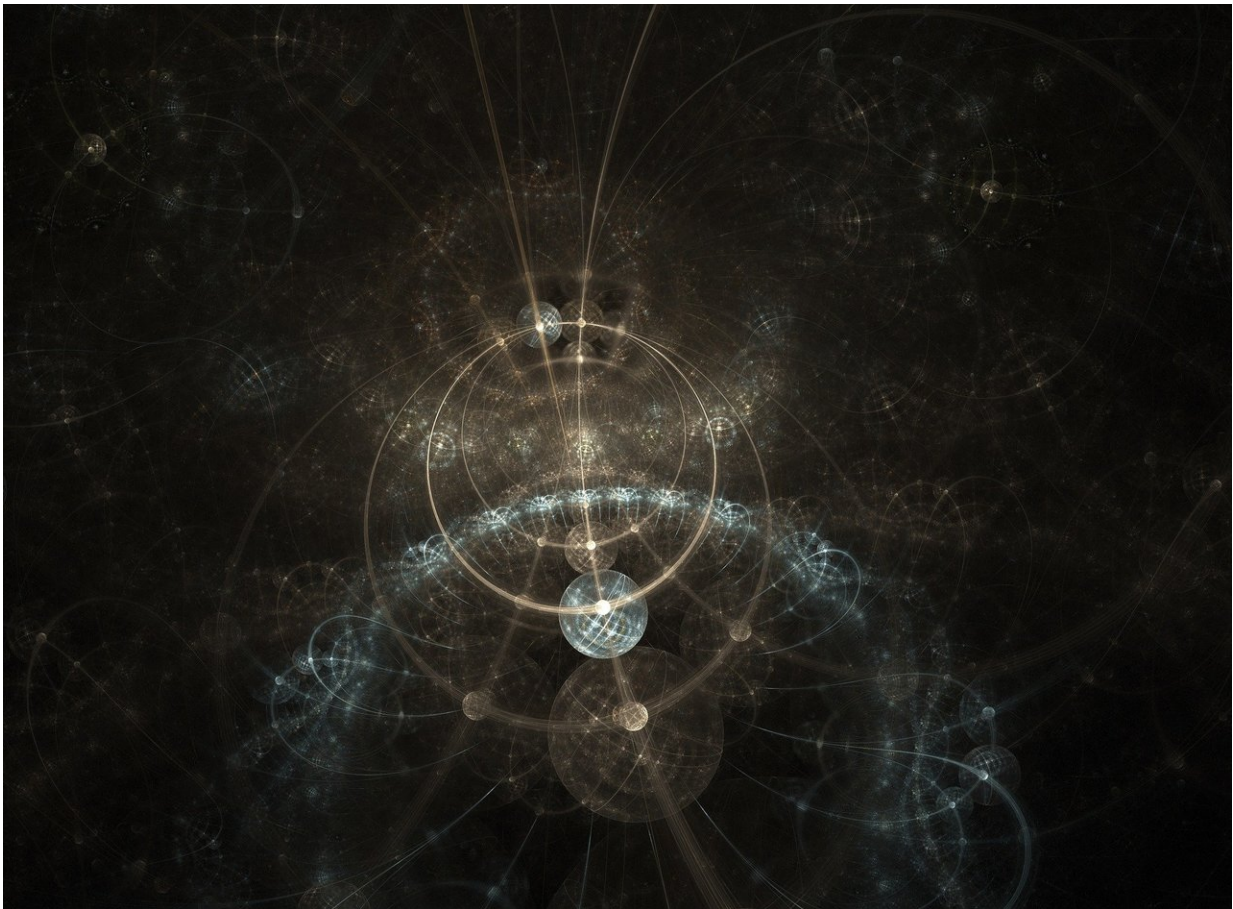


# Mathematician helps resolve question first asked 60 years ago

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An Irish mathematician, Dr. Martin Kerin, from the School of Mathematics, Statistics and Applied Mathematics at NUI Galway, has

had a research article published in the *Annals of Mathematics*, widely regarded as the top journal for pure mathematics in the world. The article, written in collaboration with Professor Sebastian Goette of the University of Freiburg and Professor Krishnan Shankar of the University of Oklahoma, resolves a question first asked around 60 years ago on the geometrical properties of seven-dimensional objects which very closely resemble spheres.

The *Annals of Mathematics* was founded in 1884 and is published by the Department of Mathematics at Princeton University, in cooperation with the Institute for Advanced Study. Only around thirty articles are accepted each year and Dr. Kerin is only the second ever Irish-based mathematician to have an article appear in the journal.

The article deals with the geometry of seven-dimensional exotic spheres. A standard [sphere](#) can be thought of as the set of all points at a fixed distance from a given point and is the result of gluing two disks (the hemispheres) together along their boundaries. If the boundaries of the two disks were instead glued together in a more interesting way, one would obtain an exotic sphere: to the casual observer it appears like the standard sphere, but it is a very different object.

The discovery of exotic spheres by John Milnor in the late 1950's resulted in his being awarded the Fields' medal, the highest honor in [mathematics](#). The subsequent quest to understand these spaces led to the development of much of modern topology and geometry. In the 1960's, mathematicians began to wonder how much the geometry of exotics spheres, that is the shape, resemble that of the standard spheres. A common measurement of shape is the curvature, the same quantity used in Einstein's general theory of relativity to describe gravity and the shape of the universe. The standard sphere is the basic example of a positively curved space, and previous work had shown that some of the seven-dimensional exotic spheres admit nonnegative curvature. In this article, a

new construction of the seven-dimensional exotic spheres was discovered, which allows one to conclude that, in fact, all of these spaces admit non-negative curvature.

Dr. Kerin said: "It is a tremendous honor, and a dream come true, to have our [article](#) appear in the *Annals* and to see our names listed among many of the greatest mathematicians in history. I am fortunate to have two fantastic collaborators in this project, each of us bringing different strengths to the table. Some of the basic ideas in the paper had been floating around in the back of my mind for around a decade, and we were able to successfully apply these basic ideas to a long-standing open problem. We are very proud of our achievement, but it is possibly even more pleasing that this project has thrown up many other interesting questions. We will likely be busy with this line of research for many years to come."

**More information:** Goette et al. Highly connected 7-manifolds and non-negative sectional curvature, *Annals of Mathematics* (2020). [DOI: 10.4007/annals.2020.191.3.3](https://doi.org/10.4007/annals.2020.191.3.3)

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