

İMBM

**İSTANBUL MATEMATİKSEL
BİLİMLER MERKEZİ**

2017/2018 FAALİYET RAPORU

İMBM – Kodirektörü tarafından
Boğaziçi Üniversitesi Rektörlüğü
Boğaziçi Üniversitesi FEF Dekanlığı
Boğaziçi Üniversitesi Matematik Bölüm Başkanlığı
ve
İMBM – Bilimsel Danışma Komitesi ve
Yönetim Kurulu için hazırlanmıştır.

Bilim Kurulu Kararları

2017 yazında gerçekleşen Bilim Kurulu toplantısında, Koç Üniversitesi öğretim üyesi Prof. Dr. Burak Özbağcı, 1 Eylül 2017 tarihinden itibaren iki yıl süre ile İMBM'nin yeni Bilimsel Kodirektörü olarak seçilmiştir. Bir önceki Bilimsel Kodirektör Doç. Dr. Kazım Büyükboduk Yönetim Kurulundaki görevine devam edecektir.

Bundan sonraki Yönetim Kurulu üyelerinin ve kodirektörlerinin belirlenmesi başta olmak üzere İMBM'nin temel kararlarını almak için iki senede bir toplanacak bir **Genel Kurul** oluşturulmasına karar verilmiştir. İlk Genel Kurulun şu an Yönetim Kurulunda yer alan ve geçmişte İşletme Komitelerinde çalışmış aşağıdaki bilim insanlarından oluşturulması düşünülmüştür:

Doç. Dr. Kazım Büyükboduk (University of Dublin)
Doç. Dr. Tınaz Ekim (Boğaziçi Üniversitesi)
Doç. Dr. Ayhan Günaydın (Boğaziçi Üniversitesi)
Prof. Dr. Burak Gürel (Boğaziçi Üniversitesi)
Prof. Dr. Varga Kalantarov (Koç Üniversitesi)
Doç. Dr. Özgür Kişisel (ODTÜ)
Prof. Dr. Burak Özbağcı (Koç Üniversitesi)
Doç. Dr. Ekin Özman (Boğaziçi Üniversitesi)
Doç. Dr. Devin Sezer (ODTÜ)
Prof. Dr. Ergün Yalçın (Bilkent Üniversitesi)
Prof. Dr. Sefa Feza Arslan (Mimar Sinan Üniversitesi)
Doç. Dr. Alp Bassa (Boğaziçi Üniversitesi)
Prof. Dr. Ferit Öztürk (Boğaziçi Üniversitesi)
Doç. Dr. Sinan Ünver (Koç Üniversitesi)
Doç. Dr. Atilla Yılmaz (Temple University)
Prof. Dr. Alp Eden (Boğaziçi Üniversitesi)
Prof. Dr. Mete Soner (ETH)
Prof. Dr. Betül Tanbay (Boğaziçi Üniversitesi)
Prof. Dr. Ali Ülger (Boğaziçi Üniversitesi)
Prof. Dr. Yalçın Yıldırım (Boğaziçi Üniversitesi)

Genel Kurulun ilk toplantısını 2019 yılında yapması öngörülmüştür.

Bilimsel Faaliyetler

İMBM'de 2017-2018 akademik yılında 44 adet bilimsel etkinlik gerçekleştirilmiştir. Bunların içinde yüksek katılımlı çalıştaylar, ortak çalışma ziyaretleri ve düzenli seminerler ve buluşmalar vardır. Etkinliklere dair detaylı bilgi son bölümde yer almaktadır. Geçtiğimiz akademik takvim, matematiksel faaliyetler bağlamında oldukça verimli geçmiştir. Doktorasını yakın geçmişte almış veya yakın tarihte Türkiye'ye taşınmış matematikçileri ve çalışmalarını İstanbul camiasına tanıtmak amacıyla, 14-15 Eylül 2017 tarihlerinde, ilk defa "*IMBM Mathematics Days*" başlıklı bir etkinlik düzenlenmiştir.

Bu rapor dönemi içerisinde İMBM, "*Recent advances in Quantum gravity*" başlıklı kış okuluna, "*Ankara-Istanbul Algebraic Geometry & Number Theory*" buluşmalarına, "*Mathematical and Theoretical Physics Afternoons*" başlıklı toplantılara, "*IMBM Probability Days*" etkinliğine, ve "*Period Integrals Associated to Algebraic Varieties*" çalıştayına ev sahipliği yapmıştır.

Ayrıca "*Protein Structure, Function and Dynamics*" başlıklı yaz okulu için İMBM ve Feza Gürsey Enstitüsü işbirliği gerçekleştirmişlerdir. Türk Kadın Matematikçiler Derneğinin düzenlediği "*Women and Mathematics: Differential Geometry*" çalıştayına da İMBM ev sahipliği yapmıştır. Bu dönem içerisinde merkezimizi yurtdışından aşağıda listesi verilen bilim insanları ziyaret etmiştir.

