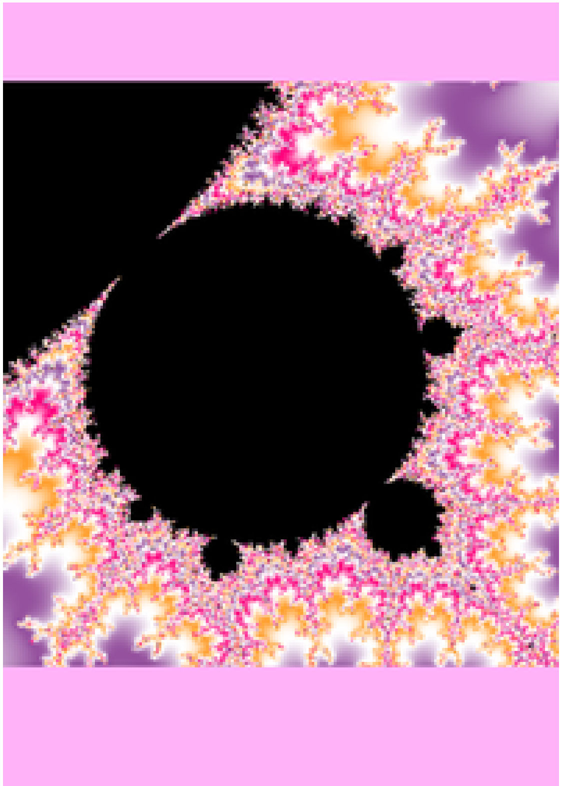
6th Austrian Day of Women in Mathematics



Report of Contributions

https://indico.global/e/15623

Contribution ID: **6** Type: **not specified**

Eli Taxacher - Does gender always exist? And if so, how many?

Gender often appears to be obvious, natural, and clearly defined —something everyone already understands. Yet when we look more closely, even the most basic assumptions begin to unravel. This talk introduces current scientific perspectives on sex and gender and also explores why discussions on gender often become emotional or political.
A talk for curious minds who enjoy questioning what seems obvious.

Eli Taxacher studied sociology (Graz, Örebro/Sweden), international gender research and feminist politics (Vienna), works in the field of coaching, facilitation and process support, and in adult education as coordinator and course manager of the GenderWerkstätte at Verein Frauenservice Graz.

Affiliation

Presenter: TAXACHER, Eli

Session Classification: Public Lecture

Contribution ID: **13** Type: **Contributed Talk**

Escape of Mass of Sequences

Friday, 27 February 2026 09:50 (20 minutes)

One way to study the distribution of nested quadratic number fields satisfying fixed arithmetic relationships is through the evolution of continued fraction expansions. In the function field setting, it was shown by de Mathan and Teullie that given a quadratic irrational Θ, the degrees of the periodic part of the continued fraction of $t^n\Theta$ are unbounded. Paulin and Shapira improved this by proving that quadratic irrationals exhibit partial escape of mass. Moreover, they conjectured that they must exhibit full escape of mass. We construct counterexamples to their conjecture in every characteristic. In this talk we shall discuss the technique of proof as well as the connection between escape of mass in continued fractions, Hecke trees, and number walls. This is part of joint works with Erez Nesharim and Uri Shapira and with Steven Robertson.

Affiliation

TU Graz

Author: SOFFER ARANOV, Noy (TU Graz)

Presenter: SOFFER ARANOV, Noy (TU Graz)

Session Classification: Applied Algebra and Number Theory

Contribution ID: **14** Type: **Contributed Talk**

Numerical approximation of the Lévy-driven stochastic heat equation on the sphere

Thursday, 26 February 2026 14:55 (20 minutes)

In this talk, we approximate the stochastic heat equation on the sphere driven by additive Lévy random field by a spectral method in space and forward and backward Euler-Maruyama schemes in time. Our spectral approximation is based on a truncation of the series expansion with respect to the real-valued spherical harmonics. We provide strong convergence rates, convergence of the expectation and second moment in dependence of the regularity of the initial condition and the driving noise. Furthermore, we present numerical simulations to confirm our theoretical results.

Affiliation

University of Klagenfurt

Authors: LANG, Annika; PAPINI, Andrea; SCHWARZ, Verena

Presenter: SCHWARZ, Verena

Session Classification: Analysis

Contribution ID: **15** Type: **Contributed Talk**

Impact of Body Mass Index on Power Distribution in High-Power RF Ablation for Atrial Fibrillation: Insights from Virtual Patients

Thursday, 26 February 2026 14:35 (20 minutes)

Background:
High-power radiofrequency ablation (HP-RFA) is a minimally invasive technique for treating atrial fibrillation (AF); pulmonary vein isolation (PVI) serves as the cornerstone of this treatment. Variations in patient characteristics, such as body mass index (BMI), can influence the effectiveness and safety of PVI procedures. Obesity is a growing concern in the population, and its impact on cardiac interventions, including PVI, remains an area of ongoing research.
Methods:
We developed virtual patient models from CT scans by performing detailed segmentation, incorporating anatomical structures such as the heart, lungs, liver, fat, and muscle, among others. We used three virtual patients, one for each of the following BMI groups: normal weight (less than 25 kg/ m^2), pre-obesity (between 25 kg/ m\squared} and 30 kg/ m^2), and morbid obesity (more than 35 kg/m^2).
Electrodes were placed at four locations on the left atrial wall near each of the pulmonary vein. A dispersive patch at the back of each virtual patient completed the circuit. The power distribution in the ablation procedure was simulated using a high-power protocol set at 90 W.

Results: The virtual patients models showed significant BMI-related variations in anatomical structures, particularly fat and muscle distribution, which impacted power delivery. In morbidly obese patients, increased fat tissue caused higher impedance with respect to normal weight patients. Despite these variations, small differences were observed in the dissipated power within the left atrial tissue. All patients showed consistently higher tissue power dissipation for thicker tissues and more specifically at the right superior pulmonary vein. However, this trend was only observed per patient, as obese patients feature lower tissue power dissipation than normal weight ones for the same wall thickness.

