Proof that the De Broglie wavelength of a moving electron is equivalent to the Beat Frequency wavelength of the electron standing wave's IN and OUT spherical wave components.

The electron (or other fundamental Quantum particle) can be modelled, using Classical Physics, as a spherical standing wave comprising the sum of an inwardly travelling wave and an outwardly travelling wave [1].

The De Broglie wave that accompanies a moving particle is evidence of the wave nature of matter and is supporting evidence for Quantum Mechanics, yet this phenomenon can also be explained using only Classical Physics and the knowledge that an electron is a spherical standing wave. In such a model the De Broglie wavelength results from the Beat Frequency arising from the IN and OUT waves (which propagate relative to the medium of space) being Doppler shifted such that they have slightly different frequencies depending if they are flowing 'upstream' (in the direction of motion), or 'downstream' (away from the direction of motion. Of course, the Relativistic effects of Time Dilation and Length Contraction must also be taken into account to model the effect exactly; however, these effects can also be explained Classically using similar considerations [2].

The following calculation proves that the Beat Frequency explanation exactly matches the usual Quantum Mechanical De Broglie wave equation.

> $\mathrm{hbar} := \frac{\mathrm{h}}{2 \cdot \pi};$

$$hbar := \frac{1}{2}\,\frac{h}{\pi}$$

> $\omega := \frac{m_e \cdot c^2}{hbar};$

$$\omega := \frac{2\, m_e\, c^2\, \pi}{h}$$

> $ElectronFrequency := \frac{\omega}{2 \cdot \pi};$

$$ElectronFrequency := \frac{m_e\, c^2}{h}$$

> $f_{electron} := \frac{ElectronFrequency}{c};$

$$f_{electron} := \frac{m_e\, c}{h}$$

> $\beta := \mathrm{sqrt}\left(1-\left(\frac{v}{c}\right)^2\right);$

$$\beta := \sqrt{1-\frac{v^2}{c^2}}$$

> $f_{electronDilatedTime} := \beta \cdot f_{electron};$

$$f_{electronDilatedTime} := \frac{\sqrt{1-\frac{v^2}{c^2}}\, m_e\, c}{h}$$

> $f_{up} := f_{electronDilatedTime} \cdot \frac{c}{c-v};$

$$f_{up} := \frac{\sqrt{1-\frac{v^2}{c^2}}\, m_e\, c^2}{h\,(c-v)}$$

> $f_{down} := f_{electronDilatedTime} \cdot \frac{c}{c+v};$

$$f_{down} := \frac{\sqrt{1-\frac{v^2}{c^2}}\, m_e\, c^2}{h\,(c+v)}$$

> $\mathrm{BeatWavenumber} := \frac{f_{up} - f_{down}}{2};$

$$BeatWavenumber := \frac{1}{2}\,\frac{\sqrt{1-\frac{v^2}{c^2}}\, m_e\, c^2}{h\,(c-v)} - \frac{1}{2}\,\frac{\sqrt{1-\frac{v^2}{c^2}}\, m_e\, c^2}{h\,(c+v)}$$

> $\mathrm{BeatWavenumberContracted} := \beta \cdot \mathrm{BeatWavenumber};$

$$BeatWavenumberContracted := \sqrt{1-\frac{v^2}{c^2}}\left(\frac{1}{2}\,\frac{\sqrt{1-\frac{v^2}{c^2}}\, m_e\, c^2}{h\,(c-v)} - \frac{1}{2}\,\frac{\sqrt{1-\frac{v^2}{c^2}}\, m_e\, c^2}{h\,(c+v)}\right)$$

> $simplify(\mathrm{BeatWavenumberContracted});$

$$\frac{m_e\, v}{h}$$

> $DeBroglieWavelnumber := \frac{m_e \cdot v}{h};$

$$DeBroglieWavelnumber := \frac{m_e\, v}{h}$$

> $simplify\left(\frac{\mathrm{BeatWavenumberContracted}}{DeBroglieWavelnumber}\right);$

References:

[1] Traill. D. A. “Wave functions for the electron and positron”, 2018,

https://www.researchgate.net/publication/326646134_Wave_functions_for_the_electron_and_positron Last accessed 16/7/2019

[2] Traill. D. A. "Relatively Simple? An Introduction to Energy Field Theory", 2008 (originally 2001),

https://www.researchgate.net/publication/228368645_Relatively_Simple_An_Introduction_to_Energy_Field_Theory Last accessed 16/7/2019