Heisenberg Uncertainty principle.

No quantum state can be measured with absolute certainty

$\sigma_a = \sqrt{\langle a \rangle^2_{av} - \langle a_{av} \rangle^2}$: Std. deviation of func / plot a.

H.U.P. $\Delta x \cdot \Delta p_x \geq \frac{\hbar}{2} \rightarrow \Delta x \cdot \Delta k \geq \frac{1}{2}$

$\Delta w \cdot \Delta t \geq \frac{1}{2}$

$\Delta E \cdot \Delta t \geq \hbar/2$

often, definition used is:

$\sigma_x = \Delta x$

$\sigma_k = \Delta k$ ..

But the main use of HUP is to ESTIMATE Bounds on certain physical quantities

order of mag, etc.

- Basic Logic: If we try to reduce σ_x - the spread in x; σ_k - the spread in k has to increase due to the nature of Fourier transform

That is, to localize the wave packet in x-space we need to sum over wider range of k-values