

to see which slit it actually goes through and, it seems, 'knowing' that information changes the way the photon operates. It no longer goes through both slits like a wave but only one or the other, like a particle. Our knowledge seems to affect how the photon behaves.



## So what has this to do with God?

A thought in our brains is a neuron (a brain cell) or sequence of them 'firing'. That may need, say, five particles within a neuron acting in a particular way. OK, work with me on this! The location of these particles is like a die throw. Imagine, for example, there are six possible clumps where the some particle might be and say they are equally likely. Each particle, effectively, rolls a die to decide its location.



What if God, from time to time, forces the die to be the number required to have some particles contribute to the neuron firing? It would be like:

3 1 1 2 6 4 2 5 5 5 4 2 3 1 1 1 3 2 6 2 5

Where all seems random but God forces the sequence 3 1 1 1 3 and the neuron fires. Such activity is completely undiscoverable, looks like a coincidence, but is not. So it seems likely that:

*God included in creation the opportunity to affect every particle of creation all the time.*

*That will always be un-measurable, scientifically, and therefore will be a matter of faith.*

## The whole universe?

Every particle in the universe works like this. The implications are immense. God's activity can be anywhere any time, and can be crucial to existence, as if God is at the helm keeping life alive. "I am the light of the world", said Jesus<sup>8</sup>.



# Science and Christian faith - Light

I left school at fifteen with two 'O' levels, and the only courses at College for 15 year olds were pre-nursing or pre-science. I was never very good with blood, so I went for the science course and have been doing science ever since, moving on from academia in 2014.

## What is science?

For me, science is finding out about the creation that God made and therefore there can be no argument, ever, between science and Christianity. Whatever we discover in science is something about the mind of God designing a place where we can be.

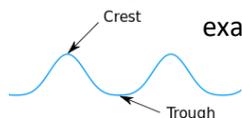


## Doesn't the Bible say 7 days?

Yes it does, right at the beginning, that God created the world in seven days. I believe that God created the universe, but for me the seven days are a timeframe, a poetry, a parable given so that we, and our ancestors could comprehend the reality and enormity of God's creation. Personally I do not believe it literally, as I do not believe the

## Where's the photon now?

One key component of all of this is the fact that the landing place of a photon is never known exactly, in advance. Because it is operating like a wave we can only say something statistical, like most of them will arrive in the most likely area and the rest in the less likely area. The wave works like this. Where there is a crest or trough of a wave, there is a high probability of the photon arriving there, where the wave (or combination of waves) is neither at a crest or trough, the probability of the photon being discovered there, is low.



This uncertainty about where something actually is located is built into the fabric of everything (not just photons) in the universe. We only know location when it hits a screen. Prior to that we know where it might land only by working out the maths of the 'wave' associated with the particle. Particles can be here one moment and somewhere else the next. It is random – not fully random but random, nevertheless.

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daughters of men had offspring from sons of gods<sup>1</sup>, or that the DNA of spotted animals was organised by their drinking from water with spotted bark<sup>2</sup>, or the first woman was created from a rib<sup>3</sup> (one story) or not<sup>4</sup> (the other story), or the animals went into an ark two by two<sup>5</sup> (one story) or seven by seven<sup>6</sup> (the other story).

Believing or not believing in these things, however, is not an issue unless, for you, an absolutely literal reading of the Bible (like some Muslims hold the Quran) is essential. Christianity is about belief in God and Jesus Christ, as God, coming into the world. It is not necessary to believe the parables in the Old or New Testaments of the Bible as historical events.

