The Center for Advanced Studies in Mathematics

Ben-Gurion University of the Negev

Activity Report
תשפ"ב
2021-2022

BEN-GURION UNIVERSIY OF THE NEGEV
P.O.B. 653, BEER-SHEVA 84105, ISRAEL

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אוניברסיטת בן-גוריון בנגב
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פרופ׳ מיכאל לין

ראש המרכז ללימודים מתקדמים במתמטיקה
המחלקה למתמטיקה
טלפון: 08-6461621   פקס: 08-6477648

Center for Advanced Studies in Mathematics

Michael Lin, Director

Executive Committee (2021-2022)
I.Tyomkin, Chairman of the Mathematics Department,
T. Meyirovich, Y. Glasner

Advisory Committee
V. Drinfeld, University of Chicago
H. Furstenberg, The Hebrew University
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Report on the Activities of the
Center for Advanced Studies in Mathematics
Academic Year 2021 - 2022

1. <u>Introduction</u>

The Center for Advanced Studies in Mathematics was established at Ben-Gurion University of the Negev (BGU) in March 2001, with the generous support of Mrs. Lis Gaines and the initiative and support of the late Prof. Beno Eckmann. Others, including Dr. Joseph Friedman, Mr. Martin Blackman and the Skirball Foundation, joined Mrs. Gaines in supporting the Center, as well as Prof. Daniel Sternheimer,a longtime friend and more recent financial supporter of the Center. A recent supporter of the center is Mrs. Julia Gauchman, who has established with her family the Prof. Hillel Gauchman Memorial Scholarship Fund in Mathematics in loving memory of her late husband Prof. Hillel Gauchman.

The Center strives to promote broad-based research activity in diverse areas of mathematics and various applications. The Center supports the whole mathematics "food chain" - from educating and inspiring the work of gifted middle and high school students through high achieving post-doctoral fellows; sponsoring visiting researchers; hosting conferences, workshops and lecture series; as well awarding prizes to outstanding Ph.D. students and outstanding MSC students upon the completion of their doctoral studies.

The distinguished International Advisory Committee for the Center is composed of world-famous mathematicians from Israel and abroad,

among them three winners of the Fields medal, three winners of the prestigious Wolf Prize in Mathematics, two winners of the Israel Prize in Mathematics, and members of the Israel Academy of Science. We are proud that Prof. Furstenberg, a member of our Advisory Committee, has received in 2020 the Abel Prize, the prestigious mathematics parallel of the Nobel Prize.

We take great pride in the exceptional level of the post-doctoral fellows admitted to the program, for they strengthen our research capacity and contribute to our high-level research profile.
We are pleased to present this report summarizing the Center's 2021-2022 activities. The scope of the report reflects the Center's wide variety of mathematical-based endeavors and the degree to which the Center has successfully achieved "vertical integration" in terms of its impact on a diverse group of beneficiaries.

The Covid pandemic around the world has afflicted every activity of the Center over the past two years. But In 2021-2022 academic year, despite the continuing pandemic, we headed back into our normal work activities. This year we had international visitors and more post docs, Conferences prize winning ceremonies were also held us usual.
We hope that the efforts made to combat the pandemic will be successful and our bustling activities will remain productive.
Professor Miriam Cohen, founding director of the Center, retired in September 2022.

2. <u>Sponsored Guests</u>

Kubis Wieslaw, Institute of Mathematics, Czech Academy of Sciences

Norman Christopher Phillips, Mathematics Department, University of Oregon

3. Special Events and Honorary Lectures

**The 2021-2022 Mathematics Excellence Day
of the Department of Mathematics and
the Center of Advanced Studies in Mathematics
to honor 2022 Wolf prize laureate Prof. George Lusztig (MIT)
and to award the Noriko Sakurai fellowship,
the Gauchman excellence scholarship and the Zabey prize**
Ben-Gurion University of the Negev, June 19, 2022

Distinguished guest lecture by Prof. George Lusztig
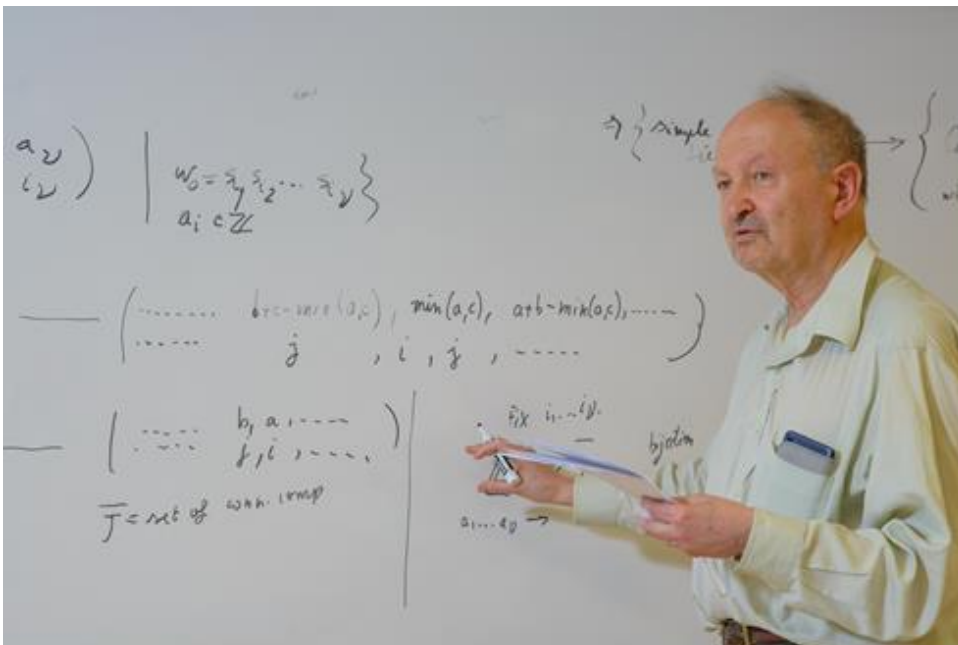
Prof. George Lusztig

Prof. George Lusztig, our Honored guest from the Massachusetts Institute of Technology, 2022 winner of The Wolf Prize in Mathematics, awarded to

him for Groundbreaking contributions to Representation Theory and related areas.

