

Data Reduction of BVIT exposures May 2013

Our main aim was establish whether BVIT/SALT could be used to study optical pulsar. These objects with the brightest in the Southern Hemisphere being about 23-24 magnitude. As this was the first BVIT data I have analysed there were some initial teething problems.

Three software packages were used.

The BVIT IDL suite of software worked well and had good support from SALT and Berkley. This software was used for the final extraction of the time series. However a number of problems were encountered firstly as the object was faint it was difficult to determine the exact location of the pulsar particularly given the pixel plate scale. Secondly the software assumed the tracking problems were linear across all frames and there was little or no geometrical optical distortion.

To get around these two problems I used two additional packages - ESO Midas and Matlab. Midas to extract the photon positions, times and pulse height and Matlab to turn these into a set of images. From these we had 341 individual fits files - see Figure 1. These were then binned into blocks of 25 images to create a better estimate of the starting and end location. A number steps were then carried out. Firstly the BVIT images were compared with HST images of the Vela region to get an exact position - see Figure 2. Secondly from this we could get an exact position of the pulsar for use by the BVIT software. Finally from the BVIT software we could extract the times from the pulsar and comparison star. To do this I hard coded the positions into the Berkley code.

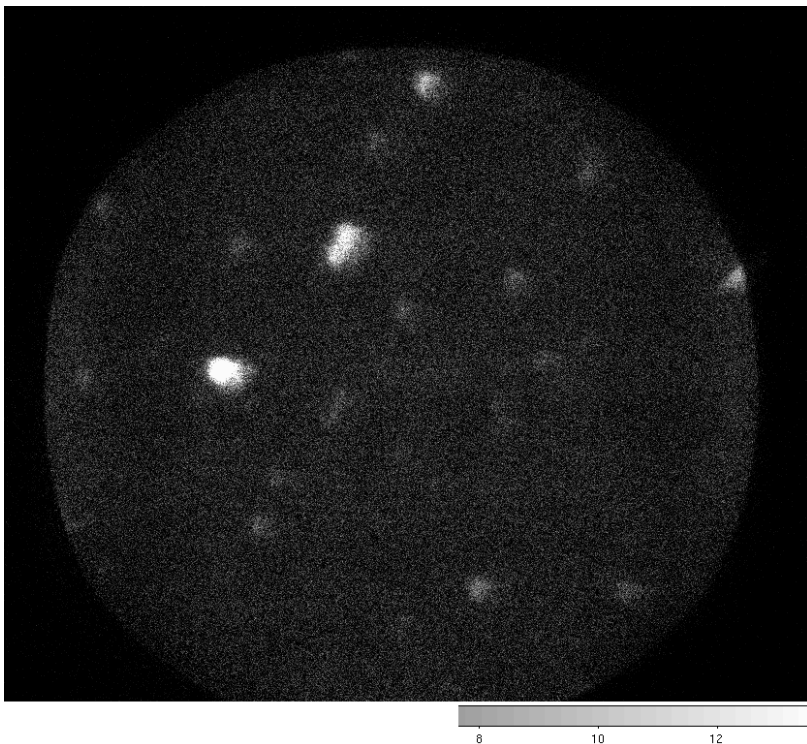


Figure 1 : Individual block summed [6 secs] at the start of the exposure

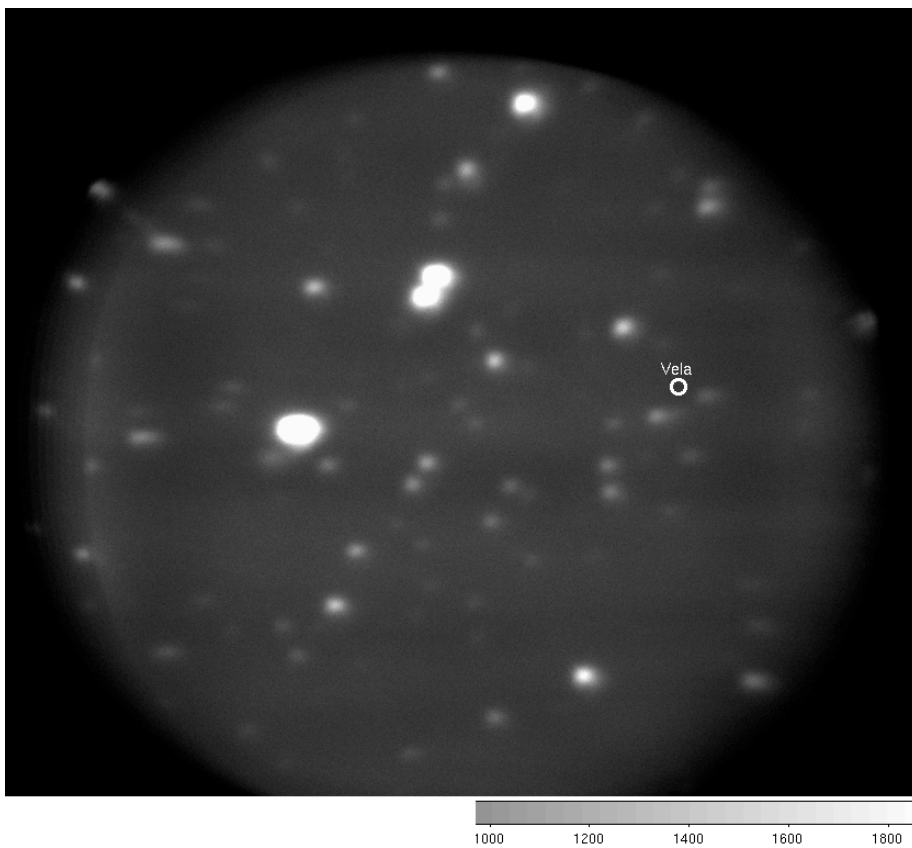
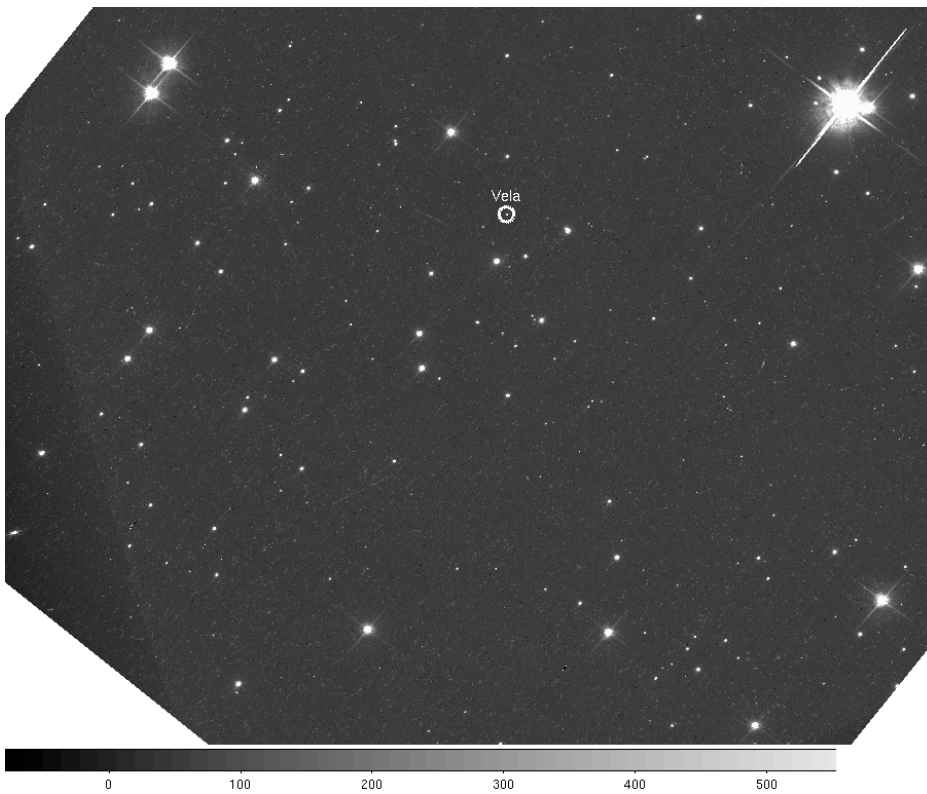


