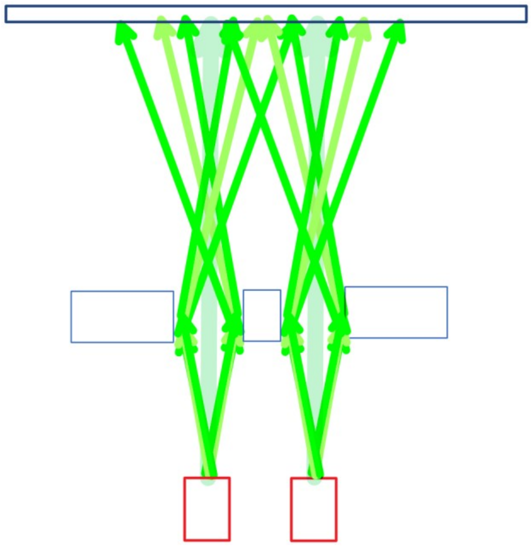
Fringe Patterns from Double-slit Experiments

Following the failure of classical physics theories to explain the interference patterns observed in double slit experiments and other light diffraction experiments and because of the similarities



between these patterns and the interference patterns generated by waves at the surface of a liquid, physicists deduced that light was behaving as a wave which led to the so-called wave-particle duality of light. Since the particle model could explain phenomena such as the photoelectric effect and since the wave model of light described the interference patterns of light, it made sense to deduce that light had to corpuscular or wave-like depending on the experiment performed on it. But what experiments actually showed is that neither accepted models of light could explain both behaviours and emphasized the need for a new theory.

The patterns generated in double-slit experiment are thought to be the results of interferences between light waves, but they can be better understood in terms of the reflection and absorption patterns of photons through a mechanism consistent with the laws governing optics (or more generally, preonics) .

Though we describe the double-slit experiments that use photons, the same explanation applies for electrons or any other particle.

Single Slit Experiment

We will first describe single slit experiments.

The momentum vector components that can be imparted to an electron is given by $\left\|\vec{P}_{\gamma}\cos\theta\right\|$ where θ is the angle between the $\vec{P}_{\gamma}$ and $\vec{P}_{e^-}$, but from the laws of momentum we know that the momentum imparted by γ must be such that $\left\|\Delta\vec{P}_{e^-}\right\| = \alpha m_{e^-}$ and we have $\alpha = \left|\frac{\left\|\vec{P}_{\gamma}\cos\theta\right\|}{m_{e^-}}\right|$.

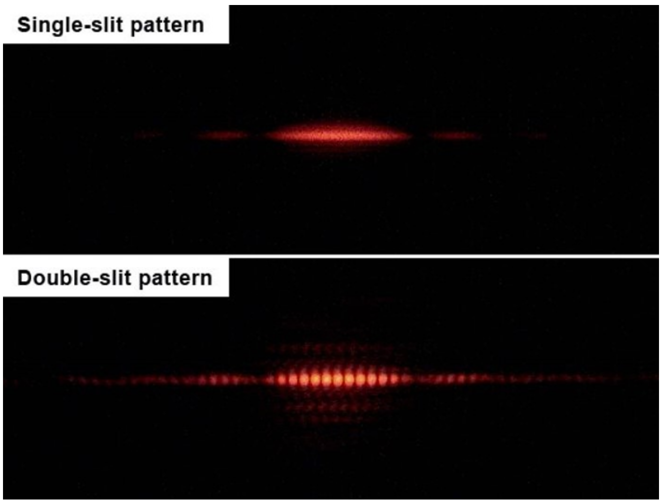
So the momentum that can be imparted to an electron by a photon is $\left\|\Delta\vec{P}_{e^-}\right\| = \left|\frac{\left\|\vec{P}_{\gamma}\cos\theta\right\|}{m_{e^-}}\right| m_{e^-}$.

We see that when $\vec{P}_\gamma$ is perpendicular to $\vec{P}_{e^-}$, $\left\|\vec{P}_\gamma \cos\theta\right\| = 0$ so that the photon is reflected back. As we move away from that angle towards, the photon will be absorbed when θ is such that $\left\|\vec{P}_\gamma \cos\theta\right\| = m_{e^-}$. This will show as a dark fringe on the screen which width depends on the width of the slit and the distance the slit and the screen.

