Astronomy Lab: Report 8

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Introduction

In this experiment our goal is to calculate magnitude of other stars based on a reference star, which we know the magnitude of. Using our Canon 1200D, we took flats, darks for our flats, pictures of orion nebula and areas around it (our target was orion belt, but unfortunately we didn't capture it).

Experiment

preprocessing

After we made the masterdark and masterflat, we had to align and stack our orion pictures. In order to do that, i located the same star in everry picture and used scipy.ndimage.shift to align the pictures.

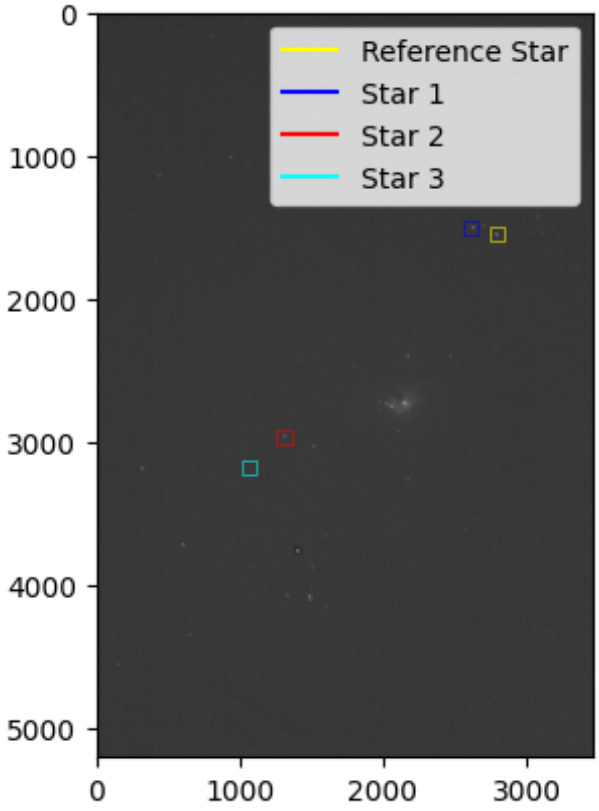

Figure 1: Selected stars for calculation

I'm not completely sure but based on cheking stellarium on the exact time and date that we took the photos:
reference star : Mizan Batil I
star 1 : 45 Ori
star 2 : HIP 26314
star 3 : HD 37188

I tried to select stars with different magnitudes, i know some of them are double stars but we did not have better choices in our image.

Relative Magnitude Calculation

In aperture photometry, we set a circular area which we call the object aperture, on the star to calculate magnitude. then in order to remove noise we select an area outside the previous area (which we set between two and three times the the star radius)
These are the equations we used to calculate magnitude and noise and errors:

$$m = -2.5log(\frac{star\ brightness - sky\ brightness}{exposure\ time} + C$$

$$noise = N\sqrt{noise_s^2 ky + noise_r^2 ead}$$
$$\frac{\Delta m}{m} = \frac{1.08}{SNR}$$
$$SNR = \frac{Brightness}{noise}$$

In order to find the best radius, we gradually raise radius and calculate SNR (singal to noise ratio) and pick the radius in which SNR is at it's peak.

