

5.7.c. Interference Experiment

From §5.7.b, we see that matter waves travelling along 2 paths joining the same end points have a phase difference

$$\delta_A = \frac{q\Phi}{\hbar c}$$

In a 2-slit interference experiment, the waves from the slits have a phase difference δ at the screen given by

$$\delta = \frac{2\pi d}{L\lambda} y$$

where λ is the wavelength of the waves, d the slit separation, L the perpendicular distance between slits & screen, and y the vertical distance from the mid point between the slits.

Thus, if one inserts a current carrying long solenoid of small cross-section into the space between the wave paths, the interference pattern should shift by a distance

$$\Delta y = \frac{L\lambda}{2\pi d} \delta_A = \frac{L\lambda}{2\pi d} \frac{q\Phi}{\hbar c}$$

This shift, which has been experimentally observed, is the basic proof of the Aharonov-Bohm effect.