Albrecht Klemm

Academic career

1987	Diploma, University of Mainz
1990	PhD, University of Heidelberg
1990 - 1993	Research Fellow, LMU and TU Munich
1993 - 1994	Research Fellow, Harvard University, Cambridge, MA, USA
1994 - 1996	Research Fellow, CERN TH-Division, Geneva, Switzerland
1996 - 1998	Research Fellow, Enrico Fermi Institute, Chicago, IL, USA
1998	Habilitation, LMU Munich
1998 - 2000	Heisenberg Fellow, Institute for Advanced Study, Princeton, NJ, USA
2000 - 2003	Professor (C3), HU Berlin
2003 - 2006	Associate Professor, University of Madison, WI, USA
2006 - 2007	Professor, University of Madison, WI, USA
Since 2007	Professor (W3), University of Bonn

Honours

1998 - 2001	Heisenberg Fellow, IAS, Princeton, NJ, USA
2006	Andrejewski Lecturer, Berlin and Potsdam
2006	Simons Professor, Berkeley, CA, USA
2011	Guest Professor, École Normale Supérieure, Paris, France
2014	Frederick W. and Lois B. Gehring Visiting Professor, LSA Mathematics, University of Michigan, Ann Arbor, MI, USA
2017	Visiting Professor, École Normale Supérieure, Paris, France
2018	Visiting Professor, MSRI, Berkeley, CA, USA

Offers

2003	University of Colorado, Boulder, CO, USA

Invited Lectures

2009	Minicourse “The Topological Vertex and its Applications”, Instituto Superior Técnico, Lisbon, Portugal
2009	Minicourse “Direct Integration in Topological String Theory”, Workshop on “Geometry and Physics”, Chendgu, China
2010	Minicourse “Topological Strings, Modularity and non-perturbative Physics”, Erwin Schroedinger Institute, Vienna, Austria
2011	Minicourse “Topological Gauge and String theories”, ENS Paris, France
2011	“Direct integration in General Omega Backgrounds”, Banff, AB, Canada
2011	String-Math, Philadelphia, PA, USA
2014	String-Math, Edmonton, AB, Canada
2015	“Topological string on elliptic CY 3-folds and the ring of weak Jacobi forms”, in “Motivic invariants related to K3 and abelian geometries”, Berlin
2015	“Elliptically fibred Calabi-Yau and the ring of weak Jacobi Forms”, in Workshop of “Moduli Spaces in algebraic Geometry and Physics”, Tianjin, China
2016	“F-theory at 20”, California Institute of Technology, CA, USA
2016	“Jacobi Forms and Curve Counting”, at the Workshop “Curves on surfaces and 3-folds”, Centre Interfacultaire Bernoulli CIB Lausanne, Switzerland
2016	“Topological String and Jacobi Forms”, Workshop on “Geometric Correspondence of Gauge Theories”, Trieste, Italy

Research Projects and Activities

DFG Project KL2271/1-1: “Exakte Methoden in Eich- und String-Theorien”
Bethe Center for Theoretical Physics
Member
DFG Cluster of Excellence “Hausdorff Center for Mathematics”
Principal Investigator

Research profile

Super String Theory is a mayor attempt to unify gauge theories with quantum gravity. Compactifications of string theory on varieties with special holonomy including calibrated submanifolds leads to quantum theories in various dimensions. Mathematical well defined sub-sectors of these theories are the topological string- and field theories. Their correlators determine topological invariants of the geometric setting. Often are different physical formulations with different manifest symmetries and duality symmetries among them available. Based on these we extended the methods to calculate the correlators exactly, such as mirror symmetry, the string/gauge theory correspondence, the modular– and the integrable system approach. In particular using the string/gauge theory correspondence we provided with the topological vertex and the topological recursions two major tools, which are widely in use. We used mirror symmetry and the modular approach to obtain high genus amplitudes on compact Calabi-Yau spaces and showed that the all genus topological string amplitudes on elliptically fibred Calabi-Yau spaces can be expressed in terms of meromorphic Jacobi forms.

