The Lie–Størmer Center

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The Lie–Størmer Center is a Norwegian research center in mathematics, hosted at UiT – The Arctic University of Norway in partnership with the University of Bergen. The Center's name honors two Norwegian mathematicians whose research bridged abstract theory and practical computation. It carries that spirit forward by serving as a research environment, a training ground, and a point of contact between mathematical sciences and society.

A house of mathematics

Norway has a remarkable mathematical tradition. The works of Niels Henrik Abel, Sophus Lie, and Carl Størmer belong to the canon of the discipline. That tradition continues: Norwegian universities are home to an active and internationally recognized community of researchers, and Norway hosts the Abel Prize, one of the field's most distinguished honors. What has been missing is a dedicated center – a house of mathematics – that brings researchers together across institutions and across the divide that opened in the twentieth century between pure and applied mathematics. That divide has narrowed in recent decades, as abstract structures have proven indispensable to computation, and computational problems have driven new mathematical theory. A center built on that convergence, serving the training of new generations and acting as a point of contact between the mathematical sciences and society, is what Norway has lacked. The Lie–Størmer Center[1] was founded to be that place.

Two Norwegians who bridged the divide

Sophus Lie (1842–1899) did not set out to found a new branch of mathematics. He was concerned with differential equations: understanding why certain methods succeed while others fail. The answer lay in symmetry. By studying the transformation groups that leave an equation invariant, he transformed a collection of ad hoc techniques into a unified theory. Lie groups now underpin general relativity, quantum field theory, and particle physics; with the rise of modern computation, they have become equally central to numerical analysis.

Carl Størmer (1874–1957) began as a number theorist, but his interest in the aurora borealis led him to problems in mathematical physics. Inspired by Kristian Birkeland's experiments on the northern lights, he spent years computing the trajectories of charged particles in the Earth's magnetic field – thousands of calculations performed by hand. The numerical method he developed to integrate the equations of motion became one of the most widely used schemes in physics and engineering and remains so today. Reinterpreted through the lens of Lie group integration, it connects directly to the research program of the Center that now bears his name.

The logo of the Lie–Størmer Center captures this connection: it is inspired by Størmer's charged particle trajectories, computed using modern Lie group methods, joining the two namesakes in a single image. The Center opened in January 2024 at UiT Tromsø and is based on the view that the dialogue between mathematical structure and computational method remains one of the most productive frontiers in contemporary mathematics.

Three pillars

The Lie–Størmer Center is organized around three pillars that are distinct in character but closely connected in practice.

Research is the central pillar. The Center brings together mathematicians working across algebra, geometry, topology, and computational mathematics, fields that, for much of the twentieth century, developed in relative isolation. They are united by the view that abstract mathematical structures and computational methods are mutually reinforcing: new algebraic and geometric ideas reshape the design of algorithms, while computational problems reveal structures that pure mathematics had not previously had reason to study. One example from recent decades is the Hopf-algebraic structures discovered by Alain Connes and Dirk Kreimer in quantum field theory, which turned out to govern the composition of numerical integration methods, linking renormalization in physics to the algebra underlying Runge–Kutta schemes. Such

[1] https://lie-stormer.no

Participants at the Fall School on Geometry in Cryptography and Communication, held in Skibotn, Norway, in 2025.
(Photo: Gabriella Óturai, UiT The Arctic University of Norway)

Marcus du Sautoy giving a public lecture during the "Celebration of Mathematics" event in Tromsø, Norway.
(Photo: Jørn Berger-Nyvoll, UiT The Arctic University of Norway)

unexpected connections are precisely what the Center seeks to uncover and develop. The research is organized into six interlinked themes, spanning algebraic and combinatorial structures, topological invariants, symbolic computation, categorical reasoning, structure-preserving algorithms, and quantum computation, forming a continuous loop between mathematical foundations and computational practice.

