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Wave-Particle

Wave-Particle Duality: de Broglie Waves and Uncertainty

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Abstract In 1925, de Broglie hypothesized that any material particle has an associated wave with $\lambda = h / p$. Electron diffraction seems to support that Hypothesis. But then, the electron at rest will have infinite wavelength, and infinite wave phase velocity. This says that for a material particle, the de Broglie relation does not hold.

Failed attempts to save the postulate, kept the flawed relation, and modified the waves into train waves, pilot waves, probability waves,... to name a few. We keep the de Broglie waves unchanged, and modify the relation.

First, we observe that the Planck energy $E = h\nu$ used by de Broglie defines virtual electromagnetic waves.

Consequently, for any particle, the virtual electromagnetic wavelength is $\lambda = c / \nu = h / mc$, and $h / m\upsilon = \lambda c / \upsilon$.

Refinement of de Broglie argument, indicates that h / mv may be Δx, Heisenberg's uncertainty in the particle location.

de Broglie's later analysis supports this interpretation, and we offer an explanation to particle diffraction as a consequence of Heisenberg's uncertainty.

We apply $h / mv = \lambda c / v$ to obtain the dispersion relations for the de Broglie virtual waves.

Finally, we observe that reinstating the matter wave, String theory avoids Uncertainty.