Jan Rosseel (University of Vienna)

Paul Voutier (London)

Marco Golla (University of Oxford)

Nicolo Petri (University of Milan)

Dmitri Bykov (Max Planck Institute for Physics)

Diederik Roest (Groningen University)

Edriss S. Titi (Texas A&M University and the Weizmann Institute of Science)

Blagoje Oblak (ETH Zurich)

Frédéric Bayart (Université Blaise Pascal)

Piotr Kowalski (Uniwersytet Wrocławski)

Samir Siksek (University of Warwick)

Azimbay Sadullaev (National University of Uzbekistan)

Edvard Musaev (Moscow Institute of Physics and Technology)

Julie Rowlett (Chalmers University of Technology and University of Gothenburg)

Wendy Goemans (KU Lueven)

Maria del Carmen Romero Fuster (University of Valencia)

Riccardo Ugolini (University of Ljubljana)

Sergei Kuksin (Paris Diderot University)
Stéphane Charpentier (Aix-Marseille University)
Juan F. Pedraza (University of Amsterdam)
Sergey Zelik (University of Surrey, Guildford, UK)
Giuseppe Dibitto (Uppsala University)
Jonathan Leake (University of California)
Hamid Rahkooy (University of Waterloo)
Dhruv Mubayi (University of Illinois)
Wilke van der Schee (Utrecht University)
Jorge Alfaro (Ponticia Universidad Catolica de Chile)
Ali Seraj (IPM Tehran)

Bu listeden de anlaşılacağı üzere İMBM dünyanın pek çok bölgesinden bilim insanlarının ziyaret etmek istediği bir merkez olma özelliğini sürdürmektedir. Bunun yanısıra bu etkinlikleri düzenleyenler içinde Boğaziçi, Koç, Sabancı, Galatasaray, Mimar Sinan, Gebze Teknik Üniversiteleri ve ODTÜ'den öğretim üyeleri bulunmaktadır.

Mali Detaylar

İMBM'nin kullanımına ayrılmış, Boğaziçi Üniversitesi öğretim üyeleri Prof. Dr. Ferit Öztürk ve Prof. Dr. Betül Tanbay adına kayıtlı hesaplar vardır.

1 Eylül 2017 itibariyle bu hesaplarda 8.919 TL, 1.000 USD ve 1.150 EURO vardı. Bu bütçe bir önceki dönemde Türk Matematik Derneğinin, MAD (Matematik Araştırma Dostları) kapsamında İMBM'ye verdiği destekten kullanılmamış olan miktardan oluşmaktadır. Hepimizin bildiği malum sebeplerden dolayı 2016-17 dönemi İMBM için çok aktif bir yıl olmamıştır.

2017-18 döneminde, geçen yıldan devreden miktar sebebiyle, TMD-MAD projesinden İMBM'ye maddi destek alınmamıştır. 31 Ağustos 2018 itibariyle İMBM hesaplarında 4.916 TL, 790 USD, 709 EURO ve 300 GBP kalmıştır.

İMBM'nin binası, bu binanın tadilat, bakım ve günlük masrafları, güvenlik ve temizlik işleri ve seminer öncesi ikramlar, **Boğaziçi Üniversitesi** tarafından sağlanmaktadır. Ayrıca BU Matematik Bölümü her sene araştırma görevlilerinden birini ziyaretçilerin konaklamasını organize etmek ve İMBM websayfasını düzenlemek için kısmi olarak görevlendirmektedir. Yıllardır sağladığı kesintisiz destek için Boğaziçi Üniversitesi Rektörlüğüne teşekkür ederiz. İMBM koordinatörü Berrenur Saylam tarafından hazırlanan bilimsel etkinlikler listesi raporun ekinde sunulmuştur.

SCIENTIFIC ACTIVITIES (01.09.2017 – 31.08.2018)

September 2017

Activity 1.

Local Host: *Burak Özbağcı* (Koç University) and *Ferit Öztürk* (Boğaziçi University)

Guests: IMBM Mathematics Days

Dates: 14.09.2017 – 15.09.2017

Scientific Goals: To introduce young mathematicians who have recently taken an academic position at a Turkish University, to the mathematical community in Istanbul.

Activity 2.

Local Host: *Nihat Sadık Değer* (Bogazici University)

Guests: *Jan Rosseel* (University of Vienna)

Dates: 25.09.2017 – 01.10.2017

Title of the talk: Newton-Cartan Gravity and Torsion

Scientific Goals: We compare the gauging of the Bargmann algebra, for the case of arbitrary torsion, with the result that one obtains from a null-reduction of General Relativity. Whereas the two procedures lead to the same result for Newton-Cartan geometry with arbitrary torsion, the null-reduction of the Einstein equations necessarily leads to Newton-Cartan gravity with zero torsion. We show, for three space-time dimensions, how Newton-Cartan gravity with arbitrary torsion can be obtained by starting from a Schroedinger field theory with dynamical exponent $z=2$ for a complex compensating scalar and next coupling this field theory to a $z=2$ Schroedinger geometry with arbitrary torsion. The latter theory can be obtained from either a gauging of the Schroedinger algebra, for arbitrary torsion, or from a null-reduction of conformal gravity.