Prof. George Lusztig gave the Honorary Lecture "Weyl's Dimension Formula, Revisited."

Abstract. Let G be a compact connected Lie group. The irreducible representations of G were classified by E. Cartan; their character and dimension as a quotient of two integers, the result being not obviously an integer. A later formula of Konstant expresses the dimension as a difference of two integers, the result being not obviously positive. We will describe a third formula in which the result is positive integer.

In the celebratory lunch in honor of Prof. George Lusztig: Dr. Li Gongqi, Prof. Lusztig's wife, Rector BGU Prof. Chaim Hames, Dean of Natural Science Faculty Prof. Gabriel Lemcoff, Dr. Ruth Blatt, Prof. Ilya Tyomkin Chair, Department of Mathematics, and Prof. Uri Abraham

The Noriko Sakurai 2022 Fellowship Award.

The Noriko Sakurai Fellowship was established in honor of the late Noriko Sakurai. It is awarded annually to an outstanding post-doctoral researcher.

The late Noriko Sakurai

Noriko's relationship with BGU developed as a result of the connections to BGU shared by her second husband, Prof. Daniel Sternheimer, and her friend, Prof. Moshe Flato, who passed away in 1998. She became a donor of BGU's Center for Advanced Studies in Mathematics in 2010, and annual support has continued by her husband in her memory.

Prof. Miriam Cohen, the Director of the Center for Advanced Studies of Mathematics, and Prof. Daniel Sternheimer, Rikkyo (Japan) and Bourgogne (France) Universities opened the ceremony.

Prof. Miriam Cohen and Prof. Daniel Sternheimer with a collage of the late Noriko Sakurai's photographs.

The establishment of the Noriko Sakurai Fellowship at BGU is a fitting tribute to Noriko and reflects the depth of her commitment to scientific endeavors and her relationship with BGU. She established the J.J. Sakurai Prize in Physics at the American Physical Society (APS), and we are pleased to share the statement read by Prof. Hirotaka Sugawara at the prize ceremony in 2010, which demonstrates the admiration she received from others.

At age 20, Noriko Sakurai left Japan for university in the United States. She met Jun (J.J.) Sakurai, then a rising star in the world of theoretical particle physics at Princeton University, where they married. She was known in the physics community as a fantastic hostess. At the end of October 1982, J.J. died while pursuing research at CERN (the European Center for Nuclear Research). One of Noriko's first actions was to establish the J.J. Sakurai Prize, contributing half of the initial endowment. Family and

friends contributed the other half. Later she donated to the American Physical Society the rights to her husband's classic textbooks, significantly increasing the endowment.

Noriko combined modesty, strength and grace in equal measure. Under an unassuming appearance was a great heart and mind, a lady of steel who knew how to achieve her goals, no matter how daunting. Warm and fun-loving, she instantly became the darling of those who met her, from ordinary people to scientific leaders.

She will live in the hearts and minds of those who knew her, through her vibrant personality and through her deeds, especially the J.J. Sakurai Prize".

We at the Center are ever appreciative of Noriko's support and dedication to our efforts. We continue to be inspired by the manner in which she pursued her goals with warmth, enthusiasm, and determination.

The 2021-2022 incumbent of the Noriko Sakurai Fellowship was Dr. Alexander Sherman, a post-doctoral fellow under the supervision of Dr. Inna Entova-Aizenbud.

Dr. Alexander Sherman is a post-doctoral student at the Mathematics Department since 2020. He completed his Ph.D. studies in 2020 at University of California, Berkeley under the supervision of Vera Serganova and later that year started his post-doctoral position at Ben Gurion University of the Negev.

Dr. Inna Entova-Aizenbud the supervisor of Dr. Alexander Sherman introduced him:

Alexander (Alex) Sherman has been a post-doctoral researcher in BGU, in my research group, since October 2020. Before that. Alex has been a graduate student at UC Berkeley, studying with Prof. Vera Serganova.

Alex works in the subject of supergeometry and representation theory of Lie superalgebras, a study of algebraic-geometric objects in the world of superspaces. He has a very impressive track record, having written about 10 new papers just within the two years he has spent in BGU. It was a pleasure seeing him work, and I am sure he has a wonderful mathematical future ahead of him. I hope he will come back to work at BGU. Congratulations, Alex!

At the fellowship award ceremony, Dr. Alexander Sherman gave a talk on "Representation Theory of Supergroups".

Abstract: We introduce the general linear supergroup over the complex numbers, along with its category of representations. Although this category is very complicated, analogies may be drawn between it and the categories of representations of complex reductive groups, and of finite groups in positive characteristic. We discuss recent successes in pushing the boundaries of the latter analogy, and some consequences. The main tools come from both algebraic and differential supergeometry, which we will hint at.

From left to right: Dr. Alexander Sherman, BGU, Mr. Guy Shtotland, BGU, Prof. George Lusztig (MIT), Dr. Dina Barak, BGU, Prof. Ilya Tyomkin, BGU.

