INFOMAT

OKTOBER 2021

ÅRETS NOBELPRIS I FYSIKK HEDRER PIONERER INNEN MATEMATISK MODELLERING

Årets Nobelprisvinner i fysikk, italieneren Giorgio Parisi (får prisen sammen med Syukuro Manabe og Klaus Hasselmann), får prisen for sine arbeider innenfor dynamiske systemer. Et av hans sentrale bidrag er den såkalte Kardar-Parisi-Zhang (KPZ)-likningen, introdusert av Parisi sammen med Mehran Kardar, og Yi-Cheng Zhang i 1986. Likningen beskriver tidsutviklingen av et høydefelt og bygger på diffusjonslikningen, men bringer også inn et støy-ledd og et ledd som avhenger av helningen i høydefeltet.

$$\frac{\partial h(\mathbf{x},t)}{\partial t} = \nu \nabla^2 h + \frac{\lambda}{2}(\nabla h)^2 + \eta(\mathbf{x},t)$$

Likningen beskriver f.eks. hvordan et snødybdefelt utvikler seg når det faller snø på en flate. Modellen kan også gi en innsikt i hvorfor kaffeflekker er mørkere i kanten enn inne i midten. Mer om Parisis arbeider inne i bladet.

INFOMAT kommer ut med 11 nummer i året og gis ut av Norsk Matematisk Forening. Deadline for neste utgave er alltid den 15. i neste måned. Stoff til INFOMAT sendes til

arnebs at math.uio.no

Foreningen har hjemmeside http://www.matematikkforeningen.no/
Ansvarlig redaktør er Arne B. Sletsjøe, Universitetet i Oslo

Matematisk kalender

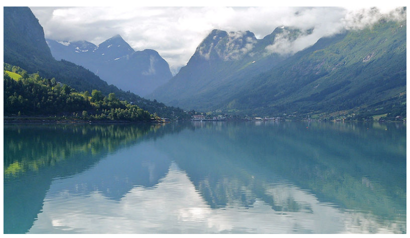
På grunn av den pågående pandemien kan flere av arrangementene bli utsatt eller avlyst. Følg med på web-sidene.

2022

Juni:

12.-19. Seminar Sophus Lie, Nordfjordeid <https://www.mathematik.uni-marburg.de/ agricola/SSL2021/>

SEMINAR SOPHUS LIE, Nordfjordeid, 12.-19. juni 2022



Seminaret er utsatt til 12.- 19. juni 2022.

Ledige stillinger

LEDIG PH.D VED UIO

Position as PhD Research Fellow in mathematics funded by the RCN project *Equations in Motivic Homotopy* available at the Department of Mathematics, UiO.

The fellowship will be for a period of 3 years, with no compulsory work. Starting date as soon as possible. The successful applicant will participate in the research activity pursued in the RCN project mentioned above (for details, see the department?s web-page https://www.mn.uio.no/math/english/research/projects/emoho/index.html). Applicants must document a background within motivic homotopy theory.

LEDIG POST.DOC i KRYPTOLOGI VED NTNU

We have a vacancy for a postdoctoral fellow in cryptography, mentored by Jiaxin Pan, at the Department of Mathematical Sciences at NTNU starting in May 2022. The concrete starting date is negotiable, and we encourage candidates who finish their PhD within 2022 to apply.

The postdoctoral fellowship position is a temporary position where the main goal is to qualify for work in senior academic positions. The workplace will be in Trondheim. The position has travel money for conferences, workshops and winter/summer schools.

The successful candidate is expected to conduct research in public-key cryptography and provable security, in particular, for digital signatures, zero-knowledge proofs and post-quantum cryptography. The candidate is expected to publish results at the top-tier conferences in cryptography and IT security (such as Crypto, Eurocrypt, ACM CCS, etc.) The candidate will collaborate with the mentor and other researchers on the related topics. The position will be involved in activities of the NTNU Applied Cryptology Lab (NaCl). NaCl is a platform across different departments for research activity in cryptology, and it includes researchers from IMF (Department of Mathematical Sciences) and IIK (Department of Information Security and Communication Technology).

Nyheter

NY MEDARBEIDER VED UIO

Alexander Müller-Hermes er fra 1. oktober 2021 ansatt som førsteamanuensis ved UiO. Alexander er tilknyttet forskningsgruppen i operatoralgebraer. Alexander sier selv om sin ansettelse:

I am excited to join the operator algebra group as *an associate professor. My research is on mathematical aspects of quantum information theory with a focus on quantum Shannon theory, entanglement theory, and their interplay with operator algebra.*

I obtained my PhD in 2015 from the Technical University Munich and worked as a postdoc at the Centre of Mathematics in Quantum Theory (QMATH) at the University of Copenhagen until 2019. From 2019 to 2021 I was a Marie-Sklodowska-Curie fellow at the Institute Camille Jordan at University of Lyon 1.

Besides mathematical research, I enjoy spending time with my family and juggling balls, clubs, and the challenges of life in general. Among my proudest achievements is a method for cutting three circular cakes exactly in half using a knife alone.