## Let there be light, and there was light<sup>7</sup>

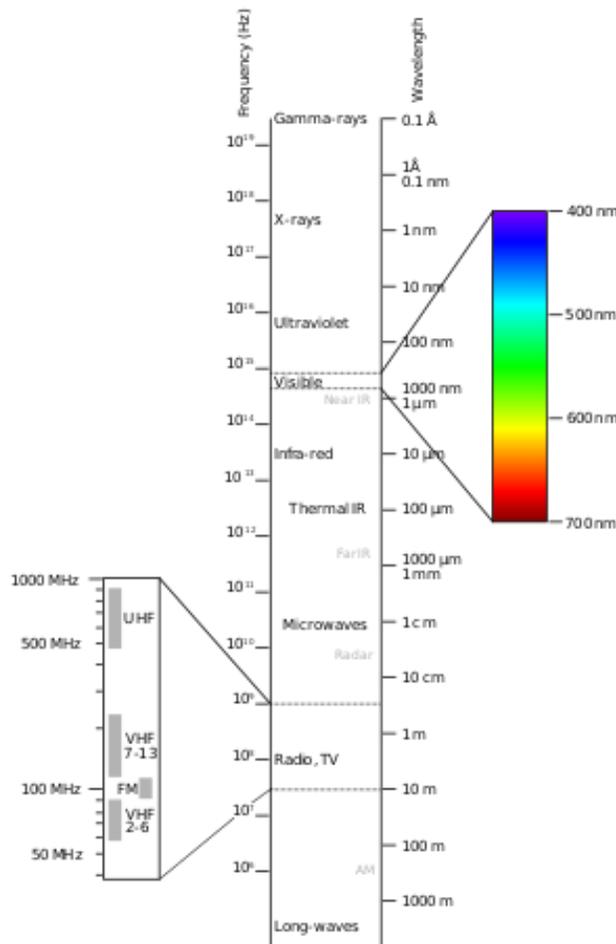
Is light made of lots of little particles? Newton thought so and that they zoomed out of torches, through space and hit surfaces, bounced off them and into our eyes. He was right.



Maxwell thought that light was not particles but a wave, part of the electromagnetic spectrum, and he was right too! Light is only one bit of the spectrum, and that is shown in the diagram. What I say here about light goes for all other parts of the spectrum as well. Surely they both can't be right?



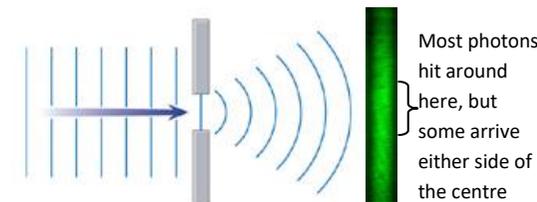
<sup>1</sup>Gen 6:4, <sup>2</sup>Gen 30:38, <sup>3</sup>Gen 2:21, <sup>4</sup>Gen 1:27, <sup>5</sup>Gen 7:15 and Gen 6:19-20, <sup>6</sup>Gen 7:2, <sup>7</sup>Gen 1:2, <sup>8</sup>John 8:12



The electromagnetic spectrum

## Diffraction

Shine a single colour of light at a narrow vertical slit and the light bends round the side of the slit. Most of the light follows a straight line through the slit, but some of it curves. This aspect of light is not unlike someone shouting from behind a wall with the door open. You do not need to be in line of sight to hear the voice. So Maxwell was right, light seemed to behave like a sound wave.



Most photons hit around here, but some arrive either side of the centre

But there is a problem with this. Sound waves travel through air. The 'wave' is actually a sequence of small pressure changes in the air. Those 'waves' are received by small hairs in the ear which move as the air around them moves. Light, if it is a wave, needs to have some medium to vibrate, to travel. However light travels across the vacuum of the universe, where there is, effectively, nothing (more about that in another leaflet). So how can it be a wave, it needs to be a particle.



## Einstein

About 100 years ago Einstein demonstrated that Newton was right. That light is made up of individual particles - photons. Diffraction bends them around a corner and they seem to behave mathematically like waves do even though they are not waves.

Our eyes are not sensitive enough to see a single photon, but some species of frogs have such sensitive eyes they can see single photons.

## Odd things

However, point one single photon at two slits and it will seem to go through both of them simultaneously. Put a detector on one of the slits