The Hillel Gauchman Memorial Scholarship fund
for Excellence in Mathematical research.

Prof. Hillel Gauchman Memorial Scholarship Fund in Mathematics was inaugurated on January 3, 2017 in the presence of his widow Julia and his daughters Orit and Ruth with their families.

Prof. Gauchman received his Ph.D. in Mathematics from Moscow State University in 1962. Ten years later he and his family immigrated to Israel and joined the young Mathematics Department at Ben-Gurion University. Within a short period of time he became one of the pillars of the department, establishing close ties with many of its members. He was promoted to Associate Professor for his outstanding research in Differential Geometry and shortly after was elected in 1980 as chair of the Mathematics Department.

The Gauchman family moved to the US in the mid-eighties, where Prof. Gauchman was an adjunct Professor at the University of Illinois at Urbana–Champaign and Full Professor at Eastern Illinois University in Charlestone. The Gauchman family kept strong ties with their friends in Israel throughout the years.

Teaching was one of Prof. Gauchman's passions. He used to say that he taught during his life in three different countries and in three different languages, but his most serious and hardworking students were those at Ben-Gurion University. His dedication was reciprocated by his students and he is still considered as one of the most brilliant and beloved lecturers in the department.

Julia Gauchman decided that the best way to remember her husband was to create a fund that awards a very generous scholarship to an outstanding research student in Mathematics at BGU.

The Special guests of the ceremony were Dr. Ruth Blatt, daughter of Ms. Julia Gauchman and the late Prof. Hillel Gauchman, and Reut Inon Berman Director of Wolf Foundation

Reut Inon Berman Director of Wolf Foundation

Dr. Ruth Blatt daughter of late Prof. Hillel Gauchman and Mrs. Julia Gauchman

The 2022 incumbent of the Hillel Gauchman scholarship is Dr. Dina Barak, a Ph.D. student under the supervision of Prof. Daniel Berend.

Prof. Daniel Berend described some of Dina's best qualifications:
I am very glad to have my student Dina Barak getting the Hillel Gauchman Prize. Dina has been working with me over the past 6 or 7 years, first as an Master of Science students, and then as a Ph.D. student. Dina is a real model student. She returned to the university after dozens of years outside the system and outside math. Naturally, one forgets a lot over the years. Thus, her return was quite difficult. However, she is highly motivated, in fact one of the most motivated students I've had a pleasure to work with in the 35 years or so. While with most of my graduate students I meet once a week, and meetings may be canceled when the student has other things on his head, Dina usually meets me several times a week, sometimes 6 days a week. She always has a lot to say about what she has done since the preceding meeting.

I can't think of someone more deserving than her for the prize and wish her the best during the rest of her Ph.D. studies, and in her career later.

After receiving the Gauchman Scholarship, Dr. Dina Barak, gave a talk.

Abstract. Our starting point is the coupon collector's problem CCP. Its formulation is as follows: How many drawings are needed on average in order to complete a collection of n types of coupons, if at each step a single coupon is drawn uniformly, independently of all the other drawings?

The Zabey Prize for outstanding M.sc Thesis.

Prof. Eitan Sayag introduced Mr. Guy Shtotland, the recipient of the Zabey Prize. The Chaim Zabey award is granted yearly since 2001, by the faculty of Natural Sciences, to one graduate student with the most outstanding thesis, in each of the departments of Math, Computer Science and Physics. This year's winner at the department of Mathematics is Guy Shtotland, an honors MSc. graduate. Guy was elected out of other leading candidates from the Department.

Excellence day Program.

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**The Department of Mathematics
and the Center of Advanced Studies in Mathematics
announce a Mathematics Excellence Day**

**to honor 2022 Wolf prize laureate Prof. George Lusztig (MIT)
and to award the Noriko Sakurai fellowship,
the Gauchman excellence scholarship
and the Zabey prize**

Sunday, June 19 at 13:15 at the Deichmann building for Mathematics (58), Seminar room -101

Program:

13:15-14:15 Buffet Lunch

14:15 Opening remarks:

Prof. Miriam Cohen,
Director of the Center of Advanced Studies in Mathematics

Prof. Daniel Sternheimer,
Rikkyo (Japan) and Bourgogne (France) Universities

Dr. Ruth Blatt, on behalf of Gauchman family

Ms. Reut Inon-Berman, the director general of the Wolf Foundation

14:30 Honorary lecture:

Prof. George Lusztig, MIT, the winner of The Wolf Prize in Mathematics ,2022
Title: "Weyl's dimension formula, revisited."
Abstract: Let G be a compact connected Lie group. The irreducible representations of G
were classified by E.Cartan; their character and dimension were described by
H.Weyl. The formula of Weyl expresses the dimension as a quotient of two
integers ,the result being not obviously an integer. A later formula of Kostant
expresses the dimension as a difference of two integers, the result being not
obviously positive. We will describe a third formula in which the result is a
positive integer.

15:30 Dr. Inna Entova-Aizenbud, Introducing the recipient of the Noriko Sakurai prize

15:35 **The 2022 Noriko Sakurai fellowship award and a lecture**
by *Dr. Alexander Charles Sherman*, recipient of the Noriko Sakurai fellowship
Title: Representation theory of supergroups: analogies with modular representation theory
Abstract: We introduce the general linear supergroup over the complex numbers, along with its
category of representations. Although this category is very complicated, analogies may
be drawn between it and the categories of representations of complex reductive groups,
and of finite groups in positive characteristic. We discuss recent successes in pushing
the boundaries of the latter analogy, and some consequences. The main tools come
from both algebraic and differential supergeometry, which we will hint at.

