Professor solved time-reversal violation

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Associate Professor Dr Joan Vaccaro, of Griffith's Centre for Quantum Dynamics, has solved an anomaly of conventional physics and shown that a mysterious effect called 'T violation' could be the origin of time evolution and conservation laws.

"I begin by breaking the rules of physics, which is rather bold I have to admit, but I wanted to understand time better and conventional physics can't do that," Dr Vaccaro says.

"I do get conventional physics in the end though. This means that the rules I break are not fundamental. It also means that I can see why the universe has those rules. And I can also see why the universe advances in time."

In her research published in The Royal Society Dr Vaccaro says T violation, or a violation of time reversal (T) symmetry, is forcing the universe and us in it, into the future

"If T violation wasn't involved we wouldn't advance in time and we'd be stuck at the Big Bang, so this shows how we escaped the Big Bang.

"I found the mechanism that forces us to go to the future, the reason why you get old and the reason why we advance in time.""The universe must be symmetric in time and space overall. But we know that there appears to be a preferred direction in time because we are incessantly getting older not younger."

The anomaly Dr Vaccaro solves involves two things not accounted for in in conventional physical theories - the direction of time, and the behaviour of the mesons (which decay differently if time went in the opposite direction).

Experiments show that the behaviour of mesons depends on the direction of time; in particular, if the direction of time was changed then their behaviour would also," she says.

"Conventional physical theories can accommodate only one direction of time and one kind of meson behaviour, and so they are asymmetric in this regard. But the problem is that the universe cannot be asymmetric overall.

"This means that physical theories must be symmetric in time. To be symmetric in time they would need to accommodate both directions of time and both meson behaviours. This is the anomaly in physics that I am attempting to solve."

Dr Vaccaro is presenting her work at the Soapbox Science event held in Brisbane as part of National Science Week, titled "The meaning of time: why the universe didn't stay put at the big bang and how it is 'now' and no other time".

Without any T violation the theory gives a very strange universe. An object like a cup can be placed in time just like it is in space.

"It just exists at one place in space and one point in time. There is nothing unusual about being at one place in space, but existing at one point in time means the object would come into existence only at that point in time and then disappear immediately.

"This means that conservation of matter would be violated. It also means

that there would be no evolution in time. People would only exist for a single point in time - they would not experience a "flow of time".

When Dr Vaccaro adds T violation to the theory, things change dramatically.

"The cup is now found at any and every time," she says,

"This means that the theory now has conservation of matter - the conservation has emerged from the theory rather than being assumed. Moreover, objects change over time, cups chip and break, and people would grow old and experience a "flow of time". This means that the theory now has time evolution.

The next stage of the research is to design experiments that will test predictions of the theory.

Provided by Griffith University