Predicting how soon the universe could collapse if dark energy has quintessence

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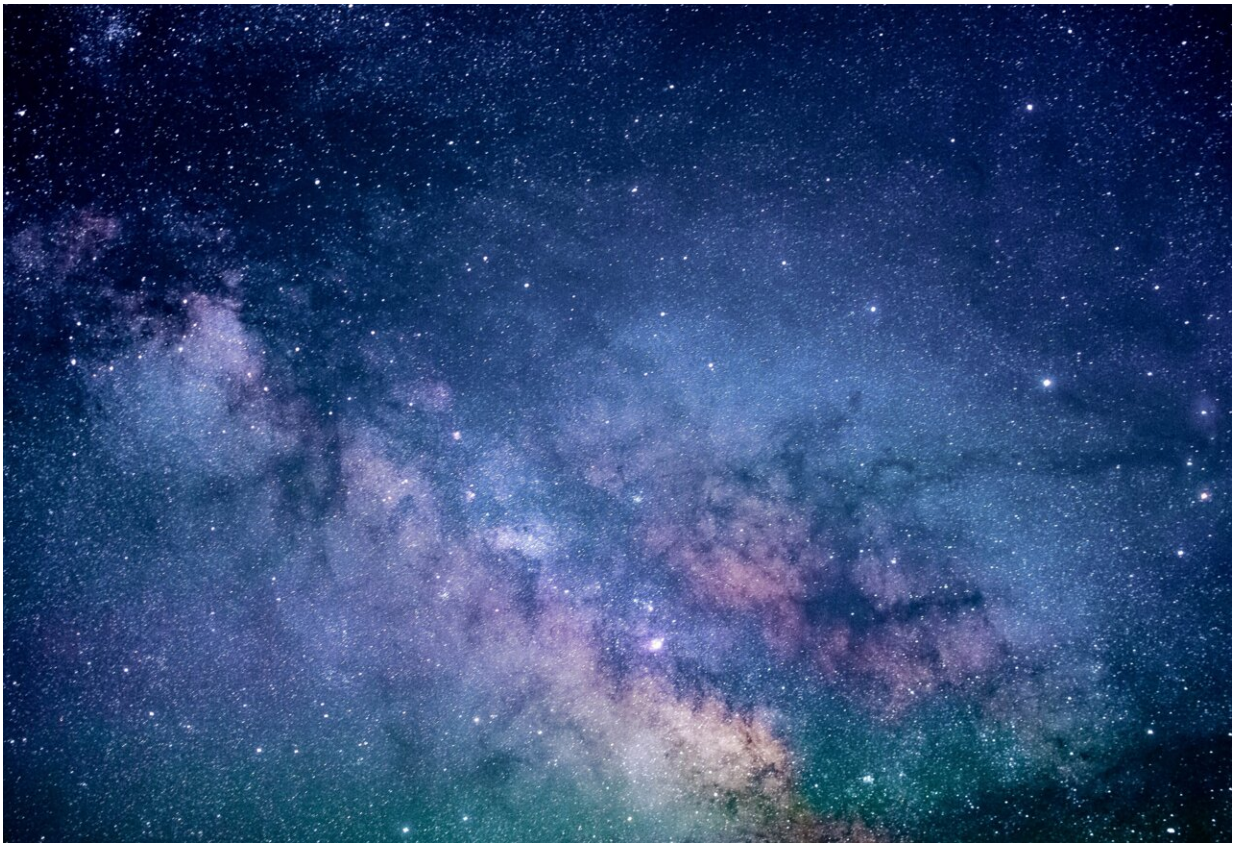

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A trio of astrophysicists, two from Princeton, the other from New York University, has calculated estimations on how soon the universe could collapse if theories regarding dark energy as having quintessence are

correct. In their paper published in *Proceedings of the National Academy of Sciences*, Cosmin Andrei, Anna Ijjas, and Paul Steinhardt suggest it could be as soon as 100 million years from now.

Over the past several decades researchers have found evidence of the universe expanding—distant objects are growing farther apart over time. Albert Einstein predicted this would be the case and suggested that the force pushing everything in the universe apart is something called dark energy. He also suggested that its force was constant, which would mean that the universe would expand forever. Since that time, others have suggested that maybe dark energy, if indeed it really exists, may not be a constant after all. And if that were the case, perhaps someday the universe would slow and perhaps even stop expanding, and/or reverse itself, allowing the universe to contract until it was smooshed down into a single entity. Proponents of such a theory describe dark energy as having a dynamic field they call quintessence—a property that would allow for expansion or contraction of the universe. And by studying evidence collected about the known universe, they have found the theory to be just as sound as the one that proposes dark energy as a constant.

In this new effort, the research trio wondered how long it might take the universe to slow down, stop, begin contracting, and eventually reach a single point if dark energy has quintessence. To envision such an idea, they built a model of the universe—one that used actual data describing features of the known universe. It showed them that if the idea of quintessence is true, then the universe could already be slowing its acceleration. It also showed that it could slow all the way to a standstill in approximately 65 million years—and could start contracting as soon as 100 million years from now. The theory, like the one that suggests dark energy is a constant, cannot be proven as there is no way to test it. Astrophysicists have to rely on signals coming from light years away, which suggests that if the universe is currently contracting, we will not be able to measure it for millions of years.

More information: Cosmin Andrei et al, Rapidly descending dark energy and the end of cosmic expansion, *Proceedings of the National Academy of Sciences* (2022). DOI: 10.1073/pnas.2200539119