October 2017

Activity 3.

Local Host: *Alp Bassa* (Boğaziçi University)

Guests: *Paul Voutier* (London)

Dates: 25.10.2017 – 27.10.2017

Title of the talk: Arithmetic properties of elliptic division polynomials and divisibility sequences

Scientific Goals: Binary linear recurrences such as the Lucas sequences, which have played an important role in number theory since its earliest days, are associated with twists of the multiplicative group. Similarly, one can associate sequences to other algebraic groups. An example is the algebraic group $E(Q)$ where E/Q is an elliptic curve. If $E(Q)$ is of positive rank, we take a non-torsion point, $P \in E(Q)$, put $[n]P = A_n/B_n^2$ with $(A_n, B_n) = 1$, $B_n \geq 1$ and consider $\{B_n\}_{n \geq 0}$. This sequence is called an elliptic divisibility sequence and is closely related to the elliptic division polynomials, Ψ_n . These sequences provide us with much important information about the arithmetic geometry of the underlying curve, E and the point, P . In this talk, we present new results on some arithmetic properties of these objects – in particular, on explicit valuations of the elliptic division polynomials and on primitive divisors of elliptic divisibility sequences. This is joint work with Minoru Yabuta.

November 2017

Activity 4.

Local Host: Çağrı Karakurt (Boğaziçi University)

Guests: Marco Golla (University of Oxford)

Dates: 07.11.2017 – 10.11.2017

Title of the talk: An obstruction to planarity of contact structures

Scientific Goals: We give new obstructions to the existence of planar open books on contact structures, in terms of the homology of their fillings. I will talk about applications to links of surface singularities, Seifert fibred spaces, and integer homology spheres. No prior knowledge of contact or symplectic topology will be assumed. This is joint work with Paolo Ghiggini and Olga Plamenevskaya.

Activity 5.

Local Host: Alp Bassa (Boğaziçi University)

Guests: Ankara-Istanbul Algebraic Geometry & Number Theory Meeting

Dates: 11.11.2017

Scientific Goals: The Ankara-Istanbul Algebraic Geometry & Number Theory Meetings aim to bring together people working on algebraic geometry, number theory and related areas in Turkey. During each academic year, monthly meetings are planned in Ankara and Istanbul alternately (and possibly other cities in the future). We hope that these meetings will facilitate communication and collaboration among researchers in the field of algebraic geometry / number theory in Turkey.

Activity 6.

Local Host: *Nihat Sadık Değer* (Boğaziçi University)

Guests: *Nicolo Petri* (University of Milan)

Dates: 17.11.2017

Title of the talk: New solutions in D=7 supergravity and holographic conformal defects

Scientific Goals: In this talk we will consider minimal gauged supergravity in D=7 with SU(2) gauge group and non-vanishing topological mass. In this framework we will present a new class of supersymmetric solutions characterized by a non-trivial profile for a dyonic 3-form gauge potential. The solutions obtained are defined by a three-dimensional Minkowski or by an AdS3 slicing of the 7d background and, in many cases, they are asymptotically AdS7. For these solutions we will discuss the eleven-dimensional interpretation as effective descriptions of a particular bound state of M2 and M5 branes. Finally, between these solutions, we will consider a particular example with an AdS3 slicing and an AdS7 asymptotics. For this case we will construct explicitly a brane picture in massive IIA string theory defined by the bound state D2-D4-D6-NS5-D8 and we will give an holographic interpretation of the 7-dimensional solution in terms of a 2-dimensional defect SCFT inside the (1,0) SCFT in D=6.

Activity 7.

Local Host: *Ümit Işlak* (Boğaziçi University)

Guests: Probability Meetings

Dates: 17.11.2017

Scientific Goals: The purpose of these meetings is to gather probabilists around Turkey.

December 2017

Activity 8.

Local Host: *Ümit Işlak* (Boğaziçi University)

Guests: Probability Meetings

Dates: 01.12.2017 & 08.12.2017 & 15.12.2017

Scientific Goals: The purpose of these meetings is to gather probabilists around Turkey.

Activity 9.

Local Host: *Ilmar Gahramanov* (Mimar Sinan University)

Guests: *Dmitri Bykov* (Max Planck Institute for Physics)

Dates: 07.12.2017 – 14.12.2017

Title of the talk: Flag manifolds: representation theory and two-dimensional sigma-models

Scientific Goals: Flag manifolds are ubiquitous objects in modern theoretical physics. I will discuss how they appear in representation theory (via coherent states), and how these representation-theoretic ideas find natural applications in the theory of spin chains and two-dimensional sigma models.

