephased data cube. Conclusion : this effect comes from the interpolation procedure of the profiles during the computation of the re-phased data cube.

In order to check if it comes come from the phase map itself, I made a parabolic model fitting of the phase map computed from adhoc to smooth out the residual rings from the adhoc phase map. Fig 2 clearly shows that both phase map are identical and that the modeled phased map has been cleaned from the residual rings see in the residual map (right panel). Fig. 3 second panel has been computed from the adhoc phase map while the third panel has been computed from the modelled phase map, it does not change anything, the residual rings are still there. The fourth panel clearly show that these rings have the same structure than the collapse calibration data cube.

Solution : first approach

The rings are due to a spectral under-sampling thus if we spectrally smooth the raw data, we enlarge a little bit the profiles and the rings vanish as illustrated in Figs. 4, 5 and 6. We nevertheless not that with a gaussian smoothing of 2 channels the residual rings are still visible on the continuum map (Fig. 4) and even with a gaussian smoothing of 5 channels the residual rings are visible in the FWHM map (Fig. 6).

Solution : second approach

In conclusion the smoothing process in not sufficient so I oversampled the raw data cube by a factor 3 by linear interpolation. This does not change the intrinsic under-sampling but

this help to define the slope of line before a spectral smoothing on the 108-channels raw data cube. The raw data has been slightly smoothed by a gaussian of 3, 5 and 10 channels (which correspond to a smoothing of 1, 1.67 and 3.33 channels on the 36-channels data cube). Figs. 7, 8 and 9 convincingly show that a smoothing of 3 channels (over 108 channels in total) is enough to cancel the residual rings.

Conclusion

1) The raw phase map is sufficient to re-phased the raw data cube.
2) A spectral oversampling by a factor 3 and a small spectral gaussian smoothing of 3 channels (over 108) solves the problem.

Action

Bruno, I suggest that you make a program in python to oversample the original raw data cube (because I did it with idl).
Procedure :
1 – Triple the raw data cube (to avoid problem with the boundaries), this is the program you have already done.
2 – Oversample by a factor (chosen by the user) the "tripled" raw data cube (TDB).
3 – Extract a 1/3 of the oversampled data cube, this is another program you have already done.
So from a practical point of view, you just have to develop item 2.

