Matter Waves: a fable

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Abstract – This article criticises the phenomenon “wave-like-behaviour” of matter and shows that the Davisson-Germer experiment, considered as the validation of De Broglie’s hypothesis, can be interpreted in another way too.

Introduction
In my article: ‘Why a photon is not a particle’ (http://vixra.org/abs/1505.0225) I argue that the generation of a photon is caused by a changing orbit of an electron around the nucleus of an atom, based on the principle of a changing magnetic field, resulting in an EM-source. A somewhat similar approach can also be applied in the situation of a linearly accelerated electron, as used in the Davisson-Germer experiment.

De Broglie’s hypothesis
The question is: what is physically meant by matter wave?
In: https://en.wikipedia.org/wiki/Matter_wave the following description is found: “All matter can exhibit wave-like behaviour. For example a beam of electrons can be diffracted just like a beam of light or a water wave. Matter waves are a central part of the theory of quantum mechanics, being an example of wave–particle duality. The concept that matter behaves like a wave is also referred to as the de Broglie hypothesis due to having been proposed by Louis de Broglie in 1924. Matter waves are often referred to as De Broglie waves.

The De Broglie wavelength is the wavelength, \( \lambda \), associated with a massive particle and is related to its momentum \( p \) through the Planck constant \( h \): \( \lambda = h/p \).

Wave-like behaviour of matter was first experimentally demonstrated in the Davisson–Germer experiment using electrons, and it has also been confirmed for other elementary particles, neutral atoms and even molecules. The wave-like behaviour of matter is crucial to the modern theory of atomic structure and particle physics.”

Remarks:
- The word “massive” is most likely meant as ‘having a mass’ because the momentum \( p \) of a particle, with mass \( m \), is defined as \( p=mv \), with \( v \) being the velocity of the particle. (‘Massive’ normally means ‘gigantic’)!

- The conception “matter-waves” is in first instance and fundamentally meant to belong to pure, so uncharged, matter, given the relation \( \lambda = h/mv \). However the Davisson–Germer experiment using electrons, is put forward as the experiment proving the correctness of the original relation of De Broglie. Further on I will show that this experiment can be interpreted in another way too, leading to the conclusion that this experiment does not necessarily prove this correctness.

- If De Broglie’s hypothesis would be valid in case of an uncharged particle \( m \) with velocity \( v \), then the fundamental question is: what kind of oscillations, with the frequency \( mvC/h \), are meant? I got the impression that no one ever answered this question and I’m not motivated to read all the given references, for the following reason.
Imagine this mass \( m \) in vacuum, for example in the universe, then the question is: with respect to what reference is the velocity \( v \) of this mass meant? Choosing different references means that the frequency of the matter waves, exhibited by this mass, depends on the chosen reference. Not a likely physical property and, on top of that, in contradiction with the Principle of Relativity (PoR), because the constant velocity \( v \) would show “matter-wave-frequencies” that would depend on this \( v \). The PoR prescribes that all physical laws are the same in all inertial systems, so \textit{independent} of their constant velocity.

Conclusion: it is, to state it softly, very unlikely that matter waves do exist.

\textbf{The Davisson-Germer experiment}

This experiment is carried out with linearly accelerated electrons:

“Electrons from a heated filament were accelerated by a voltage and allowed to strike the surface of nickel metal.”

Found in: \url{http://hyperphysics.phy-astr.gsu.edu/hbase/quantum/davger2.html}

The remarkable thing about this experiment is that the electrons are accelerated, showing a contradiction with De Broglie’s hypothesis, in which the particles are meant to have a constant velocity.

As a result there is no relation between De Broglie’s hypothesis and the circumstances of this experiment and consequently this experiment cannot be used to claim the validity of De Broglie hypothesis.

What might happen in this experiment that would exhibit a wave and what kind of wave might that be?

An electron moving along a straight line is equivalent to an electric current of the same shape. Such a current causes a circular shaped magnetic field around this current with a constant strength. When this electron will be accelerated, like in a Scanning Electron Microscope, the strength of the equivalent electric current will change as function of time. As a result the strength of the mentioned circular magnetic field will also change as a function of time. Just like as in my model of the generation of a photon: an EM-source has been created.

In this case an EM-source with likely a circular polarization!

\textbf{Conclusions}

- Matter waves are not defined in a physical way.
- It is most unlikely that matter waves exist, because they contradict the Principle of Relativity.
- The Davisson-Germer experiment does not necessarily prove the validity of De Broglie’s hypothesis. It can be interpreted in another way too.

\textbf{Encore}

De Broglie’s hypothesis was supported by Einstein. Just like Einstein must have missed the crucial importance of the Principle of Relativity formulating his hypothesis about the velocity of light, he obviously did so too judging De Broglie’s hypothesis.