NOBELPRISEN I FYSIKK TIL MATEMATISK MODELLERING

Nobelprisen i fysikk for 2021 utdeles *for groundbreaking contributions to our understanding of complex physical systems* med en halvpart delt mellom **Syukuro Manabe** og **Klaus Hasselmann** *for the physical modelling of Earth's climate, quantifying variability and reliably predicting global warming* og en halvpart til **Giorgio Parisi** *for the discovery of the interplay of disorder and fuctuations in physical systems from atomic to planetary scales* Den følgende teksten er hentet fra Den Kungliga Vetenskapsakademien sin begrunnelse for tildelingen til Parisi:

Around 1980, Giorgio Parisi presented his discoveries about how apparently random phenomena are governed by hidden rules. His work is now considered to be among the most important contributions to the theory of complex systems.

Modern studies of complex systems are rooted in the statistical mechanics developed in the second half of the 19th century by James C. Maxwell, Ludwig Boltzmann and J. Willard Gibbs, who named this field in 1884. Statistical mechanics evolved from the insight that a new type of method was necessary for describing systems, such as gases or liquids, that consist of large numbers of particles. This method had to take the particles' random movements into account, so the basic idea was to calculate the particles' average effect instead of studying each particle individually. For example, the temperature in a gas is a measure of the average value of the energy of the gas particles. Statistical mechanics is a great success, because it provides a microscopic explanation for macroscopic properties in gases and liquids, such as temperature and pressure.

The particles in a gas can be regarded as tiny balls, flying around at speeds that increase with higher temperatures. When the temperature drops, or pressure increases, the balls first condense into a liquid and then into a solid. This solid is often a crystal, where the balls are organised in a regular pattern. However, if this change happens rapidly, the balls may form an irregular pattern that does not change even if the liquid is further cooled or squeezed together. If the experiment is repeated, the balls will assume a new pattern, despite the change happening in exactly the same way. Why are the results different?

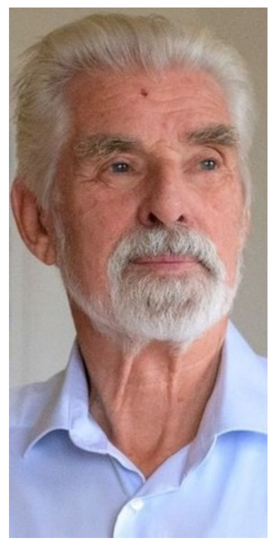
These compressed balls are a simple model for ordinary glass and for granular materials, such as sand or gravel. However, the subject of Parisi's original work was a different kind of system – spin glass. This is a special type of metal alloy in which iron atoms, for example, are randomly mixed into a grid of copper atoms. Even though there are only a few iron atoms, they change the material's magnetic properties in a radical and very puzzling manner. Each iron atom behaves like a small magnet, or spin, which is affected by the other iron atoms close to it. In an ordinary magnet, all the spins point in the same direction, but in a spin glass they are frustrated; some spin pairs want to point in the same direction and others in the opposite direction – so how do they find an optimal orientation?

In the introduction to his book about spin glass, Parisi writes that studying spin glass is like watching the human tragedies of Shakespeare's plays. If you want to make friends with two people at the same time, but they hate each other, it can be frustrating. This is even more the case in a classical tragedy, where strongly emotional friends and enemies meet on stage. How can the tension in the room be minimised? Spin glasses and their exotic properties provide a model for complex systems. In the 1970s, many physicists, including several Nobel Laureates, searched for a way to describe the mysterious and frustrating spin glasses. One method they used was the replica trick, a mathematical technique in which many copies, replicas, of the system are processed at the same time. However, in terms of physics, the results of the original calculations were unfeasible. In 1979, Parisi made a decisive breakthrough when he demonstrated how the replica trick could be ingeniously used to solve a spin glass problem. He discovered a hidden structure in the replicas, and found a way to describe it mathematically. It took many years for Parisi's solution to be proven mathematically correct. Since then, his method has been used in many disordered systems and become a cornerstone of the theory of complex systems.

Both spin glass and granular materials are examples of frustrated systems, in which various constituents must arrange themselves in a manner that is a compromise between counteracting forces. The question is how they behave and what the results are. Parisi is a master at answering these questions for many different materials and phenomena. His fundamental discoveries about the structure of spin glasses were so deep that they not only influenced physics, but also mathematics, biology, neuroscience and machine learning, because all these fields include problems that are directly related to frustration.

Parisi has also studied many other phenomena in which random processes play a decisive role in how structures are created and how they develop, and dealt with questions such as: Why do we have periodically recurring ice ages? Is there a more general mathematical description of chaos and turbulent systems? Or – how do patterns arise in a murmuration of thousands of starlings? This question may seem far removed from spin glass. However, Parisi has said that most of his research has dealt with how simple behaviours give rise to complex collective behaviours, and this applies to both spin glasses and starlings.

SYUKURO MANABE, Born 1931 in Shingu, Japan. Ph.D. 1957 from University of Tokyo, Japan. Senior Meteorologist at Princeton University, USA.



KLAUS HASSELMANN, Born 1931 in Hamburg, Germany. Ph.D. 1957 from University of Göttingen, Germany. Professor, Max Planck Institute for Meteorology, Hamburg, Germany.

GIORGIO PARISI, Born 1948 in Rome. Italy. Ph.D. 1970 from Sapienza University of Rome, Italy. Professor at Sapienza University of Rome, Italy.