15:45 **Prof. Daniel Berend, Introducing the recipient of the Hillel Gauchman fellowship**

15:50 **The 2022 Hillel Gauchman excellence scholarship and a lecture**
by *Ms. Dina Barak*, recipient of the Hillel Gauchman fellowship
Title: The Coupon Collector's Problem -- Applications
Abstract : Our starting point is the coupon collector's problem (CCP). Its formulation is as
follows: How many drawings are needed on average in order to complete a collection
of n types of coupons, if at each step a single coupon is drawn uniformly randomly,
independently of all the other drawings?
We have studied generalizations and applications of CCP in cyber security.
We have also studied simulating the process rapidly.

16:00 Prof. Eitan Sayag, Introducing Mr. Guy Shtotland, the recipient of the Zabey prize

16:05 a lecture by Mr. Guy Shtotland

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Research Workshop of the Israeli Science Foundation
C* - Algebras: Structure and Dynamics
May 16-19, 2022, Sde Boker

Supported by the Center for Advanced Studies in Mathematics in BGU, the

Dean of the Faculty of Natural Sciences and the Rector of BGU

Organized by

Prof. Ilan Hirshberg (Mathematics Department at BGU)

The workshop entitled "C*-algebras: structure and dynamics" took place

during May 16-19, 2022, at Sde Boker. The workshop was organized by

Prof. Ilan Hirshberg from BGU, with Prof. George Elliott from the University

of Toronto and Prof. N. Christopher Phillips from the University of Oregon

serving on the scientific committee. Organizing the workshop was quite an adventure: it was originally scheduled for the winter of 2021, and we had to postpone it four times due to the coronavirus pandemic. It was one of the very first in-person workshops which were organized as the pandemic waned, and some coronavirus restrictions were still in place. Indeed, one of the participants tested positive on arrival, and had to remain quarantined for the duration of the workshop, and a few others had to cancel. Nonetheless, the workshop was a great success, and participants were clearly very happy to finally meet in person again, after two years of Zoom fatigue. The workshop took place over four days and featured 23 research talks; one free afternoon had a social excursion to the nearby Ein Avedat National Park. The workshop attracted 31 participants, 27 of which were from abroad (and came despite various vaccination and testing requirements which were still in place); the ranged from some of the most senior and established researchers in the fields to graduate students and postdoctoral fellows.

A Special Day of lectures on Dynamics and Probability

Celebrating Michael Lin's 80th birthday

Ben-Gurion University of the Negev, May 31, 2022

Organizers: Yair Glasner, Tom Meyerovitch, and Guy Cohen

Professor Emeritus Michael Lin was a member of the Department of Mathematics at BGU from 1976 till 2011, Chair 1986-1990.
Since September 2022 he is the director of the center for Advanced Studies in Mathematics.

Prof. Emeritus Michael Lin

Lectures given:

Omri Sarig, Weizmann Institute.

Title: Reduction theory for additive functionals on inhomogeneous Markov chains (joint with D. Dolgopyat)

Abstract: We consider sums Sn(f) = f1(X1, X2) + ... + fn(Xn, Xn+1) where Xn is a Markov chain, and f = fn is a uniformly bounded sequence of measurable real valued functions.

The algebraic range of f is the smallest closed group G such that Sn(f) remains in cosets of G for all n. We will discuss the following problem: How small can we make the algebraic range by subtracting a tight sequence h = hn? [Tightness means that the distributions of Sn(h) are pre-compact: "no mass escapes to infinity"] The problem is classical for stationary Markov chains and when fn is independent of n(Parry & Schmidt). We will discuss the inhomogeneous case, when fn, the state spaces, and the transition kernels depend on n(Joint work with D. Dolgopyat)

Jon Aaronson, Tel-Aviv University.

Title: Some infinite ergodic renewal theory. Abstract: I'll begin with a tied-down, distributional limit for renewal processes (as defined in Chung's 1966 book) which satisfy the strong renewal theorem Caravenna) Doney, Elect.J.Prob. 2019)

and then prove a" weak Cesaro" version for pointwise dual ergodic transformations with suitably regularly varying return sequences Strong Cesaro" versions hold for such transformations admitting Gibbs-Markov return" time processes including certain" intermittent" interval maps with regularly varying. Taylor expansions at indifferent fixed points. Joint work with Toru Sera (arXiv:1910.09846 & 2104.12006).

Eli Glasner, Tel-Aviv University.

Title: Generic Properties of Dynamical Systems: From Relative Weak Mixing to Dominance.

Abstract. A classical result of Halmos asserts that among measure preserving. 'transformations the weak mixing property is generic. A relative version of Halmos theorem was proved by Schnurr and G-W in 2017. Then, in a series of works (jointly with Benjamin Weiss, J.-P. Thouvenot and Tim Austin) we developed a relative theory of generic properties which culminated in a recent work, where we show that positive entropy systems are exactly those which are dominant. We say that an ergodic system $X = (X, X, \mu, T)$ is dominant if a generic extension $\hat{T}$ of T is isomorphic to T. I will review some of these developments and then explain the main ideas behind the proof of the latter result.

Ariel Yadin, Ben Gurion University.