Activity 10.

Local Host: *Dieter Van den Bleeken* (Boğaziçi University)

Guests: Mathematical and Theoretical Physics Afternoons

Dates: 12.12.2017

January 2018

Activity 11.

Local Host: *Nihat Sadık Değer* (Boğaziçi University)

Guests: Istanbul Winter School 2018

Title of the talk: Recent Advances in Quantum Gravity

Dates: 21.01.2018 – 28.01.2018

Scientific Goals: From the very early days of quantum field theory there have been attempts to provide a consistent quantum theory of gravity and in particular to quantize General Relativity. Among the various approaches that include loop quantum gravity and dynamical triangulation, one distinguishes the approach of string theory as the most developed at the moment. Since its theoretical discovery in 1970-s the framework of string theory still produces non-trivial mathematical concepts and problems which find their applications in algebraic topology, category theory and other fields of mathematics. On the other hand, one finds a lot of phenomenological models based on D-branes of string theory and on compactifications of supergravity as its low energy approximation, which aim at providing more fundamental origin to the Standard model of elementary particles and cosmology. These aspects suggest to consider string and M-theory as a framework of quantum gravity worth studying. The recent years showed huge progress in understanding of the internal structure of string theory and of its non-perturbative aspects, that are crucial for understanding the dynamics of spacetime at small scales and its quantum properties.

Activity 12.

Local Host: *Nihat Sadık Değer* (Boğaziçi University)

Guests: *Diederik Roest* (Groningen University)

Dates: 23.01.2018

Title of the talk: Internal Supersymmetry and its Goldstini

Scientific Goals: We provide a pedagogical introduction to spontaneous symmetry breaking in the case of space-time symmetries. We highlight the universal dynamics of the corresponding Goldstone modes and the relation to the soft limit of their scattering amplitudes. Particular focus is placed on the case of a scalar field and of a fermion field, arising from the spontaneous breaking of e.g. Poincare and supersymmetry. This includes the DBI, Galileons and Volkov-Akulov theory. Finally, we discuss the supersymmetric combination of this scalar and fermion field.

February 2018

Activity 13.

Local Host: *Varga Kalantarov* (Koç University)

Guests: *Edriss S. Titi* (Texas A&M University and The Weizmann Institute of Science)

Dates: 10.02.2018 – 18.02.2018

Title of the talk: Determining the Global Dynamics of the Two-dimensional Navier-Stokes Equations by a Scalar ODE

Scientific Goals: One of the main characteristics of infinite-dimensional dissipative evolution equations, such as the Navier-Stokes equations and reaction-diffusion systems, is that their long-time dynamics is determined by finitely many parameters – finite number of determining modes, nodes, volume elements and other determining interpolants. In this talk I will show how to explore this finite dimensional feature of the long-time behavior of infinite-dimensional dissipative systems to design finite-dimensional feedback control for stabilizing their solutions. Notably, it is observed that this very same approach can be implemented for designing data assimilation algorithms of weather prediction based on discrete measurements. In addition, I will also show that the long-time Dynamics of the Navier-Stokes equations can be imbedded in an infinite-dimensional dynamical system that is induced by an ordinary differential equations, named determining form, which is governed by a globally Lipschitz vector field. Remarkably, as a result of this machinery I will eventually show that the global dynamics of the Navier-Stokes equations is determined by only one parameter that is governed by an ODE. The Navier-Stokes equations are used as an illustrative example, and all the above mentioned results equally hold to other dissipative evolution PDEs, in particular to various dissipative reaction-diffusion systems and geophysical models.

Activity 14.

Local Host: *Dieter Van den Bleeken* (Boğaziçi University)

Guests: *Blagoje Oblak* (ETH Zurich)

Dates: 26.02.2018 – 01.03.2018

Title of the talk: Berry Phases of Boundary Gravitons

Scientific Goals: This talk is devoted to Berry phases that appear in unitary representations of asymptotic symmetry groups in general relativity. These phases arise when a coherent state is acted upon by symmetry transformations that trace a closed path in the group manifold, and they can be evaluated exactly even when the group is infinite-dimensional. We apply these ideas to the Virasoro and BMS groups; seeing their representations as particles dressed with boundary gravitons, the associated Berry phases generalize Thomas precession and provide, in principle, observable signatures of asymptotic symmetries.

Activity 15.

Local Host: *Dieter Van den Bleeken* (Boğaziçi University)

Guests: Mathematical and Theoretical Physics Afternoons

Dates: 27.02.2018

March 2018

Activity 16.

