

If we use x and H in the general form of the uncertainty principle, we have

$$\Delta x \Delta H \geq \frac{1}{2} |\langle [x, H] \rangle|$$

The commutator is

$$\begin{aligned} [x, H] f &= \left[x, \frac{p^2}{2m} + V(x) \right] f = \left[x, \frac{p^2}{2m} \right] f = -\frac{\hbar^2}{2m} \left[x, \frac{d^2}{dx^2} \right] f = \\ &= -\frac{\hbar^2}{2m} \left(x \frac{d^2 f}{dx^2} - \frac{d^2}{dx^2} x f \right) = -\frac{\hbar^2}{2m} \left(x f'' - \frac{d}{dx} (f + x f') \right) = \\ &= -\frac{\hbar^2}{2m} (x f'' - f' - f' - x f'') = \frac{\hbar^2}{m} f' \end{aligned}$$

$$\text{so } [x, H] = \frac{\hbar^2}{m} \frac{d}{dx} = \frac{i\hbar}{m} p$$

Then the uncertainty principle becomes ($\Delta H \equiv \Delta E$)

$$\Delta x \Delta E \geq \frac{\hbar}{2m} |\langle p \rangle|$$

For stationary states the energy is definite, i.e. $\Delta E = 0$. This brings us to the conclusion that

$$\langle p \rangle = 0$$

Intuitively it makes perfect sense because in a stationary state nothing is moving.