Title: Abundance of Subgroups via Random Walk Entropy

Abstract: Given a (finitely generated) group, we are interested in investigating whether the group has a rich family of subgroups or not. This question is not precise enough, as stated. What we will focus on for this talk, is whether a group has many normal subgroups, or whether it has many invariant random subgroups (IRS), which are a probabilistic generalization of a normal subgroup. For example, a simple group does not have any non-trivial normal subgroups. A famous theorem of Margulis tells us that SL(3, Z) has "few" normal subgroups. Stuck & Zimmer extend this also to IRSs. Contrary to the high rank SL(n, Z) case, we believe that SL(2, Z) should have many normal subgroups and IRSs. Since SL(2, Z) contains

a free group on 2 elements with finite index, this leads one to consider subgroups of finitely generated free groups. Indeed, extending results of Bowen, in joint works with Y. Hartman and L. Ron-George, we show that finitely generated free groups and SL(2, Z) have an abundance of ergodic IRSs, where "abundant" here is measured using random walk entropy. Specifically, all a-priori random walk entropy values can be realized by some ergodic IRS. The question whether entropy values can be realized with normal subgroups is still open. Our methods involve a new construction of IRSs, by gluing together Schreier graphs, and we combine algebraic constructions with geometric and random walk considerations.

4. Post-Doctoral Fellows

We take great pride in the fact that despite the Corona Pandemic, this past year we supported 12 exceptional post-doctoral fellows from Israel and abroad. They strengthen our research capacity and contribute to our high-level research profile. This program is supported by the Skirball Foundation.

Name:	Dr. Tattwamasi Amrutam
Doctoral Degree:	Ph.D The University of Houston, Texas
Advisors:	Prof. Yair Hartman
Research Interests	Intersection between Group Dynamics and Operator Algebras

October 2021-September 2022: I worked on four different projects. One project was with Dr. Yongle Jiang, DUT, China. We worked on the ISR property of group von Neumann algebras and showed that torsion free

hyperbolic groups, among others, have this property. The paper is available at https://arxiv.org/abs/2205.10700. Another project involving subgroups, subalgebras and singularity was completed with Dr. Yair Hartman. The paper is available at https://arxiv.org/abs/2208.06019. One other ongoing project is a joint work with Dr. Eli Glasner and Dr. Yair Glasner, which deals with the structure of crossed product C*-algebras. A project which is a joint work with Dr. Hanna Oppelmayer is in progress. We have also started a new collaboration with Dr. Yair Hartman.

Invited Talks:

1. Joint UHaifa-Technion NC analysis seminar, 9th Nov 2022

2. Operator Algebras Session, Israel Mathematical Union Annual meeting, 19th September, 2022

3. Workshop on C*-algebras: Structure and Dynamics, Sde-Boker, 16th May 2022

4. Midrasha, Weizmann Institute of Science, 25th April 2022

Publications during this period:

1. On invariant von Neumann subalgebras rigidity property (Joint with Yongle Jiang), available at: https://arxiv.org/abs/2205.10700, accepted into the Journal of Functional Analysis. May 2022.

2. Subalgebras, subgroups and singularity (joint with Yair Hartman), available at https://arxiv.org/abs/2208.06019. August 2022.

Name:		Dr. Shrey Sanadhya
Doctoral Degree:		Ph.D The University of Iowa, USA
Advisors:		Prof. Tom Meyerovitch
Research Interests		Ergodic Theory and Dynamical Systems

In Oct 2021 - Sept 2022 period Dr. Shrey Sanadhya with his supervisor Prof. Tom Meyerovitch have been working on Ergodic theory and Dynamical Systems, in particular Symbolic Dynamics, and related aspects of Probability Theory.

Conference attended:

1) The 36th Summer Topology Conference, University of Vienna, July 18-22, 2022.

2) Dynamics Week in Jerusalem, Einstein Institute of Mathematics, Hebrew University, July 3-5, 2022.

3) Action Now Wandering Seminar, Weizmann Institute of Science, December 20, 2021.

4) Noncommutative Analysis at the Technion, June 26-July 1, 2022

Talks:

1) University of Vienna, Universality for R^d-flows, 36 th Summer Topology Conference, July 20, 2022.

2) Einstein Institute of Mathematics, The Hebrew University of Jerusalem, Universality for R^d-flows, Dynamics seminar, April 12, 2022.

3) Tel Aviv University, Borel hyperplane absolute winning sets in R^d, Seminar on homogeneous dynamics and applications, Dec 16, 2021.

Preprints, submitted for publication:

1) Measures and generalized Bratteli diagrams for dynamics of infinite alphabet-substitutions, submitted (with Sergey Bezuglyi and Palle Jorgensen) [arXiv:2203.14127].

2) A note on reduction of tiling problems, submitted (with Tom Meyerovitch and Yaar Solomon) [arXiv:2211.07140]

Publications:

1) Shrey Sanadhya. A shrinking target theorem for ergodic transformations of the unit interval. Discrete and Continuous Dynamical Systems, 2022, 42(8): 4003-4011. doi: 10.3934/dcds.2022042

Name:	Dr. Jiayan Ye
Doctoral Degree:	Ph.D Texas A&M University, USA
Advisors:	Prof. Ariel Yadin
Research Interests	Probability theory

In Oct 2021 - Sept 2022, Dr. Jiayan Ye with his supervisor Dr. Ariel Yadin have been working on Random Walks on Groups problems, diffusion-limited aggregation, and related aggregation processes, such as Hastings-Leviton aggregation. Dr. Jiayan Ye and Dr. Ariel Yadin have used probability techniques to study properties of groups.

