Contributed Talks

List of speakers

1. Amit Kumar, IIIT Allahabad
2. Apeksha Sanghi, IISER Mohali
3. Archita Gupta, IIT Kanpur
4. Dibyendu Biswas, IIT Bombay
5. Digjoy Paul, IISc Bangalore
6. Gurleen Kaur, IISER Mohali
7. Harish Kishnani, IISER Mohali
8. Himanshi Khurana, IISER Bhopal
9. Himanshu Setia, IIT Ropar
10. Hiranya Kishore Dey, IISc Bangalore
11. Manideepa Saha, Presidency University
12. Neeraj Kumar Dhanwani, IISER Mohali
13. Nishant, HRI Prayagraj
14. Oorna Mitra, CMI, Chennai
15. Pallabi Manna, NIT Rourkela
16. Pankaj Kapdi, IISER Bhopal
17. Pravin Kumar, IISER Mohali
18. Rahul Kaushik, IISER Pune
19. Renu Joshi, IISER Bhopal
20. Rijubrata Kundu, IISER Mohali
21. Sandeep Dalal, NISER Bhubaneswar
22. Sanjay Mukherjee, NISER Bhubaneswar
23. Sucharita Biswas, Presidency University
24. Sumit Chandra Mishra, IISER Mohali
25. Tejbir, IISER Mohali

Title and Abstract

1. **The Schur multiplier of finite multiplicative Lie algebra**

   Speaker: Amit Kumar, IIIT Allahabad

   Abstract: In 2018, R.Lal and S.K.Upadhyay developed the theory of extensions of multiplicative Lie algebras and introduced the Schur multiplier of multiplicative Lie algebras as second cohomology. Since the Schur multipliers of the groups have proved to be a powerful tool in other areas, such as algebraic number theory, block theory of group algebras, and classification of finite simple groups, to mention only a few. In my talk I will present the Schur multipliers of some finite multiplicative Lie algebras with respect to arbitrary multiplicative Lie algebra structure.

2. **Metacyclic actions on surfaces**

   Speaker: Apeksha Sanghi, IISER Mohali

   Abstract: Let $\mathrm{Mod}(S_g)$ denote the mapping class group of closed orientable surface S_g of genus $g \geq 2$. In this talk, we will discuss the necessary and sufficient conditions under which two torsion elements in $\mathrm{Mod}(S_g)$ will have conjugates that generate a finite metacyclic subgroup of $\mathrm{Mod}(S_g)$. As an application, we will analyze the liftability of certain periodic mapping class under some finite-sheeted regular cyclic covers of S_g. Furthermore, we will see that $4g$ is an upper bound on the order of a non-split metacyclic action on S_g. Moreover, we give a complete characterization of the dihedral subgroups of $\mathrm{Mod}(S_g)$ up to a certain equivalence. We conclude the talk by describing nontrivial geometric realizations of some metacyclic actions.

3. **Tensor Products of the regular Representations of** $\mathrm{GL}_2(\mathfrak{o}_r)$

   Speaker: Archita Gupta, IIT Kanpur

   Abstract: Let $\mathfrak{o}$ be the ring of integers in a non-Archimedean local field with finite residue field, $\mathfrak{p}$ its maximal ideal, and $r \geq 2$ an integer. A particular class of representations, called the regular representations of the group $\mathrm{GL}_N(\mathfrak{o}_r), N \geq 2$ have been constructed by Alexander Stansinski and Shaun Stevens (2017) and Roi Krakovski, Uri Onn and Pooja Singla (2018). In this talk, we will discuss the decomposition of tensor products of regular representations into irreducible constituents of $\mathrm{GL}_2(\mathfrak{o}_r)$. We will also see some results about multiplicities of regular representations in these tensor products.

4. **Stability of Tensor Product of Representations of Classical Groups**

   Speaker: Dibyendu Biswas, IIT Bombay

   Abstract: We will define the notion of stability of tensor product. We will mainly discuss the stability phenomenon for the general linear groups and if time permits, for other classical groups. From an irreducible representation of $\mathrm{GL}(n, \mathbb{C})$ there is a natural way to construct irreducible representations of $\mathrm{GL}(n+1, \mathbb{C})$ by adding a zero at the end of the highest weight $\underline{\lambda} = (\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_n)$ with $\lambda_i \geq 0$ of the irreducible representation of $\mathrm{GL}(n, \mathbb{C})$. We consider the decomposition of tensor products of an irreducible representation of $\mathrm{GL}(n, \mathbb{C})$ and of the corresponding irreducible representations of $\mathrm{GL}(n+1, \mathbb{C})$ and proves a stability result about such tensor products. We will review Pieri's rule for general linear groups in details and similar results for other classical groups. If time permits, I will also discuss about the results of what happens before the stability of tensor products.