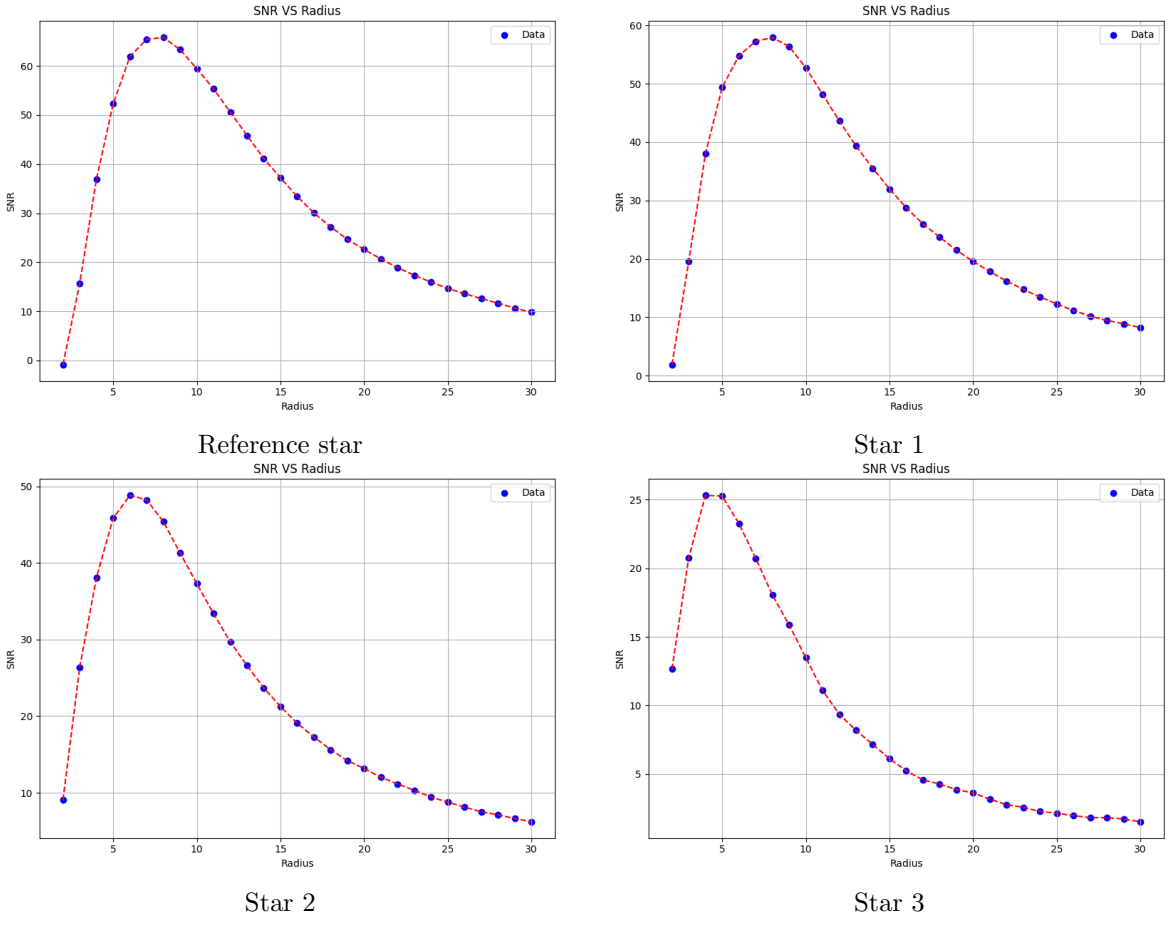

Figure 2: Max SNR method to find best radius

We calculated center of mass to find the center of each star. Since stars look elliptical, it would be better to calculate it's diameters and use an ellipse to estimate gain, but it would make things really complicated, so we just used the circle for simplicity.
Here are the resulting pictures:

