

Finding_Minima.py

```
01| import sympy as sp
02|
03| def find_quadratic_minimum(a, b, c, sigma_a, sigma_b,
sigma_c):
04|     # Define symbols
05|     x = sp.Symbol('x')
06|
07|     # Define the quadratic function
08|     quadratic = a * x**2 + b * x + c
09|
10|     # Compute the derivative
11|     derivative = sp.diff(quadratic, x)
12|
13|     # Solve for critical point (minimum)
14|     critical_points = sp.solve(derivative, x)
15|
16|     # Evaluate the quadratic at the critical point to
find the minimum y value
17|     y_values = [quadratic.subs(x, cp) for cp in
critical_points]
18|
19|     # Determine the minimum y value and its
corresponding x value (minimum point)
20|     min_y = min(y_values)
21|     min_x = critical_points[y_values.index(min_y)]
22|
23|     # Uncertainty propagation
24|     sigma_y = sp.sqrt((sigma_a**2 + (sigma_b * min_x)**2
+ (sigma_c * min_x**2)**2).evalf())
25|     sigma_x = sigma_b * (sigma_b * min_x)**2 / (2 *
sp.sqrt(a * (a * min_x**2 + b * min_x + c)))
26|
27|     return (min_x, min_y), (sigma_x, sigma_y)
28|
29| # Example usage:
30| a = 6.3812e-11
31| b = -4.9389e-09
32| c = 9.6456e-08
33| sigma_a = -2.7098e-09
34| sigma_b = 4.6798e-08
35| sigma_c = -2.2930e-09
```

```
36|  
37| min_point, uncertainties = find_quadratic_minimum(a, b,  
c, sigma_a, sigma_b, sigma_c)  
38| print("Minimum point (x, y):", min_point)  
39| print("Uncertainties (delta_x, delta_y):",  
uncertainties)
```