Discussion:
Our study demonstrates the feasibility of using computational modeling to analyze how BMI affects PVI procedures. We found that variations in body composition influence the total impedance and the dissipated tissue power at patients featuring the same wall thickness. These insights highlight the potential for personalized treatment strategies to improve the effectiveness and safety of cardiac interventions, particularly for individuals with higher BMI.

Affiliation

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Presenter: ANEES, minha (RICAM)

Session Classification: Scientific Computing, Computational Imaging and Applications in Biomedicine

Contribution ID: **17** Type: **Contributed Talk**

Attractors for a class of Degenerate Parabolic Equations

Thursday, 26 February 2026 14:55 (20 minutes)

Degenerate parabolic equations arise in a variety of models in which diffusion vanishes or weakens in certain regions, thereby giving rise to substantial analytical difficulties. In particular, degeneracy strongly affects compactness and dissipative properties, which play a crucial role in the study of long-time dynamics and asymptotic behavior.

In this talk, we focus on a class of degenerate parabolic equations of Caldiroli–Musina type, characterized by the diffusion operator

-

operatornamediv$\big(\sigma(x)\nabla u\big), where \sigma$ is a non-negative measurable function that may vanish at finitely many points. More precisely, σ satisfies the structural conditions introduced by Caldiroli and Musina (2000). In recent years, the existence and asymptotic behavior of parabolic equations of the form

$$labele1 u_t - operatornamediv\big(\sigma(x)\nabla u\big) + f(u) + g(x) = 0, tag1 \tag{1}$$

have attracted considerable attention. Equation
eqrefe1 can be viewed as a simplified model for neutron diffusion arising in feedback control of nuclear reactors, where u and σ denote the neutron flux and the neutron diffusion coefficient, respectively.

We investigate equation
eqrefe1 under various assumptions on the nonlinear terms, considering both autonomous and non-autonomous settings, as well as bounded and unbounded domains in $\mathbb{R}^N$. The main aim of the talk is to illustrate how appropriate energy methods combined with suitable functional frameworks ensure the existence of global attractors and allow for a qualitative description of their structure. Finally, we provide an overview of related open problems and outline several directions for future research. This presentation is intended for a broad audience interested in partial differential equations and infinite-dimensional dynamical systems.

Affiliation

https://scholar.google.com/citations?user=jScEXFoAAAAJ&hl=en

Author: LE THI, Thuy (Electric Power University)

Presenter: LE THI, Thuy (Electric Power University)

Session Classification: PDEs

Contribution ID: **18** Type: **Contributed Talk**

Real Algebraic Overtwisted Contact Structures on 3-Spheres

Friday, 27 February 2026 09:50 (20 minutes)

A real algebraic link in the 3-sphere is defined as the zero locus in the 3-sphere of a real algebraic function from $\mathbb{R}^4 \to \mathbb{R}^2$ with an isolated singularity at the origin. A real algebraic open book decomposition on
the 3-sphere is by definition the Milnor fibration of such a real algebraic function. In this talk, I will present our recent result which proves that every overtwisted contact structure on the 3-sphere with positive three-dimensional invariant d_3 are real algebraic with the
pages of the associated open books being planar.

Affiliation

Bogazici University

Author: KARADERELI, Şeyma (Bogazici University)

Co-author: Prof. ÖZTÜRK, Ferit (Bogazici University)

Presenter: KARADERELI, Şeyma (Bogazici University)

Session Classification: Geometric Analysis and Geometric Topology

Contribution ID: **23** Type: **Contributed Talk**

Factorization in Cluster Algebras: An Algorithmic Approach

Thursday, 26 February 2026 14:15 (20 minutes)

Cluster algebras are built by repeated "mutation,"but their basic arithmetic is still mysterious: do elements factor uniquely? I'll describe algorithms that, for a large class of cluster algebras (including many from surfaces and Grassmannians), compute the divisor class group, decide when unique factorization holds, and even list all factorizations of a given element. This is a joint work with D. Smertnig.

Affiliation

University of Graz

Author: POMPILI, Mara (University of Graz)

Co-author: Prof. SMERTNIG, Daniel

Presenter: POMPILI, Mara (University of Graz)

Session Classification: Algebra and Number Theory

Contribution ID: **25** Type: **Contributed Talk**

Supersymmetric Null and Timelike Warped AdS and Strings in $D = 3$, $N = 2$ Gauged Supergravity and Their Uplift to $D = 6$

Thursday, 26 February 2026 14:35 (20 minutes)

We classify and construct supersymmetric solutions of D=3, N=2 gauged supergravity extended with a Fayet-Iliopoulos term. Null and timelike warped AdS spacetimes are seen among them. From the first one, a well-defined black hole can be obtained via periodic identification.
We also find charged string solutions that interpolate between two supersymmetric AdS or Minkowski extrema of the scalar potential, one of which corresponds to a horizon with a singularity behind it, and the other determines the asymptotic geometry.

Affiliation

Bogazici University

Authors: DERAL, Ceren Ayse (Bogazici University); DEGER, Nihat Sadik (Bogazici University)

Presenter: DERAL, Ceren Ayse (Bogazici University)

Session Classification: Mathematical Physics and Geometry

Contribution ID: **26** Type: **Invited Talk**

From Individual Bites to Ecosystem Patterns: Size-Structured Dynamics in Aquatic Food Webs

Friday, 27 February 2026 10:10 (20 minutes)

Aquatic ecosystems are shaped by countless interactions between individual organisms - but how do these microscopic encounters scale up to the large-scale patterns we observe in nature? How sensitive are these systems to human influence? Since the 1960s, research has revealed that body size plays a central role in structuring aquatic food webs, acting as a "master trait"that governs how biomass, abundance, and production are distributed across species.