Figure 2 : HST and summed BVIT images showing location of pulsar marked with a circle on both images - the summed image corresponds to about a 600 second exposure. It would help if Vela was initially position more centrally.

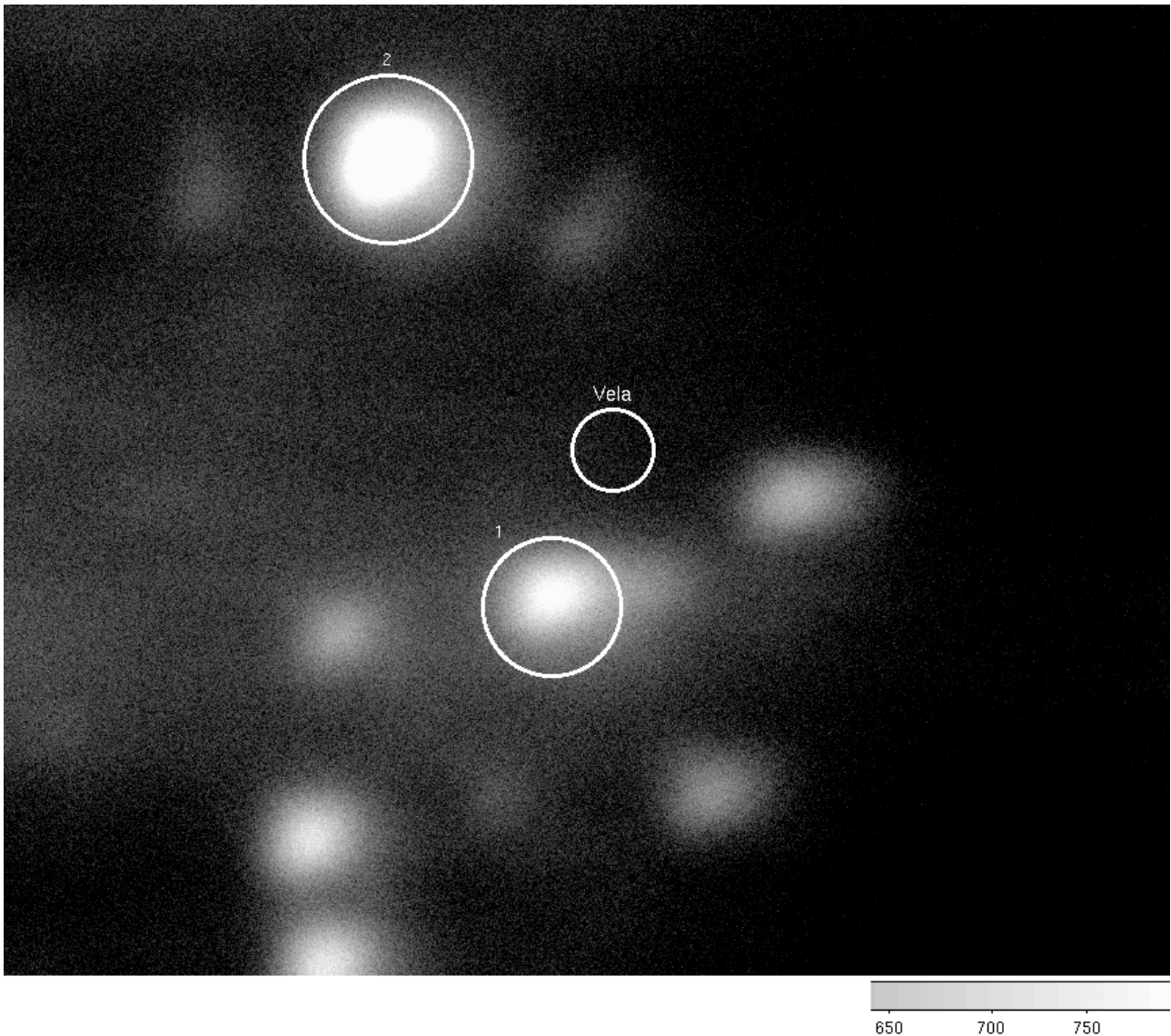


Figure 3 blow-up of pulsar region : Vela marked. Note the faint star above and to the left of Vela is just becoming visible in BVIT image but this is clearly visible in the HST image. There is some evidence of geometrical distortion in this high contrast image.

Flux determination

We compared the BVIT counts, from a 60 pixel radius aperture with stellar magnitudes from the USNO-B catalogue. Our aperture corresponded to the average seeing or $2''.4$. The chosen stars are shown in Figure 3 and the count vs magnitude plot in Figure 4. There is rough agreement, without allowance for possible flat field effects. One star is significantly out and we are investigating this but is probably due to our calculation of the unfiltered BVIT response.

