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QUANTUM TEMPERATURE

Scientists at the Vienna University of Technology

manage to study the physics that connect the classical to the quantum world

by Florian Aigner

*How does a classical temperature form in the quantum world? An experiment at the Vienna University of Technology has directly observed the emergence and the spreading of a temperature in a quantum system. Remarkably, the quantum properties are lost, even though the quantum system is completely isolated and not connected to the outside world.*

Florian, what constitutes the boundary between the quantum system and what you are calling "The Outside World?"

How can you completely isolate the system from all the particles, including the neutrinos and virtual particles that could interact with the quantum system?

Unless you can do that, you don't have a completely isolated quantum system.

*Quantum and Classical Physics:*

*From the Microscopic to the Macroscopic World*

*The connection between the microscopic world of quantum physics and our everyday experience, which is concerned with much larger objects, still remains puzzling. When a quantum system is measured, it is inevitably disturbed and some of its quantum properties are lost.*

*A cloud of atoms, for example, can be prepared in such a way that each atom is simultaneously located at two different places, forming a perfect quantum superposition.*

Florian, what evidence do you offer to support the claim that an atom can exist in two different places at the same time?

You admitted that when measurements are taken, an atom only appears in one place. So how can you prove that the atom existed in two places at once, if every time you try to measure it ... it won't cooperate?

Those two atoms would interact with the quantum foam around each of them. If one atom were in two different places, the virtual particles would have to be the same. How is that possible at two different locations unless the quantum foam is also in superposition?

If they were really one atom, any particle (for example, a neutrino) that interacted with one atom would have to interact with the other at the other location. If the neutrino didn't interact with both, then they couldn't be the same atom. So what evidence do you offer to support the requirement that neutrinos go into superposition when interacting with atoms in superposition?

Do you have any evidence that either of those scenarios have been tested, and resulted in support for the concept of superposition?

Unless I am mistaken (which is entirely possible), the concept of superposition has the same support, at this point in time, as string theory ... mathematics alone.

Mathematics can prove that things are mathematically impossible. But the opposite is not necessarily true: something that is mathematically possible isn't necessarily true ... only possible.

Florian, we know the weight of an electron. If an electron actually existed in all the places that it could possibly be (superposition) wouldn't it have infinite weight?

Mathematically, those who believe that superposition is real, solve that problem by making all the electrons orthogonal to each other, and therefore, the weight is only the weight of any one electron. That is awfully convenient. But while you can use that trick in mathematics, what evidence do you offer that the real world, containing real electrons, works that way? If the weight is the same as one electron (which it always is) then you have no way to differentiate your theory from the simple reality that you have one electron, which is exactly what all experimental results show.

*As soon as the location of the atoms is measured, however, this superposition is destroyed.*

Florian, I am reminded of something eerily similar: Christians claim that their invisible ghost is real. But every time we attempt to record, photograph, or otherwise prove His existence ... He goes into hiding.

Likewise, every time we try to pin down the location of the atoms, we always find them ... but never in more than one place at the same time. Superposition goes into hiding.

See the similarities, Florian?

In both cases the results are the same: every time we look ... no supporting evidence.

*All that is left are atoms sitting at some well-defined places. They behave just as classical objects would.*

Florian, same thing with God. After a storm destroys a city for wickedness, it moves on to other towns before finally dissipating ... just as we expect them to behave based on years of meteorological data.

*In this case, the transition from quantum behavior to classical behavior is initiated by the measurement – a contact with the outside world.*

Florian, that statement is a logical fallacy: it assumes its conclusion. It is only true if the quantum superposition actually existed. If no superposition existed then we are simply making scientific measurements.

*But what happens, if a quantum system is not influenced from the outside at all? Can classical properties still emerge?*

Florian, we may soon find that out. The Nobel Prize in physics in 2012 went to two separate teams of researchers who developed methods for making quantum measurements without destroying the targets.

*Disorder in the Quantum World*

*“We are studying clouds consisting of several thousand atoms, such a cloud is small enough to effectively isolate it from the rest of the world, but it is large enough to study how quantum properties are lost.”*

Florian, how do you "effectively isolate" anything within the fabric of spacetime? Does the quantum foam end at some point and then resume elsewhere? Do neutrinos magically halt when they reach the boundary of an isolated system? What evidence is there, that indicates that anything in our Universe can be effectively isolated from everything else?