In this work, we propose and analyze a deterministic jump-growth model that links individual-level feeding interactions to ecosystem-level structure. The model is formulated as a kinetic equation for coalescing particles and is derived from an underlying stochastic, individual-based description of predator–prey dynamics. At its core lies the assumption that ecosystem dynamics are driven by binary interactions: predators consume prey, assimilating a fraction of their biomass and thereby growing, while contributing to plankton production.

By studying this equation across multiple parameter regimes, we explore how simple rules at the level of individual interactions can generate emergent, size-structured patterns characteristic of aquatic ecosystems. We present analytical results alongside numerical simulations, offering insights into the mechanisms that shape food-web structure and their potential sensitivity to external perturbations.

Affiliation

CNRS Paris

Author: KANZLER, Laura (CNRS Paris)

Presenter: KANZLER, Laura (CNRS Paris)

Session Classification: PDEs

Contribution ID: **28** Type: **Invited Talk**

The boundaries of mathematics: infinite games and very large sets

Friday, 27 February 2026 08:45 (40 minutes)

The independence phenomenon is a central theme in set theory and more generally in mathematics. Starting from the Continuum Problem, there are numerous statements in various areas of mathematics that can neither be proven nor disproven in the usual axiomatic framework given by the Zermelo Fraenkel Axioms. The most promising approach to attack this issue is by studying extensions of the usual axiomatic framework, their connections, and their impact on previously independent statements. Two famous examples in set theory are the hierarchies given by the determinacy of infinite two-player games and large cardinals. The deep connection between these two hierarchies forms the backbone of inner model theory. We outline this connection and discuss recent progress as well as important open questions in the area.

Affiliation

Presenter: MÜLLER, Sandra (TU Wien)

Session Classification: Invited talk

Contribution ID: **29** Type: **not specified**

Supervision in Focus: From expertise to good practice.

Two parallel sessions: one for doctoral students and one for those who supervise students. Coaches are Yasmin Dolak-Struss and Gerald Lind.

Yasmin Dolak-Struss is a trainer and systemic coach specialising in the professional development of researchers. With a background in technical physics and a PhD in mathematics, she has worked both in academia and in a major research funding organisation before founding her own consultancy. Today, she supports researchers and research leaders in developing productive working relationships, strengthening their skill set and shaping successful, meaningful careers.

As Deputy Head of the Research Careers Campus (University of Graz), Gerald Lind develops institutional strategies to support the personal and academic development of researchers across disciplines. His work aims to foster an inclusive research culture that enables equitable development opportunities for researchers at different career stages. Apart from academic papers and literary reviews, Gerald Lind also published two novels.

Affiliation

Presenters: LIND, Gerald; DOLAK-STRUSS, Yasmin

Session Classification: Supervision in Focus: ”From experience to Good Practice”

Contribution ID: **30** Type: **Contributed Talk**

Global contraction of second-order Langevin dynamics and applications

Friday, 27 February 2026 09:50 (20 minutes)

In this talk, we study the long-time behaviour of second-order Langevin dynamics and establish global contraction in an L^1-Wasserstein distance with an explicit dimension-free rate. The contraction result is not restricted to forces corresponding to strongly convex confining potentials. It rather includes multi-well potentials and non-gradient-type forces. In the proof, we use a coupling approach and construct a distance function carefully adjusted to the coupling.
As a consequence, we outline how this result and the associated proof technique can be extended to analyse nonlinear Langevin dynamics with distribution-dependent forces and to establish uniform-in-time propagation of chaos for the corresponding particle system. Further, we discuss applications to kinetic Langevin samplers, that is, numerically implementable discretisations of the dynamics.

Affiliation

TU Wien

Author: SCHUH, Katharina

Presenter: SCHUH, Katharina

Session Classification: Probability and Statistics

Contribution ID: **31** Type: **Contributed Talk**

First-passage time for PDifMPs: an Exact simulation approach for time-varying thresholds

Friday, 27 February 2026 10:10 (20 minutes)

Piecewise Diffusion Markov Processes (PDifMPs) are valuable for modelling systems where continuous dynamics are interrupted by sudden shifts and/or changes in drift and diffusion. The first-passage time (FPT) in such models plays a central role in understanding when a process first reaches a critical boundary. In many systems, time-dependent thresholds provide a flexible framework for reflecting evolving conditions, making them essential for realistic modelling. We propose a hybrid exact simulation scheme for computing the FPT of PDifMPs to time-dependent thresholds. Exact methods traditionally exist for pure diffusions, using Brownian motion as an auxiliary process and accepting sampled paths with a probability weight. Between jumps, the PDifMP evolves as a diffusion, allowing us to apply the exact method within each inter-jump interval. The main challenge arises when no threshold crossing is detected in an interval: We then need the value of the process at the jump time, and for that, we introduce an approach to simulate a conditionally constrained auxiliary process and derive the corresponding acceptance probability. Furthermore, we prove the convergence of the method and illustrate it using numerical examples.

Affiliation

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Presenter: MEDDAH, Amira (Johannes Kepler University, Linz, Austria)

Session Classification: Probability and Statistics

Contribution ID: **32** Type: **Contributed Talk**

Approximate Bayesian computation for stochastic hybrid systems with ergodic behaviour

Friday, 27 February 2026 09:30 (20 minutes)

Piecewise diffusion Markov processes (PDifMPs) form a versatile class of stochastic hybrid systems that combine continuous diffusion processes with discrete event-driven dynamics, enabling flexible modelling of complex real-world hybrid phenomena. The practical utility of PDifMP models, however, depends critically on accurate estimation of their underlying parameters. In this work, we present a novel framework for parameter inference in PDifMPs based on approximate Bayesian computation (ABC). Our contributions are threefold. First, we provide detailed simulation algorithms for PDifMP sample paths. Second, we extend existing ABC summary statistics for diffusion processes to account for the hybrid nature of PDifMPs, showing particular effectiveness for ergodic systems. Third, we demonstrate our approach on several representative example PDifMPs that empirically exhibit ergodic behaviour. Our results show that the proposed ABC method reliably recovers model parameters across all examples, even in challenging scenarios where only partial information on jumps and diffusion is available or when parameters appear in state-dependent jump rate functions. These findings highlight the potential of ABC as a practical tool for inference in various complex stochastic hybrid systems.

