

From: Jack Sarfatti <sarfatti@pacbell.net>
Subject: **Re: Cramer's Upcoming Retrocausality Experiment Back From The Future - new twist**
Date: January 22, 2007 9:26:58 AM PST
To: Sarfatti_Physics_Seminars <Sarfatti_Physics_Seminars@yahoogroups.com>
3 Attachments, 109 KB

Ah, yes, here it is.

Begin forwarded message:

From: ANTIGRAY@cs.com
Date: January 21, 2007 10:14:26 PM PST
To: marssouthpolereturns@yahoogroups.com
Cc: sarfatti@pacbell.net
Subject: Researchers condense entire image into single photon

Researchers condense entire image into single photon?



Posted Jan 21st 2007 4:06AM by Conrad Quilty-Harper
Filed under: Storage **A team of researchers has managed to find a way to store a large amount of data in a single photon of light.** Although the first stored item -- an image of the characters "UR" -- implies that the inventor was a 13 year old girl dealing with an extremely low text messaging limit, the image was in fact intended to signify the institution which developed the technology, the University of Rochester (either that or it's the shortest example of the "UR IN MY ... " meme that we've seen in the while.) **Apparently the system works because "instead of storing ones and zeros" (a la binary code), the team has figured out how to store an entire image in a single photon, which sounds sort of impossible to us. Funny, because that's exactly what John Howell, the leader of the team said about the system. One of the key components of the process is the particle-wave duality nature of light: by firing a single photon of light through a stencil -- we presume one heckuva small one -- the wave carries a shadow of the image along with it at a very high signal-to-noise ratio, even with low light levels. The light is then slowed down in a cell of cesium gas, where it is compressed to 1 percent of its original length. This is where the storage aspect of the device comes in, as the researchers hope to be able to delay a single photon almost permanently, resulting in a device that can store "incredible amounts of information in just a few photons": an enticing thought for a world currently satisfied with a maximum of 1TB hard drives based on physical platters. A pity then that the world is completely distracted by the potential for "Photon on photons" jokes that this throws into the ring.**

<http://hdtv.engadget.com/2007/01/21/researchers-condense-entire-image-into-single-photon/>

On Jan 22, 2007, at 9:00 AM, Jack Sarfatti wrote:

There was also a report of being able to imprint a complex image on a single photon!

Well, if that is true then what happens if that is done one photon pair at a time to the delayed photon in Cramer's experiment? Will that complex image be transmitted backwards in time to the undelayed twin photon. Since, it's one photon pair at a time the usual argument of the late H.Pagels et-al of the random washing out of the nonlocal signal in the statistical accumulation (e.g. local probabilities stay at 1/2) would be side-stepped, completely irrelevant to this new kind of total experimental arrangement seemingly permitted by the new technology beyond the wildest dreams of the creators of quantum theory almost 100 years ago now.

On Jan 22, 2007, at 12:19 AM, Jack Sarfatti wrote:

Begin forwarded message:

Go to

<http://www.sfgate.com/cgi-bin/article.cgi?file=/c/a/2007/01/21/ING5LNJSBF1.DTL&type=printable>

Science hopes to change events that have already occurred

- Patrick Barry

Sunday, January 21, 2007

Ever wish you could reach back in time and change the past? Maybe you'd like to take back an unfortunate voice mail message, or rephrase what you just said to your boss. Or perhaps you've even dreamed of tweaking the outcome of yesterday's lottery to make yourself the winner.

Common sense tells us that influencing the past is impossible -- what's done is done, right? Even if it were possible, think of the mind-bending paradoxes it would create. While tinkering with the past, you might change the circumstances by which your parents met, derailing the key event that led to your birth.

Such are the perils of retrocausality, the idea that the present can affect the past, and the future can affect the present. Strange as it sounds, retrocausality is perfectly permissible within the known laws of nature. It has been debated for decades, mostly in the realm of philosophy and quantum physics. Trouble is, nobody has done the experiment to show it happens in the real world, so the door remains wide open for a demonstration.

It might even happen soon. Researchers are on the verge of experiments that will finally hold retrocausality's feet to the fire by attempting to send a signal to the past. What's more,

they need not invoke black holes, wormholes, extra dimensions or other exotic implements of time travel. It should all be doable with the help of a state-of-the-art optics workbench and the bizarre yet familiar tricks of quantum particles. **If retrocausality is confirmed -- and that is a huge if -- it would overturn our most cherished notions about the nature of cause and effect and how the universe works.**

Dating back to Newton's laws of motion, the equations of physics are generally "time symmetric" -- they work as well for processes running backward through time as forward. The situation got really strange in the early 20th century when Einstein devised his theory of relativity, with its four-dimensional fabric of space-time. In this model, our sense that history is unfolding is an illusion: The past, present and future all exist seamlessly in an unchanging "block" universe.

