

```
In [10]: import glob

        from astropy import units as u
        from astropy.io import fits
        import numpy as np
        import matplotlib.pyplot as plt
```

```
In [11]: files=glob.glob('*.fits')
        files_osr=[line.rstrip('\n') for line in open('files_osr.list')]
```

```
In [12]: n=len(files)

        for i in range(0,n):
            data=fits.getdata(files[i])
            new_data=data[350:1650,350:1650]
            fits.writeto(files_osr[i],new_data)
```

```
In [14]: biasfiles=glob.glob('osr*bias*.fits')
        biasfiles
```

```
Out[14]: ['osr_arctic_bias.0001.fits',
          'osr_arctic_bias.0002.fits',
          'osr_arctic_bias.0003.fits',
          'osr_arctic_bias.0004.fits',
          'osr_arctic_bias.0005.fits']
```

```
In [15]: data_stack = []
        for file in biasfiles:
            data_stack.append(fits.getdata(file))

        medianBias = np.median(data_stack,axis=0)

        header = fits.getheader(biasfiles[0])

        header['HISTORY'] = 'Median combined'
```

```
In [16]: datafilesin = [line.rstrip('\n') for line in open('files_without_bias.list')]
        datafilesout = [line.rstrip('\n') for line in open('files_subtracted_bias.lis
t')]

        n = len(datafilesin)

        for i in range(0,n):
            data = fits.getdata(datafilesin[i],header=False)
            dataout = data - medianBias
            # header['HISTORY'] = 'Bias subtracted'
            fits.writeto(datafilesout[i],dataout)
```

```
In [17]: flatfiles_5007=[line.rstrip('\n') for line in open('flats_5007.list')]
flatfiles_5007
```

```
Out[17]: ['no_bias_arctic_5007_flat.0009.fits', 'no_bias_arctic_5007_flat.0010.fits']
```

```
In [18]: _5007_flat_stack = []
for file in flatfiles_5007:
    data = fits.getdata(file,header=False)
    data = data / np.median(data)
    _5007_flat_stack.append(data)
```

```
In [19]: _5007_flat=np.median(_5007_flat_stack,axis=0)
m=np.mean(_5007_flat)
_5007_flat_avg=_5007_flat/m

#header['HISTORY'] = 'Combined and normalized flat field'
fits.writeto('5007_flat_avg.fits',_5007_flat_avg)
```

```
In [6]: r_datain = [line.rstrip('\n') for line in open('5007_data.list')]
r_dataout = [line.rstrip('\n') for line in open('5007_data_out.list')]
r_dataout
```

```
Out[6]: ['no_bias_flattend_arctic_m97.0003.fits',
'no_bias_flattend_arctic_m97.0004.fits']
```

```
In [21]: n=len(r_datain)

for i in range(0,n):
    data = fits.getdata(r_datain[i],header=False)
    dataout = data / _5007_flat_avg
    fits.writeto(r_dataout[i],dataout)
```

C:\Users\Ben\Anaconda3\lib\site-packages\ipykernel_launcher.py:5: RuntimeWarning: divide by zero encountered in true_divide
 """

```
In [4]: from astropy.io import fits
import numpy as np
import glob
import matplotlib.pyplot as plt
from photutils import CircularAperture as ca
from photutils import CircularAnnulus as can
from photutils import aperture_photometry
import photutils
from matplotlib.colors import LogNorm
```

```
In [7]: r_ap=483
        r_in=485
        r_out=490

        x=621;y=632
        position =[(x,y)]
        aperture = ca(position,r_ap)
        Annulus_aperatures = can(position, r_in,r_out)
        r_dataout
```

```
Out[7]: ['no_bias_flattend_arctic_m97.0003.fits',
        'no_bias_flattend_arctic_m97.0004.fits']
```

```
In [1]: image_data=fits.getdata(r_dataout[0])
        aperature_values=aperture_photometry(image_data,Annulus_aperatures,method='center')
        mean_background=aperature_values['aperture_sum']/Annulus_aperatures.area()
        mean_background
        a=np.ones((1300,1300))
        background = a*mean_background

        new_image = image_data-background

        fits.writeto('no_bias_flatted_arctic_m97.0003.fits',new_image)
```

```
In [3]: image_data=fits.getdata(r_dataout[1])
        aperature_values=aperture_photometry(image_data,Annulus_aperatures,method='center')
        mean_background=aperature_values['aperture_sum']/Annulus_aperatures.area()
        mean_background
        a=np.ones((1300,1300))
        background = a*mean_background

        new_image = image_data-background

        fits.writeto('no_bias_flatted_arctic_m97.0004.fits',new_image)
```