Affiliation

Johannes Kepler University

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Presenter: MALLINGER, Agnes (Johannes Kepler University)

Session Classification: Probability and Statistics

Contribution ID: **33** Type: **Contributed Talk**

Singularity theorems in low regularity

Thursday, 26 February 2026 14:15 (20 minutes)

The singularity theorems of General Relativity (GR) are considered among
the most relevant works in mathematical physics of the last century. They form a body of important results in Lorentzian differential geometry that establishes the occurrence of spacetime "singularities", in the sense of causal geodesic incompleteness of the spacetime manifold under certain physically reasonable conditions. The most relevant of them are the ones proved by Roger Penrose and Stephen Hawking in the 1960-ies. These results were formulated for smooth spacetimes, however for the theorems to make physically meaningful predictions, one needs to extend their validity to spacetime metrics of low regularity. Already Hawking and Ellis in their book considered the issue of a lack of low regularity version of the theorems, i.e. for spacetime metrics below the C^2-class. In recent years there have been efforts in finding low regularity versions of the singularity theorems, getting as low as Lipschitz Lorentzian metrics. The main goal of my research is lowering the regularity threshold to H\"older continuous metrics with L^p bounded curvature. To reach this goal we make use of the RT-equations, elliptic equations whose solution describe the coordinate transformations regularizing connections to one derivative above its curvature, enabling us to apply methods a priori only available for more regular metrics.

Affiliation

Universität Wien

Author: VEGA GONZÁLEZ, Inés (Universität Wien)

Presenter: VEGA GONZÁLEZ, Inés (Universität Wien)

Session Classification: Mathematical Physics and Geometry

Contribution ID: **35** Type: **Poster Presentation**

In-silico comparison between in-vitro experiments and in-vivo application of cardiac radiofrequency ablation

Thursday, 26 February 2026 15:33 (9 minutes)

Radiofrequency ablation (RFA) is a minimally invasive treatment for cardiac arrhythmia. Experimental studies play a central role in the investigation of RFA treatment effects. Typically, in-vitro and in-vivo experiments are conducted on animal cardiac tissue. In-vitro experiments consider the cardiac tissue outside the organism, while during in-vivo experiments the tissue remains in its natural state. The difference in the experimental setup leads to a discrepancy in the predicted lesion. Our aim is to assess this discrepancy between the two experimental approaches using in-silico models.

A validated computational model for an in-vitro experimental setup is presented in. Building on this model, we derive the mathematical description of the in-vivo experimental setup by adjusting the governing equations to reflect the impact of blood perfusion on the bioheat equation.
A comparison between the experiment types is established by simulating a standard power of 30 W ablation protocol for 30 s. We observed that the volume of the created lesion and the maximum temperature in the cardiac tissue differ significantly according to the simulated experiment type.

Affiliation

Austrian Academy of Sciences, RICAM - Johann Radon Institute for Computational and Applied Mathematics

Authors: Dr PETRAS, Argyrios; FÜSSEL, Laura; Prof. GERARDO-GIORDA, Luca

Presenter: FÜSSEL, Laura

Contribution ID: **36** Type: **Contributed Talk**

Almost All Products of Projections Converge

Thursday, 26 February 2026 14:35 (20 minutes)

Let $C_1, \ldots, C_K$ be closed, convex and quasi-symmetric subsets of a Hilbert space H with a nonempty intersection $C = \bigcap_1^K C_j$.
A sequence of indices $\alpha \in \{1, \ldots, K\}^{\mathbb{N}}$ and $x_0 \in H$ generate the sequence of projections
$\mathrm{x}_{n+1} = P_{\alpha(n)} x_n, \qquad n = 0, 1, 2, \ldots ; here \mathrm{P}_{\alpha(n)}$ denotes the nearest point projection onto the convex set $C_{\alpha(n)}$.

We show that for almost all sequences α of indices the generated sequence of projections converges to a point in C.

Affiliation

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Universität Innsbruck

Author: Prof. KOPECKA, Eva (Universität Innsbruck)

Presenter: Prof. KOPECKA, Eva (Universität Innsbruck)

Session Classification: Analysis

Contribution ID: **37** Type: **Contributed Talk**

First-order homogenization

Thursday, 26 February 2026 14:15 (20 minutes)

In this talk, we provide a first-order homogenization result for quadratic functionals via a variational approach. In particular, we identify the scaling of the energy and the explicit form of the limiting functional in terms of the first-order correctors. The main novelty of the paper is the use of the dual correspondence between quadratic functionals and PDEs, combined with a refinement of the classical Riemann-Lebesgue Lemma. This is the joint work with Riccardo Cristoferi (Radboud University).

Affiliation

TU Wien

Authors: D'ELIA, Lorenza (TU Wien); CRISTOFERI, Riccardo

Presenter: D'ELIA, Lorenza (TU Wien)

Session Classification: Analysis

Contribution ID: **38** Type: **Contributed Talk**

CFD-Based Risk Assessment in VV-ECMO

Thursday, 26 February 2026 14:15 (20 minutes)

Veno-venous extracorporeal membrane oxygenation (VV-ECMO) is a life-support therapy used for patients with severe respiratory failure, including those affected by COVID-19. In this therapy, gas exchange is partially or fully supported by an extracorporeal circuit, thereby substituting impaired lung function. Despite its clinical effectiveness, the presence of non-physiological flow conditions introduces significant risks of adverse outcomes such as thrombosis (clot formation) and hemolysis (red blood cell damage). This study examines how ECMO flow influences the risk of thrombosis and hemolysis at the patient-specific level.