Attended conferences:
"Challenges in Probability and Statistical Mechanics" in Technion Haifa in June 2022

Articles:

Dr. Jiayan Ye published (co-author) a paper in Journal of Theoretical Probability:

"On Chemical Distance and Local Uniqueness of a Sufficiently Supercritical Finitary Random Interlacements, Zhenhao Cai, Xiao Han, Jiayan Ye & Yuan Zhang, Journal of Theoretical Probability, June 2022

Name:	*Dr. Alexander Sherman*
Doctoral Degree:	*Ph.D., University of California, Berkeley*
	DR. Inna Entova
Advisor:	
	Representation Theory.
Research Interests:	

During the October 2021 – September 2022 academic year, Dr. Alexander Sherman, jointly with Dr. Inna Entova, has been working on Duflo - Serganova Functor and a Superdimension Formula for the periplectic Lie superalgebra. "We review old and new results concerning the DS functor and associated varieties for Lie superalgebras. These notions were introduced in the unpublished manuscript by Michel Duflo and Vera Serganova. This paper includes the results and proofs of the original manuscript, as well as a survey of more recent results".

In addition to the above, Dr. Alexander Sherman was presented the Sakurai Prize for a post-doctoral researcher by the Center for Advanced Studies in Mathematics. He gave a short lecture on his work at the ceremony, entitled: Representation theory of supergroups: analogies with finite groups.

Attended conferences:

1. Winter Star Workshop at Weizmann Institute of Science. The given talk: "Localization theorem for super varieties", December 27-29, 2021
2. Summer Star Workshop at Weizmann Institute of Science. The given

talk: "Two spectral sequences for gl(1|1)-modules", May 29-June 02, 2022

Talks:

Stars Seminar: "On the Duflo-Serganova functor,

27 October 2021, The Weizmann Institute of Science

Oberseminar Analysis Summer 2022 at the University of Bonn:

"Supercharacters of the queer Lie superalgebra

Publications:

1. The Duflo-Serganova functor, vingt ans après, March 2022
2. On symmetries of the Duflo-Serganova functor, arXiv: January 2022.12808
3. On the Duflo-Serganova functor for the queer Lie superalgebra, with M. Gorelik, arXiv: April 2022.05048
4. On the Grothendieck ring of a quasireductive Lie superalgebra, with M. Gorelik and V. Serganova, arXiv: June 2022 .07709
5. Splitting quasireductive supergroups and volumes of supergrassmannians, with V. Serganova, arXiv: June 2022.07693
6. Ghost distributions on supersymmetric spaces II: basic classical superalgebras, arXiv: augusr 2022.09866
7. Localization theorem for homological vector fields, with V. Serganova, arXiv: October 2022.13264

Name:	Dr. Roman Panenko
Doctoral Degree:	Ph.D. Sobolev Institute of Mathematics, Novosibirsk State University, Russia
Advisor:	Prof. Vladimir Goldshtain
Research Interests:	Mathematical Modeling, Functional Analysis, Geometric analysis

The period during October 2021-September 2022 was devoted to the study of the Lipschitz version of de Rham Calculus on Metric Simplicial Complexes with Bounded Geometry. We focused our attention on the de Rham operators' underlying properties which are specified by intrinsic effects of differential geometry structures. Then we applied the procedure of regularization in the context of simplicial complexes in order to describe the de Rham L_p-cohomology.

As a result, a preprint was published. The version of the text for a peer-reviewed journal was submitted as well.

Publications:

V. Gol'dshtein, and R. Panenko, A Lipschitz version of de Rham theorem for L_p-cohomology, arXiv:2211.12396, November 2022.

Name:	Dr. Daniel Igebretson
Doctoral Degree:	Ph.D. Department of Mathematical Sciences University of Indianapolis, USA
Advisors:	Prof. Fedor Pakovich
Research Interests	Dynamical Systems, Dimension Theory and smooth Ergodic Theory

During the 2021-2022 academic year Dr. Daniel Igebretson with his supervisor worked on understanding the Ergodic Theory of Rational Maps and extending this to rational semigroups. This semester I have been working independently, he advised me to focus on my own projects because I have a lot backed up that I need to publish. I am working on exact formulas for Hausdorff and Packing Measure of Fractal Sets that arise in numeration systems, particularly continued fractions and Luroth

expansions. We compute the exact Hausdorff and packing measure of sets of real numbers whose digital expansions in a given base are missing the digits beyond a given threshold.

I plan to return to the Ergodic Theory of rational maps and extending this to rational semigroups this upcoming semester as soon as I can finish the projects that I'm working on independently now.

Articles:

The Hausdorff and packing measure of some digital expansions, Acta Arith. 206(4) (2022), 339-352. April 2022.

Name:	Dr. Yatir Halevi	
Doctoral Degree:	Ph.D. The Hebrew University of Jerusalem	
Advisor:	Prof. Asaf Hason	
Research Interests	Model Theory and its application to Geometry and Algebra.	

During January 2022 - September 2022 (I only started my postdoc in January this year) I have been involved with three major projects. The first is a continuation of work with Assaf Hasson and Kobi Peterzil; we studied interpretable groups in various valued fields and as a result we concluded that in the 1-dimensional case every such group is abelian-by-finite. We also started to study definably semisimple groups interpretable in p-adically closed fields. The second is a project together with Gabriel Conant, Chirstian d'Elbee, Leo Jimenez and Silvain Rideau-Kikuchi in which we

studied expansions of the integers. One of our main results there is giving the first example of a strictly stable expansion of the integers. The third is a project together with Yuval Dor. We prove the existence and describe the model companion of separably closed valued fields together with a distinguished endomorphism. I also gave talks at conferences online.