*In the experiment, the atom clouds are split into two halves. After a certain time the two halves are compared to each other. In that way, the scientists can measure the amount of quantum mechanical connection between the clouds. Initially, this connection is perfect; all atoms are in a highly ordered quantum state. But as the cloud is a large object consisting of thousands of particles, this order does not remain for long.*

*Loss of Quantum Properties Without Influence From Outside*

*As the atoms interact with each other, disorder begins to spread with a certain velocity. Atoms in the already disordered regions lose their quantum properties. A temperature can be assigned to them – just as in a classical gas. The velocity with which the disorder spreads depends on the number of atoms. This defines a clear border between the regions which can be described by a classical temperature and regions where quantum properties remain unchanged.*

*After a certain time the disorder has spread over the whole cloud.*

Florian, how did the disorder spread to the other cloud? In other words, how was it transferred between the two halves?

*The remarkable observation is that this loss of quantum properties happens just because of quantum effects inside the atom cloud, without any influence from the outside world.*

Florian, I still don't think you've shown that there is such a thing as "an outside world." How can you be sure that no neutrinos nor other cosmic rays have entered the cloud?

*Atomic Clouds: A World on its Own*

*In a way, the atomic cloud behaves like its own miniature universe. It is isolated from the environment, so its behavior is solely determined by its internal properties.*

Florian, how can you stop neutrinos from entering your separate Universe? How can you rip a piece of quantum foam out of the fabric of spacetime? What evidence indicates that anything in our Universe exists, isolated from the fabric of spacetime?

*Starting with a completely quantum mechanical state, the cloud looks “classical” after some time, even though it evolves according to the laws of quantum physics. That is why the experiment could not just help us to understand the behavior of large atom clouds, it could also help to explain, why the world that we experience every day looks so classical, even though it is governed by quantum laws.*

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THE SCIENCE SEGMENT

Where Earth's Gold Came From

Gold is rare on Earth in part because it's also rare in the universe. Unlike elements like carbon or iron, it cannot be created within a star. Instead, it must be born in a more cataclysmic event - like one that occurred last month known as a short gamma-ray burst. Observations of this gamma-ray burst provide evidence that it resulted from the collision of two neutron stars - the dead cores of stars that previously exploded as supernovae. Moreover, a unique glow that persisted for days at the gamma-ray burst location potentially signifies the creation of substantial amounts of heavy elements.

Scientists estimate that the amount of gold produced and ejected during the merger of the two neutron stars may be as large as 10 moon masses - quite a lot of bling!

A gamma-ray burst is a flash of high-energy light (gamma rays) from an extremely energetic explosion. Most are found in the distant universe. Researchers studied gamma-ray burst 130603B which, at a distance of 3.9 billion light-years from Earth, is one of the nearest bursts seen to date.

Gamma-ray bursts come in two varieties - long and short - depending on how long the flash of gamma rays lasts. gamma-ray burst 130603B, detected by NASA's Swift satellite, lasted for less than two-tenths of a second.

Although the gamma rays disappeared quickly, gamma-ray burst 130603B also displayed a slowly fading glow dominated by infrared light. Its brightness and behavior didn't match a typical "afterglow," which is created when a high-speed jet of particles slams into the surrounding environment.

Instead, the glow behaved like it came from exotic radioactive elements. The neutron-rich material ejected by colliding neutron stars can generate such elements, which then undergo radioactive decay, emitting a glow that's dominated by infrared light - exactly what the team observed.

Astronomers have been looking for a 'smoking gun' to link a short gamma-ray burst with a neutron star collision. The radioactive glow from gamma-ray burst 130603B may be that smoking gun.

The team calculates that about one-hundredth of a solar mass of material was ejected by the gamma-ray burst, some of which was gold. By combining the estimated gold produced by a single short gamma-ray burst with the number of such explosions that have occurred over the age of the universe, all the gold in the cosmos might have come from gamma-ray bursts.

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FAMOUS QUOTES

WINSTON CHURCHILL (no biography - previously quoted)

"If the human race wishes to have a prolonged and indefinite period of material prosperity,

they have only got to behave in a peaceful and helpful way toward one another,

and science will do for them all they wish

and more than they can dream."