A possible dark origin of Matter

Why is there something, rather than nothing? While we know that there must have been more matter than antimatter created in the first moments after the Big Bang, we don't know why. One clue to the possible origin of this asymmetry between baryonic matter (protons and neutrons, normal matter that we are familiar with) and antimatter comes from a recent paper published by MSI professor Jim Cline and his collaborators.

According to Cline, this asymmetry, which is not predicted by current particle physics theory, "is one of nature's main clues to us that there must be new particles and interactions beyond those in the standard model of particle physics."

In a meeting with a colleague at the Aspen Center for Physics, a discussion lead to a novel idea — that bubbles in the Higgs field and a new dark matter particle play an important role in creating the baryonic matter/antimatter asymmetry.

Other theories of the origin of baryonic matter, or baryogenesis, work at energy scales that are too large to test with current laboratory experiments. Cline's theory of "electroweak baryogenesis", which works at energies associated with the electroweak interactions, is testable with current particle colliders. The theory makes a prediction of new interactions between standard matter particles, which could be observed by the Large Hadron Collider (LHC) at CERN.

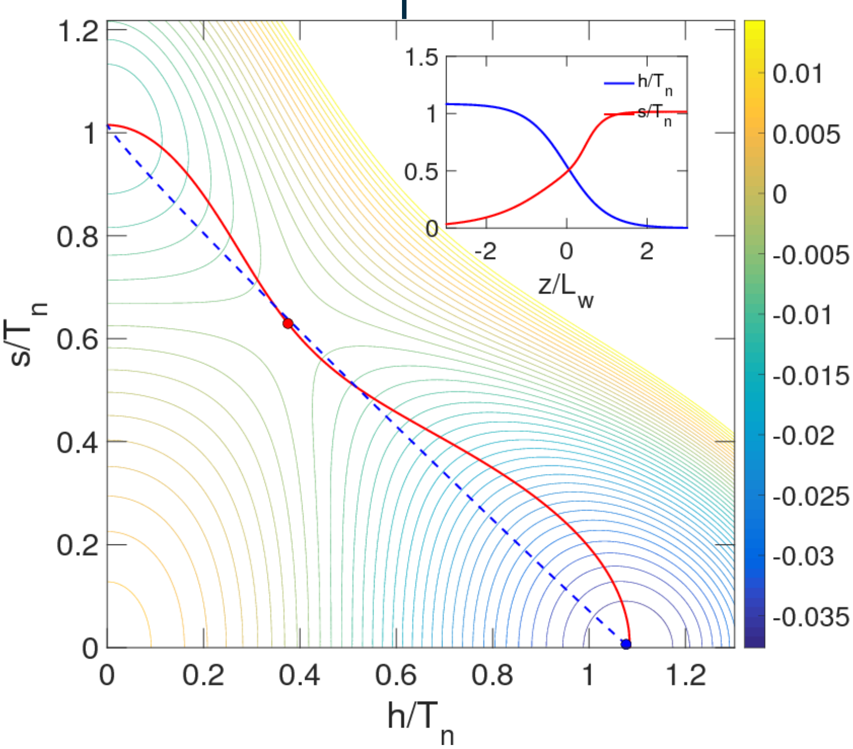
Cline emphasized the importance of working with his collaborators Kimmo Kainulainen, and David Tucker-Smith, "We had a few false starts, finding theories that seemed to work, then discovering that there was a problem. I almost convinced myself that the kind of theory we were seeking was impossible for various reasons, before we discovered one that worked."

Cline, J. M., Kainulainen, K., & Tucker-Smith, D. 2017b, *Electroweak baryogenesis from a dark sector*, PhRvD, 95, 115006

Why this is important

It opens up a new possibility, the idea that dark matter has interactions that don't respect the symmetry between particles and antiparticles, and this eventually leads to the baryon asymmetry at the electroweak scale. Even if our particular example turns out to be wrong, this more general idea could prove to be correct.

Prof . Jim Cline *is a professor of Physics at McGill University and CERN. His research focuses on the interface between particle physics and cosmology.*



» Shape of the bubble wall of the Higgs field used in Cline's electroweak baryogenesis model.