Preprints:

On groups interpretable in various valued fields, with Assaf Hasson and Ya'acov Peterzil, submitted. arxiv:2206.05677

 Enriching a predicate and tame expansions of the integers, with Gabriel Conant, Christian d'Elbee, Leo Jimenez and Silvain Rideau-Kikuchi, submitted. arxiv:220307226

Definably semisimple groups interpretable in p-adically closed fields, with Assaf Hasson and Ya'acov Peterzil, submitted. arxiv:2211:001417

Name:	Dr. Hanna Oppelmayer
Doctoral Degree:	Ph.D. Chalmers University of Technology
Advisor:	Dr. Yair Hartman
Research Interests	Random walks

During the 2021-2022 academic Dr Hanna Oppelmayer and her supervisor Yair Hartman, with assistance of Dr. Tattwamasi Amrutam, have been working on Generalizations of the Poisson Boundary, Property (T) of IRAs and on the Uniqueness of Stationary Actions. Her collaborators in that field of work during this period were Dr. Sara Brofferio from University of Paris and Tomasz Szarek from University of Gdansk, Poland

Talks;

"Random walks in view of commensurated subgroup", University of Vienna, Austria, 10th Austrian Stochastic Days 08. September 2022,

"Random walk boundaries on Hecke pairs", CIRM, France, Operator Algebras and Group Dynamics Conference, 16. June 2022

Attendance only in conference:

ICM at HUJI, Jerusalem, July 2022

Self-Similarity of Groups, Trees and Fractals, IHP, Paris, May 2022.

Name:	Dr. Jeremy Siegert	
Doctoral Degree:	Ph.D The University of Tennessee, Knoxville, USA	
Advisors:	Prof. Michael Levin	.
Research Interests:	Topology, Coarse Geometry, Dimension Theory.	

In Oct 2021 - Sept 2022, Dr. Jeremy Siegert with his supervisor Prof. Michael Levin and with Prof. Jerzy Dydak from the University of Tennessee have been worked on our joint paper, "Mardesic factorization theorem for Asymptotic dimension". Part of this work took place while Prof. Levin and I were staying at the Institute for mathematics at the Polish Academy of Sciences.

We have also worked on improving Prof. Michael Levin's paper "P-adic actions raising dimension by 2", which generalized some earlier work by

Raymond and Williams on the subject.

Raymond and Wiliams constructed an action of the p-adic integers on an n-dimensional compactum, n>1, with the orbit space of dimension n+2. The author earlier presented a simplified approach for constructing such an action.

In this paper we generalize this approach to show that for every n>1, an (n+2)-dimensional compactum X can be obtained as the orbit space of an action of the p-adic integers on an n-dimensional compactum if and only if the cohomological dimension of X with coefficients in Z[1/p] is at most n.

Prof. Levin then provided guidance while I prepared talks on the subject that were given in 2022. The paper has since been submitted to Fundamenta Mathematica.

Since then, Prof. Levin and I have been working to understand Elon Lindenstrauss' on mean dimension. In particular we are trying to produce a more digestible proof of Lindenstrauss' embedding theorem.

Talks:

•   "Universal spaces for asymptotic dimension zero" at the Institute of Mathematics at the Polish Academy of Sciences. November of 2021

•   "Universal spaces for asymptotic dimension zero" University of Gdansk November of 2021

•   "P-adic Actions Raising Dimension by 2". Ben Gurion University. July 2022

Preprints:

1.   "Abbott Dimension, Mathematics Inspired by Flatland"
Made available on the arxiv in late 2021. Has since been accepted for publication in the American Mathematical Monthly.

2.   "Mardesic Factorization Theorem for Asymptotic Dimension"
Joint work with Michael Levin and Jerzy Dydak.
Made available on the arXiv archive in March of 2022.

3. "Coarse Structure of Ultrametric spaces with Applications"

Joint work with Yuankui Ma and Jerzy Dydak. Made available on the arXiv in March of 2022. Has since been accepted for publication in the European journal of mathematics.

4. "Relative asymptotic dimension to Ponomarev's cofinal

5. dimension via coarse proximities"

Made available on the arXiv in May of 2022.

	Name:	Dr. Sibaprasad Barik
	Doctoral Degree:	Ph.D. Indian Institute of Technology, Bombay
	Advisor:	Prof. Michael Lin
	Research Interests	Mathematics Operator Theory

During the 2021-2022 academic year, I have been working on a research problem with Prof. Victor Vinnikov and made significant progress on that. Also, I collaborated with a postdoc from a different university and wrote a paper which we have uploaded in the arXiv later in mid October 2022. During this time two of my papers have been accepted and one of them has been published.

Conferences attended:

I have attended an international conference named "International Workshop on Operator Theory and its Applications (IWOTA)" which was held in September 2022, organized by the University of Agriculture, Krakow. There I presented my work in the special session named "Model spaces, their operators, and applications".

Talks:

I have given two Departmental Seminars during November 2021 to December 2021.

Publications:

S. Barik and B. Bisai, A generalization of Ando's dilation, and isometric dilations for a class of tuples of q-commuting contractions, october 2022 arXiv:2210.10617.

S. Barik and B.K. Das, Isometric dilations of commuting contractions and Brehmer positivity, Complex Anal. Oper. Theory 16 no. 5, Paper No. 69, 25 pp. July 2022.

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S. Barik, M. Bhattacharjee and B. K. Das, Commutant lifting in the Schur-Agler class, to appear in the Journal of Operator Theory. July 2022

Name:	Dr. Paolo Dolce
Doctoral Degree:	Ph.D University of Nottingham & University Oxford
Advisors:	Dr. Daniel Disegni
Research Interests:	Arithmetic Geometry

In Oct 2021 - Sept 2022, Dr. Paolo Dolce with his supervisor Dr. Daniel Disegni have been working on some research projects involving Arakelov Geometry and Diophantine Geometry.

Arakelov Geometry is a discipline at the crossroad between Number Theory, Complex Analysis and Algebraic Geometry, which aims at bringing geometric intuition to arithmetic. Landmarks of Arakelov Geometry have been the proofs of Mordell conjecture by Faltings and by Vojta, and the

equidistribution results by Szpiro, Ullmo and Zhang that led to the proof of Bogomolov conjecture by Ullmo and by Zhang.

