NUS National University of Singapore | Department of Biological Sciences, Faculty of Science

ON-SITE BIOLOGY COLLOQUIUM

Friday, 13 Nov 2026 | 4 pm | S3 05-02 Conference Room 1

Hosted by Assist Prof Long Yuchen

Map to Block S3

Life's Beautiful Instabilities: Unleashed by Physics, Tamed by Evolution

Michel Milinkovitch is Full Professor in the Department of Genetics & Evolution at the University of Geneva (Switzerland), where he served as President of the Faculty of Biology (2019–2025). He is also a Group Leader at the SIB Swiss Institute of Bioinformatics and a member of the Institute of Genetics & Genomics in Geneva. He earned his PhD in Biology (summa cum laude) from Yale University (USA) and the Université Libre de Bruxelles (Belgium) in 1994. After beginning his career in molecular phylogenomics and conservation genetics, he pioneered a transdisciplinary approach to morphogenesis, integrating computational methods, physics, and evolutionary developmental genetics to explain how organisms acquire their form. He has published over 150 papers—including in Nature, Science, and leading physics journals—and delivered more than 150 invited lectures worldwide. He has received an ERC Advanced Grant, co-founded the biotech company Delphi Genetics, and runs a renowned animal facility with his wife, Dr. Athanasia Tzika.



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Much of morphogenesis —the process by which embryos acquire their form— occurs through chemical and mechanical self-organising symmetry-breaking events that generate patterns of gene expression, cell differentiation, as well as tissue, organ, and body geometries. I will discuss how morphogenesis can be modelled efficiently and quantitatively, despite the seemingly unmanageable profusion of cellular and molecular variables involved.

First, Turing's reaction-diffusion models are tremendously effective in explaining the spatial patterning of vertebrate skin colours and appendages (scales, feathers, hairs), without parametrising the profusion of variables at the microscopic scale.

Second, an elastic 3D mechanical model, integrating growth and the material properties of embryonic tissues, captures the patterning of head scales in crocodiles, tortoises, and possibly dinosaurs.

Third, the strikingly ordered pattern of snake scales is explained by a reaction-diffusion-taxis model, and their spectacular morphogenesis —into strongly overlapping appendages— is recapitulated with a 3D mechanical model integrating tissue plasticity and active material properties.

All three examples illustrate that macroevolution —changes in shape and form across evolutionary time— can be explained by genetic variation affecting the parameters of these self-organising processes.

Finally, I will argue that biology is now not only at the forefront of scientific and technological discovery but also a new frontier for physicists and mathematicians.