A patient-specific model of the right atrium and connecting veins was reconstructed from a CT scan. The drainage and return cannulas were positioned 10 cm apart, corresponding to clinical practice. Blood flow was computed by solving the incompressible Navier–Stokes equations at three ECMO flow conditions (2, 4, and 6 L/min). Simulation results were used to evaluate thrombosis risk through endothelial cell activation potential and hemolysis via a cumulative shear-based hemolysis index.

As ECMO flow increased from 2 to 6 L/min, the average thrombotic risk declined by 33%, whereas the risk of hemolysis increased by 319%. Regional analysis revealed that thrombotic risk depends on patient anatomy, with the right atrial appendage demonstrating higher vulnerability. Patient-specific modelling shows promise for individualized risk prediction~in~VV-ECMO.

Affiliation

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Presenter: ONDRUSOVA, Beata (Johannes Kepler University)

Session Classification: Scientific Computing, Computational Imaging and Applications in Biomedicine

Contribution ID: **39** Type: **Poster Presentation**

Lie Algebroids as a Natural Extension of Differential Geometry

Thursday, 26 February 2026 15:42 (9 minutes)

Lie algebroids provide a unifying framework that extends several classical structures of differential geometry, including tangent bundles, Lie algebras of vector fields, and foliations. The aim of this contribution is to present Lie algebroids from an introductory and conceptually transparent perspective, emphasizing how they arise naturally from familiar geometric objects.

We begin by reviewing the necessary background material, such as vector bundles, sections, tangent and cotangent bundles, bundle maps, and pullbacks. We also recall basic operations on differential forms, including the exterior derivative, interior product, and Lie derivative, which play a fundamental role in the formulation of Lie algebroid structures.

After introducing the definition of a Lie algebroid, we discuss its two main components: the anchor map and the Lie bracket on sections. We explain how these structures generalize the classical Lie bracket of vector fields and clarify the geometric meaning of the anchor map. Different types of Lie algebroids are briefly discussed through the properties of the anchor.

As a concrete example, we construct a Lie algebroid structure on the derivation bundle of a vector bundle. This example illustrates how Lie algebroids naturally emerge from standard differential-geometric constructions and highlights their role as a natural extension of classical geometry.

Affiliation

Department of Mathematics, Gebze Technical University, Kocaeli, Türkiye

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Presenter: Ms ERGÜL, Deniz (Gebze Technical University)

Contribution ID: **40** Type: **Contributed Talk**

Mathematical models and multiharmonic algorithms for contrast-enhanced ultrasound

Thursday, 26 February 2026 14:35 (20 minutes)

Contrast-enhanced ultrasound is a valuable tool in biomedical applications, using gas-filled microbubbles to enhance both diagnostic and therapeutic imaging. Once injected, microbubbles oscillate nonlinearly in response to ultrasound waves, making sound propagation through bubbly liquids a highly nonlinear problem. This behavior is modeled by a nonlinear acoustic wave equation coupled with Rayleigh–Plesset-type models for bubble dynamics. In this talk, we derive such coupled models from constitutive laws and then based on the periodic-in-time nature of the excitation, we further develop multiharmonic algorithms for computing time-periodic solutions. These methods significantly reduce computational cost compared to time-stepping approaches while accurately capturing nonlinear effects. Numerical experiments demonstrate the efficiency of the proposed algorithms.

Affiliation

University of Graz

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Co-author: NIKOLIĆ, Vanja (Radboud University)

Presenter: RAUSCHER, Teresa (University of Graz)

Session Classification: PDEs

Contribution ID: **41** Type: **Contributed Talk**

Multiphase cross-diffusion models for tissue structures: modeling, analysis, numerics

Thursday, 26 February 2026 14:15 (20 minutes)

Volume-filling cross-diffusion equations for the components of a tissue structure are formally derived from mass conservation laws and force balances for the interphase pressures and viscous drag forces in a multiphase approach. The equations include Maxwell–Stefan, tumor-growth, thin-film solar cell models as well as novel volume-filling population systems. The Boltzmann and Rao entropy structures are explored. If the drag coefficients are all equal to one, the global-in-time existence of bounded weak solutions, their long-time behavior, and the weak–strong uniqueness of solutions to a regularized system are proved using entropy methods. In the general case, the resulting diffusion matrix is positively stable, ensuring local-in-time existence of solutions. Global-in-time existence of weak solutions is proved if the drag coefficients are sufficiently close to each other. This restriction is explained by the fact that the pressure forces are of degenerate type, while the drag forces are nondegenerate in the volume fractions. Numerical simulations are presented in one space dimension to illustrate the solution behavior beyond the entropy regime.

Affiliation

TU Wien

Author: XHAHYSA, Sara (TU Wien)

Co-authors: JÜNGEL, Ansgar; REISCH, Cordula

Presenter: XHAHYSA, Sara (TU Wien)

Session Classification: PDEs

Contribution ID: **42** Type: **Contributed Talk**

Curvature in nonsmooth spacetimes

Friday, 27 February 2026 09:30 (20 minutes)

Timelike lower Ricci curvature bounds in smooth spacetimes are known to be characterised by the convexity of a suitable entropy functional along geodesics in the space of probability measures. Such geodesics are defined via optimal transport, in analogy with the Wasserstein distance in the Riemannian setting. Pioneering work in this direction was carried out by McCann [1] and by Mondino–Suhr [2], who considered cost functions given by the p-th power of the time separation function for $0 < p \leq 1$.

