Collapse of the universe is closer than ever before

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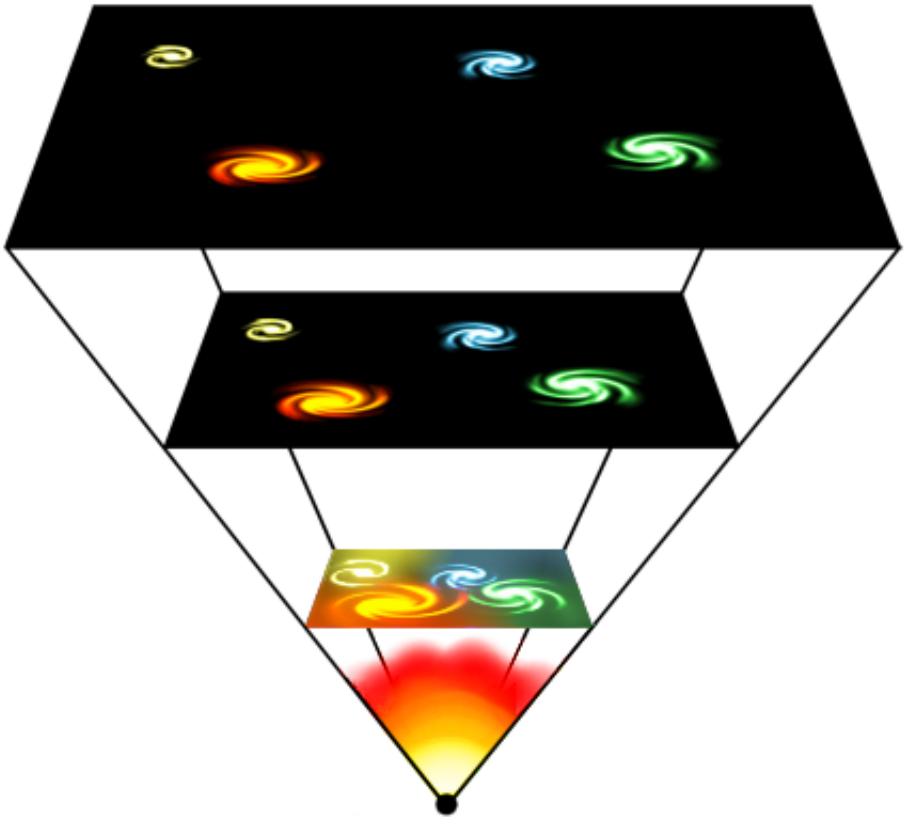

A collapse of the universe will happen if a bubble forms in the universe where the Higgs particle-associated Higgs-field will reach a different value than the rest of the universe. If this new value means lower energy, and if the bubble is large enough, the bubble will expand at the speed of light in all directions. All elementary particles inside the bubble will reach a mass that is much heavier than if they were outside the bubble, and thus they will pull each other into supermassive centers.

Maybe it happens tomorrow. Maybe in a billion years. Physicists have long predicted that the universe may one day collapse, and that everything in it will be compressed to a small hard ball. New calculations from physicists at the University of Southern Denmark now confirm this prediction – and they also conclude that the risk of a collapse is even greater than previously thought.

Sooner or later a radical shift in the forces of the universe will cause every little particle in it to become extremely heavy. Everything - every grain of sand on Earth, every planet in the solar system and every galaxy – will become millions of billions times heavier than it is now, and this will have disastrous consequences: The new weight will squeeze all material into a small, super hot and super heavy ball, and the universe as we know it will cease to exist.

This violent process is called a phase transition and is very similar to what happens when, for example water turns to steam or a magnet heats up and loses its magnetization. The phase transition in the universe will happen if a bubble is created where the Higgs-field associated with the Higgs-particle reaches a different value than the rest of the universe. If this new value results in lower energy and if the bubble is large enough, the bubble will expand at the speed of light in all directions. All elementary particles inside the bubble will reach a mass, that is much heavier than if they were outside the bubble, and thus they will be pulled together and form supermassive centers.

"Many theories and calculations predict such a phase transition– but there have been some uncertainties in the previous calculations. Now we have performed more precise calculations, and we see two things: Yes, the universe will probably collapse, and: A collapse is even more likely than the old calculations predicted", says Jens Frederik Colding Krog, PhD student at the Center for Cosmology and Particle Physics Phenomenology (CP^3 - Origins) at University of Southern Denmark and

co-author of an article on the subject in *Journal of High Energy Physics*.

"The phase transition will start somewhere in the universe and spread from there. Maybe the collapse has already started somewhere in the universe and right now it is eating its way into the rest of the universe. Maybe a collapse is starting right now right here. Or maybe it will start far away from here in a billion years. We do not know", says Jens Frederik Colding Krog.

More specifically he and his colleagues looked at three of the main equations that underlie the prediction of a phase change. These are about the so-called beta functions, which determine the strength of interactions between for example light particles and electrons as well as Higgs bosons and quarks.

So far physicists have worked with one equation at a time, but now the physicists from CP3 show that the three equations actually can be worked with together and that they interact with each other. When applying all three equations together the physicists predict that the probability of a collapse as a result of a phase change is even greater than when applying only one of the equations.

The theory of phase transition is not the only theory predicting a collapse of the universe. Also the so-called Big Crunch theory is in play. This theory is based on the Big Bang; the formation of the universe. After the Big Bang all material was ejected into the universe from one small area, and this expansion is still happening. At some point, however, the expansion will stop and all the material will again begin to attract each other and eventually merge into a small area again. This is called the Big Crunch.

"The latest research shows that the universe's expansion is accelerating, so there is no reason to expect a collapse from cosmological

observations. Thus it will probably not be Big Crunch that causes the universe to collapse", says Jens Frederik Colding Krog.

Although the new calculations predict that a collapse is now more likely than ever before, it is actually also possible, that it will not happen at all. It is a prerequisite for the phase change that the universe consists of the elementary particles that we know today, including the Higgs particle. If the universe contains undiscovered particles, the whole basis for the prediction of phase change disappears.

"Then the collapse will be canceled", says Jens Frederik Colding Krog.

In these years the hunt for new particles is intense. Only a few years ago the Higgs-particle was discovered, and a whole field of research known as high-energy physics is engaged in looking for more new particles.

At CP3 several physicists are convinced that the Higgs particle is not an elementary particle, but that it is made up of even smaller particles called techni-quarks. Also the theory of super symmetry predicts the existence of yet undiscovered particles, existing somewhere in the universe as partners for all existing particles. According to this theory there will be a selectron for the electron, a fotino for the photon, etc.

More information: *Journal of High Energy Physics*: Standard Model Vacuum Stability and Weyl Consistency Conditions, Authors: Oleg Antipin, Marc Gillioz, Jens Grund, Esben Mølgaard, Francesco Sannino (CP3 - Origins and DIAS). arXiv:1306.3234 arxiv.org/abs/1306.3234

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