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           563

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Page 2

The launch of this Advanced Lectures in Mathematics series is aimed at keeping mathematicians informed of the latest developments in mathematics as well as toaid in the learning of new mathematical topics by students all over the world. Each volume consists of either an expository monograph or a collection of signify cant introductions to important topics This series emphasizes the history and sources of motivation for the topics under discussion and also gives an overview of the current status of research in each particular field. These volumes are the first source to which people will turn in order to learn new subjects and to dis cover the latest results of many cutting-edge fields in mathematics. This book contains many substantial papers from distinguished speakers of a conference " Geometric Analysis Present and Future" and an overview of the works of Professor Shing-Tung Yau. Contributors include E. Witten Y.T. Siu R. Hamilton H. Hitchin B. Lawson A. Strominger C. Vafa W. Schmid V. Guillemin N. Mok D. Christodoulou. This is a valuable reference that gives an up-to-dated summary of geometric analysis and its applications in many different areas of mathematics.

Part 3 Mathematical Physics Algebraic Geometry and Other Topics The Coherent-Constructible Correspondence and Homological Mirror Symmetry for Toric Varieties Bohan Fang Chiu-Chu Melissa Liu David Treumann and Eric Zaslow. 1 Introduction 1. 1 Outline 2 Mirror symmetry for toric manifolds 2. 1 Hori-Vafa mirror 2.2 Categories in mirror symmetry 2.3 Results to date 3 T-duality 3.1 Moment polytope 3.2 Geometry of the open orbit 3.3 Statement of symplectic results 3.4 T-dual of an equivariant line bundle 4 Microlocalization 4.1 Algebraic preliminaries 4.2 The cast of categories 4.3 Fukaya-Oh theorem 4.4 Building the equivalence 4.5 Equivalence and the inverse functor 4.6 Singular support and characteristic cycles 4.7 Comments on technicalities 4.8 Statement of results 5 Coherent-constructible correspondence 6 Examples 6.1 Taking the mapping cone 6.2 Toric Fano surfaces 6.3 Hirzebruch surfaces References Superspace a Comfortably Vast Algebraic Variety T. Hübsch 1 Introduction 1.1 Basic ideas and definitions 1.2 The traditional superspace 2 Off-shell worldline supermultiplets 2.1 Adinkraic supermultiplets 2.2 Various hangings 2.3 Projected supermultiplets 2.4 Supermultiplets vs. superfields 3 Superspace by construction 3.1 Superpartners of time 3.2 A telescoping deformation structure 3.3 Nontrivial superspace geometry 3.4 Higher-dimensional spacetime 4 The comfortably vast superspace References A Report on the Yau-Zaslow Formula Naichung Conan Leung 1 Yau-Zaslow formula and its generalizations 2 Yau-Zaslow approach 3 Matching method 4 Degeneration method 5 Calabi-Yau threefold method 6 Conclusions References Hermitian-Yang-Mills Connections on Kahler Manifolds Jun Li 1 Introduction 1.1 Hermitian-Yang-Mills connections 1.2 HYM connections lead to stable bundles 1.3 Stable bundles and their moduli spaces 1.4 Flat bundles and stable bundles on curves 2 Donaldson-Uhlenbeck-Yau theorem 2.1 Donaldsons proof for algebraic surfaces 2.2 Uhlenbeck-Yaus proof for Kahler manifolds 3 Hermitian-Yang-Mills connections on curves 4 Hermitian-Yang-Mills connections on surfaces 4.1 Extending DUY correspondence 4.2 Stable topology of the moduli spaces 4.3 Donaldson polynomial invariants 5 HYM connections on high dimensional varieties 5.1 Extending the DUY correspondence in high dimensions 5.2 Donaldson-Thomas invariants 6 Concluding remark References ~ Additivity and Relative Kodaira Dimensions Tian-Jun Li and Weiyi Zhang 1 Introduction 2 Kodaira Dimensions and fiber bundles 2.1 h for complex manifolds and up to dimension 3 2.2 Ks for symplectic 4~manifolds 2.3 Additivity for a fiber bundle 3 Embedded symplectic surfaces and relative Kod. dim. in dim. 4 3.1 Embedded symplectic surfaces and maxinmlity 3.2 The adjoint class 3.3 Existence and Uniqueness of relatively minimal model 3.4 M w F) 4 Relative Kod. dim. in dim. 2 and fibrations over a surface 4.1 F D) Riemann-Hurwitz formula and Seifert fibrations... 4.2 Lefschetz fibrations References Descendent Integrals and Tautological Rings of Moduli Spaces of Curves Kefeng Liu and Hao Xu 1 Introduction 2 Intersection numbers and the Witten-Kontsevich theorem 2.1 Witten-Kontsevich theorem 2.2 Virasoro constraints 3 The n-point function 3.1 A recursive formula of n-point functions 3.2 An effective recursion formulae of descendent integrals 4 Hodge integrals 4.1 Fabers algorithm 4.2 Hodge integral formulae 5 Higher Weil-Petersson volumes 5.1 Generalization of Mirzakhanis recursion formula 5.2 Recursion formulae of higher Weil-Petersson volumes 6 Fabers conjecture on tautological rings 6.1 The Faber intersection number conjecture 6.2 Relations with n-point functions 7 Dimension of tautological rings 7.1 Ramanujans mock theta functions 7.2 Asymptotics of tautological dimensions 8 Gromov-Witten invariants 8.1 Universal equations of Gromov-Witten invariants 8.2 Some vanishing identities 9 Wittens r-spin numbers 9.1 Generalized Wittens conjecture 9.2 An algorithm for computing Wittens r-spin numbers References A General Voronoi Summation Formula for GL n Z) Stephen D. Miller and Wilfried Schmid 1 Introduction 2 Automorphic Distributions 3 Vanishing to infinite order 4 Classical proof of the formula 5 Adelic proof of the formula References Geometry of Holomorphic Isometries and Related Maps between Bounded Domains Ngaiming Mok 1 Examples of holomorphic isometries 1.1 Examples of equivariant embeddings into the projective space 1.2 Non-standard holomorphic isometries of the Poincardisk into polydisks 1.3 A non-standard holomorphic isometry of the Poincardisk into a Siegel upper half-plane 1.4 Examples of holomorphic isometries with arbitrary normalizing constants A > 1 2 Analytic continuation of germs of holomorphic isometries 2.1 Analytic continuation of holomorphic isometries into the projective space equipped with the Fubini-Study metric 2.2 An

extension and rigidity problem arising from commutators of modular correspondences2.3 Analytic continuation of holomorphic isometries up tonormalizing constants with respect to the Bergmanmetric - extension beyond the boundary2.4 Canonically embeddable Bergman manifolds andBergman meromorphic compactifications3 Holomorphic isometries of the Poincar disk intobounded symmetric domains3.1 Structural equations on the norm of the secondfundamental form and asymptotic vanishing order3.2 Holomorphic isometries of the Poincar disk intopolydisks structural results3.3 Calculated examples on the norm of the secondfundamental form3.4 Holomorphic isometries of the Poincar5 disk intopolydisks uniqueness results3.5 Asymptotic total geodesy and applications4 Measure-preserving algebraic correspondences on irreduciblebounded symmetric domains4.1 Statements of results4.2 Extension results on strictly pseudoconvexalgebraic hypersurfaces4.3 Alexander-type extension results in the higher-rank case 4.4 Total geodesy of germs of measure-preserving holomorphie

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