Local Host: *Semra Pamuk* (Middle East Technical University)

Guests: Women and Mathematics: Differential Geometry

Dates: 10.03.2018

Scientific Goals: As TKMD we are organizing a one day event called Women and Mathematics: Differential Geometry, on March 10, 2018. This meeting focuses on differential geometry. Our aim is to bring women mathematicians and graduate students working in this specific area together and discuss about some recent developments in this area. We are planning 3 to 4 talks, our speakers include Julie Rowlett, Wendy Goemans, and Maria del Carmen Romero Fuster.

Activity 17.

Local Host: *Özgür Martin* (Mimar Sinan University)

Guests: *Frédéric Bayart* (Université Blaise Pascal)

Dates: 19.03.2018 – 23.03.2018

Title of the talk: Hypercyclic Algebras

Scientific Goals: Let X be a topological space and let T be a bounded operator on X . We say that T is hypercyclic if T admits a dense orbit, namely if there exists a vector $x \in X$, called a hypercyclic vector for T , such that $\{T^n x; n \geq 0\}$ is dense in X . We shall denote by $HC(T)$ the set of hypercyclic vectors for T . It is known that, provided $HC(T)$ is nonempty, then it has some nice topological and algebraic properties. For instance, $HC(T) \cup \{0\}$ always contains a dense subspace, and there are nice criteria for the existence of a closed infinite-dimensional subspace in it. When moreover X is an algebra, it is natural to study whether $HC(T)$ contains a nontrivial algebra. In this talk, we will explain some recent (negative and positive) results on this problem.

Activity 18.

Local Host: *Dieter Van den Bleeken* (Boğaziçi University)

Guests: Mathematical and Theoretical Physics Afternoons

Dates: 27.03.2018

April 2018

Activity 19.

Local Host: *Özlem Beyarslan* (Boğaziçi University)

Guests: *Piotr Kowalski* (Uniwersytet Wrocławski)

Dates: 13.04.2018

Title of the talk: Global Fields in Continuous Logic

Scientific Goals: I will give an introductory talk focusing on examples and motivations. 1. Global fields, product formula. 2. Ultraproducts in continuous logic. 3. Multiply Valued Fields (MVF's) and Globally Valued Fields (GVF's), global as GVF's. 4. The class of GVF's is elementary in an appropriate continuous set-up.

Activity 20.

Local Host: *Alp Bassa* (Boğaziçi University)

Guests: Ankara-Istanbul Algebraic Geometry & Number Theory Meeting

Dates: 13.04.2018 – 15.04.2018

Scientific Goals: The Ankara-Istanbul Algebraic Geometry & Number Theory Meetings aim to bring together people working on algebraic geometry, number theory and related areas in Turkey. During each academic year, monthly meetings are planned in Ankara and Istanbul alternately (and possibly other cities in the future). We hope that these meetings will facilitate communication and collaboration among researchers in the field of algebraic geometry / number theory in Turkey.

Activity 21.

Local Host: *Ekin Özman* (Boğaziçi University)

Guests: *Samir Siksek* (University of Warwick)

Dates: 15.04.2018 – 20.04.2018

Title of the talk: Which integers are sums of seven cubes?

Scientific Goals: In 1851, Carl Jacobi made the experimental observation that all integers are sums of seven non-negative cubes, with precisely 17 exceptions, the largest of which is 454. Building on previous work by Maillet, Landau, Dickson, Linnik, Watson, Bombieri, Ramaré, Elkies and many others, we complete the proof of Jacobi's observation.

Activity 22.

Local Host: *Nihat Gokhan Göğüş* (Sabancı University)

Guests: *Azimbay Sadullaev* (National University of Uzbekistan)

Dates: 18.04.2018 – 22.04.2018

Title of the talk: Further developments of the pluripotential theory

Scientific Goals: We will make a survey of some recent developments of the pluripotential theory.

Activity 23.

Local Host: *Ilmar Gahramanov* (Mimar Sinan University)

Guests: *Tahsin Çağrı Şişman* (University of Turkish Aeronautical Association)

Dates: 21.04.2018 – 25.04.2018

Title of the talk: Born-Infeld Gravity Theories

Scientific Goals: Born-Infeld (BI) gravity theories gained a recent, rather wide interest. There are two main approaches in the development of BI gravities. In one of the approaches, the metric is the only independent field while in the other case, the Christoffel connection is also an independent field. Due to this fact, this second class is dubbed as the Eddington inspired BI gravity. This talk is focussed on the metric based BI gravity theories. Mainly, the construction of unitary BI gravity theories will be discussed around the flat and maximally symmetric backgrounds. The constructed unitary BI gravity theories have some nice features. By construction, in 2+1 dimensions, the unitary BI gravity theory has the same spectrum as the new massive gravity while in higher dimensions they have the same spectrum as the Einstein's gravity. The constructed theories have a unique unitary vacuum. In addition to these features, the c -function and the entropy related properties of these theories will also be discussed.

Activity 24.