In this talk, I will discuss an approach based on more general cost functions, namely Lorentz–Orlicz costs. I will introduce the associated optimal transport problem and explore classical aspects such as Kantorovich duality. I will then explain how these costs lift to the space of probability measures, inducing a spacetime structure and, in particular, a notion of geodesics. Finally, I will address the characterisation of timelike lower Ricci curvature bounds for this class of costs. This is an ongoing work with Argam Ohanyan (University of Toronto).

Affiliation

University of Vienna

Author: SÁLAMO CANDAL, Marta (University of Vienna)

Presenter: SÁLAMO CANDAL, Marta (University of Vienna)

Session Classification: Geometric Analysis and Geometric Topology

Contribution ID: **43** Type: **Contributed Talk**

Untangling Twisted Thue Equations

Thursday, 26 February 2026 14:55 (20 minutes)

In his 10th problem, Hilbert asked for an algorithm to determine whether a given Diophantine equation has integer solutions.
While it has been proven that such an algorithm does not exist, several important classes of Diophantine equations can still be solved effectively.\\
In this talk, we will study one such class, the class of Thue equations, with a particular focus on the family of so-called “twisted” Thue equations.
We will look at a method to completely solve a certain family of twisted Thue equations, i.e. to determine all integer solutions.

Affiliation

Universität Salzburg

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Presenter: PREMSTALLER, Carina (Universität Salzburg)

Session Classification: Algebra and Number Theory

Contribution ID: **44** Type: **Contributed Talk**

Analysis of DAEs and PDEs in the form of abstract differential-algebraic equations with a higher-index regular pencil

Friday, 27 February 2026 09:50 (20 minutes)

This talk presents an approach to the qualitative analysis of differential-algebraic equations (DAEs) and partial differential equations (PDEs) presented in the form of abstract differential-algebraic equations (ADAEs) with the regular characteristic pencils of arbitrarily high indices. We will deal with the ADAE of the form $\frac{d}{dt}[Ax] + Bx = f(t,x)$, where A and B are closed linear operators from a Banach space X into a Banach space Y with domains D_A and D_B ($\overline{D_A} = \overline{D_B} = X$) and $f \in C(\mathbb{R}_+ \times D, Y)$, $D = D_A \cap D_B \neq \{0\}$. The pencil $\lambda A + B$, associated with the linear part (left-hand side) of the ADAE, is called characteristic. It is known that any PDE can be represented in the form of an ADAE (possibly with a complementary boundary condition) in appropriate spaces. In this talk we consider the examples of PDEs which can be represented as the ADAE mentioned above and the conditions of their unique solvability, Lagrange stability and Lagrange instability. Also, we will discuss the dynamics of electrical circuits which are described by the higher-index DAEs.
The talk is based on the work [https://doi.org/10.48550/arXiv.2510.04433].

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Presenter: FILIPKOVSKA, Mariia (B. Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine)

Session Classification: PDEs

Contribution ID: **45** Type: **Contributed Talk**

From 2D+t Cine MRI to 3D Ventricular Models: A pipeline for Segmentation, Registration, and Shape Modeling

Thursday, 26 February 2026 14:55 (20 minutes)

Effective segmentation and registration of 2D+t cardiac cine magnetic resonance images (cMRI) is crucial for accurate and fast 3D cardiac model construction, forming the basis for individual hearts in cardiac digital twins. While 2D cMRI scans often have higher temporal resolution and quality than 3D MRI, they frequently suffer from spatial misalignment due to patient movement and irregular breath holds during acquisition. These misalignments pose significant challenges for 3D model construction, as they introduce artifacts and inaccuracies that compromise model fidelity.

Building on Banerjee et al. (2021), we present the developments of a semi-automated, modular pipeline for segmenting and registering 2D+t cMRIs to construct personalized 3D anatomical models of the ventricles, designed for future integration into a multi-modal imaging environment. Data from the ILearnHeart project (ILearnHeart 2016; Gillette et al.,2021) consist of 2D+t cMRI scans in 2-chamber (2CH), 4-chamber (4CH), and stacked short axis (SAX) views from seven healthy subjects. Each slice includes 30 time frames covering a full cardiac cycle with an in-plane resolution of approximately 1.4 mm x 1.4 mm and slice thickness of 8 mm (SAX) and 1 mm (2CH/4CH). After preprocessing and metadata extraction, we segment the left and right ventricle blood pools and left ventricular myocardium (MYO) across all 2D+t slices using nnU-Net (Isensee et al., 2018; Isensee et al., 2021) and a few-shot segmentation approach based on Gaussian processes (Johnander et al., 2022; Viti et al., 2025). For registration, we employ a two-step approach. First, intensity-based registration aligns 2CH and 4CH slices at each time step by optimizing the normalized cross-correlation (NCC) at their intersection line via rigid transformations. Second, contours-based registration aligns the SAX stack contours to the previously registered 2CH and 4CH contours by minimizing intersection distances through translations in x, y, and z.

Initial results show an average NCC improvement of $(17.5 \pm 16.7)\%$ from intensity-based registration compared to the unregistered slices. Contours-based registration shows promising results but requires further refinement, including in-plane rotation corrections. Future work will focus on 3D ventricle modeling across time frames testing Gaussian splatting and NeRFs.

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Session Classification: Scientific Computing, Computational Imaging and Applications in Biomedicine

Contribution ID: **46** Type: **Poster Presentation**

Algebraic Codes from Cubic Surfaces in PG(3,13)

Thursday, 26 February 2026 15:51 (9 minutes)

Algebraic geometry codes have gained significant attention due to their strong structural properties. In this study, we investigate the construction of linear codes from cubic surfaces in the projective space $PG(3, 13)$. A smooth cubic surface over a finite field is known to contain exactly 27 lines. The configuration of these lines and their intersection points, specifically the Eckardt points, determines the isomorphism class of the surface.We focus on the classification of these surfaces over the finite field $GF(13)$. Using the computational algebra software Orbiter, we analyze surfaces with varying numbers of Eckardt points (specifically classes with 4, 6, 10, and 18 points). We employ the Clebsch map to relate the geometry of 6 points in the projective plane P^2 to the cubic surface in P^3.The main objective of this work is to construct linear codes by utilizing the incidence matrices of lines and points on these surfaces. We explore the potential of these geometric structures to generate Locally Recoverable Codes (LRC) and analyze their parameters $[n, k, d]$. Furthermore, we investigate whether these constructions yield Maximum Distance Separable (MDS) codes by checking the Singleton bound $d \leq n - k + 1$. This research aims to bridge classical algebraic geometry with modern coding theory applications.

