THE WATT UNCERTAINTY PRINCIPLE

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Abstract: Not only we have the Heisenberg Uncertainty Principle, but also a power based (watt) Uncertainty Principle holds.

HEISENBERG	WATT	
$\Delta p \cdot \Delta x \geq \hbar/2$	$\Delta p \cdot \Delta a \geq \hbar_W/2$	
$\Delta E \cdot \Delta t \geq \hbar/2$	$\Delta E \cdot \Delta f \geq \hbar_W/2$	($\hbar_W$ has the same value of $\hbar$, but in watt)

Let's start from the Heisenberg Uncertainty Principle (taken with the equal sign, out of simplicity):

$\Delta p \cdot \Delta x = \hbar/2$ $\quad (\hbar/2 = h/4\pi = 0{,}527 \cdot 10^{-34} J \cdot s)$

($m_e c \cdot r_e = \hbar \cdot \alpha$, where $\alpha = 1/137{,}0359 \cong 1/137$ is the Fine Structure Constant and r_e is the classic radius of the electron: $r_e = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{m_e \cdot c^2} \cong 2{,}8179 \cdot 10^{-15} m$)

About the units: $[\mathrm{kg \cdot m/s}][\mathrm{m}] = [\mathrm{J \cdot s}]$.

We know that [J x s] is an angular momentum. If now we replace it by a power [W], we will see that the Uncertainty Principle is still standing, but what about the other quantities?

If we hold $\Delta p = m_e c$, then: $[\mathrm{kg \cdot m/s}][?] = [W]$ and we can say that [?] must be an acceleration; in fact:

$[\mathrm{kg \cdot m/s}][\mathrm{m/s^2}] = [W]$

We see that the following formula holds:

$\Delta p \cdot \Delta a = \hbar_W/2 = 0{,}527 \cdot 10^{-34} W$ ($\hbar_W$ has the same value of $\hbar$, but in watt) if:

$\Delta a = \frac{1}{(2\pi)^2}\frac{Gm_e}{r_e^2}$, which is exactly an acceleration related to the electron.

If now we want to take the energy-time uncertainty, according to Heisenberg we know that:

$\Delta E \cdot \Delta t = \hbar/2$ $\quad$ ($[J][\mathrm{s}] = [J \cdot \mathrm{s}]$), but once again, if we replace [Js] with [W], we have:

$[J][?] = [W]$ and [?] must be [Hz], a frequency:

$[J][\mathrm{Hz}] = [W]$

Once again, if we hold ΔE $\quad$ ($\Delta E = m_e c^2$), then:

$\Delta E \cdot \Delta f = m_e c^2 \cdot \Delta f = \hbar_W/2 = 0{,}527 \cdot 10^{-34} W$

but, once again, we immediately realize that $\Delta f = \frac{1}{2\pi\alpha h}\frac{Gm_e^2}{r_e}$ and this quantity is a frequency strictly related to an electron.

Thank you.
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