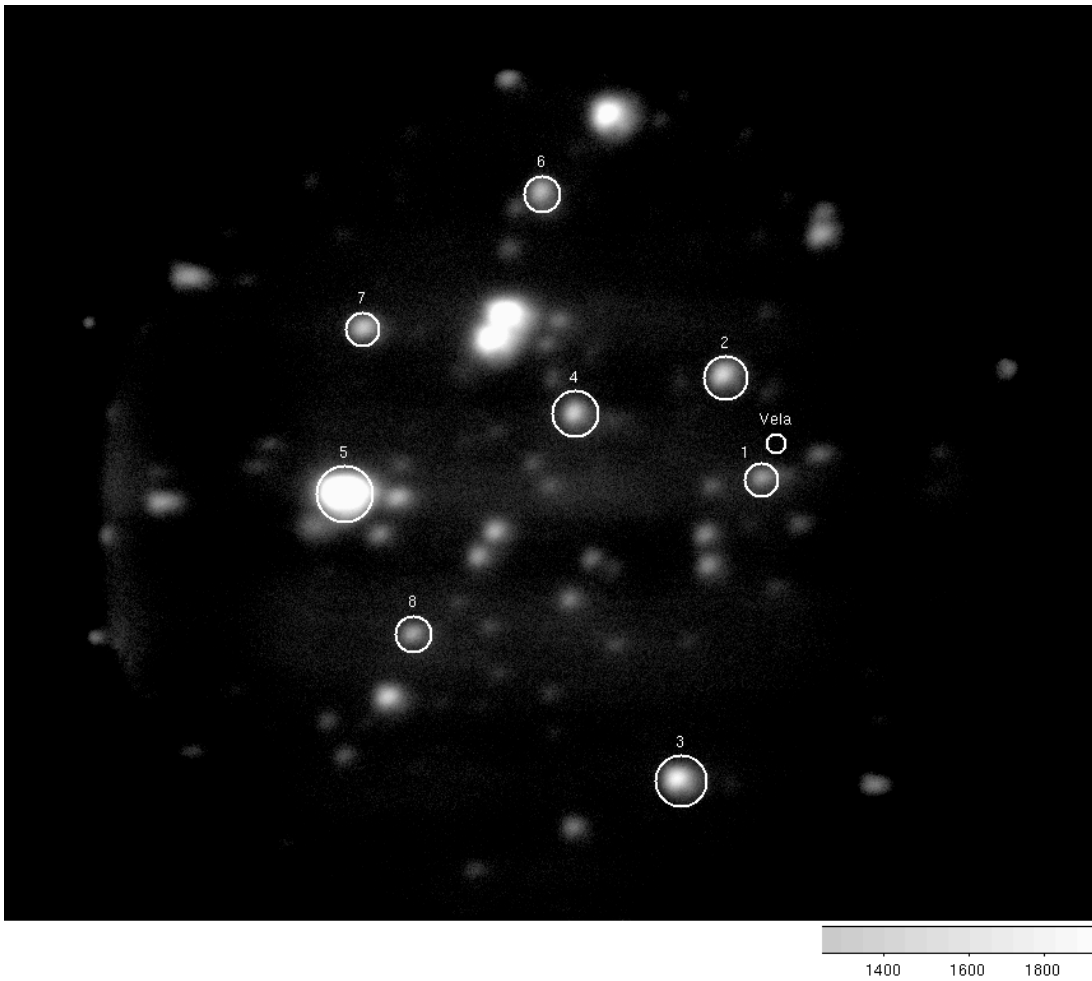


Figure 4 : Comparison stars for flux comparison

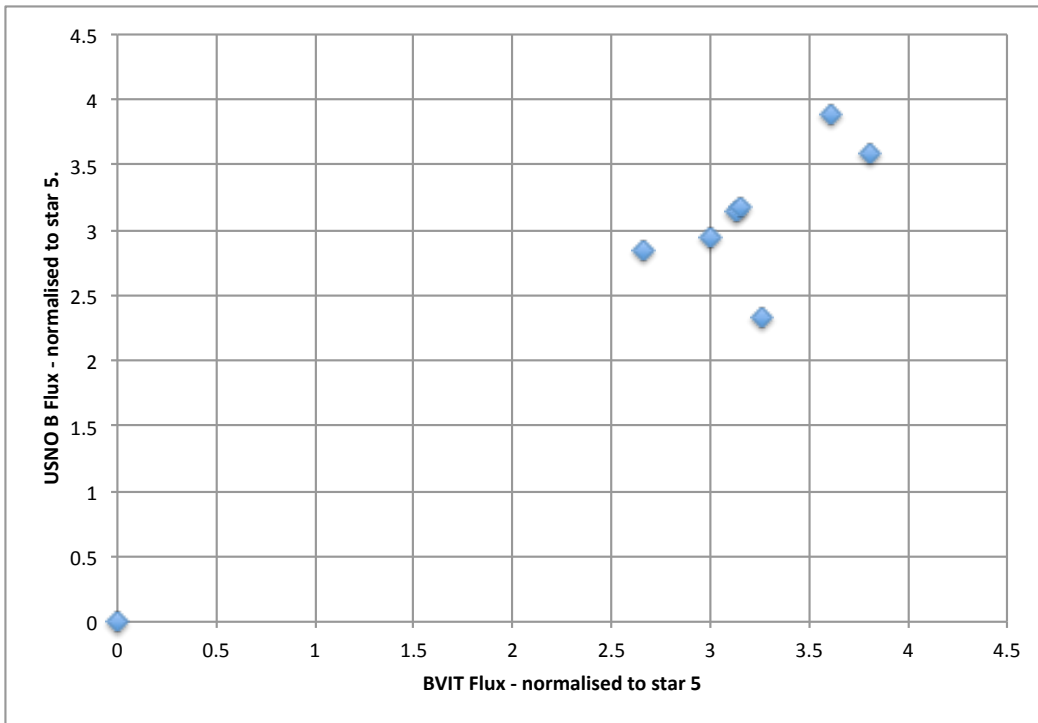


Figure 5 : Flux comparison against USNOB catalogue - the zero zero point is star 6.

Recommendations and requests

1. The iris is reduced so that the ND filter can be removed and pellicle guiding is performed
2. The pulsar is moved to a more central position as there seems to be evidence of some geometrical distortion close to the edge - see Figure 3.
3. A flat field is taken this will help our relative photometry.
4. If at all possible the drift in position should be uniform when the observation is taken unguided. This allows for the BVIT software to be used for a quick look analysis.

Figure 6 : Geometrical distortion towards the edge.