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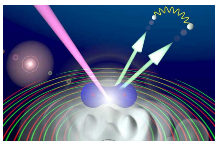

Artistic impression of the X-ray photon hitting the hydrogen molecule which emits two electrons
Till Jahnke, University Frankfurt

By: Gabriel Gache, Science News Editor

The Universe's Secrets Hidden in Paradoxes

Particle-wave duality

One of the most troubling paradoxes in the world of quantum physics is represented in the particle-wave duality, which implies that subatomic particles, or particles close to the quantum levels, exist in two different states at the same time - particle and wave.Traditional particle-wave duality experiments, study the behavior or light aimed at solid plates, which have two parallel slits cut into the plate. As light or electrons are fired at the plate, they have only two possible choices, either go through the slit on the left, or the one on the right. Subatomic particles break this rule, by going through both slits at the same time. Imagine a tennis ball thrown at a wall that has two separate windows. Then imagine the same ball passing through both windows at the same time. This is the paradox which the physicists are fighting with for over a century, you can't have a single object in two places at once. The weirdest thing of the particle duality is that it depends on the observer, and how much attention he/she will give to a certain event. If the observer concentrates on the slits, to detect through which one of them the particle will pass, it will observe that the particle will only pass through one of them, thus behaving like a particle. If it will concentrate on the effect produced after the particle has passed through the solid plate, it will discover that the interactions show that the particle has passed through both the slits at the same time, behaving like a wave.De Broglie postulated in 1924 that all matter must present the particle-wave duality, not just the light, after he created an experiment in which he demonstrated the electrons' diffraction, while shooting a beam of electrons through a thin metal film. Heisenberg, tried to explain the effect as a consequence of the measuring process, and originally said that it was not possible to measure a particle's exact position without disturbing its quantum momentum and vice versa, but later retracted his affirmation and explained that it makes no sense to speak about the position of a wave, since particles don't have precise positions. To resolve the problem that exists for over the a hundred years, an international team of physicists started an experiment to exhibit the quantum identity crisis, by using a single hydrogen molecule. The hydrogen molecule is hit by a single X-ray photon, which determines the decay of the atoms, by emitting its only two electrons, orbiting the nucleus. However, before the electrons leave the nucleus, they pass by the nucleus for the last time, in the same way they would pass through two slits in a way, one going left, and the other right. The emitted electrons have different levels of energy. The so-called 'fast' electron, which carries most of the energy taken from the photon, acts just as expected, in a dual manner, sometimes behaving like a wave, other times like a particle. But in looks like this behavior is greatly affected by the presence of the second electron which has a lover energy level, and acts like an observer. As it has little energy, it will experience difficulties in measuring the position of the fast electron, so it would seem that the higher energy level electron will go by both sides of the nucleus, behaving like a wave. But if it had more energy, it would have a better chance of observing the other electron, thus the particle would respond back by acting like a particle, and only go by one of the sides of the nucleus.