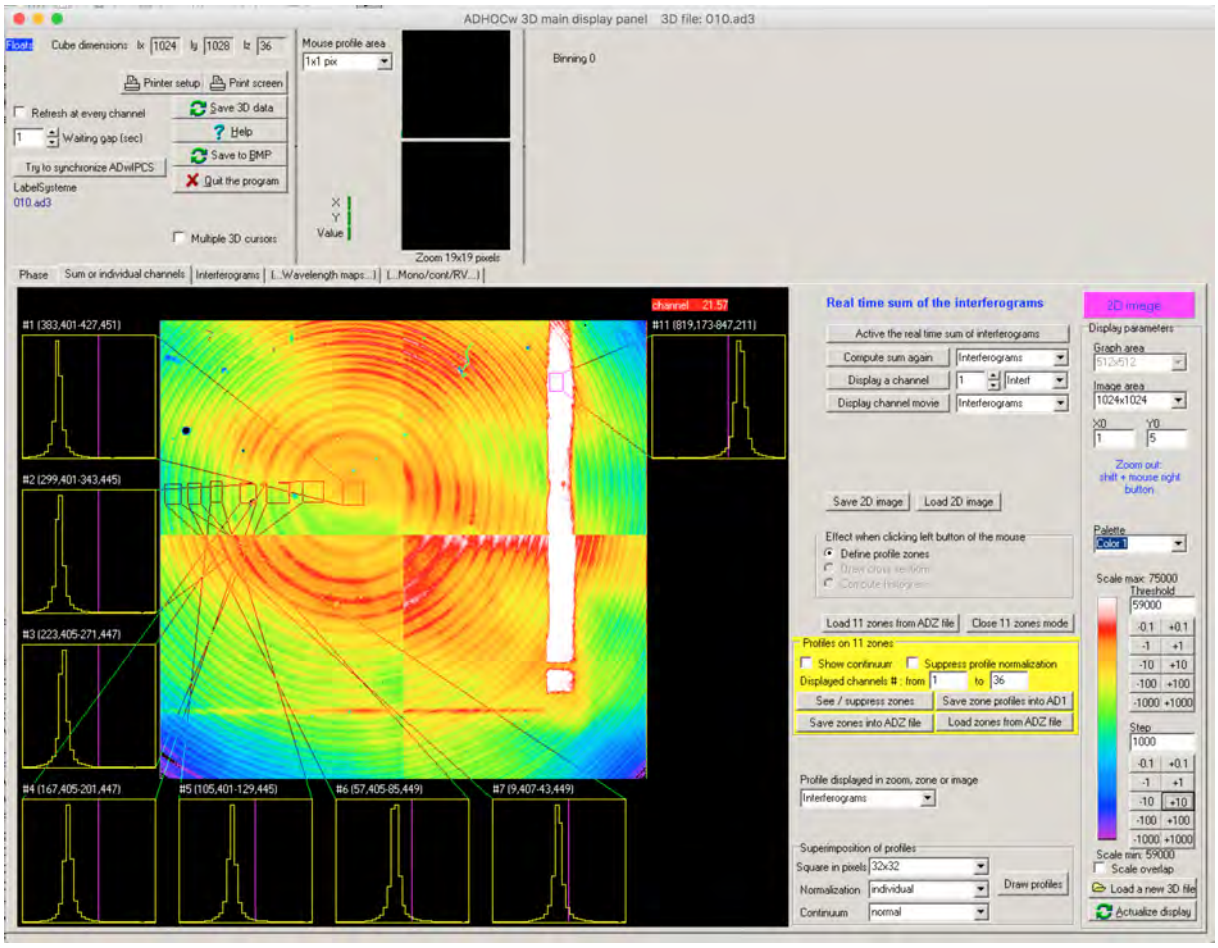

FIGURE 1 – 36 Channels. Sum of the 36 channels of the calibration data cube.

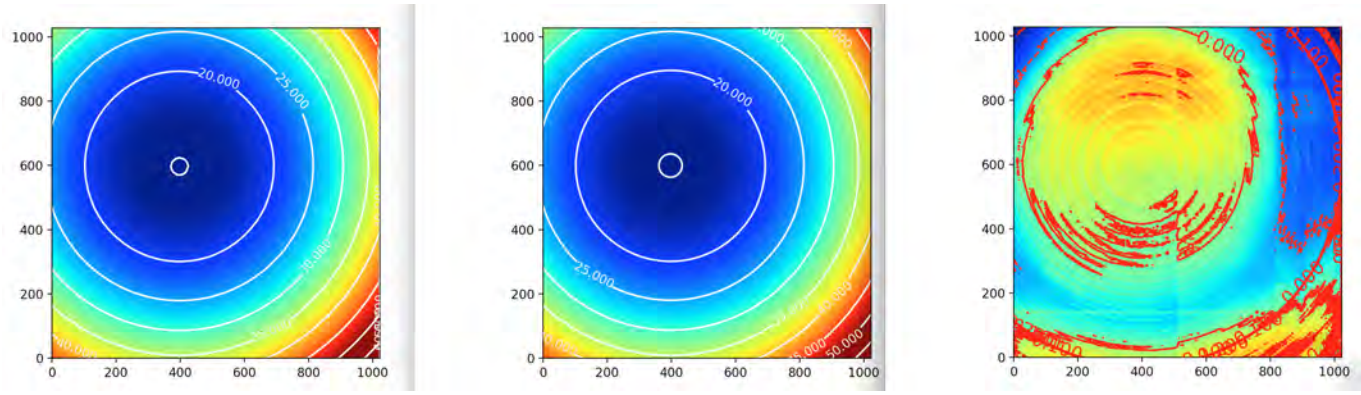

FIGURE 2 – 36 Channels. Phase-maps. Left : phase computed with ADHOCw. Middle : Phase modelled with a parabola. Right : difference between the phase observed and the phase modelled. The numbers correspond to the values of the phase in channels.