In addition, Dr. Paolo Dolce and Dr. Daniel Disegni, were involved in the organization of Research Seminars among the Number Theory and Algebraic Geometry Groups in BGU.

Talks:

Intercity Seminar on Arakelov Geometry. Numerical equivalence of R-divisors and Shioda-Tate formula for arithmetic varieties. Madrid, La Cristalera, 11-15 September 2022

Abstract: For varieties defined over the ring of integers of a number field, and inspired by the geometric case, Arakelov geometry offers a suitable notion of arithmetic Chow groups and of an arithmetic intersection product. In a joint work with Roberto Gualdi (University of Regensburg), we prove an arithmetic analogue of the classical Shioda-Tate formula, relating the dimension of the first Arakelov-Chow vector space of an arithmetic variety to some of its geometric invariants. In doing so, we also characterize numerically trivial arithmetic divisors, confirming part of a conjecture by Gillet and Soulé.

Publications:

Explicit Deligne pairing. European Journal of Mathematics, 8, Suppl. 1 (2022), pp. 101--129

Adelic geometry on arithmetic surfaces I: idelic and adelic interpretation of .the Deligne pairing. Kyoto Journal of Mathematics, 62, 2 (2022), pp. 433--70

Preprint:

On the generalisation of Roth's theorem https://arxiv.org/abs/2111.12409
Paolo Dolce, Francesco Zucconi, November 2021

Name:	Dr. Prahllad Deb
Doctoral Degree:	Ph.D Department of Mathematics and Statistics IISER Kolkata, India
Advisor:	Prof. Victor Vinnicov
Research Interests:	Mathematics Operator Theory

During the 2021-2022 academic year, I have been working on Operator Theory research problems.

I joined the Department of Mathematics at Ben-Gurion University on 1st February, 2021. Since then, I have been attending the Non-Commutative seminar which is held weekly at the Department of Mathematics

In November 2021, I delivered a series of two lectures on "The Cowen-Douglas class of operators and homogeneity" in this seminar.

In November 2022, I delivered a series of two lectures on "Noncommutative Gleason's problem and its application in noncommutative Cowen-Douglas class". This is a part of an ongoing work with Professor Victor Vinnikov

I am also attending a learning seminar on operator theory and operator algebras in the current semester.

Regarding my research with Professor Victor Vinnikov, we have introduced a non-commutative (nc) version of the Cowen-Douglas class. As of now, we have been able to model such operators by the tuple of adjoint of the multiplication operators on a nc reproducing kernel Hilbert space. A notion of nc hermitian holomorphic vector bundle has been introduced and we have shown that every element in the nc Cowen-Douglas class gives rise to such a vector bundle which determines the noncommuting tuple in the nc Cowen-Douglas class up to unitary equivalence. Thus it leads to study unitary invariants of such vector bundles (for example, the "nc curvatures" of them) which is our next goal of research I have planned.

The following research article has been communicated : "A family of homogeneous operators in the Cowen-Douglas class over poly-disc" (with Somnath Hazra)

Visits:

I visited Silesian University, Mathematical Institute in Opava, Czechia from 4th July, 2022 to 16th August, 2022.

Publications:

A Family of Homogeneous Operators In The Cowen-Douglas Class Over The Poly-disc. Prahllad Deb, Somnath Hazra, arXiv:2205.08962, May 2022

Abstract: We construct a large family of positive-definite kernels $K:D_n \times D_n \to M(r,C)$, holomorphic in the first variable and anti-holomorphic in the second, that are quasi-invariant with respect to the subgroup Möb$\times \cdots \times$Möb (n times) of the bi-holomorphic automorphism group of D_n. The adjoint of the n - tuples of multiplication operators by the co-ordinate functions on the Hilbert spaces H_K determined by K is then homogeneous with respect to this subgroup. We show that these n - tuples are irreducible, are in the Cowen-Douglas class $B_r(D_n)$ and that they are mutually pairwise unitarily inequivalen.

5. Program for Gifted High School Students – Supported by Martin Blackman

The Department of Mathematics at BGU has a long tradition of supporting gifted and academically motivated high school students, by encouraging them to enroll in undergraduate courses while still in high school.

In 2007, the Department began a formal program for these students in collaboration with the Center for Advanced Studies in Mathematics. Their studies are supported by a special fund established at the Center by Martin Blackman. Some of these students will be able to complete their undergraduate degree before entering the army.

The high school students are assigned faculty mentors who guide them throughout their studies. The program was established to combat the recent and consistent decrease in the number of students studying pure sciences, and mathematics in particular, at the university level, as well as to address the ongoing decline in the quality of the mathematics curriculum in Israeli high schools.

By publicizing the program and making it accessible to a larger number of motivated students we are able to realize our vision of providing a high-level mathematics program to talented high school students, contributing to social and cultural progress in Israel, and creating a pool of outstanding undergraduate students (and hopefully excellent future graduate students) at BGU's Department of Mathematics.

In 2021-2022 the Center of Advanced Studies in Mathematics supported the academic studies of 12 gifted high school students.

6. Looking Forward

The 2022-2023 academic year has gotten off to a very fruitful start at the Center for Advanced Studies in Mathematics as we welcomed aboard a diverse group of 10 post-doctoral researchers from Israel and around the globe. Each researcher has begun to pursue their research and take steps

to initiate new collaborations, enhancing the richness of our research profile and adding depth to our Center.

We once again thank you for your support and invite you to come visit us next time at BGU!