Vertex Operator Algebras and the Monster

IGOR FRENKEL JAMES LEPOWSKY ARNE MEURMAN

Xiaolong Qi

Vertex Operator Algebras and the Monster Igor Frenkel, James Lepowsky, Arne Meurman, 1989-05-01 This work is motivated by and develops connections between several branches of mathematics and physics the theories of Lie algebras finite groups and modular functions in mathematics and string theory in physics The first part of the book presents a new mathematical theory of vertex operator algebras the algebraic counterpart of two dimensional holomorphic conformal quantum field theory. The remaining part constructs the Monster finite simple group as the automorphism group of a very special vertex operator algebra called the moonshine module because of its relevance to monstrous moonshine.

Introduction to Vertex Operator Algebras and Their Representations James Lepowsky, Haisheng Li, 2012-12-06 Introduces the fundamental theory of vertex operator algebras and its basic techniques and examples Begins with a detailed presentation of the theoretical foundations and proceeds to a range of applications Includes a number of new original results and brings fresh perspective to important works of many other researchers in algebra lie theory representation theory string theory quantum field theory and other areas of math and physics Spinor Construction of Vertex Operator Algebras, Triality, and \$E^{(1)} 8\$ Alex J. Feingold, Igor Frenkel, John F. X. Ries, 1991 The theory of vertex operator algebras is a remarkably rich new mathematical field which captures the algebraic content of conformal field theory in physics Ideas leading up to this theory appeared in physics as part of statistical mechanics and string theory. In mathematics the axiomatic definitions crystallized in the work of Borcherds and in Vertex Operator Algebras and the Monster by Frenkel Lepowsky and Meurman The structure of monodromies of intertwining operators for modules of vertex operator algebras yield braid group representations and leads to natural generalizations of vertex operator algebras such as superalgebras and para algebras Many examples of vertex operator algebras and their generalizations are related to constructions in classical representation theory and shed new light on the classical theory This book accomplishes several goals The authors provide an explicit spinor construction using only Clifford algebras of a vertex operator superalgebra structure on the direct sum of the basic and vector modules for the affine Kac Moody algebra Dn 1 They also review and extend Chevalley's spinor construction of the 24 dimensional commutative nonassociative algebraic structure and triality on the direct sum of the three 8 dimensional D4 modules Vertex operator para algebras introduced and developed independently in this book and by Dong and Lepowsky are related to one dimensional representations of the braid group The authors also provide a unified approach to the Chevalley Greiss and E8 algebras and explain some of their similarities A Third goal is to provide a purely spinor construction of the exceptional affine Lie algebra E8 1 a natural continuation of previous work on spinor and oscillator constructions of the classical affine Lie algebras These constructions should easily extend to include the rest of the exceptional affine Lie algebras The final objective is to develop an inductive technique of construction which could be applied to the Monster vertex operator algebra Directed at mathematicians and physicists this book should be accessible to graduate students with some

background in finite dimensional Lie algebras and their representations Although some experience with affine Kac Moody algebras would be useful a summary of the relevant parts of that theory is included This book shows how the concepts and techniques of Lie theory can be generalized to yield the algebraic structures associated with conformal field theory The careful reader will also gain a detailed knowledge of how the spinor construction of classical triality lifts to the affine algebras and plays an important role in the spinor construction of vertex operator algebras modules and intertwining operators with nontrivial monodromies Vertex Operator Algebras and Related Areas M. J. Bergvelt, Gaywalee Yamskulna, Wenhua Zhao, 2009-10-01 Vertex operator algebras were introduced to mathematics in the work of Richard Borcherds Igor Frenkel James Lepowsky and Arne Meurman as a mathematically rigorous formulation of chiral algebras of two dimensional conformal field theory. The aim was to use vertex operator algebras to explain and prove the remarkable Monstrous Moonshine conjectures in group theory The theory of vertex operator algebras has now grown into a major research area in mathematics These proceedings contain expository lectures and research papers presented during the international conference on Vertex Operator Algebras and Related Areas held at Illinois State University in Normal IL from July 7 to July 11 2008 The main aspects of this conference were connections and interactions of vertex operator algebras with the following areas conformal field theories quantum field theories Hopf algebra infinite dimensional Lie algebras and modular forms This book will be useful for researchers as well as for graduate students in mathematics and physics Its purpose is not only to give an up to date overview of the fields covered by the conference but also to stimulate new directions Vertex Operator Algebras in Mathematics and Physics Stephen Berman, and discoveries by experts in the areas Vertex operator algebras are a class of algebras underlying a number of recent constructions results and themes in mathematics These algebras can be understood as string theoretic analogues of Lie algebras and of commutative associative algebras They play fundamental roles in some of the most active research areas in mathematics and physics Much recent progress in both physics and mathematics has benefited from cross pollination between the physical and mathematical points of view This book presents the proceedings from the workshop Vertex Operator Algebras in Mathematics and Physics held at The Fields Institute It consists of papers based on many of the talks given at the conference by leading experts in the algebraic geometric and physical aspects of vertex operator algebra theory. The book is suitable for graduate students and research mathematicians interested in the major themes and important developments on the frontier of research in vertex operator algebra theory and its applications in mathematics and physics Lie Algebras, Vertex Operator Algebras and Their Applications Yi-Zhi Huang, Kailash C. Misra, 2007 The articles in this book are based on talks given at the international conference Lie algebras vertex operator algebras and their applications The focus of the papers is mainly on Lie algebras quantum groups vertex operator algebras and their applications to number theory combinatorics and conformal field theory

