

De Broglie's theory of "matter waves" was not treated very seriously at the beginning. Some took it as "an interesting hypothesis with little chances to be ever confirmed by experiments". Some called it even "crazy".

But the experimental confirmation came much faster than anybody expected!

In 1926, Davisson and Germer illuminated a crystal of Ni with a beam of electrons, and they found that the scattering effects were exactly the same as in the case of X-rays.

Many other experimental tests were conducted afterwards with electrons and other particles (neutrons, and even light atoms). The scattering effects were found to obey the same Bragg Law that X-rays do, namely:

$$2d \sin \theta = n\lambda$$

and the λ values inferred from those experiments were found to exactly agree with the de Broïgle equation $\lambda = \frac{h}{p}$

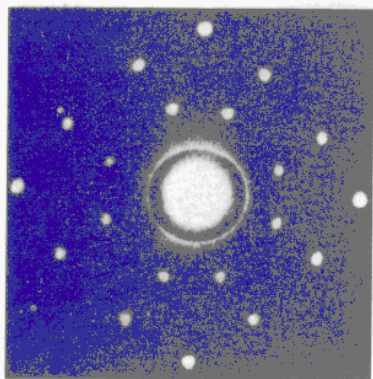


FIGURE 4.7 Diffraction of neutrons by a sodium chloride crystal.

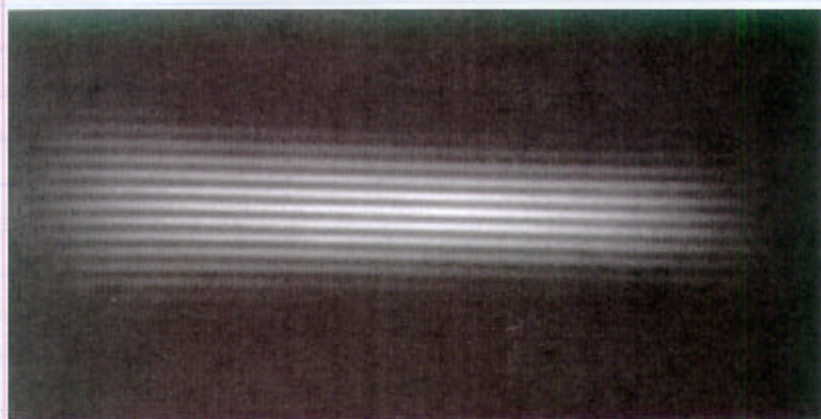
Diffraction of neutrons from a NaCl crystal

But not only diffraction from crystals was studied in such tests. The first experiment that confirmed beyond any doubts the wave-like nature of light, was the Thomas Young's double-slit experiment.

So - physicists reasoned - if particles also have a wave-like nature, why don't we do the double-slit experiment using a particle beam instead of light beam?

The diffraction image should then look exactly like that obtained using light!

Such experiments were indeed performed for electrons and neutrons, and the results appeared to be in spectacular agreement with the de Broglie theory!



Diffraction pattern from a double-slit experiment with electrons.

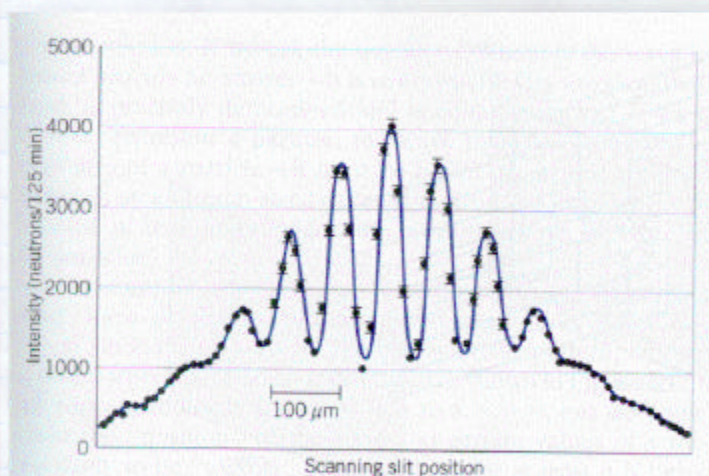


FIGURE 4.12 Intensity pattern observed for double-slit interference with neutrons. The spacing between the maxima is about $75 \mu\text{m}$. [Source: R. Gähler and A. Zeilinger, *American Journal of Physics* **59**, 316 (1991).]

Diffraction pattern recorded in a double-slit experiment with neutrons.

More recently, double-slit experiments were performed using beams of atoms, and even heavier molecules (the famous C_{60} "buckyballs"), and all confirmed the de Broglie equation.