Last name	First name	Institution	Title of proposed presentation	Abstract
Berkolaiko	Gregory	Texas A&M University	Spectral shift via lateral perturbation	The first step in the proofs of several spectral geometry theorems is perturbing the operator "along" a given eigenfunction f, i.e. adding a perturbation that vanishes on f and therefore leaves the corresponding eigenvalue lambda in its place. But such perturbation may still affect the sequential number of lambda in the spectrum, creating a spectral shift. We will discuss a general theorem that recovers the value of the spectral shift by looking at the stability of lambda with respect to small variations of the perturbation. Based on joint work with P.Kuchment, arXiv: 2011.11142.
Cho	Manki	University of Houston - Clear Lake	Steklov representation of harmonic functions with various boundary conditions	This talk describes an eigenvalue problem with a spectral parameter in a boundary condition and its applications to study the electric potential and velocity potential for the flow of an inviscid, incompressible, and heavy fluid in the polygonal region. The key idea of the method to represent solutions of the Laplace equation is to construct an orthonormal basis of trace spaces of harmonic functions using Steklov eigenfunctions. With a few number of Steklov eigenfunctions, the Steklov expansion of a harmonic function provides a good accuracy to a solution of the mixed boundary value problem and the physical capacitances. In rectangular domains, this representation provides an advantage of having explicit formulas of Steklov eigenfunction to study solutions at any point in the region. Some physical examples are presented to validate the method.
Dang	Thuyen	University of Houston	Homogenization of One-way Coupled Stokes Flow with Paramagnetic Inclusions	(join with Yuliya Gorb and Silvia Jimenez Bolanos) A homogenization result for a simplified model of the one-way coupling problem between Stokes flow and magnetic field, via two-scale convergence, is proven. As a consequence of this result, an asymptotic analysis of Levy and Sanchez-Palencia on particulate steady-state Stokes flow is also justified mathematically.

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Feng	Baofeng	UT Rio Grande Valley	The dark and breather solutions for the Fokas-Lenells equation	In this talk, we will construct the dark and breather solutions to the Fokas-Lenells (FL)equation by the KP reduction method. The FL equations gives a set of three bilinear equations. However, one of these bilinear equations cannot be obtained directly from the bilinear equations of the KP-Toda hierarchy. Instead, we have to introduce an auxiliary tau function and start from four bilinear equations to reduce to this particular bilinear equations. The rogue wave solution can be constructed in a similar way.
Fillman	Jake	Texas State University	Random Hamiltonians with arbitrary point interactions in one dimension	We consider disordered Hamiltonians given by the Laplace operator subject to arbitrary random self-adjoint singular perturbations supported on random discrete subsets of the real line. Under minimal assumptions on the type of disorder, we prove the following dichotomy: Either every realization of the random operator has purely absolutely continuous spectrum or spectral and exponential dynamical localization hold. In particular, we establish Anderson localization for Schr\"odinger operators with Bernoulli-type random singular potential and singular density. [Joint work with David Damanik, Mark Helman, Jacob Kesten, and Selim Sukhtaiev]
Harrison	Jonathan	Baylor University	Periodic-orbit evaluation of a spectral statistic of quantum graphs without the semiclassical limit	Spectral statistics of classically chaotic quantum systems are analyzed using their periodic orbit structure via Gutzwiller's trace formula, which holds in the semiclassical limit (a limit of long orbits in large systems). We show that for chaotic 4-regular quantum graphs the variance of coefficients of the characteristic polynomial of the quantum evolution operator can be evaluated via periodic orbits without taking the semiclassical limit. The variance of the n-th coefficient is precisely determined by the number of primitive pseudo orbits (sets of distinct primitive periodic orbits) with n bonds that fall in the following classes: those with no self-intersections, and those where all the self-intersections consist of two sections of the pseudo orbit crossing at a single vertex (2-encounters of length zero). This is joint work with Tori Hudgins (University of Dallas).

Last name	First name	Institution	Title of proposed presentation	Abstract
Kiessling	Michael	Rutgers University	On the large-distance asymptotics of the ground state of the Schroedinger-Newton aka Choquard equation	In several different contexts (mathematical) physicists have proposed a nonlinear system of PDEs which can be recast into a single Schroedinger equation with a Schroedinger potential that is the solution to a Poisson equation with the square of the solution of the Schroedinger equation as source term; as such it is known under a variety of different names. For instance, Roger Penrose proposed it in his theory of gravity-induced quantum-mechanical wave function collapse, but also down-to-earth condensed matter theories, by Pekar and later by Choquard, produce this equation without invoking gravity. Interestingly, the question of the asymptotic large-distance behavior has received several plausible but conflicting answers which cannot all be true simultaneously. This talk settles the issue of the leading order term rigorously. Subsequently Andrey Yudin from Moskow managed to tickle Maple to produce an intriguing formula for all the putative asymptotic correction terms to the leading order term which are of power law type. Numerically this formula seems quite accurate, but it has yet to be proved; moreover, there are correction terms beyond all orders of powers, and a formula for these terms has yet to be found. Lastly, an intriguing numerical coincidence is presented, which calls for a deeper inquiry.

