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On algebras which are inductive limits of Banach spaces

Motivated by the theory of non commutative stochastic distributions, we introduce algebras which are inductive limits of Banach spaces and carry inequalities which are counterparts of the inequality for the norm in a Banach algebra. We then define an associated Wiener algebra, and prove the corresponding version of the well-known Wiener theorem. Finally, we consider factorization theory in these algebra, and in particular, in the associated Wiener algebra. The talk is based on joint work with Guy Salomon.

Catherine Beneteau

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Cyclicity and extremal polynomials in Dirichlet spaces of the disk and bidisk

In this talk, I will discuss cyclic functions that belong to the Dirichlet-type spaces of the disk, that is, spaces of analytic functions in the disk whose derivatives are square integrable against a certain weighted area measure. In particular, for certain functions f, I will consider extremal polynomials p of degree at most n that are "best approximants" of $1/f$ in the sense that the norm of $pf - 1$ is minimal, and will give sharp rates of decay of these norms. I will then examine optimal approximants and rates of decay for functions in the Dirichlet spaces of the bidisk. These questions lead immediately to the surprising fact that not all non-vanishing polynomials in the bidisk are cyclic.

Roman Bessonov

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Analytic continuation of regular atomic Hardy spaces

Let μ be a discrete doubling measure on the unit circle of the complex plane. Assume that its discrete Hilbert transform $(H_\mu)(t) = \sum_{t_k \neq t} \frac{\mu\{t_k\}}{t-t_k}$ is bounded on the support of μ. We describe the standard atomic Hardy space with respect to μ in terms of analytic functions in the open unit disk.

Jeremiah Buckley

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The variance and hole probabilities for the hyperbolic GAF

The zero set of the hyperbolic Gaussian analytic function (GAF) is a random point process in the unit disc, whose distribution is invariant under automorphisms of the disc. I will discuss asymptotics of the variance of the number of points in a large (hyperbolic) disc, and a 'hole theorem', the probability that there are no zeroes in such a disc. This second result is joint work with A. Nishry, R. Peled and M. Sodin.

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Weak-star convergence and approximation by polynomials

Let E be an arbitrary subset of the unit circle T in the complex plane and let f be a function defined on E. When there exist polynomials P_n which are uniformly bounded by a number $M > 0$ on T and converge (pointwise) to f at each point of E? We give a necessary and sufficient description of such functions, and also discuss some related questions.

Vladimir Goldshtein

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Brennan's conjecture for bounded domains

The Inverse Brennan's conjecture states that for any simply connected plane domain U with nonempty boundary and for any conformal homeomorphism from the unit disc onto U the complex derivative of the homeomorphism is integrable in the degree $-2 < s < 2/3$. If the domain U is bounded than we prove that $-2 < s \leq 2$. The upper estimate is exact. We prove that integrability in the degree $s > 2$ is not possible for bounded simply connected domains with infinite geodesic diameter.

The last conclusion is a corollary of the following property of Sobolev homeomorphisms: Let $\Omega \subset R^n$ be a domain that supports the p-Poincaré inequality for $p > n$. If a homeomorphism $\varphi \in L^1_p(\Omega)$ then the domain $\varphi(\Omega)$ has finite geodesic diameter. A joint work with A. Ukhlov.

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A nonsingular Z_3 curve of genus 4

There are many quantities that can be computed on a hyperelliptic curve because of its representation as a branched two sheeted cover of the sphere. An example is the values of the Abel Jacobi map on Weierstrass points when the base point is also a Weierstrass point.

In this talk we show how to do analogous things for Z_3 curves and use our computations to write down theta constant identities with third integer characteristics for the family of nonsingular Z_3 curves of genus 4. Then we conjecture that some identities define a parameter space of this family of curves.

Joint work by: H. Farkas, Y. Kaminski, E. Yakubov.

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Some open problems for polynomials of one and several complex variables

We shall discuss several problems : 1) Possible extensions of the Fundamental Theorem of Algebra to a wider class of polynomials, e.g., harmonic polynomials; 2) Walsh's coincidence theorem and certain "super" symmetric algebraic varieties; 3) Estimates of Bohr's radius for polynomials of one and several variables of degree n in terms of n.

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On Beurling's method in the theory of quasianalytic functions

The talk is will be devoted to two questions in the theory of quasianalytic Carleman classes. The first one is how to describe the image of a quasianalytic Carleman class under Borel's map? The second one is how to sum the formal Taylor series of functions in quasianalytic Carleman classes?

In the talk, I will present a method of Beurling that gives a solution to both of the problems for some quasianalytic Carleman classes. In addition, we will discuss the limitations of this method and some of its generalizations.