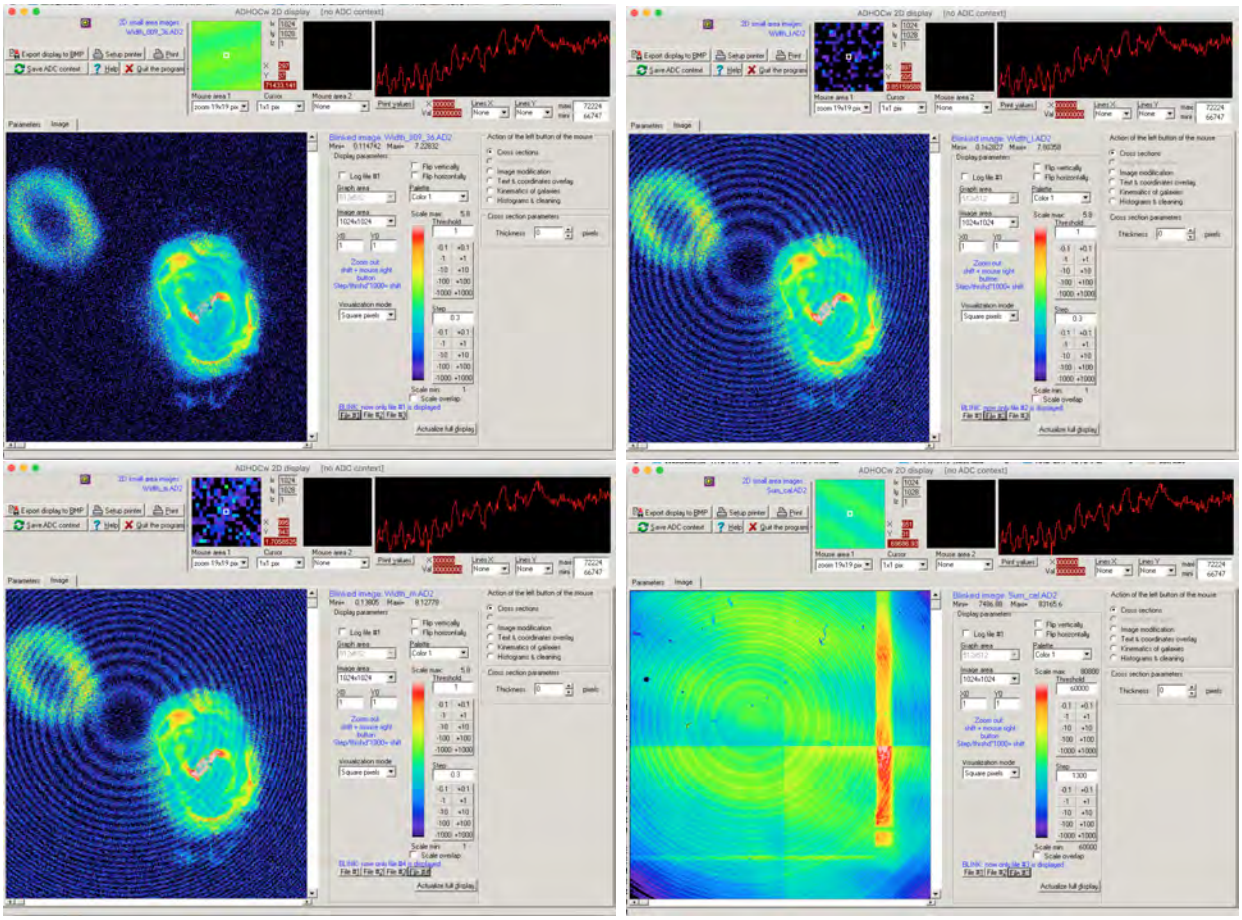

FIGURE 3 – 36 Channels. - from left to right : FWHM computed from the raw (non-rephased) data cube, FWHM computed from the adhoc rephased data cube, FWHM computed from the modeled rephased data cube, collapse in the scanning direction of the calibration data cube.