"If you have the block universe view, the future and the past are not any different, so there's no reason why you can't have causes from the future just as you have causes from the past," says David Miller of the Centre for Time at the University of Sydney in Australia.

With the advent of quantum mechanics in the 1920s, the relative timing of particles and events became even less relevant. "Real temporal order in general, for quantum mechanics, is not important," says Caslav Brukner, a physicist at the University of Vienna, Austria. By the 1940s, researchers were exploring the possibility of time-reversed phenomena. Richard Feynman lent credibility to the idea by proposing that particles such as positrons, the antimatter equivalent of electrons, are simply normal particles traveling backward in time. Feynman later expanded this idea with his mentor, John Wheeler of Princeton University. Together they worked out a theory of electrodynamics based on waves traveling forward and backward in time. Any proof of reverse causality, however, remained elusive.

Fast forward to 1978, when Wheeler proposed a variation on the classic double-slit experiment of quantum mechanics. Send photons through a barrier with two slits in it, and choose whether to detect the photons as waves or particles. If you put up a screen behind the slits, you will get a pattern of light and dark bands, as if each photon travels through both slits and interferes with itself, like a wave. If, on the other hand, you take a snapshot of the slits themselves, you will find each photon passes through one slit or the other: it is forced to pick a path, like a particle. But, Wheeler asked, what if you wait until just after the photon has passed the slits to make your choice? In theory, you could suddenly raise the screen to expose two cameras behind it, one trained on each slit. It would seem that you can affect where the photon went, and whether it behaved like a wave or particle, after the fact.

In 1986, Carroll Alley at the University of Maryland at College Park, found a way to test this idea using a more practical set-up: an interferometer which lets a photon take either one path or two after passing through a beam splitter. Sure enough, the photon's path depended on a choice made after the photon had to "make up its mind." Other groups have confirmed similar results, and at first blush this appears to show the present affecting the past. Most physicists, however, take the view that you can't say which path the photon took before the measurement is made. In other words, still no unambiguous evidence for retrocausality.

That's where **John Cramer** comes in. In the mid-1980s, working at the University of Washington in Seattle, he proposed the "**transactional interpretation**" of quantum mechanics, one of many attempts to relate the mathematics of quantum theory to the real world. It says particles interact by sending and receiving physical waves that travel forward and backward through time. In June, at a conference of the American Association for the Advancement of Science, Cramer proposed an experiment that can at last test for this sort of retrocausal influence. It combines the wave-particle effects of double slits with other mysterious quantum properties in an all-out effort to send signals to the past.

The experiment builds on work done in the late 1990s in Anton Zeilinger's lab, when he was at the University of Innsbruck, Austria. Researcher Birgit Dopfer found that photons that were "entangled", or linked by their properties such as momentum, showed the same wave-or-particle behavior as one another. Using a crystal, Dopfer converted one laser beam into two so that photons in one beam were entangled with those in the other, and each pair was matched up by a circuit known as a coincidence detector. One beam passed through a double slit to a photon detector, while the other passed through a lens to a movable detector, which could sense a photon in two different positions.

The movable detector is key, because in one position it effectively images the slits and measures each photon as a particle, while in the other it captures only a wave-like interference pattern. Dopfer showed that measuring a photon as a wave or a particle forced its twin in the other beam to be measured in the same way.

To use this setup to send a signal, it needs to work without a coincidence circuit. Inspired by Raymond Jensen at Notre Dame University, Cramer then proposed passing each beam through a double slit, not only to give the experimenter the choice of measuring photons as waves or particles, but also to help track photon pairs.

Instead of the "double slit" use the "stencil" on the delayed photon! See what happens.

One of the key components of the process

is the particle-wave duality nature of light: by firing a single photon of light through a stencil

The double slits should filter out most unentangled photons and either block or let pass both members of an entangled pair, at least in theory. So a photon arriving at one detector should have its twin appear at the other. As before, the way you measure one should affect the other. Jensen suggested that such a setup might let you send a signal from one detector to another instantaneously -- a highly controversial claim, since it would seem to demonstrate faster-than-light travel.

If you can do that, Cramer says, why not push it to be better-than-instantaneous, and try to make the signal arrive before it was sent? His extra twist is to run the photons you choose how to measure through several kilometers of coiled-up fiber-optic cable, thereby delaying them by microseconds. This delay means that the other beam will arrive at its detector before you make your choice. However, since the rules of quantum mechanics are indifferent to the timing of measurements, the state of the other beam should correspond to how you choose to measure the delayed beam. The effect of your choice can be seen, in principle, before you have even made it.

That's the idea anyway. What will the experimenters actually see? Cramer says they could control the movable detector so that it alternates between measuring wave-like and particle-like behavior over time. They could compare that to the pattern from the beam that wasn't delayed and was recorded on a sensor from a digital camera. If this consistently shifts between an interference pattern and a smooth singleparticle pattern a few microseconds before the respective choice is made on the delayed photons, that would support the concept of retrocausality. If not, it would be back to the drawing board.