5. **On Restriction Problem**

   Speaker: Digjoy Paul, IISc Bangalore

   Abstract: Given an irreducible polynomial representation $W_\lambda(\mathbf{C}^n)$ of the general linear group $\mathrm{GL}_n(\mathbf{C})$, we can restrict it to the symmetric group S_n that seats inside $\mathrm{GL}_n(\mathbf{C})$ as a subgroup. The *restriction coefficient* $r_{\lambda\mu}$ is the multiplicity of the irreducible representation V_μ of S_n in the restriction of $W_\lambda(\mathbf{C}^n)$. To find combinatorial interpretations of the restriction coefficients is a long stand open problem in algebraic combinatorics. We briefly survey how we interpret the restriction coefficient as a *moment* of certain *character polynomials*. Character polynomials have been used to study characters of families of representations of symmetric groups by Macdonald, Garsia, and Goupil and in the context of FI-modules by Church, Ellenberg, and Farb. Finally, we present a combinatorial interpretation of $r_{\lambda\mu}$ when μ is a row/column partition, and λ is a hook/two-column partition. This talk is based on joint works with Narayanan, Prasad, and Srivastava.

6. **On the embedding of finite solvable groups**

   Speaker: Gurleen Kaur, IISER Mohali

   Abstract: A fundamental problem in group algebras is to explicitly determine the algebraic structure of rational group algebras, i.e., the Wedderburn decomposition and complete set of primitive central idempotents. A new direction to this investigation was provided by Olivieri, del Río and Simón, in 2004, when they introduced the notion of Shoda pairs and strongly monomial groups. In a joint work with Bakshi, we introduced the class of generalized strongly monomial groups which is a generalization of strongly monomial groups and provided an explicit description of the complete algebraic structure of rational group algebra for such groups. In this talk, we will see the vastness of the class of generalized strongly monomial groups. Recently, it has been proved that every finite solvable group can be (isomorphically) embedded in some generalized strongly monomial group with the same derived length (fitting length, supersolvable length).

7. **Word maps in finite simple groups and in finite nilpotent groups**

   Speaker: Harish Kishnani, IISER Mohali

   Abstract: Let F_d denote the free group on d letters and $0 \neq w \in F_d$ be a word. For a group G, let G^d denote the group of d-tuples in G. A *word map* $\tilde{w} : G^d \to G$ is the evaluation map of w on these d-tuples. The image of $\tilde{w}$ is denoted by $w(G)$.

   In this talk, I will first discuss some already known results on word maps and some open problems. My focus will be the work of Lubotzky, where he proves that for a finite simple group G, if A ia an automorphism invariant subset containing the identity element then there exists $w \in F_2$ such that $A = w(G)$.

   Then, I will present a work done in collabration with Dr. Amit Kulshrestha and Dr. Dilpreet Kaur in where we have proved that for any nilpotent group G except the abelian groups of prime exponent, there exists a subset $A \subseteq G$ with the following properties

   (a). $1 \in A$.

   (b). A is $\mathrm{Aut}(G)$-*invariant.*

   (c). $A \neq w(G)$ for every word w.

   Further, we classify all such subsets for the class of extraspecial p-groups. In the same article, we have introduced the concept of *d-exhaustive set* for word images and gave a 2-exhaustive set for nilpotent groups of class-2 which turns out to be a minimnal exahustive set for an infinite family of special-p groups.

8. **A certain Twisted Jacquet module of GL(4) over a finite field**

   Speaker: Himanshi Khurana, IISER Bhopal

   Abstract: In the first part of the talk, we will briefly discuss the work of Prasad on the twisted Jacquet module to motivate our problem. In the second part of the talk, we will understand the structure of the twisted Jacquet module $\pi_{N,\psi}$ of an irreducible cuspidal representation π of $G = \mathrm{GL}(4, F)$, where F is a finite field.

9. **The normal complement problem in group algebras of symmetric groups**

   Speaker: Himanshu Setia, IIT Ropar

   Abstract: Let S_n be the symmetric group and A_n be the alternating group on n symbols. In this talk, we have proved that if F is a finite field of characteristic $p > n$, then there does not exist a normal complement of S_n (n is even) and A_n $(n \geq 4)$ in their corresponding unit groups $\mathcal{U}(FS_n)$ and $\mathcal{U}(FA_n)$. Moreover, if F is a finite field of characteristic 3, then A_4 does not have normal complement in the unit group $\mathcal{U}(FA_4)$. This is a joint work with Dr. Manju Khan.