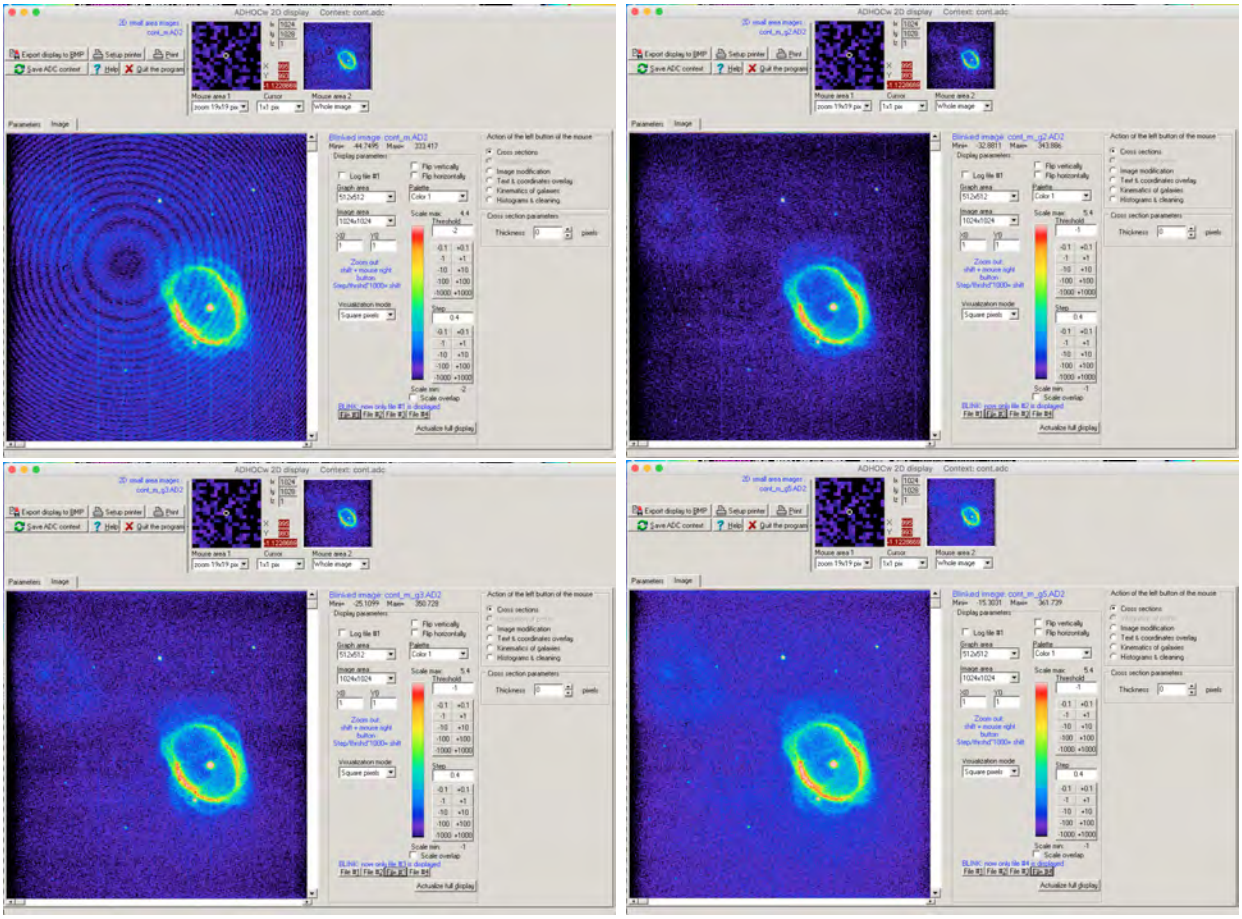

FIGURE 4 – 36 Channels. - Raw data, Gaussian smoothing : 2-3-5 channels, continuum

