Everything from cells to stars to particles exists on the edge of chaos

Complex systems, be they living beings or fundamental particles, need to have enough structure to hang together along with unpredictability that can allow for change. Columnist Thomas Lewton explores whether this idea is simply a pattern seen across the cosmos or could be a “theory of everything”

By Thomas Lewton on July 21, 2026

Chaos is a key ingredient of the cosmos. Allexxandar/imageBROKER/Shutterstock

As an undergraduate, to earn some extra cash, I spent my summer holidays working at a local pub in my home village (shout out Giggleswick). When punters heard that I was studying physics, a fair few of them divulged their own theories of how the universe really worked – scribbling on the back of napkins à la Richard Feynman.

These days, as a features editor at *New Scientist*, not much has changed. I keep a folder in my inbox called “theories of everything”, populated with ideas from retired engineers, artists, academics and everyone in between. Some contain obvious flaws; others arrogantly dismiss all physicists who’ve come before as holding the wrong end of the stick. Most are, at least, entertaining.

Recently, one of these purported theories of everything landed on my desk that seemed to be onto something. Dynamic symmetry theory (DST) holds that all complex systems in the cosmos – from living beings to fundamental particles – thrive at the shifting boundary between order

and chaos. Here, systems are structured enough to hold them together and unpredictable enough to change.

Everything is in flux, flourishing at the "edge of chaos", writes the theory's architect, philosopher Benedict Rattigan at The Schweitzer Institute in the UK. To put his idea to the test, Rattigan organised a conference in May at the Royal Society in London where eminent scientists from fields as diverse as quantum theory, Earth systems and genetics were there to tell us if they thought DST held water. Everyone agreed that these dynamics were innate to the systems they studied each day – yet something about DST still seemed woolly.

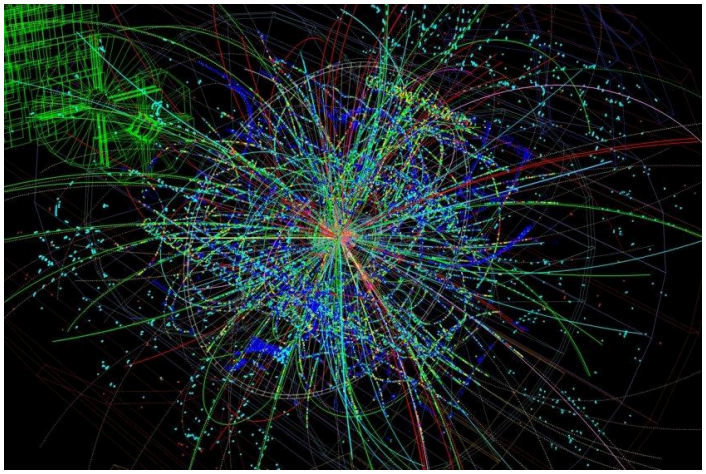
At the start of the day, DST's core equation, which is used to calculate the balance between order (O) and disorder (D) through time, appeared on the projector:

$$DSI(t) = 1 - \alpha O(t) - \beta D(t)$$

If you're confused by this, don't worry, so am I. If anything, it seemed to be dressing up an interesting insight about the balance of order and chaos with undefined mathematical symbols. During coffee breaks I asked some researchers how they saw DST helping them to make novel discoveries in their field of expertise and was largely met with silence.

Don't get me wrong: I'm a fan of DST. It seems to be part of broader trend among scientists and philosophers to find new lenses through which we can better learn about the world. Reductionism, the idea you can understand something complex by breaking it down into its smaller parts, has held sway in Western science since René Descartes in the 17th century, who argued that the universe was essentially a complicated clock that could be broken apart. Yet recently the limitations of this approach have become apparent.

Reductionism is exemplified by high-energy particle smashers like CERN's Large Hadron Collider (LHC), which went looking for novel elementary particles – and found them exactly where theorists predicted them to be. The power of the approach led many physicists to believe that the LHC would find evidence of "supersymmetric particles" to plug various holes in our theories of fundamental physics. At one point, Stephen Hawking even asked, "Is the end in sight for theoretical physics?" Needless to say, supersymmetric particles weren't found. But that hasn't put the brakes on building ever-bigger particle smashers.



Particle smashers have given us great insight into matter. Pcharito

No doubt this approach has yielded deep insights about the nature of reality. But in *The Blind Spot*, astrophysicist Adam Frank, theoretical physicist Marcelo Gleiser and philosopher Evan Thompson argue that continuing along the path of reductionism may be preventing us from uncovering even deeper truths in the study of cosmology and consciousness. At the same time, reducing everything to lumps of matter and physical forces, they write, leads us to view nature as nothing but material resources to be extracted. So, if our attempts to break things down are reaching their limits, what can we do instead?

There are plenty of alternative ideas about how to gain knowledge, called epistemology, and what the basic stuff of the world is, called ontology, that embrace complexity rather than demolishing it. For instance, enactivism is the idea that we don't acquire knowledge by passively receiving information, instead it arises through our actions and engagements. Incredibly, in doing so, we bring the world into existence – as do other complex beings – through the knowledge that we gain. The world is not made of objects or organisms existing in environments; the real stuff of the world is the relationships between all these things. Not only are ideas like this mind blowing, but they carry with them ethical implications: we aren't merely passive bystanders in a vast and dead universe, but part of an unfolding whole in which our choices really matter.

DST holds some parallels with enactivism. It takes symmetry to be an active, generative process rather than a static feature of the universe – symmetry breaking in fundamental physics gives rise to new forces, for example, or in living beings it might allow for novel evolutionary innovations. Rethinking basic assumptions about the behaviour of core concepts like symmetry may well help scientists and philosophers to find the new foundations they seek.

But I'm just not sure that DTS is really a *theory* – let alone a theory of everything. As well as explaining something about the natural world, a good theory should make predictions that can ultimately be tested. The real value of DST seems less in its predictive power, and more in its observation of a general principle, or pattern, that exists across many scales – from the building blocks of reality to ecological and social systems. Rather than continuing to reach for a single

underlying theory of everything, we can welcome new frameworks like this as offering partial and complementary perspectives about the world and our place in it.