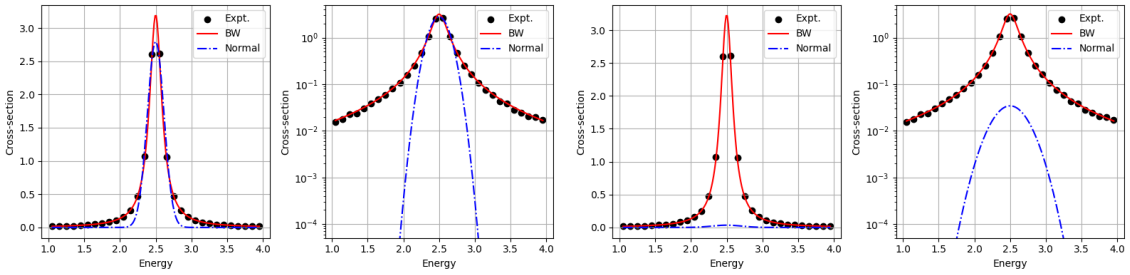
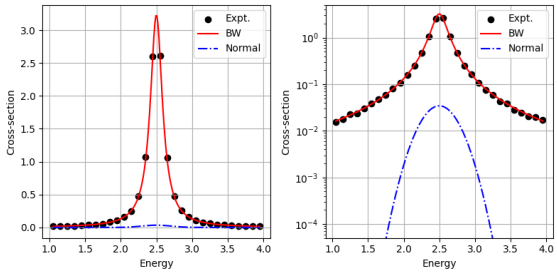
Chynelle Ziarah C. Villostas Lab Output - Approximation
Below are the graphs generated by different methods for fitting the distribution to the given data set:




(a) Curve Fitting




(b) Nelder-Meads




(c) BFGS

Figure 1: Curve fitting of the given data set using different methods

Compare in terms of results, approach, convergence speed, how sensitive it is to the choice of x0:

- APPROACH:
  - curve_fit uses gradient based minimization (Levenberg-Marquadt algorithm), and automatically adjusts step sizes to give the best fit. From the name itself, it's meant to fit a curve to some given data set (minimizes sum of squared differences).
  - Nelder-Meads does not use gradient based minimization, instead relies on a simplex algorithm, which only requires function evaluations. Unlike curve_fit, it's not really meant to fit a curve to some data set, rather it just minimizes a function. So to use it for curve fitting, you need to set first your cost function and then minimize that.
  - BFGS (Broyden-Fletcher-Goldfarb-Shanno) just like curve_fit uses the gradient of the objective function to minimize. Also, just like Nelder-Meads, it's just a general minimizing function, you need to set up the cost function to fit a curve to the data.
- RESULTS: The results mainly differed in the Gaussian Distribution. For (a), gaussian fit goes all the way to the actual peak, while for (b) and (c), it does not reach that high. This is a result of the nature of the approach of the methods. The curve_fit method will try to fit the gaussian into the data set using least-squares fitting, hence why we see that gaussian actually touches the higher points in Figure (a).
- CONVERGENCE SPEED: In terms of number of iterations, we have: Nelder-Meads>BGFS>curve_fit, which makes sense because of how they differ in their approach. Nelder-Meads doesn't use gradients so it has no idea of the slope, rather it just keeps testing points and finding the least error. BFGS on the other hand, does make use of gradients however it isn't specifically designed for least-squares fitting unlike curve_fit
- x0 CHOICE: The BFGS method was the most sensitive to the initial guess. This is because it relies fully on gradients, unlike curve_fit which can automatically adjust step size or Nelder-Meads which doesn't rely on gradients.