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Contribution ID: **47** Type: **Contributed Talk**

Sylvester forms for pose estimation

Friday, 27 February 2026 09:30 (20 minutes)

Real-time pose estimation is a fundamental challenge in computer vision. It involves finding a rotation and a translation that transforms one set of points into another. This problem is often posed as a non-linear least squares problem, which can be reduced to a homogeneous zero-dimensional polynomial system.
In this talk, we explain how to use resultant matrices to solve the problem in a closed-form, and we show how to exploit Sylvester forms to reduce its complexity.

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Session Classification: Applied Algebra and Number Theory

Contribution ID: **48** Type: **Contributed Talk**

Aut-stable subspaces of algebras

Thursday, 26 February 2026 14:35 (20 minutes)

In this talk, we recall some challenging problems in algebra, such as the characterization problem of polynomial rings, the automorphism groups of certain algebras, and the Dixmier property of algebras. We then explain how the concept of Aut-stable subspaces can be used as a tool to approach these problems, [1, 2, 3, 4, 5].
[1] H. Huang, Z. Nazemian, X. Tang, X.-T. Wang, Y. Wang, and J. J. Zhang, Dixmier property for Poisson algebras, preprint, 2026.
[2] Z. Nazemian and M. K. Demir, Aut-stable subspaces of Grassmann algebras, preprint, 2025.
[3] H. Huang, Z. Nazemian, Y. Wang, and J. J. Zhang, Relative cancellation, Proceedings of the American Mathematical Society, 2025.
[4] H. Huang, Z. Nazemian, Y. Wang, and J. J. Zhang, Universal homogeneity, in progress.
[5] H. Kraft, Challenging problems on affine n-space, Séminaire Bourbaki, Vol. 1994/95, Exp. No. 802, Société Mathématique de France, 1996, pp. 295-317.

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Session Classification: Algebra and Number Theory

Contribution ID: **49** Type: **Contributed Talk**

On homomorphic encryption using abelian groups

Friday, 27 February 2026 10:10 (20 minutes)

In this talk, we will look at the public key encryption scheme suggested by Leonardi and Luiz-Ropez that is based on the hardness of the learning homomorphism with noise problem (this is a generalisation of the learning with errors (LWE) problem to groups). Our results on the cryptanalysis of this protocol tell us which instantiations of groups aren't suitable for this cryptosystem, thus leading to a better understanding for our search for suitable groups.

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Session Classification: Applied Algebra and Number Theory

Contribution ID: **50** Type: **Poster Presentation**

Certifying physics-informed neural networks through lower error bounds

Thursday, 26 February 2026 15:24 (9 minutes)

Physics-informed neural networks (PINNs) bring together machine learning and physical laws to solve differential equations. While Hillebrecht and Unger (2022) provide rigorous a posteriori upper bounds for PINN prediction errors, certification requires complementary lower bounds to establish complete error enclosures. In this paper, we derive computable a posteriori lower bounds for PINN errors in ODEs under strong monotonicity conditions. These bounds rely solely on the neural network approximation and the ODE residual, requiring no a priori knowledge of the true solution. This work gives fully certified error bands for nonlinear ODEs and for linear ODEs satisfying structural assumptions, providing robust bounds without needing a lot of training data.

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Contribution ID: **52** Type: **Contributed Talk**

Finite dimensional stochastic filtering and smoothing

Friday, 27 February 2026 09:30 (20 minutes)

This talk deals with the so-called filtering problem, the optimal estimation of a hidden state given partial and noisy observations. In the seminal paper by Kushner \cite{KUSHNER1967179}, a nonlinear stochastic partial differential equation for the conditional density of continuous processes with continuous observations has been derived. In a subsequent paper, Zakai \cite{zakai1969optimal} was able to obtain a linear stochastic partial differential equation for the unnormalized density using Girsanov transformation. In the general case, these filtering equations are infinite dimensional. Only in very special cases, arguably the most commonly known of them, the Kalman-Bucy filter, one obtains finite dimensional filtering equations. Another case in which the filtering equations are finite dimensional is when the so called Bene\v{s} condition is fulfilled (\cite{benevs1981exact}). We consider an instance in which this Bene\v{s} condition is satisfied and for which we can explicitly formulate filter and smoother density and statistics, relying on the work in \cite{ocone1982explicit}. Interestingly, the filtering density turn out to be a mixture of Gaussians.

This is joint work with Aleksandar Arandjelović (ETH Zürich) and David Hirnschall (WU Wien).

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Session Classification: Stochastic Analysis and Topological Asymptotic Analysis

Contribution ID: **53** Type: **Contributed Talk**

Vertex characterization via second-order topological derivatives

Friday, 27 February 2026 09:50 (20 minutes)

This talk focuses on identifying vertex characteristics in 2D images using topological asymptotic analysis. Vertex characteristics include both the location and the type of the vertex, with the latter defined by the number of lines forming it and the corresponding angles. This problem is crucial for computer vision tasks, such as distinguishing between fore- and background objects in 3D scenes. We compute the second-order topological derivative of a Mumford-Shah type functional with respect to inclusion shapes representing various vertex types. This derivative assigns a likelihood to each pixel that a particular vertex type appears there. Numerical tests demonstrate the effectiveness of the proposed approach.
This is a joint work with Peter Gangl and Otmar Scherzer.