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Liu	Chaoqun	University of Texas at Arlington	Liutex and third generation of vortex definition and identification	A short review of the history of vortex identification is made. The article mainly introduces the new academic breakthrough and newest vortex identification methods in vortex science and turbulence research, developed by the research team and their collaborators at University of Texas at Arlington (UTA) led by Prof. Chaoqun Liu. Vortex is very common in nature but has no strict definition. Almost all textbooks in the world recognizes vortex as vorticity tube and there is no difference between vorticity tube and vortex. Confusing vortex with vorticity may be one of major obstacles of vortex science and turbulence research. The most significant progress made by Liu and his team is finding a physical quantity called Liutex which is a vector and can be applied to describe the fluid rotation quantitatively first time in history, which has many advantages over other vortex identification methods. This has been proved by wide applications and accepted gradually by the vortex and turbulence community as a unique mathematical definition of vortex. This discovery opens the gate of quantified research on vortex and turbulence. The main idea is to extract the rigid rotation from fluid motion called Liutex as a new physical quantity which is then applied for vortex definition, vorticity decomposition, velocity gradient tensor decomposition, fluid motion decomposition, turbulence structure, mechanism of turbulence generation and vortex identification. This also means to revisit the whole fluid kinematics. Being different from first generation of vortex identification methods which uses vorticity to measure vortex, and from the second generation of vortex identification methods which uses vortex criteria like Q, Lambda2, Lambda_Ci for vortex identification, the third generation of vortex visualization and identifiction methods like Liutex vector, Liutex lines, Liutex iso-surface, Liutex-Omega iso-surface, Liutex core center lines, and Liutex Similarity (-5/3 Power law) are all briefly introduced in this paper.Liutex Similarity law could be a very significant discovery which could be very important to turbulence modeling.

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Miller	Joseph	UT - Austin	Derivation of Boltzmann's system for mixtures	With Ioakeim Ampatzoglou and Natasa Pavlovic, we rigorously derive a Boltzmann equation for mixtures from the dynamics of two types of hard sphere gases. We prove that the microscopic dynamics of two gases with different masses and diameters are well defined, and introduce the concept of a two parameter BBGKY hierarchy to handle the non-symmetric interaction of these gases. As a corollary of the derivation, we prove Boltzmann's propagation of chaos assumption for the case of a mixtures of gases.
Mitrouskas	David	Institute of Science and Technology (IST) Austria	Weak coupling limit for the ground state energy of the 2D Fermi polaron	We analyze the ground state energy for N fermions in a two-dimensional box interacting with an impurity particle via two-body point interactions. We allow for mass ratios M > 1.225 between the impurity mass and the mass of a fermion and consider arbitrarily large box sizes while keeping the Fermi energy fixed. Our main result shows that the ground state energy in the limit of weak coupling is given by the polaron energy. The polaron energy is an energy estimate based on trial states up to first order in particle-hole expansion, which was proposed by Chevy in the physics literature. For the proof we apply a Birman-Schwinger type principle that was recently obtained by Griesemer and Linden. One of the new ingredients is a suitable localization of the polaron energy.

Last name	First name	Institution	Title of proposed presentation	Abstract
Ojeda-Ruiz	Ivan	Texas State University	An Image Inpainting Via Constrained Smoothing and Dynamic Mode Decomposition	Co-Authors: Gwanghyun Jo, Young Ju-Lee Abstract: We present an algebraic and graph theoretic image inpainting algorithm. The algorithm can be used to reconstruct area or volume data from one- and two-dimensional slice data. Given one- or two-dimensional slice data, our algorithm first performs a simple algebraic presmoothing of the data, e.g., Gaussian filters. The second step is to construct low dimensional representation of presmoothed data via Dynamic Mode Decomposition and perform initial area or volume reconstruction via interpolation. The last step is to smooth the result from the second step using a constraint bilateral smoothing, which respects slice data constraints. A number of test cases, including MRI of a three-year-old and a CT scan of a Covid-19 patient, are presented to demonstrate the superiority of the proposed techniques in comparisons with other methods, including a commercial code and the recent multichannel Cahn-Hilliard inpainting algorithm.