Editorships

• Zeitschrift für Naturforschung A

Research Area C A relation between the modular anomaly of topological string theory on elliptic Calabi-Yau spaces and the chiral anomaly of certain six dimensional superconformal theories was discovered recently [7, 5, 6, 1]. As was shown in the eighties, six is the maximal dimension in which these remarkable superconformal symmetries can be realized in quantum theories. The theories are self dual, couple to string degrees of freedom, do not admit a Langrangian description and stayed therefore elusive despite the potential to obtain a classification of lower dimensional theories by dimensional reduction. With the new techniques in topological string theory one can obtain information of their spectrum of BPS states [4]. Another application of the refined topological string that we pursue is the study of non-perturbative effects in quantum systems using resurgence. On the geometrical side our group investigates more generally

the effective action of four dimensional field theories obtained by dimensional reduction of maximal supersymmetric theories on special holonomy manifolds or manifolds with G-structures. Currently under investigation is a promising class of manifolds with G2 holonomy obtained using the twisted gluing construction proposed by Kovalev.

Supervised theses

Master theses: 5, currently 2
Diplom theses: 4
PhD theses: 12, currently 8

Selected PhD students

Babak Haghighat (2009): “On Topological String Theory with Calabi-Yau Backgrounds”,
now Postdoc, Harvard University, MA, USA
Denis Klevers (2011): “Holomorphic Couplings In Non-Perturbative String Compactifications”,
now Fellow, CERN, Theoretical Physics Department, Switzerland
Jie Gu (2014): “Braiding knots with topological Strings”,
now Postdoc, LPTHE ENS Paris, France

Habilitations

Ralph Blumenhagen (2002), now Permanent Staff Member, Max Planck Institute for Physics, Munich

Selected publications

[1] Jie Gu, Min-xin Huang, Amir-Kian Kashani-Poor, and Albrecht Klemm. Refined bps invariants of 6d scfts from anomalies and modularity. *J. High Energy Phys.*, (5):130, front matter+61, 2017.

[2] S. Katz, A. Klemm, and R. Pandharipande. On the motivic stable pairs invariants of k3 surfaces. In *K3 surfaces and their moduli*, volume 315 of *Progr. Math.*, pages 111–146. Birkhäuser/Springer, [Cham], 2016. With an appendix by R. P. Thomas.

[3] Jie Gu, Hans Jockers, Albrecht Klemm, and Masoud Soroush. Knot invariants from topological recursion on augmentation varieties. *Comm. Math. Phys.*, 336(2):987–1051, 2015.

[4] Jie Gu, Albrecht Klemm, Marcos Mariño, and Jonas Reuter. Exact solutions to quantum spectral curves by topological string theory. *J. High Energy Phys.*, (10):025, front matter+68, 2015.

[5] Babak Haghighat, Albrecht Klemm, Guglielmo Lockhart, and Cumrun Vafa. Strings of minimal 6d scfts. *Fortschr. Phys.*, 63(5):294–322, 2015.

[6] Min-xin Huang, Sheldon Katz, and Albrecht Klemm. Elliptically fibered calabi-yau manifolds and the ring of jacobi forms. *Nuclear Phys. B*, 898:681–692, 2015.

[7] Min-xin Huang, Sheldon Katz, and Albrecht Klemm. Topological string on elliptic cy 3-folds and the ring of jacobi forms. *J. High Energy Phys.*, (10):125, front matter+78, 2015.

[8] Vincent Bouchard, Albrecht Klemm, Marcos Mariño, and Sara Pasquetti. Topological open strings on orbifolds. *Comm. Math. Phys.*, 296(3):589–623, 2010.

[9] A. Klemm, D. Maulik, R. Pandharipande, and E. Scheidegger. Noether-lefschetz theory and the yau-zaslow conjecture. *J. Amer. Math. Soc.*, 23(4):1013–1040, 2010.

[10] M.-x. Huang, A. Klemm, and S. Quackenbush. Topological string theory on compact calabi-yau: modularity and boundary conditions. In *Homological mirror symmetry*, volume 757 of *Lecture Notes in Phys.*, pages 45–102. Springer, Berlin, 2009.

[11] Mina Aganagic, Albrecht Klemm, Marcos Mariño, and Cumrun Vafa. The topological vertex. *Comm. Math. Phys.*, 254(2):425–478, 2005.

[12] Kentaro Hori, Sheldon Katz, Albrecht Klemm, Rahul Pandharipande, Richard Thomas, Cumrun Vafa, Ravi Vakil, and Eric Zaslow. *Mirror symmetry*, volume 1 of *Clay Mathematics Monographs*. American Mathematical Society, Providence, RI; Clay Mathematics Institute, Cambridge, MA, 2003. With a preface by Vafa.