If the experiment does show evidence for retrocausation, it would open the door to some troubling paradoxes. If you could see the effects of your choice before you make it, could you then make the opposite choice and subvert the laws of nature? Some researchers have suggested retrocausality can occur only in limited circumstances in which not enough information is available for you to contradict the results of an experiment.

Another way to resolve this is to say that even if the present can influence the past, it cannot change it. The fact that your hair is shorter today has as much influence on your going to the barber yesterday as the other way around, yet you can't change that decision. "You wouldn't be able to talk about altering, but you could talk about causing or affecting," says Phil Dowe, an expert on causation at the University of Queensland in Australia. While it would mean we cannot change the past, it also implies that we cannot change the future.

If all that gives you a headache, then consider this: if retrocausality does exist, it says something profound about how the universe works. "It has the potential to solve what is one of the biggest problems in modern physics," says Huw Price, head of Sydney's Centre for Time. It goes back to quantum entanglement and "nonlocality" -- one particle instantaneously affecting another, even from the other side of the galaxy. That doesn't sit well with relativity, which states that nothing can travel faster than light. Still, the latest experiments confirm that one particle can indeed instantaneously affect the other. Physicists argue that no information is transmitted this way: Whether the spin of a particle is up or down, for instance, is random and can't be controlled, and thus relativity is not violated.

Retrocausality offers an alternative explanation. Measuring one entangled particle could send a wave backward through time to the moment at which the pair was created. The signal would not need to move faster than light; it could simply retrace the first particle's path through space-time, arriving back at the spot where the two particles were emitted. There, the wave can interact with the second particle without violating relativity. "Retrocausation is a nice, simple, classical explanation for all this," Dowe says.

While Cramer last week prepared to start a series of experiments leading up to the big test of retrocausality, some researchers expect reverse causality will play an increasingly important role in our understanding of the universe. "I'm going with my gut here," says Avshalom Elitzur, a physicist and philosopher at Bar-Ilan University in Israel, "but I believe that when we finally find the theory we're all looking for, a theory that unifies quantum mechanics and relativity, it will involve retrocausality."

But if it also involves winning yesterday's lottery, Cramer won't be telling.

Did we reach back to shape the Big Bang?

If retrocausality is real, it might even explain why life exists in the universe -- exactly why the universe is so "finely tuned" for human habitation. Some physicists search for deeper laws to explain this fine-tuning, while others say there are millions of universes, each with different laws, so one universe could quite easily have the right laws by chance and, of course, that's the one we're in.

Paul Davies, a theoretical physicist at the Australian Centre for Astrobiology at Macquarie University in Sydney, suggests another possibility: The universe might actually be able to fine-tune itself. If you assume the laws of physics do not reside outside the physical universe, but rather are part of it, they can only be as precise as can be calculated from the total information content of the universe. The universe's information content is limited by its size, so just after the Big Bang, while the universe was still infinitesimally small, there may have been wiggle room, or imprecision, in the laws of nature.

And room for retrocausality. If it exists, the presence of conscious observers later in history could exert an influence on those first moments, shaping the laws of physics to be favorable for life. This may seem circular: Life exists to make the universe suitable for life. If causality works both forward and backward, however, consistency between the past and the future is

all that matters. "It offends our common-sense view of the world, but there's nothing to prevent causal influences from going both ways in time," Davies says. "If the conditions necessary for life are somehow written into the universe at the Big Bang, there must be some sort of two-way link."

-- Patrick Barry

Retrocausality: Can the present affect the past?

Researchers have devised an experiment using laser light to demonstrate a property of quantum mechanics: That pairs of entangled photons show identical properties as either a wave or a particle. By using this knowledge, they hope to demonstrate how to influence an event that has already occurred.

1. A laser beam is directed into a crystal that makes two streams of photons.

2a. One stream of photons travels through a screen with two slits.

2b. The other stream of photons travels through an identical screen with two slits BUT is routed through six miles of fiber-optic cable that delays the light by microseconds.

3a. A detector captures the light and records it as a wave-like or particle-like photon (you don't know which yet).

3b. The delayed light is sensed by a movable detector. If the detector is closer to the lens it's recorded as a wave-like interference pattern. If its farther from the lens it is recorded as a particle.

What is happening here: By choosing to measure the delayed photon as either a wave or particle photon, the experimenter forces the other photon to appear in the same way - because they are entangled - even though it reaches the detector earlier.

Sources: John Cramer, University of Washington; NewScientist, Sept. 2006

Patrick Barry wrote this piece for the New Scientist, where it first appeared. Contact us at insight@sfchronicle.com.

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URL: <http://sfgate.com/cgi-bin/article.cgi?file=/c/a/2007/01/21/ING5LNJSBF1.DTL>

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"If we knew what it was we were doing, it would not be called research, would it?"

- Albert Einstein

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