Local Host: *Ayhan Günaydın* (Boğaziçi University)

Guests: *Serge Randriambololona* (Galatasaray University)

Dates: 27.04.2018

Title of the talk: Banach lattices as first-order structures in unbounded continuous logic

Scientific Goals: We will describe the following. 1. Banach spaces as structures in bounded continuous logic. 2. Languages, formulas (quantifiers!), structures and theories in the setting of unbounded continuous logic. 3. Banach spaces as structures in unbounded continuous logic.

Activity 25.

Local Host: *Ilmar Gahramanov* (Mimar Sinan University)

Guests: *Edvard Musaev* (Moscow Institute of Physics and Technology)

Dates: 27.04.2018 – 04.05.2018

Title of the talk: Non-geometry in string theory

Scientific Goals: Using duality transformations of conventional string backgrounds one can arrive at the so-called non-geometric backgrounds. These are non-commutative or non-associative spaces, which sometimes can be described by T-folds or U-folds. This talk will consider such backgrounds, their origin from branes of string theory and their description by means of generalized geometry.

May 2018

Activity 26.

Local Host: *Sibel Şahin* (Sabancı University)

Guests: *Riccardo Ugolini* (University of Ljubljana)

Dates: 02.05.2018 – 06.05.2018

Title of the talk: A new Notion of tameness

Scientific Goals: In 1988 Rosay and Rudin described many properties of the group of holomorphic automorphisms of \mathbb{C}^n , $n > 1$. Later on their ideas were applied to more general complex manifolds. Starting from their work, we will explore an equivalent definition of tameness developed in the last year in collaboration with R. Andrist.

Activity 27.

Local Host: *Mine Çağlar* (Koç University)

Guests: *Sergei Kuksin* (Paris Diderot University)

Dates: 08.05.2018 – 11.05.2018

Title of the talk: Lectures on KAM Theory

Activity 28.

Local Host: *Alp Bassa* (Boğaziçi University)

Guests: Ankara-Istanbul Algebraic Geometry & Number Theory Meeting

Dates: 11.05.2018 – 13.05.2018

Scientific Goals: The Ankara-Istanbul Algebraic Geometry & Number Theory Meetings aim to bring together people working on algebraic geometry, number theory and related areas in Turkey. During each academic year, monthly meetings are planned in Ankara and Istanbul alternately (and possibly other cities in the future). We hope that these meetings will facilitate communication and collaboration among researchers in the field of algebraic geometry / number theory in Turkey.

Activity 29.

Local Host: *Özgür Martin* (Mimar Sinan University)

Guests: *Stéphane Charpentier* (Aix-Marseille University)

Dates: 16.05.2018 – 20.05.2018

Title of the talk: Hypercyclic Sets

Scientific Goals: A bounded linear operator T on a Banach or Fréchet space X is said to be hypercyclic if there exists a vector x in X whose orbit $\text{Orb}(x, T) := \{T^n x, n \geq 0\}$ under T is dense in X . Two classical results show that the definition of a hypercyclic operator can be somehow weakened: 1) If the union $\bigcup_{i=1}^l \text{Orb}(x_i, T)$ of finitely many orbits is dense in X , then one of these orbits also [Costakis/Peris, 2000/2001, independently]; 2) If the set $\text{Orb}(Tx, T) := \{\lambda T^n x, n \geq 0, |\lambda| = 1\}$ is dense in X , then $\text{Orb}(x, T)$ also [Léon-Müller, 2004]. In this talk we will be interested in extensions of these results and we will discuss the following general question: which sets have the property that the density of their orbit under some operator T automatically implies the hypercyclicity of T ? This is a joint work with R. Ernst, which is the continuation of a previous work with R. Ernst and Q. Menet.

Activity 30.

Local Host: *Ayhan Günaydın* (Boğaziçi University)

Guests: Probability Meetings

Dates: 19.05.2018 & 20.05.2018

Scientific Goals: The purpose of these meetings is to gather probabilists around Turkey.

Activity 31.

Local Host: *Dieter Van den Bleeken* (Boğaziçi University)

Guests: *Juan F. Pedraza* (University of Amsterdam)

Dates: 20.05.2018 – 24.05.2018

Title of the talk: Aspects of bulk reconstruction for subregions

Scientific Goals: In the holographic correspondence, subregion duality posits that knowledge of the mixed state of a finite spacelike region of the boundary theory allows full reconstruction of a specific region of the bulk, known as the entanglement wedge. In this talk I will discuss recent progress in this program from the point of view of hole-ography, i.e., in terms of differential entropy of the dual CFT. I will discuss subtleties that arise when employing this method for bulk subregions, focusing for simplicity in the Poincare and Rindler wedges of global AdS₃. In particular, I will show that spacelike curves within a generic wedge are in fact not fully reconstructible with entanglement entropies in the corresponding boundary region. We overcome this problem by showing that the information about the nonreconstructible curve segments is encoded in a slight generalization of the concept of entanglement purification, whose holographic dual has been discussed very recently. We introduce the notion of ‘differential purification’, and demonstrate that, in combination with differential entropy, it enables the complete reconstruction of all spacelike curves within an arbitrary entanglement wedge in any 3-dimensional bulk geometry.