Education is the second pillar. The Center hosts Mathesis, Norway's national doctoral school for the mathematical foundations of computation, funded by the Research Council of Norway. Mathesis connects PhD students across Norwegian universities through advanced courses, masterclasses, and research schools, with the aim of building fluency in both pure and computational mathematics. The Lie–Størmer Masterclass runs in a hybrid format, combining weekly online lectures with intensive in-person sessions, and brings research-level topics to students in Bergen, Oslo, Stavanger, Tromsø, and Trondheim that are not typically part of standard curricula. In 2024, the program expanded internationally through a partnership with Centre International de Mathématiques Pures et Appliquées (CIMPA): fellows from developing countries joined the masterclass and spent research periods in Tromsø, taking part in the scientific life of the Center. A further collaboration with the Indian National Centre for Mathematics is underway, supported by the Indo-Norwegian Cooperation Programme in Higher Education.

Outreach is the third pillar. It is rooted in the view that mathematics is a shared intellectual heritage. The Center organizes public lectures, open days for school students and teachers, and science communication through digital media. The opening of the Center in January 2024 set the tone: alongside the scientific program, it included a public lecture by Simon Singh, whose books on Fermat's Last Theorem, cryptography, and the hidden mathematics of popular culture have brought rigorous ideas to audiences well beyond the university. Also this year, a "celebration of mathematics" featuring Marcus du Sautoy brought the beauty of mathematics to the general public.

Research: six themes, one conversation

The Center's scientific program is structured around six research themes, each addressing a fundamental question about the relationship between mathematical structure and computation.

Algebraic and Combinatorial Structures addresses how algebraic symmetries encode the laws of computation and dynamics. It develops the algebraic backbone of the Center's research – Lie algebras, Hopf algebras, quantum groups, and operads – and their connections to combinatorics, topology, and geometry.

Geometric and Topological Invariants addresses how geometry and topology reveal hidden order in computation and data. It develops tools for identifying invariants that remain stable under deformation or noise, with applications ranging from dynamical systems to topological data analysis.

Symbolic and Homological Computation addresses how algebraic and topological structures can be made computationally effective. Working with polynomials, ideals, complexes, and representation-theoretic data, it develops algorithms that exploit symmetry and categorical structure to reach computations previously out of reach.

Categorical Dualities and Diagrammatic Reasoning examines the universal language connecting structure and computation. Categorical dualities, between algebra and geometry, syntax and semantics, and classical and quantum theories, provide the conceptual framework for structure-aware algorithms.

The first recipients of the Lie–Størmer–CIMPA Fellowship during their stay in Tromsø in 2024. Hans Munthe-Kaas and Cordian Riener together with fellows Yadav Rohit and Ngwongwo Ignatius.
(Photo: Lluïsa Puig Moner, UiT The Arctic University of Norway)

Structure-Preserving Algorithms and Learning addresses how mathematical structure can guide computation, learning, and inference. It develops algorithms that respect the symmetries and geometric constraints of the problems they address, including Lie-group-based numerical integration and geometrically informed architectures for machine learning.

Quantum and Noncommutative Computation explores the structural possibilities and limits of quantum computation. Drawing on representation theory, tensor categories, and quantum topology, it explores the algebra underlying quantum information and closes the loop by uncovering new mathematical structures through the demands of computation itself.

An international research environment

The Lie–Størmer Center is a member of ERCOM, a network of European mathematical research centers. The scientific life of the Center is built around schools, colloquia, and workshops that regularly bring the international mathematical community to Tromsø, complemented by a visitor program for extended research stays. In collaboration with CIMPA, the Center hosts two fellows from developing countries each year for one-month visits. It also runs an annual open call for proposals to organize thematic research weeks. Each autumn, the Center issues an open call to organize a research week, inviting proposals from the broader mathematical community. The Center also publishes a book series with Springer, titled Fundamental Structures in Computational and Pure Mathematics.

Funding and context

The Lie–Størmer Center grew out of a collaboration between the mathematics communities at UiT and the University of Bergen that began in 2021, supported by the national project "Pure Mathematics in Norway" and by grants from the Research Council of Norway and the European Research Council. Early support from the Trond Mohn Foundation enabled the Center to establish its organizational framework and begin its scientific activities.

The scientific advisory committee, consisting of Felipe Cucker (City University of Hong Kong), Jesús María Sanz-Serna (Universidad Carlos III de Madrid), and Roland Speicher (Universität des Saarlandes), meets annually to provide an independent assessment of the Center's research direction and development.

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