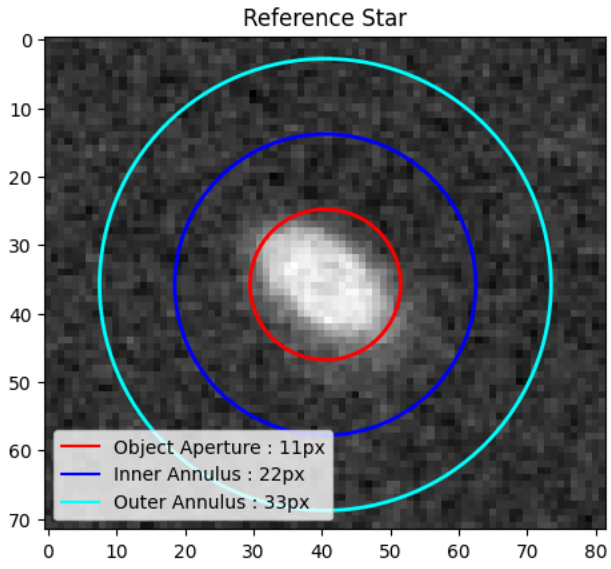

Figure 3: SNR = 65.80

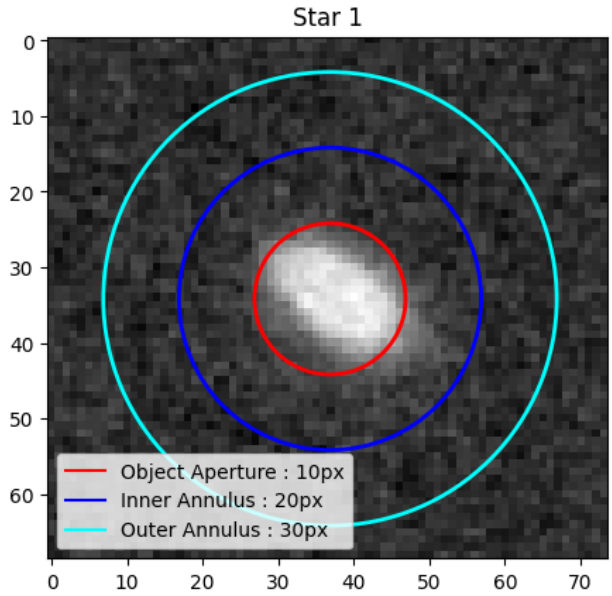

Figure 4: SNR = 57.93

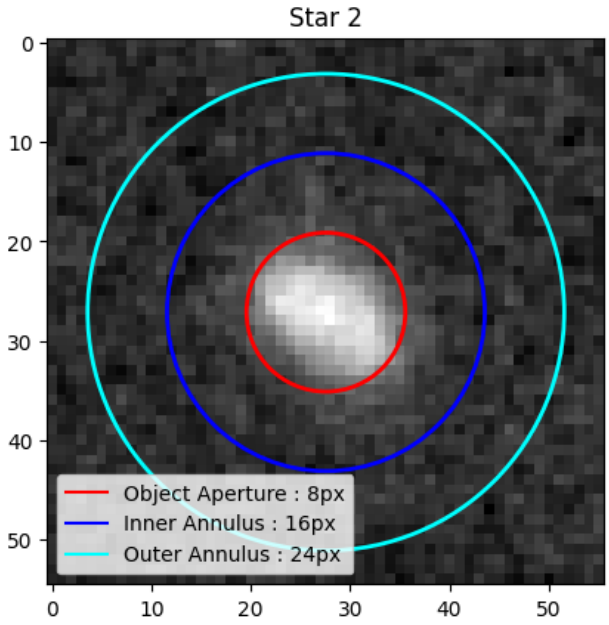

Figure 5: SNR = 48.83

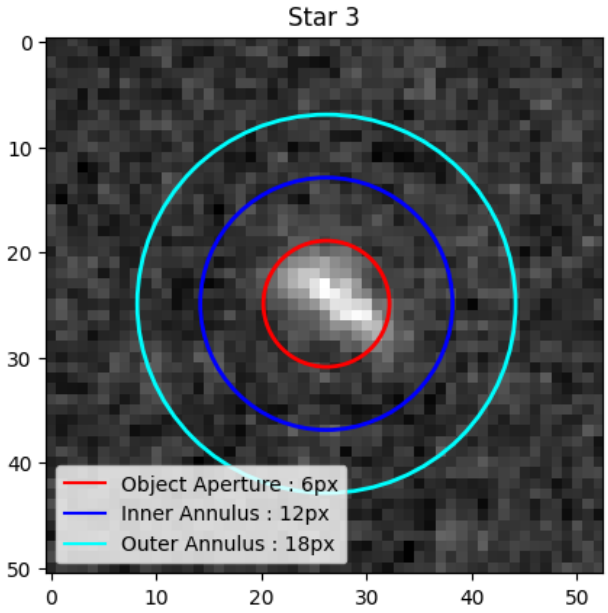

Figure 6: SNR = 25.32

assuming our reference star has a magnitude of 4.59 (from stellarium):

Title	*Magnitude*
Reference Star	4.59
Star1	4.749 ± 0.025
Star 2	5.389 ± 0.028
Star 3	6.762 ± 0.046

Table 1: resulting magnitude