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Session Classification: Stochastic Analysis and Topological Asymptotic Analysis

Contribution ID: **57** Type: **Contributed Talk**

Well-Posedness for the Generalized Camassa-Holm Equations

Friday, 27 February 2026 10:10 (20 minutes)

The classical Camassa-Holm (CH) equation is used to describe dynamics of shallow water waves, and features interesting behavior such as solitons or wave breaking. The study of CH has been extensively investigated in the literature. In this talk, we consider a generalized version of CH where the momentum can be of arbitrarily high order and the nonlinearity can be of any polynomial order. More precisely, the equation reads as
\begin{equation}
m_t + m_x u^p + b m u^{p-1}u_x = -(g(u))_x + (b+1)u^p u_x, \quad \text{where } m = (1-\partial_x^2)^k u,
\end{equation}
where $p \geq 1$, $k \geq 1$, b is a real parameter, and $g(u)$ is a smooth function. We prove local well-posedness using Kato's semigroup, where nonlinearity is treated directly using commutator estimates and the fractional Leibniz rule without having to use tricky manipulation. Furthermore, in the case where the momentum is conserved, we show that the solution is in fact global.

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Session Classification: PDEs

Contribution ID: **58** Type: **Contributed Talk**

Mean field limit of assymetric Cucker-Smale model

Friday, 27 February 2026 09:30 (20 minutes)

Flocking is a form of collective behavior commonly observed in nature, particularly among birds and fish. We focus on the Motsch-Tadmor particle model for birds flocking, which differs from the classical Cucker-Smale model due to its use of a relative influence term which introduce an asymmetry in the interactions. While mean field limit has been rigorously established for the Cucker-Smale model, the corresponding result for the Motsch-Tadmor model remains an open problem. We aim to derive the kinetic equation corresponding to the microscopic Motsch–Tadmor model and to provide a rigorous proof of propagation of chaos. In this talk, I will provide an overview of the model and problem, and present our strategy toward resolving this open question.

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Session Classification: PDEs

Contribution ID: **59** Type: **Poster Presentation**

Existence, Invariance, and Reduction in a Fast–Slow HPT-Axis-Model

Thursday, 26 February 2026 15:15 (9 minutes)

Singular perturbed dynamical systems provide a principled way to analyze mathematical models with widely separated times scales, where solutions typically evolve rapidly toward a slow manifold and then drift along it. The hypothalamus–pituitary–thyroid (HPT) axis is a central endocrine control loop that maintains thyroid hormone homeostasis via negative feedback: hypothalamic and pituitary signals regulate thyroid hormone production, while circulating thyroid hormones suppress upstream stimulation. Autoimmune thyroiditis can introduce slower changes in thyroid function and tissue state, motivating a fast–slow modeling perspective in which rapid hormonal regulation interacts with gradual diseasedriven dynamics.
Building on earlier fast–slow studies of endocrine feedback, this poster completes the existence theory and provides a fully rigorous singular-perturbation argumentation for an ordinary differential equation model of a negative-feedback loop describing regulation of the hypothalamus–pituitary–thyroid (HPT)-axis under slow autoimmune disease progression.
A positively invariant region capturing physiologically meaningful states is first established, and explicit sufficient conditions for local existence and uniqueness of solutions are derived. This results in a well-posed problem and provides the technical foundation required for a justified time-scale separation. Leveraging this groundwork, we then state verifiable criteria that guarantee normal hyperbolicity of the critical manifold and attraction by the fast subsystem, and we apply Tikhonov-Fenichel type arguments to establish convergence of trajectories of the full system to those of the reduced model in the singular limit. In this way, the poster extends earlier analyses by making the assumptions transparent, tightening the logical links between full and reduced dynamics, and delivering a complete and selfcontained justification of the reduction.

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Contribution ID: **60** Type: **Contributed Talk**

#HeyMathGirl! –An intervention to promote female students'mathematical self-concept and belonging

Friday, 27 February 2026 10:10 (20 minutes)

Self-concept and sense of belonging in mathematics are well-established predictors of mathematical performance, study choice motivation, and study retention, particularly in STEM disciplines. Yet, pronounced gender disparities remain: female students consistently report lower levels of mathematical self-concept and a reduced sense of belonging in mathematics. These differences are associated with the underrepresentation of women in mathematics-related fields. Our talk presents the theoretical foundation, design, and first findings of an intervention targeting female students'mathematical self-concept and sense of belonging. Building on positive psychology approaches, the intervention includes a modified "Three Good Things" reflection exercise as well as brief video-based role model encounters with female mathematicians. The first findings are being presented and discussed on how such interventions may contribute to greater equity in mathematics participation.

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Session Classification: Didactic

Contribution ID: **61** Type: **Invited Talk**

Splitting methods for nonlinear evolution equations

Thursday, 26 February 2026 13:30 (40 minutes)

Exponential operator splitting methods constitute a favourable class of time integration methods for various kinds of linear and nonlinear evolution equations. They rely on the presumption that the defining right-hand side comprises two (or more) operators and that the numerical approximation of the associated subproblems is significantly simpler compared to the numerical approximation of the original problem. Under these premises, their excellent behaviour with respect to stability, accuracy, and the preservation of conserved quantities has been confirmed by a remarkable amount of contributions.
In my talk, I will review well-known achievements and recent advances on exponential operator splitting methods. As fundamental test problems, I will study Gross-Pitaevskii equations modelling Bose-Einstein condensates, their parabolic counterparts arising in ground and excited state computations, complex Ginzburg-Landau equations having a similar structure, and high-order semilinear parabolic equations describing quasicrystalline patterns. I will contrast standard splitting schemes involving real coefficients with two alternative approaches that are based on the incorporation of complex coefficients or double commutators, respectively.

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Session Classification: Invited talk