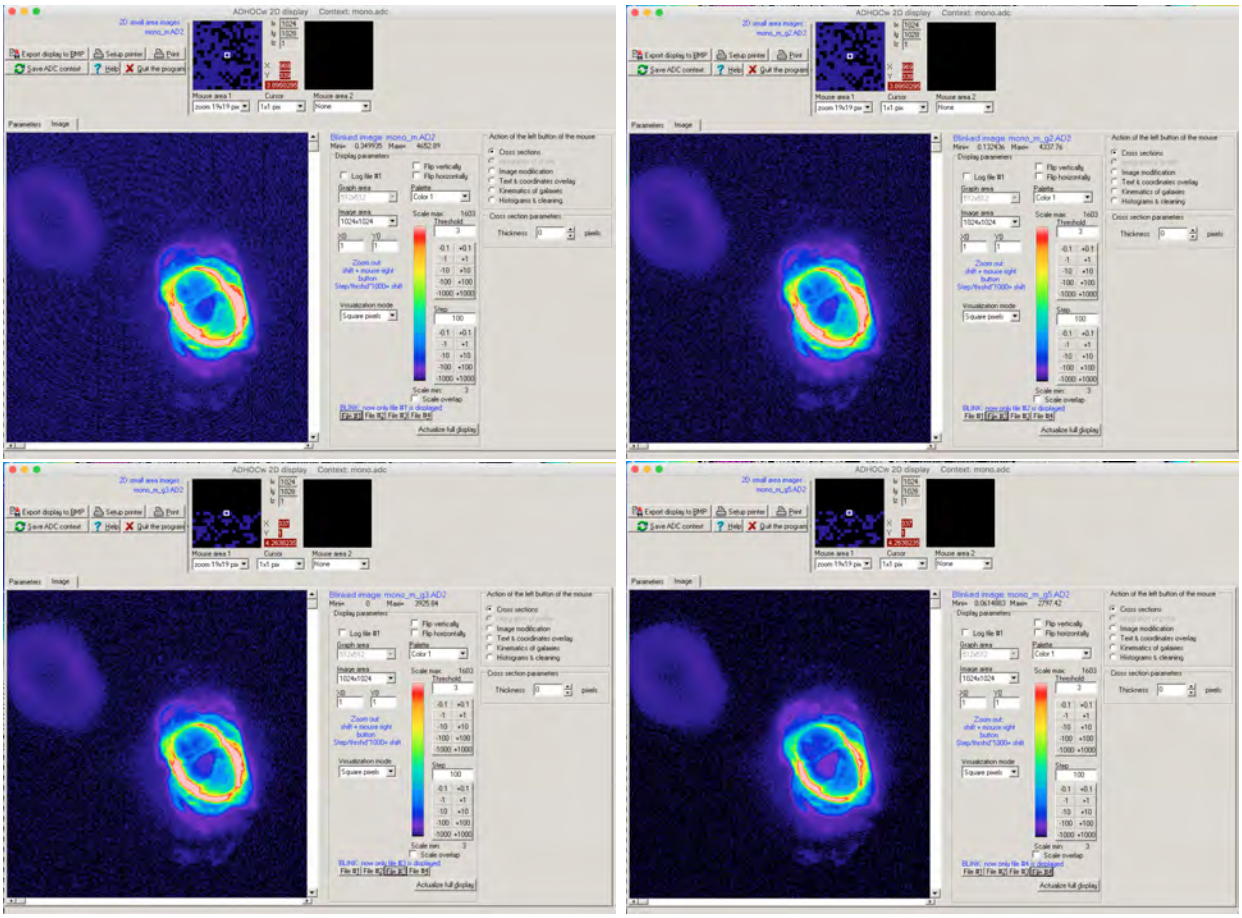

FIGURE 5 – 36 Channels. - Raw data, Gaussian smoothing : 2-3-5 channels, Monochromatic