10. **On sum of powers of element orders in finite groups**

    Speaker: Hiranya Kishore Dey, IISc Bangalore

    Abstract: For a finite group G, let $\psi(G)$ denote the sum of element orders of G. This function was introduced by H. Amiri, S. M. Jafarian Amiri, and I. M. Isaacs in 2009 and they proved that for any finite group G of order n, $\psi(G)$ is maximum if and only if $G \simeq \mathbb{Z}_n$ where $\mathbb{Z}_n$ denotes the cyclic group of order n. Furthermore, M. Herzog, P. Longobardi, and M. Maj in 2018 proved that if G is non-cyclic, $\psi(G) \leq \frac{7}{11}\psi(\mathbb{Z}_n)$. S. M. Jafarian Amiri and M. Amiri in 2014 introduced the function $\psi_k(G)$ which is defined as the sum of the k-th powers of element orders of G and they showed that for every positive integer k, $\psi_k(G)$ is also maximum if and only if G is cyclic.

    In this talk, we will at first see that if G is a non-cyclic group of order n, then $\psi_k(G) \leq \dfrac{1 + 3.2^k}{1 + 2.4^k + 2^k}\psi_k(\mathbb{Z}_n)$. Setting $k = 1$ in our result, we immediately get the result of Herzog et al. as a simple corollary. Besides, a recursive formula for $\psi_k(G)$ is also obtained for finite abelian p-groups G, using which one can explicitly find out the exact value of $\psi_k(G)$ for finite abelian groups G. Finally, we prove a new criterion for the solvability of the finite groups, depending on the function $\psi_k(G)$. We show that our result can be used to show the solvability of some groups for which the solvability does not follow from earlier similar kind of results and we emphasize the following: looking at $\psi_k(G)$ for $k > 1$ can be useful to get further pieces of information about the group G.

11. **On Graphs Defined on Groups**

    Speaker: Manideepa Saha, Presidency University

    Abstract: Associating graphs with groups dates back to Arthur Cayley. Cayley graphs play an important role in various fields of mathematics, ranging from geometric group theory to algebraic combinatorics, from representation theory to discrete mathematics, from operator algebras to coding theory. In this talk, we discuss about another such graph defined on groups, called *comaximal subgroup graph* $\Gamma(G)$ of a group G whose vertices are non-trivial proper subgroups of G and two vertices H and K are adjacent if $HK = G$. Though the definition allows the possibility of G to be infinite, in our discussion, we will focus mainly on finite groups. We discuss various graph parameters like diameter, connectedness, girth, bipartiteness etc. Finally, we will highlight some problems on realizability and graph isomorphisms, and some partial solutions to those questions in terms of properties of G.

12. **Dehn quandles of surfaces**

    Speaker: Neeraj Kumar Dhanwani, IISER Mohali

    Abstract: We begin the talk by defining the Dehn quandle of a surface. By analysing the characterization of these quandles, we generalise the construction to arbitrary groups. We discuss generating sets of these quandles, their automorphism groups and their canonical quotients. Returning to surfaces, we discuss relations between the Dehn quandle and the geometry of surfaces. We conclude the talk by discussing approaches to write presentations of these quandles.

13. **Extension and cohomology of Rota-Baxter groups**

    Speaker: Nishant, HRI Prayagraj

    Abstract: The notion of Rota-Baxter groups was recently introduced by Guo, Lang and Sheng [*Adv. Math.* 387 (2021), 107834, 34 pp.] in the geometric study of Rota-Baxter Lie algebras. They are closely related to skew braces as observed by Bardakov and Gubarev. In this talk, we will discuss about different type of cohomologies associated with Rota-Baxter groups and study extensions of Rota-Baxter groups by defining suitable second cohomology group.

14. **The conjugacy problem and other related algorithmic questions in solvable Baumslag Solitar groups**

    Speaker: Oorna Mitra, CMI, Chennai

    Abstract: In this talk, we will introduce some algorithmic problems in groups, namely the twisted conjugacy problem (TCP) and orbit decidability (OD), which are closely related to the classical conjugacy problem (CP) in groups. We will state some new results towards solving the CP in certain extensions of the solvable Baumslag Solitar groups, using a strategy developed by Bogopolski-Martino-Ventura (Orbit decidability and the conjugacy problem for some extensions of groups. Trans. Amer. Math. Soc. 362 (2010), no. 4, 2003–2036), which gives a way of solving CP in certain extensions of a group by solving the TCP in the group. This is based on joint work with Mallika Roy and Enric Ventura.