The number of absorption fringes will be equal to $n_{fringes} = 2\left|\frac{\left\|\vec{P}_\gamma \cos\theta_{\max}\right\|}{m_{e^-}}\right|$.

Double-Slit Experiments

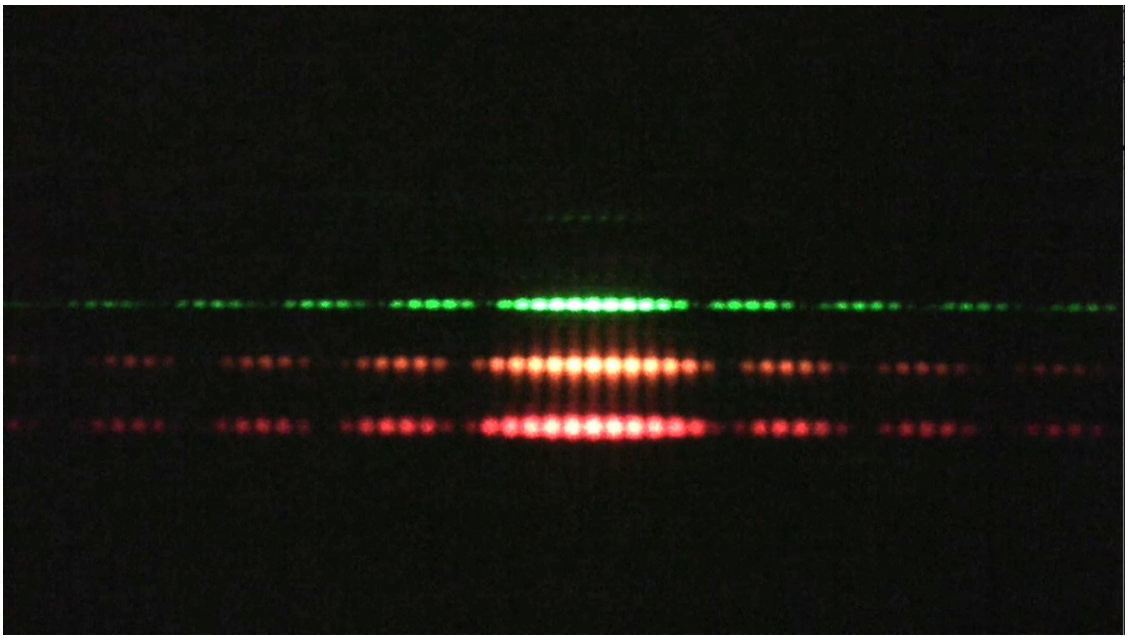
When there are two slits, two or more photons from different angles can simultaneously interact with an electron. In the case of two photons, they will be absorbed if $\left\|\vec{P}_{\gamma_1}\cos\theta_1 + \vec{P}_{\gamma_2}\cos\theta_2\right\| = \alpha m_{e^-}$. If this condition is not met, then both photons γ_1 and γ_2 will be reflected.



At the centre of the screen (which is the point on the screen that is at equal distance from both slits), $\left\|\vec{P}_{\gamma_1}\cos\theta_1 + \vec{P}_{\gamma_2}\cos\theta_2\right\| = 0$ and the photons will be reflected. But away from the centre, we there will be angles θ_1 and θ_2 such that $\left\|\vec{P}_{\gamma_1}\cos\theta_1 + \vec{P}_{\gamma_2}\cos\theta_2\right\| = \alpha m_{e^-}$ creating dark fringes which width depend on the width of the slits and the distances from each other and the screen.

As for the number of dark fringes (absorption fringes), it is a function of the angular ranges of photons from the two slits.

From the mathematical description we find that the momentum of the photons will affect the distances between the fringes. Everything else being equal, the greater the momentum of photons, the closer adjacent absorption fringes will be as shown in the picture below which compares the patterns emerging from photons of three momentums (energies).



Therefore, the distance between absorption fringes is inversely proportional to the momentum of the photons used in the experiments.

As we have seen in this section, the emergence of fringe patterns in double-slit experiments can be explained in terms of absorption and reflection of photons using the singularly corpuscular model of light proposed by QGD. In fact QGD's corpuscular model and the laws of momentum together explain all optical phenomena which are normally attributed to wave-like behaviour of light. In fact, all optical phenomena can be described a single consistent set of equations that can replace the distinct equations currently used to describe distinct phenomena.