Section3

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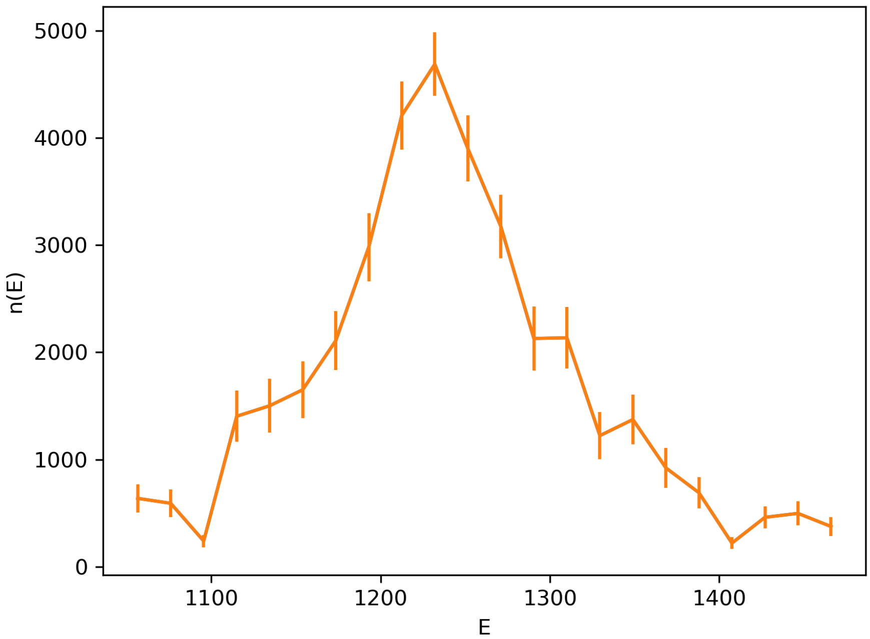
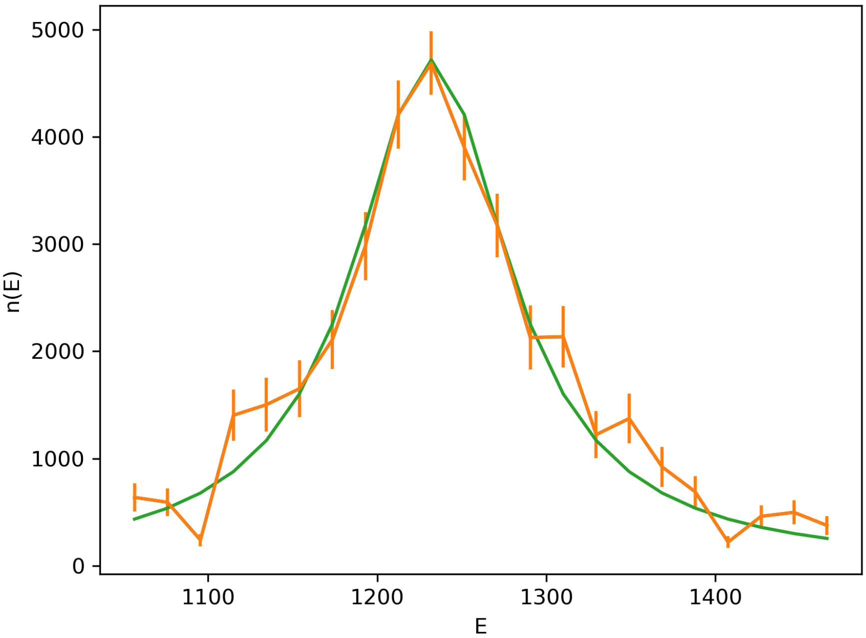
1 q1



2 q2

As E increases from 1000 n(E) increases at an increasing rate until around 1200 where the gradient change decreases to a peak at around 1250. This shape is mirrored on the other side ending around 1500.

3 q3



$$w = \frac{600\sqrt{163}}{\sqrt{4687}} \tag{1}$$

Changing w effects the maximum value of the peak of the theoretical curve without changing the minimum values at roughly $n(E) = 500$. Increasing w decreases the maximum (since w^2 is divided by in $n(E)$). Whereas decreasing w increases the maximum of $n(E)$.

4 q4

```python
from numpy import sum as sm


def discrepancy(r, dn):
    '''where r is the residuals,
    and dn is the error on the residuals'''
    return sm([(r[i] / dn[i]) ** 2 for i in range(len(r))])
```

This function takes in the values of the residuals and their errors and returns a sum over each residual divided by their error squared.

5 q5

Manually using trial and error to reduce the discrepancy results in a minimum discrepancy of 86.76 which is when $w = 113.15$. The method used is just iterating on the value of w and returning the value of the discrepancy each time.

6 q6

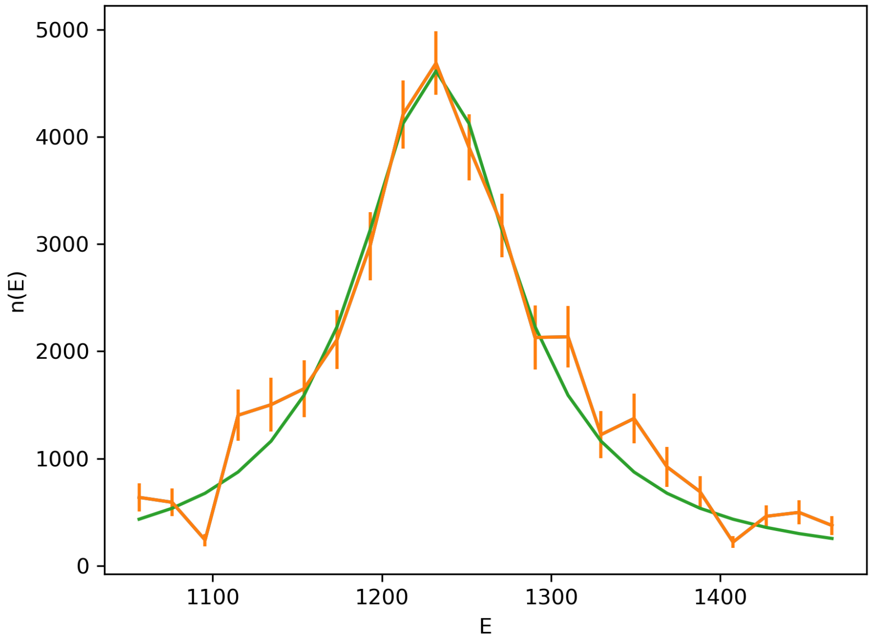
Using the gmin function like:

```
from minimise import gmin
from numpy import exp


def f(x):
    return exp(x) + 1 / x


print(gmin(f, 0, 5, tol=3.0e-8))
```

This returns the only minimum in the curve since in the negatives, f(x) is decreasing to a asymptote.
This returns:
$\rightarrow$ (0.7034674247387416, 3.4422772944949744)
which is the (x, y) coords of the minimum.

7 q7

Using gmin() on the discrepancy function reveals a minimum w of 113.14847521305097 where the discrepancy is 86.76529920076851. using these values in a plot yields:



8 q8

```
x = linspace(start=ea[0], stop=ea[-1], \
        num=len(theory(ea, gmin(discrep, \
        80, 120, tol=3.0e-8)[0])))
popt, pcov = curve_fit(theory, x, \
        theory(ea, gmin(discrep, \
        80, 120, tol=3.0e-8)[0]), \
        sigma=dn, absolute_sigma=True)
print(popt)
print(pcov)
```

This outputs a value of w of 113.14847521 with an uncertainty of 4.84317108