15. **On the groups whose power graph is P_4-free**

    Speaker: Pallabi Manna, NIT Rourkela

    Abstract: Let G be a group. An undirected power graph, denoted by $P(G)$, of the group G is the graph whose vertices are the elements of the group G and there is an edge between two vertices u and v of G, $u \neq v$, such that either u is a power of v or v is a power of u.

    A graph Γ, is called H-free if it does not contain H as an induced subgraph. In particular, a P_4-free graph is called cograph. We completely identify the nilpotent groups whose power graphs are cograph. We investigate two finite groups G and H, for which power graph of $G \times H$ is a cograph. We show that groups whose power graph is a cograph can be characterized by a condition only involving elements whose orders are prime or the

product of two (possibly equal) primes. For finite simple groups we show that in most of the cases their power graphs are not cographs: the only ones for which the power graphs are cographs are certain groups $PSL(2, q)$ and $Sz(q)$ and the group $PSL(3, 4)$. However, a complete determination of these groups involves some hard number-theoretic problems.

16. **Infinite metacyclic subgroups of the mapping class group**

    Speaker: Pankaj Kapdi, IISER Bhopal

    Abstract: For $g \geq 2$, let $\mathrm{Mod}(S_g)$ be the mapping class group of the closed orientable surface S_g of genus g. In this talk, we will discuss a complete characterization of the infinite metacyclic subgroups of $\mathrm{Mod}(S_g)$ up to conjugacy. In particular, we discuss equivalent conditions under which a pseudo-Anosov mapping class generates a metacyclic subgroup of $\mathrm{Mod}(S_g)$ with another mapping class. As application to our main results, we show the existence of certain infinite metacyclic subgroups of $\mathrm{Mod}(S_g)$ explicitly.

17. **Congruence subgroups of small Coxeter groups**

    Speaker: Pravin Kumar, IISER Mohali

    Abstract: It is a well-known result of Tits that a Coxeter group $W =< S|R >$ of rank n admits a faithful representation $W \to GL(n, \mathbb{R})$. We call a Coxeter system to be small if its Tits representation is integral. Examples of small Coxeter groups include, symmetric groups, universal Coxeter groups and right angled Coxeter groups. Furthermore, two canonical extensions of symmetric groups called twin groups and triplet groups are also small Coxeter groups. These groups can be thought of as planar forms of Artin braid groups, and have deep connection with low dimensional topology. In this talk, we will discuss principal congruence subgroups of small Coxeter groups, with a focus on twin groups and triplet groups. The content of this talk is part of a recent work with Dr. Mahender Singh and Dr. Tushar Kanta Naik.

18. **Commutators and commutator subgroups in finite p-groups**

    Speaker: Rahul Kaushik, IISER Pune

    Abstract: For a finite group G, denote by $\gamma_2(G)$ the commutator subgroup of G and set $K(G) := \{[x, y]|x, y \in G\}$, where $[x, y] = x^{-1}y^{-1}xy$ for $x, y \in G$. Notice that $\gamma_2(G)$ is generated by the set $K(G)$. A very old and well known theme in group theory is to determine whether $\gamma_2(G)$ is equal to $K(G)$ or not for a given group G. As is well known, $K(G) = \gamma_2(G)$ for all finite simple groups G (Ore conjecture, resolved in 2010). The study has also been taken up for many other classes of groups. Our interest here is in the groups of prime power order. It is planned, in this talk, to survey some relevant literature, also to present our work in the same direction. More precisely we'll talk about a characterisation of groups G having 4-generated $\gamma_2(G)$ of order p^4 and groups G of order p^7, p prime, in which $K(G) \neq \gamma_2(G)$.

19. **The Schur Multiplier of finite p-groups of maximal class**

    Speaker: Renu Joshi, IISER Bhopal

Abstract: Let G be a finite group. The Schur multiplier $M(G)$ of G is defined as $H^2(G, \mathbb{C}^*)$, where $\mathbb{C}^*$ is the trivial G-module. For finite groups, several authors have determined the upper bounds of the order, rank, and exponent of $M(G)$. We demonstrated that the Schur multiplier $M(G)$ is an elementary abelian p-group whenever $4 \leq n \leq p+1$ and G is a p-group of maximal class of order p^n. The case $n = p+1$ answers the question raised by Primož Moravec in a research article. This is a joint work with Dr. Siddhartha Sarkar.