Last name	First name	Institution	Title of proposed presentation	Abstract
Ott	William	University of Houston	Quantization of fractal sets and measures in Banach spaces	To what extent can finite-dimensional data be used to make inferences about infinite-dimensional objects? Consider a set X or a measure μ in a Banach space $\mathfrak{B}$. A nonlinear map $f : \mathfrak{B} \to \mathbb{R}^{m}$ produces a quantized image of the set or measure, $f(X)$ or $f_{*} (\mu)$. In this talk, we use prevalence, the theory of projection constants, and thickness exponents to investigate how well a typical nonlinear map f preserves the structure of X or μ. Does a typical f embed X? If so, what is the H\"{o}lder regularity of the inverse? Does a typical f preserve the Hausdorff dimension of X? For the embedding problem, we present a new theorem that improves upon recent work of Margaris and Robinson. Our theorems on preservation of Hausdorff dimension build upon work that has been done in the Hilbert space setting. Overall, we draw inspiration from the attracting sets produced by evolution partial differential equations. This is joint work with Edward Stout and Zijie Zhou.
P. Bustamante	Adrian	Georgia Institute of Technology	Gevrey estimates for asymptotic expansions of tori in weakly dissipative systems	We consider a singular perturbation of a family of analytic symplectic maps possessing a KAM torus, the perturbation introduces dissipation and contains and adjustable parameter (a counterterm). By choosing the adjustable parameter one can ensure that, for a fixed frequency, the torus persist under perturbation. We prove that the asymptotic expansions of quasi periodic orbits satisfy Gevrey estimates, that is the n-th term of the expansion is bounded by a power of n!. The Gevrey class depends only on the Diophantine condition of the frequency and the order of the dissipation. The method of proof we introduce may be of interest beyond the problem considered here. Join work with Rafael de la Llave

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Simanek	Brian	Baylor University	Electrostatics and Zeros of Orthogonal Polynomials	The work of Heine and Stieltjes in the 19th century connected the zeros of Jacobi polynomials to the points of equilibrium of charged particles confined to an interval by fixed charges at the endpoints of that interval. We will show how to adapt their methods to find points of equilibrium of charged particles on the unit circle. We will also show that the zeros of exceptional Jacobi polynomials have a similar interpretation and present some results about the zeros of exceptional orthogonal polynomials more generally.
Vilaça Da Rocha	Victor	Georgia Institute of Technology	Visiting Assistant Professor	Intermittency is a property observed in the study of turbulence and many interpretations have been given to it. Two of the most popular ones are based on the concept of flatness, one with structure functions in the physical space and the other one with high-pass filters in the frequency space. Experimental and numerical simulations suggest that the two approaches do not always give the same results. In this talk, we prove they are not analytically equivalent. For that, we first adapt them to a rigorous mathematical language and we test them with generalizations of Riemann's non-differentiable function. This work follows the program of "mathematizing" widespread concepts in turbulence and is motivated by the discovery of Riemann's non-differentiable function as a trajectory of polygonal vortex filaments.
Vougalter	Vitali	University of Toronto	Solvability of some integro-differential equations with concentrated sources	The work deals with the existence of solutions of an integro-differential equation in the case of the normal diffusion and the influx/efflux term proportional to the Dirac delta function. The proof of the existence of solutions is based on a fixed point technique. Solvability conditions for non Fredholm elliptic operators in unbounded domains are used.

Last name	First name	Institution	Title of proposed presentation	Abstract
Young	Giorgio	Rice University	Orthogonal rational functions with real poles, root asymptotics, and GMP matrices	There is a vast theory of the asymptotic behavior of orthogonal polynomials with respect to a measure on $\mathbb{R}$ and its applications to Jacobi matrices. That theory has an obvious affine invariance and a very special role for ∞. In this talk, I will describe some extensions of this theory in the setting of rational functions with poles on $\overline{\mathbb{R}} = \mathbb{R} \cup \{\infty\}$, and show how we obtain a formulation which allows multiple poles and prove an invariance with respect to $\overline{\mathbb{R}}$-preserving M\"obius transformations. This will lead to a characterization of Stahl--Totik regularity of a GMP matrix in terms of its matrix elements. Finally, I will show how this theory allows us to give a proof of a conjecture of Simon -- a Ces\`aro--Nevai property of regular Jacobi matrices on finite gap sets. This is based on joint work with Benjamin Eichinger and Milivoje Luki\'c.
Young	Amanda	TU Munich and MCQST	A Non-Vanishing Spectral Gap for a 1/3-Filled Fractional Quantum Hall Spin Chain	We study an effective Hamiltonian for the standard 1/3-filled fractional quantum Hall system in the thin cylinder regime. A complete description of the (exponentially degenerate) ground state space is given in terms of what we call Fragmented Matrix Product States and labeled by lattice tilings. Using this description we prove that the model has a spectral gap above the ground states for a range of coupling constants that includes physical values. As a consequence of the gap we establish the incompressibility of the fractional quantum Hall states. Further results related to decay of correlations and low-lying excitations will be discussed. This is joint work with Bruno Nachtergaele (UC Davis) and Simone Warzel (TUM and MCQST).