Trends and Perspectives in Mathematics

November 14-15, 2011

Conference Organizers:

Wolfgang Lück (The University of Bonn)

Tsachik Gelander (The Hebrew University, Jerusalem)

All lectures take place at the conference hall of Beit Hatfutsot – The Museum of the Jewish People, Tel Aviv University, Klausner Street, Ramat Aviv

Program

Monday, November 14, 2011

9:30-10:00 Registration

10:00 Welcome

10:10-11:10 Alex Lubotzky (The Hebrew University of Jerusalem)
Arithmetic Quotients of Automorphism Groups

Coffee Break

11:45-12:45 Elon Lindenstrauss (The Hebrew University of Jerusalem)
Dynamics and Geometry of Numbers

Lunch Break

14:30-15:30 Uri Bader (The Technion, Haifa)
Warum Weyl?

15:45-16:45 Roman Sauer (The University of Regensburg)
From quasi-Isometry to Measure Equivalence of Groups: Some Rigidity Questions

Coffee Break

17:30-18:30 Katrin Tent (The University of Münster)
On the Isometry Group of the Urysohn Space

19:00 **Opening of the Exhibition and Reception**

Tuesday, November 15, 2011

10:00-11:00 Peter Teichner (Max Planck Institute for Mathematics, Bonn)
Field Theories and Algebraic Topology

Coffee Break

11:45-12:45 Katrin Wendland (The University of Freiburg)
Kummer K3 Surfaces and Automorphisms of the Golay Code

Lunch Break

14:30-15:30 Christian Baer (The University of Potsdam)
Path and Functional Integrals on Manifolds

15:45-16:45 Noam Berger (The Hebrew University of Jerusalem)
Wolfgang Doeblin and Chains with Unbounded Memory

Coffee Break

17:30-18:30 Leo Corry (Tel-Aviv University)
Landau's Hebrew List of 23 Problems: Higher Mathematics Makes 'Aliyah' in 1925

19:00 **Conference Dinner**

Sponsored by

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Leibniz Award of the German Science Foundation for Wolfgang Lück

Abstracts (in alphabetical order)

Uri Bader (The Technion, Haifa)

Warum? Weyl!

Hermann Weyl was a German mathematician. In 1930 he served as the director of the University of Göttingen's famous Mathematical Institute. Married to a Jew, he shared the fate of many Jewish mathematicians in Nazi Germany and left to become a member of the IAS in Princeton.

The Weyl group is a finite group of inner symmetries associated to any algebraic group. It is well understood how the representation theory of the Weyl group controls the representation theory of the ambient algebraic group. In a joint work with Alex Furman we associate a "Weyl group" to any locally compact group, and establish a similar phenomenon: the representation theory of a group is controlled by the Weyl group. Our techniques are ergodic theoretical.

Christian Baer (The University of Potsdam)

Path and Functional Integrals on Manifolds

In quantum physics integrals over the space of paths or over other spaces of maps are quite common. In most cases these functional integrals are not mathematically rigorously defined. We will discuss three approaches to overcome this problem.

Noam Berger (The Hebrew University of Jerusalem)

Wolfgang Doeblin and Chains with Unbounded Memory.

Wolfgang Doeblin, the son of the famous Jewish German author Alfred Doeblin, fled Nazi Germany in 1933 and settled in Paris. There he studied Mathematics, and finished his PhD in 1938 at the age of 23. Two years later Doeblin died as a French soldier during the German invasion to France. Before his death he sent an envelope full of his Mathematical contributions to the academy of sciences in Paris. The envelope was opened and read in 2000. Among other things, his notes contained a complete theory of stochastic integration, essentially equivalent to the one developed around the same time by Ito. For this reason many people nowadays use the term Ito-Doeblin formula for the formula known as Ito formula. In the talk I will speak about Doeblin's life, and will concentrate on his work on chains with unbounded memory. I will present Doeblin's results in this field, show his elegant proof, which may be the first non-trivial use of coupling techniques, and will end with a description of the development of the study of this field in the decades after Doeblin's death.