Activity 32.

Local Host: *Özlem Beyarslan* (Boğaziçi University)

Guests: *Piotr Kowalski* (Uniwersytet Wrocławski)

Dates: 25.05.2018

Title of the talk: GVF structures on Global Fields

Scientific Goals: Following Hrushovski’s lecture notes (Section 3), I will discuss the following.

1. Classification of GVF structures on global fields.
2. GVF structures on the field of meromorphic functions.
3. Vojta’s dictionary.

Activity 33.

Local Host: *Varga Kalantarov* (Koç University)

Guests: *Sergey Zelik* (University of Surrey, Guildford, UK)

Dates: 27.05.2018 – 02.06.2018

Title of the talk: Strichartz estimates and attractors for measure driven quintic wave equation & Hyperbolic Relaxation of the 2d Navier-Stokes Equations in A Bounded Domain

June 2018

Activity 34.

Local Host: *Nihat Sadık Değer* (Boğaziçi University)

Guests: *Giuseppe Dibitto* (Uppsala University)

Dates: 01.06.2018 – 03.06.2028

Activity 35.

Local Host: *Ekin Özman & Alp Bassa* (Boğaziçi University)

Guests: Summer School on Effective Algebraic Geometry

Dates: 04.06.2018 & 08.06.2018

Scientific Goals: The mathematical school will focus on effective and explicit methods in the theory of algebraic curves and applications to coding theory and cryptography. An important aspect of the school will be tutorials accompanying each of the lecture series. In these tutorials participants will have the opportunity to put into practice the theory from the lectures and experiment with the introduced object using various computer algebra systems. Depending on the background of the students, they might be given small research problems on which they can work together during the week. Active participation and interaction will be a key aspect of the mathematical school. This school also serves the purpose of preparing students for a sequence of conferences and workshops to be organized in the near future.

Activity 36.

Local Host: *Mohan Ravichandran* (Mimar Sinan University)

Guests: *Jonathan Leake* (University of California)

Dates: 08.06.2018

Title of the talk: Applications and Extensions of Real Stability Preservers

Scientific Goals: Linear operators on polynomials which preserve the property of having only real roots have been studied since the seminal work of Polya and Schur in the early 20th century. Various progress has been made in the direction of this problem, culminating in 2009 in the Borcea-Branden characterization of all such real-rootedness preservers. Their result relies on a multivariate generalization of real-rootedness called "real stability", a concept which has recently had a strong influence on fields including combinatorics, optimization, and theoretical computer science. In all applications, the Borcea-Branden characterization has become an essential and heavily-utilized tool. In this talk, we will discuss this characterization, and a number of its most interesting theoretical consequences. We will further discuss a few combinatorial implications of the theory, particularly related to matchings of a graph. If time permits, we will also discuss the relation of this theory to that of "mesh polynomials", which are real-rooted polynomials with a certain minimum spacing between consecutive roots.

Activity 37.

Local Host: *Zafeirakis Zafeirakopoulos* (Gebze Technical University)

Guests: *Hamid Rahkooy* (University of Waterloo)

Dates: 10.06.2018 – 12.06.2018

Title of the talk: Algorithms for Zero Dimensional Ideals

Scientific Goals: Starting with Berlekamp-Massey's algorithm for finding recurrence relationships of a sequence, we present Sakata's generalization of this problem, related algorithms and our recent work. We use those algorithms in order to obtain a randomized primary decomposition algorithm for a zero dimensional ideal in polynomial rings. Some related computations on Gorenstein algebras will be presented.

Activity 38.

Local Host: *Arzu Boysal* (Boğaziçi University)

Guests: *Dhruv Mubayi* (University of Illinois)

Dates: 15.06.2018 – 22.06.2018

Title of the talk: New Developments in Hypergraph Ramsey Theory

Scientific Goals: I will describe several new constructions in hypergraph Ramsey theory. These constructions settle old conjectures of Erdos-Hajnal (1972) on classical Ramsey numbers and Ajtai-Erdos-Komlos-Szemerédi (1981) on off-diagonal variants, as well as more recent questions due to Conlon-Fox-Lee-Sudakov and others on generalized Ramsey problems. The talk will be accessible to a general combinatorial/mathematical audience.

Activity 39.

