THE YOUNG'S SLIT EXPERIMENTS

ELECTRONS have mass and so are *particles*, but undergo diffraction so must be *waves*.

During diffraction the arrival of individual electrons can be detected, so electrons are *particles*.

In a diffraction experiment, the energy (and so *momentum* and wavelength) are *known* from the conditions of operation of the electron gun, but the *position* at which a particular electron will arrive on the screen is *unknown* - we can only speak of the *probability* of its arriving within an element of area at a particular place.

Although the position of arrival of any electron cannot be known, the cumulative effect of superimposition of thousands of electrons is known - this is the diffraction pattern.

With one slit open, a 'single slit' diffraction pattern is produced, with two slits open a 'double slit' pattern.

Although there may be 'only one electron' in the apparatus at a given time and the position at which it will arrive on the screen cannot be predicted, but it will contribute to the build up of either a 'single slit' pattern or a 'double slit' pattern, depending of which slits are open. *How does the electron 'know' whether the other slit is open?*

The central mystery of the quantum world.

If we observe the electron as it passes through a slit, a 'single slit' diffraction pattern is produced, even if both slits are open. *The act of observation influences the result of the experiment.*

The same considerations, mutatis mutandis, *apply to **LIGHT**.*

Results such as these led to the concept of

- **wave/particle duality**: $\lambda = h/p$

- and the
Uncertainty Principle: $\Delta p.\Delta x \geq h/4\pi$