20. **Breadth and Breadth type of Nilpotent Lie algebras**

    Speaker: Rijubrata Kundu, IISER Mohali

    Abstract: Classification of finite dimensional nilpotent Lie algebras is an in- teresting and rather unexplored topic in Lie theory. It shares a lot of similarity with that of finite nilpotent groups and in particular p-groups. It is often helpful to understand this general problem by imposing certain stronger conditions on these Lie algebras. In this talk, we will discuss the notion of breadth and breadth-type of nilpotent Lie algebras which are interesting invariants in these directions.

21. **Lambda Number of the enhanced power graph of a finite group**

    Speaker: Sandeep Dalal, NISER Bhubaneswar

    Abstract: The enhanced power graph of a finite group G is the simple undirected graph whose vertex set is G and two distinct vertices x, y are adjacent if $x, y \in \langle z \rangle$ for some $z \in G$. An $L(2,1)$-labeling of a graph Γ is an integer labeling of $V(\Gamma)$ such that adjacent vertices have labels that differ by at least 2 and vertices distance 2 apart have labels that differ by at least 1. The λ-number of Γ, denoted by $\lambda(\Gamma)$, is the minimum range over all $L(2,1)$-labelings. In this talk, we will discuss the lambda number of the enhanced power graph $\mathcal{P}_E(G)$ of the group G. This work extends the corresponding results, obtained in [X. Ma, M. Feng, and K. Wang. Lambda number of the power graph of a finite group. *J. Algebraic Combin.*, 53(3):743–754, 2021], of the lambda number of power graphs to enhanced power graphs. Moreover, for a non-trivial simple group G of order n, we will show that $\lambda(\mathcal{P}_E(G)) = n$ if and only if G is not a cyclic group of order $n \geq 3$. Finally, we will discuss the lambda number of the enhanced power graphs of nilpotent groups.

22. **On the super graphs and reduced super graphs of some finite groups**

    Speaker: Sanjay Mukherjee, NISER Bhubaneswar

    Abstract: For a finite group G, let B be an equivalence (equality, conjugacy or order) relation on G and let A be a (power, enhanced power or commuting) graph with vertex set G. The B super A graph is a simple graph with vertex set G and two vertices are adjacent if either they are in the same B-equivalence class or there are elements in their B-equivalence classes that are adjacent in the original A graph. The graph obtained by deleting the dominant vertices (adjacent to all other vertices) from a B super A graph is called the reduced B super A graph. In this talk, for some pairs of B super A graphs, we will discuss about the finite groups for which a pair of graphs are equal. We also discuss the dominant vertices for the order super commuting graph $\Delta^o(G)$ of G. We will find the

values of n for which the reduced order super commuting graph $\Delta^o(S_n)^*$ of S_n and the reduced order super commuting graph $\Delta^o(A_n)^*$ of A_n are connected. We also prove that if $\Delta^o(S_n)^*$ (or $\Delta^o(A_n)^*$) is connected then the diameter is at most 3 and show that the diameter is 3 for many values of n.

23. **Difference Graphs on Groups**

    Speaker: Sucharita Biswas, Presidency University

    Abstract: The difference graph $D(G)$ of a finite group G is the difference of enhanced power graph of G and power graph of G, with all isolated vertices are removed. In this talk we will discuss the connectedness, diameter and perfectness of $D(G)$ with respect to various properties of the underlying group G.

24. **Local-global principles for norms and product of norms over semi-global fields**

    Speaker: Sumit Chandra Mishra, IISER Mohali

    Abstract: A well-known result of Hasse states that the local-global principle holds for norms over number fields for cyclic extensions. In other words, if L/F is a cyclic extension of number fields then an element $\lambda \in F$ is in the image of norm map $N_{L/F} : L \to F$ if and only if λ is in the image of the norm map locally everywhere i.e., for completions associated to all archimedean and non-archimedean places of F. In this talk, we would consider local-global principles for norms and product of norms over fields which are function fields of curves over complete discretely valued fields, for example, $\mathbb{C}((t))(x)$.

25. **Reversibility of affine transformations**

    Speaker: Tejbir, IISER Mohali

    Abstract: An element of group G is called reversible if it is conjugate to its inverse in G. An element of group G is called strongly reversible if it can be expressed as the product of two involutions in G. It has been a problem of broad interest to classify reversible and strongly reversible elements in a group. The first part of the talk will be based on basic notions, examples, and some known results related to the reversibility problem. The second part of the talk will constitute a recent work with Dr. Krishnendu Gongopadhyay and Dr. Chandan Maity, where we investigated the reversibility problem in the affine group $\mathrm{GL}(n, \mathbb{D}) \ltimes \mathbb{D}^n$, where $\mathbb{D} = \mathbb{R}, \mathbb{C}$, or $\mathbb{H}$.