Shanwen Hu, Huaxin Lin, Yifeng Xue

The Tracial Topological Rank of C^*-algebras (II)

The work of the second-name author has directed a lot of attention to the concept of tracial topological rank, mainly in the case where this rank is zero. Even those skeptical about the merits of studying higher tracial ranks, mainly because the concept is so technical, must admit that the present paper presents some evidence that tracial rank is a reasonable notion of dimension for C* algebras. The paper is very well written—with a laudable consistency in notation and attention to detail—which makes the quite technical proofs very readable.

D. R. Adams, J. Xiao

Nonlinear potential analysis on Morrey spaces and their capacities

The authors of this paper present a development of capacity for potentials of functions in the Morrey spaces $L^{p,\lambda}$. They define a Riesz-type capacity $C_\alpha(\cdot; L^{p,\lambda})$, prove its equivalence to its dual capacity via the minimax theorem, and study the metric properties of the capacities of balls. An analogous development is given for a capacity $C_\alpha(\cdot; H^{q,\lambda})$ whose competitors lie in the predual space $H^{q,\lambda}$. Central to their analysis and interesting in its own right is the equivalence of three predual spaces $H^{q,\lambda}$, $K^{q,\lambda}$, and $Z^{q,\lambda}$ to $L^{p,\lambda}$, each of which is used in turn in subsequent estimates. Finally the authors consider the Choquet integrability of Riesz potentials of functions in $H^{q,\lambda}$ with respect to the dual capacity of $C_\alpha(\cdot; H^{q,\lambda})$. The results of this paper are non-trivial extensions of corresponding theorems in the theory of L^p capacities, which will make the paper an important contribution to the literature and an excellent candidate for publication in IUMJ.

Calin G. Ambrozie

Remarks on the operator-valued interpolation for multivariable bounded analytic functions

The main result of the paper generalizes in a non-trivial fashion the representation theorem of J. Agler for Agler-Schur class functions in the polydisc. The author works with a collection of matrix-valued functions Δ_λ parameterized by $\lambda \in \Lambda$, where Λ is a compact Hausdorff space and the parameterization is continuous. The special case of $\Delta_j = z_j$ recovers the result of Agler. A simplified view is as follows. Take the collection Δ_λ as the starting point. Let $\mathcal{F}$ denote the collection of commuting tuples of operators Z so that $\Delta_\lambda(Z)$ makes sense and is a strict contraction. Let $\mathcal{S}$ denote the corresponding Agler-Schur class functions. That is, F in S means that $F(Z)$ makes sense and is a contraction whenever Z in $\mathcal{F}$. Here is the Main Thm. F is in $\mathcal{S}$ if and only if F has a (canonical) transfer function representation (realization) in terms of the Δ_λ. A precise formulation and proof of the Main Theorem was not obvious. There are a number of interesting applications/examples, beyond those given in the paper, which require the full generality of the Main Theorem. The result is natural from a dilation theory point of view (see for instance the paper of Blecher and Paulsen). The author's contribution here is significant and, as background for my recommendation, I will discuss the two aspects of his/her contribution in detail. 1. A key piece of the argument in the F in $\mathcal{S}$ implies F has a realization direction is the introduction of appropriate cone(s) and a Hahn-Banach argument separating a given thing outside the cone from the cone. In this regard it should be noted that a delta version of a somewhat weaker version of the result is not so hard to obtain. Namely, if one assumes that there is a C so that $C^2 - z_j w_j$ is in C (a mild, but unpleasant added hypothesis), then, if F is in $\mathcal{S}$ and $|\delta| < 1$, then δF has a realization. Indeed, δF is actually in a smaller cone (and so one gets a somewhat stronger realization formula) which does not require passage to the dual of $C(\Lambda)$. Dropping the added hypothesis and allowing $\delta = 1$ necessitates the introduction of $B(C(\Lambda), B(E))$ (dual of $C(\Lambda)$). See example 17. It is not simply enough to let δ tend to 1, rather the author cleverly considers just the right cones depending upon ε and lets ε tend to 0. 2. As a formal statement, that the direction F has a realization implies that F in $\mathcal{S}$ is evident. A precise formulation requires non-trivial use of the Taylor spectrum and functional calculus.

Thierry Goudon, Pierre-Emmanue Jabin, Alexis Vasseur

Hydrodynamic limit for the Vlasov-Navier-Stokes equations. Part I: Light particles regime.

In this work the authors study the limit $\varepsilon \to 0$ of the system

$$\partial_t f^\varepsilon + \frac{1}{\varepsilon} v \cdot \nabla_x f^\varepsilon = \frac{1}{\varepsilon^2} div((v - \varepsilon u) f^\varepsilon + \nabla_v f^\varepsilon)$$

$$\partial_t u^\varepsilon + Div_x(u^\varepsilon \oplus u^\varepsilon) + \nabla_x p - \Delta_x u^\varepsilon = \int (v - u^\varepsilon) f^\varepsilon dv$$

$$div u^\varepsilon = 0$$

proposed by Caflish and Papanicolaou (eqution (6.2) in [2]). This system describes the motion of an ensemble of particles (governed by the Vlasov equation) immersed in a fluid modeled by the Navier-Stokes system. The resulting limiting equation is

$$\partial_t \rho + div_x(\rho u - \nabla_x \rho) = 0,$$

$$\partial_t u + Div_x(u \oplus u) + \nabla_x p - \Delta_x u = 0$$

$$div u = 0.$$

Thierry Goudon, Pierre-Emmanue Jabin, Alexis Vasseur

Hydrodynamic limit for the Vlasov-Navier-Stokes equations. Part II: Fine particles regime.