Local Host: *Olca Coşkun* (Boğaziçi University)

Guests: Visitors of Summer School/Workshop on Protein Structure, Function and Dynamics

Dates: 24.06.2018 – 01.07.2018

Scientific Goals: As attested by the award of the 2013 Chemistry Nobel prize, computational methods are becoming increasingly more important in description of protein structure, function and dynamics. Continuous increase in computational power, together with introduction of new computational methods have enabled realistic description of proteins and their interactions. The newly-established predictive power of computational methods means that the synergy between experiment and theory, taken granted in physics and chemistry, can now be exploited in molecular biology. The aim of these workshops is to introduce the new computational methods to young researchers through lectures and practical sessions. Description of protein structure, function and dynamics via molecular dynamics simulations and other bioinformatical methods form the main agenda of the workshop. The target audience are the researchers working in biophysics, biochemistry, molecular biology and pharmacology, who are interested in using computational methods in their research projects.

July 2018

Activity 40.

Local Host: *Ilmar Gahramanov* (Mimar Sinan University)

Guests: *Wilke van der Schee* (Utrecht University)

Dates: 08.07.2018 – 11.07.2018

Title of the talk: Collisions in AdS, quark-gluon plasma and energy conditions

Scientific Goals: The collisions of gravitational shock waves in Anti-de-Sitter spacetime can give important insights into far-from-equilibrium physics of strongly coupled quantum field theory (sQFT), which hence has important implications for quark-gluon plasma. Recent progress I will review includes finite coupling corrections, which goes beyond the usual infinite coupling approximation. The end of the talk will analyse regions in the sQFT that violate the Null Energy Condition, but still satisfy and sometimes saturate the new Quantum Null Energy Condition (QNEC). This QNEC is derived from entanglement entropy and may in turn give insights into the emergence of a gravitational theory from the entanglement structure of a quantum field theory.

Activity 41.

Local Host: *Levent Akant* (Boğaziçi University)

Guests: *Jorge Alfaro* (Ponticia Universidad Catolica de Chile)

Dates: 13.07.2018 – 18.07.2018

Title of the talk: Electroweak standard model with very special relativity

Scientific Goals: The Very Special Relativity Electroweak Standard Model (VSR EW SM) is a theory with $SU(2)_L \times U(1)_R$ symmetry, with the same number of leptons and gauge fields as in the usual Weinberg-Salam (WS) model. No new particles are introduced. The model is renormalizable and unitarity is preserved. However, photons obtain mass and the massive bosons obtain different masses for different polarizations. Besides, neutrino masses are generated. A VSR invariant term will produce neutrino oscillations and new processes are allowed. In particular, we compute the rate of the decays $\mu \rightarrow e + \text{photon}$. All these processes, which are forbidden in the Electroweak Standard Model, put stringent bounds on the parameters of our model and measure the violation of Lorentz invariance. Violations of Lorentz invariance have been predicted by several theories of Quantum Gravity. It is a remarkable possibility that the low energy effects of Lorentz violation induced by Quantum Gravity could be contained in the non-local terms of the VSR EW SM.

Activity 42.

Local Host: *Susumu Tanabe* (Galatasaray University)

Guests: Visitors of Period Integrals Associated to Algebraic Varieties Workshop

Dates: 27.07.2018 – 30.07.2018

Scientific Goals: Though the main topics to be discussed are those of precedent working seminars (toric geometry-Riemann-Roch Hirzebruch formula, Todd class-, topology of algebraic functions -torus knots- and analysis of them -generalized hypergeometric function-, monodromy presentation and the fundamental groups-Zariski-VanKampen theorem-) some related subjects can be discussed with the participation of wider audience i.e. not necessary of our research group. The working seminar will be open to public and anybody from Istanbul can participate.

August 2018

Activity 43.

Local Host: *Alp Bassa* (Boğaziçi University)

Guests: *Özgür Kişisel* (Middle East Technical University)

Dates: 04.08.2018 – 12.08.2018

Title of the talk: Complex algebraic surfaces close to the BMY line

Scientific Goals: This will be an exposition of the work of Roulleau and Urzua on constructing examples of complex algebraic surfaces with controlled fundamental group, whose slopes are arbitrarily close to the BMY line.

Activity 44.

Local Host: *Dieter Van den Bleeken* (Boğaziçi University)

Guests: *Ali Seraj* (IPM Tehran)

Dates: 26.08.2018 – 08.09.2018

Title of the talk: Symmetries in gauge theory & gravity

Scientific Goals: Fundamental forces of nature are described by theories involving gauge symmetries. In this course, we will concentrate on the crucial role of symmetries in these theories and how they constrain the low energy structure of these theories. This is a PhD course which assumes a background knowledge of gravity and quantum field theory. This topic involves an active research field, and hence there is no standard textbook covering different aspects. However, there are great articles that we can use and we try to cover. A good review article which the course will be partly based on is Strominger, A., 2018. Lectures on the infrared structure of gravity and gauge theory, Princeton University Press. We will also cover extra material, e.g. the role of symmetries in holography as well as a number of exciting mathematical tools.