Alexander Kozhevnikov

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On Multi-Weighted Parabolic Initial Boundary Value Problems

In a bounded domain $\Omega \subset \mathbb{R}^n$ with smooth boundary $\partial\Omega$, an elliptic boundary value problem

$$(A + \lambda I)\, u = f \quad \text{in } \Omega, \quad Bu = 0 \text{ on } \partial\Omega \tag{1}$$

is considered. Here A is an elliptic partial differential operator of even order, B is an operator of boundary conditions and λ is the spectral parameter. S. Agmon (1962) introduced a condition on principal symbols of A, B which it was called the condition for having "the ray of minimal growth of the resolvent". More precisely, under the condition, the resolvent operator $R(\lambda) : f \to u$ solving the problem (1), is a bounded operator in the space $L_2(\Omega)$ and

$$\|R(\lambda)\| \leq const\, (|\lambda| + 1)^{-1} \tag{2}$$

for large enough modulo λ belonging to a ray on the complex plane emerging from the origin. The condition called "Agmon's condition" by R. Seeley where (2) was proved for of elliptic systems of even order. Agranovich and Vishik (1964) investigated operators polynomially dependent on λ under the condition called "ellipticity with a parameter". The estimate (2) was obtained in Grubb (1996) under corresponding parameter-ellipticity condition for pseudodifferential boundary value problems.

The parameter-ellipticity condition for matrix Douglis-Nirenberg elliptic operators acting on compact manifolds without boundary was introduced by the author (1972) and the estimate (2) was proved for $R(\lambda)$ acting in an appropriate Sobolev space. The parameter-ellipticity condition was elaborated further by the author as well as by R. Denk, M. Feierman, R. Mennicken, L. Volevich in a series of papers (1995-2013) but the estimate (2) was obtained only for very special cases.

This work is devoted to the problem (1) with Douglis-Nirenberg operator A. The aim of the work is to prove the estimate (2) for $R(\lambda)$ acting in an appropriate Sobolev space. Using (2) the unique solvability of the corresponding t-dependent initial-boundary value problem

$$(\partial/\partial t + A)\, u = f \quad \text{in } \Omega, \quad u|_{t=0} = 0, \quad Bu = 0 \text{ on } \partial\Omega.$$

is proved in appropriate anisotropic Sobolev-Slobodetskii spaces. The problem is not parabolic in the usual sense but it may be naturally called "multi-weighted parabolic" according to an author's paper (2013) where the boundaryless case was investigated.

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Milin's coefficient inequalities with applications to Teichmüller spaces and geometric function theory

The Milin coefficient inequalities arose as a generalization of the classical Grunsky inequalities but coincide with the later only for conformal maps of the unit disk.

We create a quasiconformal variant of these inequalities which is applied to investigation of complex metric geometry and complex geodesics of two Teichmüller spaces: the universal Teichmüller space and Teichmüller space of the punctured disk. This technique allows us to establish that all non-expanding invariant metrics in either of these spaces coincide with its intrinsic Teichmüller metric.

Other applications concern the variational theory for univalent functions with quasiconformal extension. It turns out that geometric features caused by the equality of metrics and connection with complex geodesics provide deep distortion results for various classes of such functions and cause surprising phenomena which do not arise in the classical geometric function theory.

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A functional analytic approach to homogenization problems

This talk is devoted to the homogenization of boundary value problems in a periodically perforated domain by an approach which is alternative to those of asymptotic analysis and of classical homogenization theory.

The domain has a periodic structure, and the size of each cell is determined by a positive parameter d. The size of each periodic perforation is instead determined by a positive parameter r.

We analyze the behavior of a family of solutions of a boundary value problem defined in the periodically perforated domain as d and r degenerate to zero.

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Quasicrystals and Poisson's summation formula

The subject of this talk is the analysis of discrete measures in $\mathbb{R}^n$, whose Fourier transform is also a pure point measure. It will be discussed in the framework of "quasicrystals", inspired by the experimental discovery in the middle of 80's of non-periodic atomic structures with diffraction patterns consisting of spots. Based on joint work with Alexander Olevskii.

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The Fourier transform of a function with bounded Hardy's variation

Many results has been obtained during last 25 years on the Fourier transform of a function of one variable with bounded variation. In several dimensions much is still open. One of the reasons is that there are several notions of bounded variation in the multivariate case. The notion of Hardy's variation is one of the most natural among them. We study in detail the behavior of the Fourier transform of a function with bounded Hardy's variation. The obtained results are applied to the integrability of multiple trigonometric series.

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Cyclicity in some function spaces in two variables

A function f in a function space X is said to be cyclic if the polynomial multiples of f form a dense subspace of X. We consider the question of characterizing the cyclicity of a polynomial f in the family of Dirichlet-type spaces, D_α, in two variables, that is, the space of holomorphic functions over the unit bidisk with Taylor coefficients $\{a_{k,l}\}$ such that

$$\sum_{k,l=0}^{\infty} |a_{k,l}|^2 (k+1)^\alpha (l+1)^\alpha < \infty.$$

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Bombieri - Pila's lemma and Norming constant of images of smooth mappings

In a highly influential paper [1] of E. Bombieri and J. Pila a new method was proposed for bounding density of rational points on "analytically defined sets". This method was further developed in many publications, and ultimately it led to solving of several important open problems in Number Theory. One of the steps in [1] is a lemma providing an upper bound for a "generalized Vandermonde determinant" built through a sequence of smooth functions. We shall discuss some consequences of this lemma for the accuracy of polynomial interpolation on sets $Z = F(I^n)$ which are images under a smooth map F of a unit cube I^n. We shall discuss also some initial observations showing that the number-theoretic results of [1] can be possibly extended to a much larger class of sets.

References

1. E. Bombieri and J. Pila, The number of integral points on arcs and ovals, Duke Math. J. 59 (1989), 337 - 357.