In this paper the authors study the limit $\varepsilon \to 0$ of the system

$$\partial_t \rho + v \cdot \nabla_x f^\varepsilon = \frac{1}{\varepsilon} \mathrm{div}((v-u)f^\varepsilon + \nabla_v f^\varepsilon),$$

$$\partial_t u^\varepsilon + (u^\varepsilon \cdot \nabla_x) u^\varepsilon + \nabla_x p - \Delta_x u^\varepsilon = \frac{1}{\varepsilon} \int (v - u^\varepsilon) f^\varepsilon dv,$$

$$\mathrm{div} u^\varepsilon = 0.$$

The limiting system is:

$$\partial_t \rho + \mathrm{div}_x(\rho u) = 0,$$

$$\partial_t((1+\rho)u) + \mathrm{div}_x(u \otimes (u + \rho u)) + \nabla_x p - \Delta_x u = 0,$$

$$\mathrm{div} u = 0.$$

The model is strongly based on the dimensionless analysis given in the previous paper [Editor's note: article 2508 in this Journal], which is a continuous reference for this one. The convergence properties are analyzed for the density function and for the distribution function. In this paper the techniques are quite different from the previous one [2508] and are based on relative entropy methods together with the control of energy and moments.

Eduard Feireisl

On the motion of a viscous, compressible, and heat conducting fluid

This nicely written paper is concerned with the global existence of weak solutions for the full system of the Navier-Stokes equations with the non-slip boundary condition. The fluid is assumed to be Newtonian, that is, the viscous stress tensor $\mathbb{S}$ is given by $\mathbb{S} = \mu(\nabla u + \nabla^T u) + \lambda \div u\mathbb{I}$, where λ and μ are the viscosity coefficients. In an earlier work the author established the global existence of weak solutions in the case where λ and ν are constants. The main result of the paper under review is an extension of the previous results to the case when λ and μ depend on the temperature, however with some growth restrictions. The main feature in the proof is the weak continuity of the effective viscous pressure when λ and ν depend on the temperature.

Nicolas Burq, Fabrice Planchon, John G. Stalker, A. Shadi Tahvildar-Zadeh

Strichartz estimates for the wave and Schroedinger equations with potentials of critical decay

Gustavo Garrigos, Eugenio Hernandez

Sharp Jackson and Bernstein inequalities for N-term approximation in sequence spaces with applications

The topic of the paper is interesting. The authors study N-term approximation in sequence spaces. As a basis for forming N-term approximation they have chosen a canonical basis for sequence spaces $\{e_I\}$. They study approximation in special quasi-Banach spaces $f^s_{p,r}$ and $b^\alpha_{\tau,q}$. The goal is to characterize the approximation spaces $A^\gamma_q(\mathcal{F})$. They follow a well developed way of using the Jackson and Bernstein inequalities. I want to point out that there exists a new approach to the characterization of $A^\gamma_q(\mathcal{F})$ that is based on concepts of greedy basis and quasi-greedy basis. Some results in this direction are discussed in [12], [28] cited in the paper. There exists a general theory of greedy bases that can be used in a particular case discussed in the paper. For instance, Theorem 2.4 is a direct corollary of one of the theorems of that general theory: a basis is greedy $\Leftrightarrow$ it is unconditional and democratic. The property (ii) in Theorem 2.4 is exactly the property of a basis to be democratic. There is a general approach to the characterization of $A^\gamma_q(\mathcal{F})$ and to proving the Jackson and Bernstein inequalities in the case of greedy bases (see [12], [28] and also the papers listed below).

William T. Ross, Warren R. Wogen

Common cyclic vectors for normal operators

In this paper the authors examine the question concerning the existence of a common cyclic for multiplication operators M_φ on $L^2(\mu)$, with certain restrictions on the L^∞-symbol φ. If μ is purely atomic, they show that the operators in

$$S_\mu := \{M_\varphi : \varphi \in L^\infty(\mu) \quad \text{and} \quad \varphi \text{ is univalent a.e. } \mu\}$$

have a common cyclic vector. And they go on to show that if μ is not purely atomic, then the operators in S_μ do not have a common cyclic vector. They finish the paper with a theorem to the effect that, in the case that $\mu = m$ – normalized Lebesgue measure on $\mathbb{T}$ – the operators of the form M_φ, where $\varphi \in C^{1+\varepsilon}(\mathbb{T})$ and φ is univalent except (possibly) on a finite subset of $\mathbb{T}$, have a common cyclic vector. This paper is interesting and well-written.

Alexander M. Meadows

Stable and singular solutions of the equation $Deltau = 1/u$

Paulo D. Cordaro, Evandro R. da Silva

Local solvability in corank one involutive real-analytic structures

I like this paper a lot and strongly recommend publication in its present form in the Indiana University Mathematics Journal. It is a well-known and important observation that starting with a function $Z(x,t), dZ(0,0) \neq 0$, one can define a complex of differential operators. The work of Treves and his collaborators have related the solvability of these operators to the properties of Z. The present paper reproves a basic result of Treves concerning a real analytic Z. The paper is carefully written and (as much as possible) self-contained. The proof presents a new and useful way of looking at this problem, combined with technical estimates which strengthen Treves' original result. The basic elements come from Hardy theory, Gaussian approximation, the homotopy formula for the deRham complex and sub-analytic sets.

Sergei Treil

An operator corona theorem