Algebraic Combinatorics and the Monster Group Alexander A. Ivanov, 2023-08-17 The current state of knowledge on

the Monster group including Majorana theory Vertex Operator Algebras Moonshine and maximal subgroups The Monster and Lie Algebras Joseph Ferrar, Koichiro Harada, 2011-06-24 Thisseries is devoted to the publication of monographs lecture resp seminar notes and other materials arising from programs of the OSU Mathemaical Research Institute This includes proceedings of conferences or workshops held at the Institute and other mathematical writings Symposium Proceedings Innovative Teaching Practices Janina Morska, Alan Rogerson, 2023-06-14 This volume contains the papers presented at the International Symposium Innovative Teaching Practices held on August 14 18 2023 in The Queen's College Oxford University The Symposium was organized by The Mathematics Education for the Future Project an international philanthropic project founded in 1986 and dedicated to innovation in mathematics science computer and statistics education Geometric Methods In Theoretical Physics - Proceedings Of The Xx International Conference (In 2 Volumes) Sultan Catto, Alvany Rocha, 1992-01-27 This proceedings reports on some of the most recent advances on the interaction between Differential Geometry and Theoretical Physics a very active and exciting area of contemporary research The papers are grouped into the following four broad categories Geometric Methods Noncommutative Geometry Quantum Gravity and Topological Quantum Field Theory A few of the topics covered are Chern Simons Theory and Generalizations Knot Invariants Models of 2D Gravity Quantum Groups and Strings on Black Holes Algebraic Groups and Their Generalizations: Quantum and Infinite-Dimensional Methods William Joseph Haboush, 1994 Proceedings of a research institute held at Pennsylvania State University July 1991 focusing on quantum and infinite dimensional methods of algebraic groups Topics include perverse sheaves finite Chevalley groups the general theory of algebraic groups representations invariant theory general

Recent Developments in Infinite-Dimensional Lie Algebras and Conformal Field Theory Stephen Berman, 2002
Because of its many applications to mathematics and mathematical physics the representation theory of infinite dimensional
Lie and quantized enveloping algebras comprises an important area of current research This volume includes articles from
the proceedings of an international conference Infinite Dimensional Lie Theory and Conformal Field Theory held at the
University of Virginia Many of the contributors to the volume are prominent researchers in the field Thisconference provided
an opportunity for mathematicians and physicists to interact in an active research area of mutual interest The talks focused
on recent developments in the representation theory of affine quantum affine and extended affine Lie algebras and Lie
superalgebras They also highlightedapplications to conformal field theory integrable and disordered systems Some of the
articles are expository and accessible to a broad readership of mathematicians and physicists interested in this area others
are research articles that are appropriate for more advanced readers

Proceedings on Moonshine and Related Topics
John McKay, 2001 This volume contains the proceedings of the Moonshine workshop held at the Centre de Recherches
Mathematiques CRM in Montreal In this volume all the classical Moonshine themes are presented namely the Monster simple
group and other finite groups automorphic functions and forms and related congruence groups and vertex algebras and their