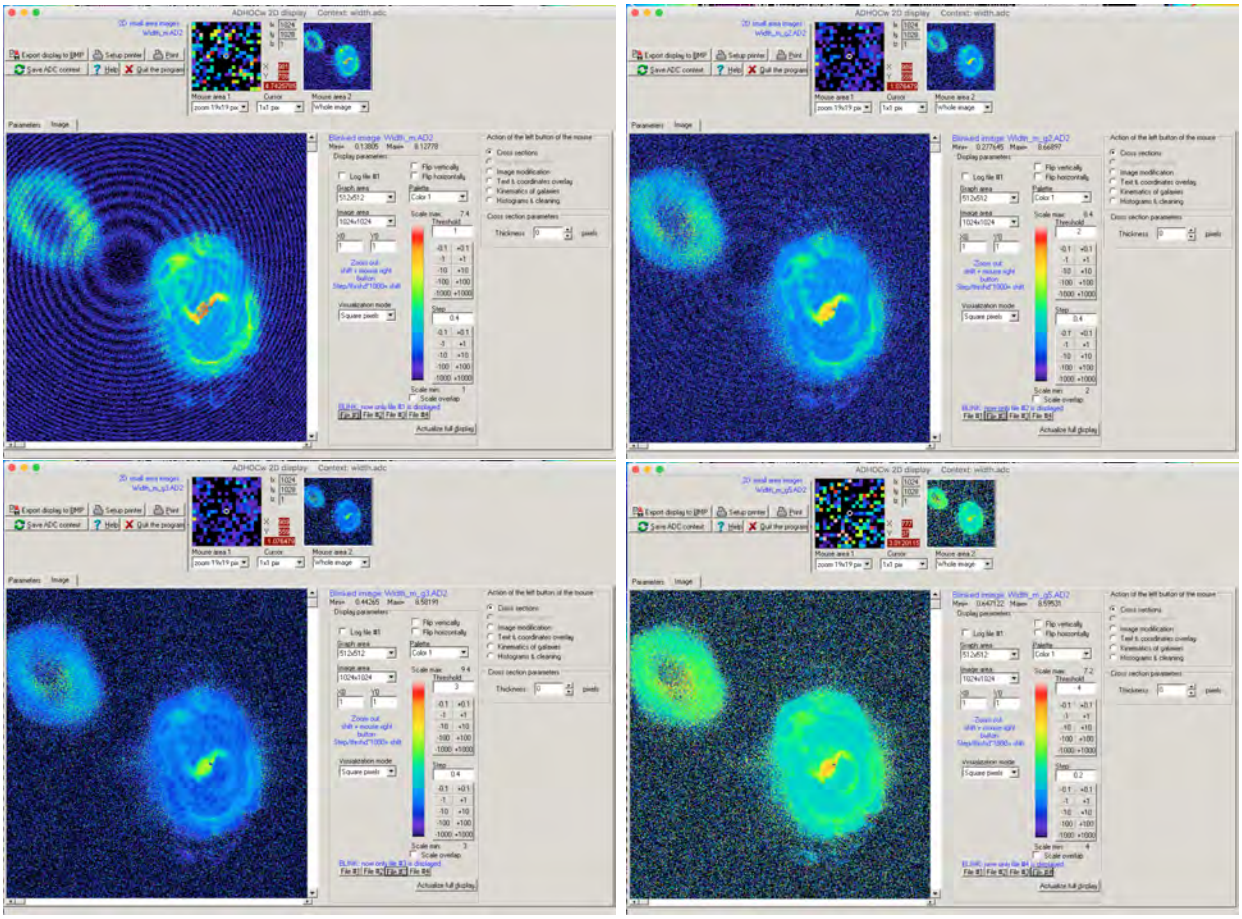

FIGURE 6 – 36 Channels. - Raw data, Gaussian smoothing : 2-3-5 channels, FWHM

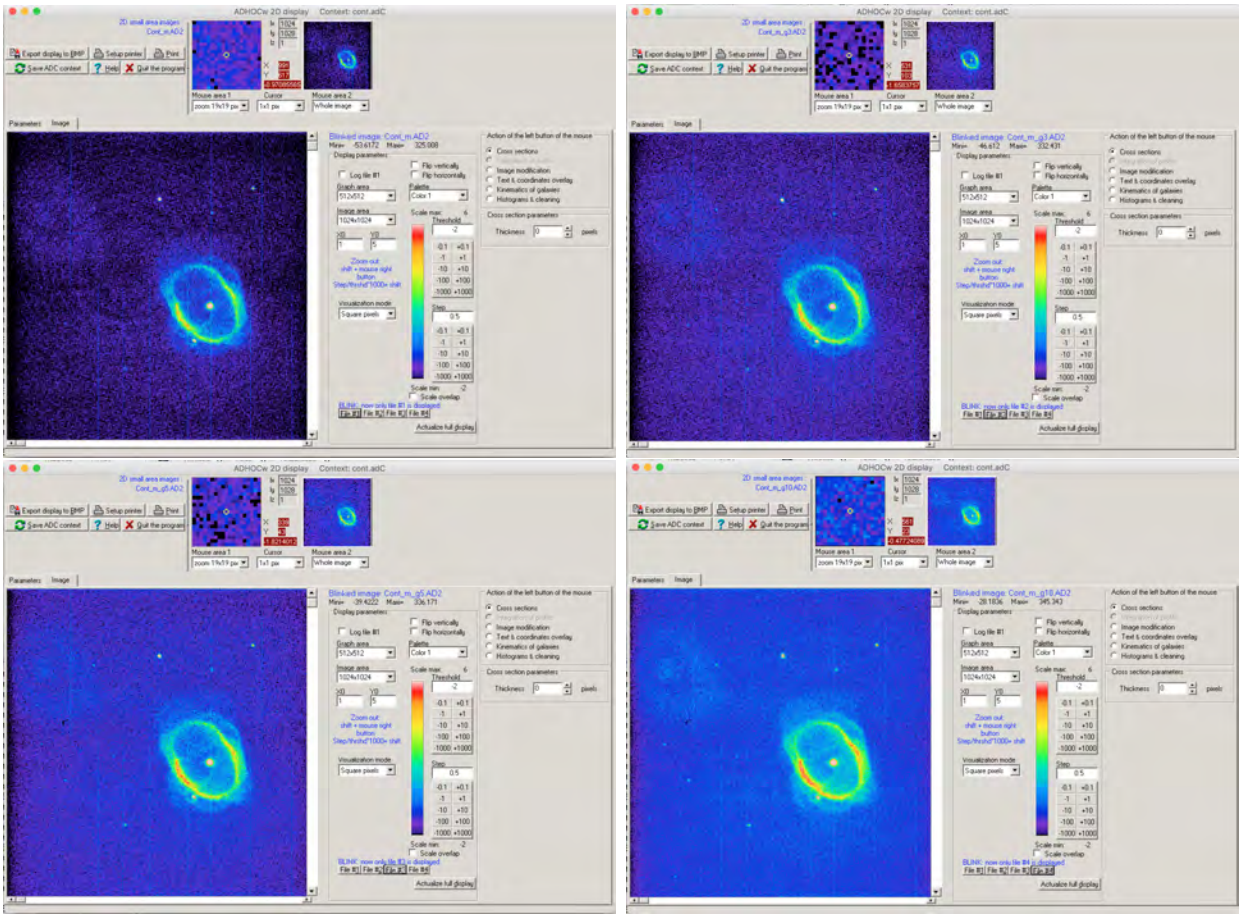

