



Press Release

## Studying Curved Spaces

Freiburg mathematician Sebastian Goette is awarded funding from the Simons Foundation

The Freiburg mathematician Prof. Dr. **Sebastian Goette** will receive a total of 650,000 US dollars in funding over the coming four years for his involvement in the project “Special Holonomy in Geometry, Analysis, and Physics.” The funding is being provided by the Simons Foundation, a non-profit organization in the USA that supports fundamental research in mathematics and natural sciences. Director of the project is the mathematics professor **Robert Bryant** from Duke University, USA. Other collaborators include researchers from Stony Brook University and University of California in the USA and Imperial College London, King's College London, University of Bath, and University of Oxford in England.

The project focuses on Riemannian manifolds with special holonomy. These are spaces whose curves have special properties, in particular the so-called Calabi–Yau,  $G_2$ , and  $\text{spin}(7)$  manifolds. These spaces fulfill the Einstein equations in vacuum, meaning that a universe without matter could take on their shape. In physics, they are needed to establish a connection between various string theories in ten dimensions or the M-theory in eleven dimensions and the space–time continuum. Described in Albert Einstein’s general theory of relativity, the space–time continuum is the unification of space and time in a single four-dimensional structure. The string theories and the M-theory, which was developed on the basis of the former, are regarded as a promising approach for resolving the theoretical incongruities between quantum physics and the general theory of relativity.

University of Freiburg

Rectorate

Public Relations

Fahnenbergplatz  
D -79085 Freiburg

Contact:

Nicolas Scherger

Tel. +49 (0)761 / 203 - 4301

[nicolas.scherger@pr.uni-freiburg.de](mailto:nicolas.scherger@pr.uni-freiburg.de)

[www.pr.uni-freiburg.de](http://www.pr.uni-freiburg.de)

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“From a mathematical standpoint, Riemannian manifolds with special holonomy are spaces with an especially beautiful geometry,” says Goette. The goal of the collaboration is to construct more examples of such spaces and to gain further insight on the relationship between their geometrical and physical properties as well as these properties themselves. “The Freiburg subproject focuses on  $G_2$  manifolds, which are necessary for M-theory,” says Goette. “We are studying global geometrical properties and using them to compare various constructions of  $G_2$  manifolds.”

James Simons, an American mathematician, hedge-fund manager, and CO-founder of the Simons Foundation, with his wife, Marilyn Simons, also dealt with special holonomy in his 1962 doctoral dissertation.

**Further information:**

[www.simonsfoundation.org/mathematics-and-physical-science/news-announcements/foundation-announces-simons-collaboration-on-special-holonomy-in-geometry-analysis-and-physics](http://www.simonsfoundation.org/mathematics-and-physical-science/news-announcements/foundation-announces-simons-collaboration-on-special-holonomy-in-geometry-analysis-and-physics)

**Contact:**

Prof. Dr. Sebastian Goette  
Institute of Mathematics  
University of Freiburg  
Phone: +49 (0)761/203-5571  
E-Mail: [sebastian.goette@math.uni-freiburg.de](mailto:sebastian.goette@math.uni-freiburg.de)

The University of Freiburg achieves top positions in all university rankings. Its research, teaching, and continuing education have received prestigious awards in nationwide competitions. Over 24,000 students from 100 nations are enrolled in 188 degree programs. Around 5,000 teachers and administrative employees put in their effort every day – and experience that family friendliness, equal opportunity, and environmental protection are more than just empty phrases here.