representations These topics appear in either a pure form or in a blend of algebraic geometry dealing with algebraic surfaces Picard Fuchsequations and hypergeometric functions Recent Developments in Quantum Affine Algebras and Related Topics Naihuan Jing, Kailash C. Misra, 1999 This volume reflects the proceedings of the International Conference on Representations of Affine and Quantum Affine Algebras and Their Applications held at North Carolina State University Raleigh In recent years the theory of affine and quantum affine Lie algebras has become an important area of mathematical research with numerous applications in other areas of mathematics and physics Three areas of recent progress are the focus of this volume affine and quantum affine algebras and their generalizations vertex operator algebras and their representations and applications in combinatorics and statistical mechanics Talks given by leading international experts at the conference offered both overviews on the subjects and current research results. The book nicely presents the interplay of these topics recently occupying centre stage in the theory of infinite dimensional Lie theory The Gelfand Mathematical Seminars, 1990-1992 L. Corwin, I.M. Gelfand, J. Lepowsky, 2012-12-06 This Seminar began in Moscow in November 1943 and has continued without interruption up to the present We are happy that with this volume Birkhiiuser has begun to publish papers of talks from the Seminar It was unfortunately difficult to organize their publication before 1990 Since 1990 most of the talks have taken place at Rutgers University in New Brunswick New Jersey Parallel seminars were also held in Moscow and during July 1992 at IRES in Bures sur Yvette France Speakers were invited to submit papers in their own style and to elaborate on what they discussed in the Seminar We hope that readers will find the diversity of styles appealing and recognize that to some extent this reflects the diversity of styles in a mathematical society. The principal aim was to have interesting talks even if the topic was not especially popular at the time The papers listed in the Table of Contents reflect some of the rich variety of ideas presented in the Seminar Not all the speakers submit ted papers Among the interesting talks that influenced the seminar in an important way let us mention for example that of R Langlands on per colation theory and those of J Conway and J McKay on sporadic groups In addition there were many extemporaneous talks as well as short discus sions Annihilating Fields of Standard Modules of \$\mathfrak \{s\}\(2, \mathbb \{C\})^\sim \\$ and Combinatorial Identities Arne Meurman, Mirko Primc, 1999 In this volume the authors show that a set of local admissible fields generates a vertex algebra For an affine Lie algebra tilde frak g they construct the corresponding level k vertex operator algebra and show that level k highest weight tilde frak g modules are modules for this vertex operator algebra. They determine the set of annihilating fields of level k standard modules and study the corresponding loop tilde frak g module the set of relations that defines standard modules In the case when tilde frak g is of type A 1 1 they construct bases of standard modules parameterized by colored partitions and as a consequence obtain a series of Rogers Ramanujan type combinatorial identities

Facets of Algebraic Geometry: Volume 1 Paolo Aluffi, David Anderson, Milena Hering, Mircea Mustață, Sam Payne, 2022-04-07 Written to honor the 80th birthday of William Fulton the articles collected in this volume the first of a pair

present substantial contributions to algebraic geometry and related fields with an emphasis on combinatorial algebraic geometry and intersection theory Featured topics include commutative algebra moduli spaces quantum cohomology representation theory Schubert calculus and toric and tropical geometry. The range of these contributions is a testament to the breadth and depth of Fulton's mathematical influence. The authors are all internationally recognized experts and include well established researchers as well as rising stars of a new generation of mathematicians. The text aims to stimulate progress and provide inspiration to graduate students and researchers in the field Differential and Difference Equations with Applications Sandra Pinelas, Tomás Caraballo, Peter Kloeden, John R. Graef, 2018-05-08 This book gathers papers from the International Conference on Differential Difference Equations and Applications 2017 ICDDEA 2017 held in Lisbon Portugal on June 5 9 2017 The editors have compiled the strongest research presented at the conference providing readers with valuable insights into new trends in the field as well as applications and high level survey results The goal of the ICDDEA was to promote fruitful collaborations between researchers in the fields of differential and difference equations All areas of differential and difference equations are represented with a special emphasis on applications Group Theory and Computation N.S. Narasimha Sastry, Manoj Kumar Yadav, 2018-09-21 This book is a blend of recent developments in theoretical and computational aspects of group theory. It presents the state of the art research topics in different aspects of group theory namely character theory representation theory integral group rings the Monster simple group computational algorithms and methods on finite groups finite loops periodic groups Camina groups and generalizations automorphisms and non abelian tensor product of groups Presenting a collection of invited articles by some of the leading and highly active researchers in the theory of finite groups and their representations and the Monster group with a focus on computational aspects this book is of particular interest to researchers in the area of group theory and related fields of mathematics

"Moonshine" of Finite Groups Koichiro Harada,2010 This is an almost verbatim reproduction of the author's lecture notes written in 1983 84 at Ohio State University Columbus A substantial update is given in the bibliography Over the last 20 plus years there has been energetic activity in the field of finite simple group theory related to the monster simple group Most notably influential works have been produced in the theory of vertex operator algebras from research that was stimulated by the moonshine of the finite groups Still we can ask the same questions now that we did 30 40 years ago What is the monster simple group Is it really related to the theory of the universe as it was vaguely so envisioned What lies behind the moonshine phenomena of the monster group It may appear that we have only scratched the surface These notes are primarily reproduced for the benefit of readers who wish to start learning about modular functions used in moonshine

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