FIGURE 7 – 108 Channels. Raw data, Gaussian smoothing : 3-5-10 channels, continuum

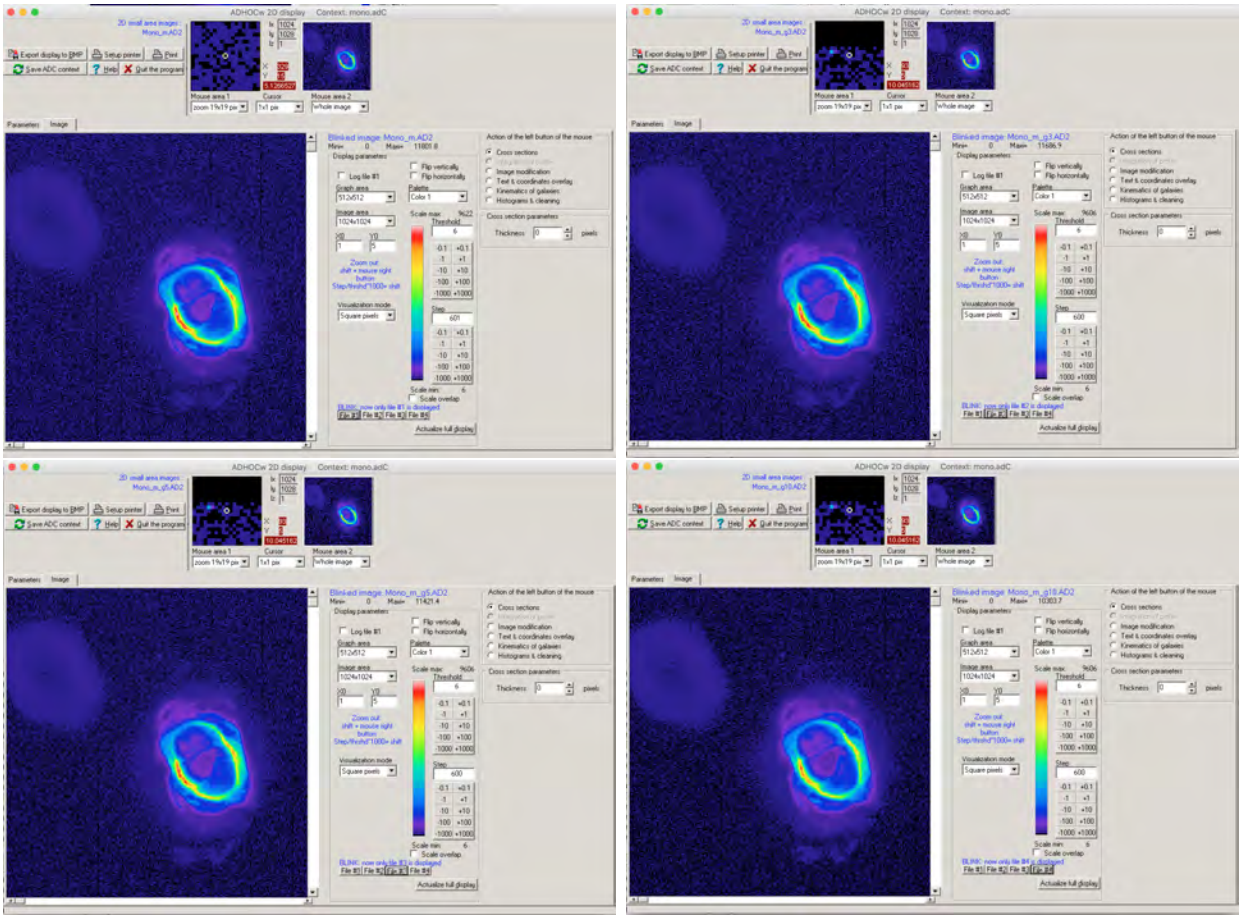

FIGURE 8 – 108 Channels. Raw data, Gaussian smoothing : 3-5-10 channels, Monochromatic