Leo Corry (Tel-Aviv University)

Landau's Hebrew List of 23 Problems: Higher Mathematics Makes 'Aliyah' in 1925

At the opening ceremony of the Hebrew University in Jerusalem in 1925, Edmond Landau, one of the five invited speakers, delivered a lecture where he presented to a lay audience a list of twenty-three problems in number theory. On the surface, the lecture appears to be a slightly awkward attempt by a distinguished German-Jewish mathematician to popularize a few number-theoretical tidbits. The same text, however, can be given a less straightforward reading that turns it into a focal point from which to analyze central aspects of the beginning of institutionalized, higher mathematical research in Mandatory Palestine. Landau's 1925 Jerusalem lecture stands at the crossroads of various historical contexts of great interest: Landau's biography, the involvement of Jewish scientists in the German Zionist movement, the founding of the Hebrew University in Jerusalem, and the creation of a Modern Hebrew mathematical language. The lecture and the various historical contexts that surround it will be the topic of my talk.

Elon Lindenstrauss (The Hebrew University of Jerusalem)

Dynamics and Geometry of Numbers

In the late 19th century, the German mathematician Hermann Minkowski discovered that by recasting problems in number theory in terms of lattices in R^n one can simultaneously get sharper and more transparent proofs of several fundamental number theoretic results, in particular regarding ideal classes in number fields. Minkowski called this new branch of number theory which he invented the "Geometry of Numbers".

Homogeneous dynamics is the study of natural group actions on quotient spaces of locally compact groups, a prominent example being the space of lattices in R^n. This gives a new perspective, and new tools, to the study of problems in the geometry of numbers. A notable success of this approach has been the proof by Margulis in the mid-80s of the long-standing Oppenheim Conjecture. I will explain more recent (partial) results in this vein, in particular concerning Littlewood's conjecture on simultaneous Diophantine approximations and a sharpening of one of Minkowski's results regarding ideal classes for cubic and higher-order fields.

Alex Lubotzky (The Hebrew University of Jerusalem)

Arithmetic Quotients of Automorphism Groups

Let F be a free group on n generators and A=Aut(F) its automorphism group. It is well known and easy to see that A is mapped onto the arithmetic group GL(n,Z). We will present a joint work with Fritz Gruenwald in which we produced many more arithmetic quotients of A. We will give some applications (joint work with Chen Meiri) and describe possible extensions when A is replaced by the mapping class group.

Roman Sauer (The University of Regensburg)

From quasi-Isometry to Measure Equivalence of Groups: Some Rigidity Questions

We explain the notion of measure coupling and how it is related to quasi-isometry and orbitequivalence of groups. Further, we discuss rigidity results about measure couplings of hyperbolic lattices. This is based on joint work with Uri Bader and Alex Furman.

Peter Teichner (Max Planck Institute of Mathematics, Bonn)

Field Theories and Algebraic Topology

There is a mathematical definition of (functorial) field theories, including both classical and quantum theories. In this talk we'll discuss various relations to algebraic topology that have arisen in the last years.

Katrin Tent (The University of Münster)

On the Isometry Group of the Urysohn Space

The Urysohn space can be characterized as the unique complete, separable and homogeneous space which embeds every finite metric space. Using model theoretic techniques we prove that the normal closure of any unbounded isometry is the whole isometry group. This result extends to many other natural classes of very homogeneous structures and generalizes a number of known results.

Katrin Wendland (The University of Freiburg)

Kummer K3 Surfaces and Automorphisms of the Golay Code

By classical results due to Nikulin, Mukai, Xiao and Kondo in the 1980's and 90's,the finite symplectic automorphism groups of K3 surfaces are always subgroups of the sporadic simple group known as the Mathieu group M24, which can be constructed as the automorphism group of the Golay code. There are eleven "maximal" subgroups of M24, which were also determined by Mukai, such that every finite ymplectic automorphism group of a K3 surface is contained in one of these eleven groups as a subgroup. The group M24 is by a factor of about half a million larger than each of these eleven groups. inspired by a recent observation by Eguchi, Ooguri and Tachikawa that the elliptic genus of K3 surfaces seems to exhibit a mysterious footprint of M24, we investigate the polarization preserving automorphisms of Kummer K3 surfaces in terms of automorphisms of the Golay code. We explain how several such automorphism groups can be combined to a subgroup of M24 which is by a factor of 100 larger than any of Mukai's eleven "maximal" groups.