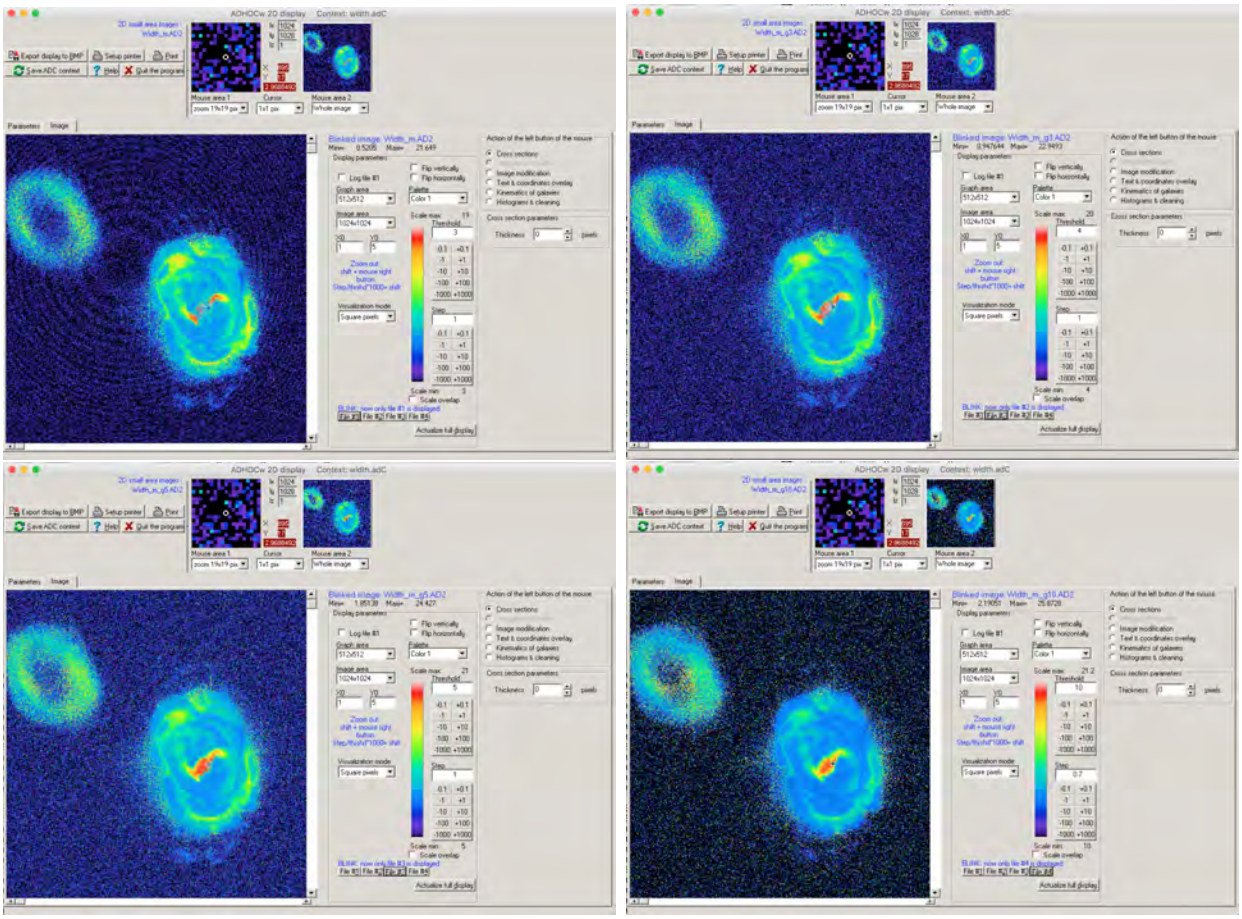

FIGURE 9 – 108 Channels. Raw data, Gaussian smoothing : 3-5-10 channels, FWHM