Curriculum Vitae

Volker Friedrich Braun

Personal

Last Name:	BRAUN
First Name:	Volker Friedrich
Date of Birth:	10. July 1975
Place of Birth:	Bamberg, Germany
Nationality:	German
Marital Status:	Single
Languages:	German (native language) English (fluent) Français (courant)
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Education

2003–now	PostDoc at the University of Pennsylvania in Philadelphia, joint appointment by the Department of Mathematics and Department of Physics. Contract duration is 3 years.
2004	Participated in the Oberwolfach Workshop "String-Theorie und Geometrie"
2003	Participated in the Les Houches Winter School "Frontières entre Théorie des Nombres, Physique et Géométrie" and the KITP miniprogram "Geometry, Topology and Strings" (Santa Barbara).
2002–2003	Chercheur Associé (PostDoc) at the École Normale Supérieure in Paris. Proposed duration was 2 years, but I accepted UPenn's offer after 1 year.
24.07.2002	Ph.D., Humboldt-University Berlin Thesis advisor: Prof. D. Lüst Title: K-Theory and Exceptional Holonomy in String Theory
2001–2002	Participated in the Les Houches Summer School "Unity from Duality: Gravity, Gauge theory and Strings", the IAS/PCMI Summer School "Quantum Field Theory, Supersymmetry, and Enumerative Geometry", and the Clay Mathematics Institute/Isaak Newton Institute "School on Geometry and String Theory" (Cambridge).
19.12.1998	Master of Arts, University of Texas at Austin Thesis advisor: Prof. P. Candelas Title: The Moricone of a Calabi-Yau space from toric geometry
1997–1998	Studied physics at the University of Texas at Austin.
1994–1997	Studied physics at the University of Würzburg.

List of Publications

Volker Braun, Sakura Schäfer-Nameki:
D-Brane Charges in Gepner Models,
hep-th/0511100

Volker Braun, Yang-Hui He, Burt A. Ovrut, Tony Pantev:
Moduli Dependent μ-Terms in a Heterotic Standard Model,
hep-th/0510142

Volker Braun:
Computations of Some K-groups,
to appear in the Oberwolfach Reports 2005

Volker Braun, Yang-Hui He, Burt A. Ovrut, Tony Pantev:
Heterotic Standard Model Moduli,
hep-th/0509051

Volker Braun, Yang-Hui He, Burt A. Ovrut, Tony Pantev:
Vector Bundle Extensions, Sheaf Cohomology, and the Heterotic Standard Model,
hep-th/0505041

Volker Braun, Yang-Hui He, Burt A. Ovrut, Tony Pantev:
A Standard Model from the $E_8 \times E_8$ Heterotic Superstring,
JHEP 0506 **(2005)** 039, hep-th/0502155

Volker Braun, Yang-Hui He, Burt A. Ovrut, Tony Pantev:
A Heterotic Standard Model,
Phys.Lett. B618 **(2005)** 252-258, hep-th/0501070

Volker Braun, Burt A. Ovrut, Tony Pantev, René Reinbacher:
Elliptic Calabi-Yau Threefolds with $\mathbb{Z}_3 \times \mathbb{Z}_3$ Wilson Lines,
JHEP 0412 **(2004)** 062, hep-th/0410055

Volker Braun, Sakura Schäfer-Nameki:
Minimal Models and K-theory,
Oberwolfach Reports 2004

Volker Braun, Sakura Schäfer-Nameki:
Supersymmetric WZW Models and Twisted K-Theory of $SO(3)$,
hep-th/0403287

Volker Braun:
Twisted K-Theory of Lie Groups,
JHEP 0403 **2004** 029, hep-th/0305178

Volker Braun:
On Berenstein-Douglas-Seiberg Duality,
JHEP 0301 **(2003)** 082, hep-th/0211173

Ralph Blumenhagen, Volker Braun, Boris Körs, Dieter Lüst:
The Standard Model on the Quintic,
hep-th/0210083

Volker Braun, Bogdan Stefański, jr:
Orientifolds and K-Theory,
hep-th/0206158

Ralph Blumenhagen, Volker Braun, Boris Körs, Dieter Lüst:
Orientifolds of K3 and Calabi-Yau Manifolds with Intersecting D-branes,
JHEP 0207 **(2002)** 026, hep-th/0206038

Ralph Blumenhagen, Volker Braun:
Superconformal Field Theories for Compact Manifolds with $Spin(7)$ Holonomy,
JHEP 0112 **(2001)** 013, hep-th/0111048

Ralph Blumenhagen, Volker Braun:
Superconformal Field Theories for Compact G_2 Manifolds,
JHEP 0112 **(2001)** 006, hep-th/0110232

Ralph Blumenhagen, Volker Braun, Robert Helling:
Bound States of D(2p)-D0 Systems and Supersymmetric p-Cycles,
Phys. Lett. B510 **(2001)** 311–319, hep-th/0012157

Volker Braun:
K-Theory Torsion,
hep-th/0005103

Volker Braun, Philip Candelas, Xenia de la Ossa, Antonella Grassi:
Toric Calabi-Yau Fourfolds, Duality Between N=1 Theories and Divisors that Contribute to the Superpotential,
hep-th/0001208

Volker Braun, Chien-Hao Liu:
On extremal transitions of Calabi-Yau threefolds and the singularity of the associated 7-space from rolling,
hep-th/9801175

Teaching Experience

Fall 2004 Math 104 (Calculus) at the University of Pennsylvania

Fall 2003 Math 104 (Calculus) at the University of Pennsylvania

Research Interests

String theory is currently our best candidate for the fundamental theory of interactions. Although it has a number of desirable features, there remains a basic problem to make contact with particle physics: string theory predicts 10-dimensional spacetime. This necessity turned out to lead to many important insights into physics and mathematics. For example, it led to Mirror Symmetry, which is one of the most celebrated results of the theory so far.

My research is centered around a better understanding of the interplay between this geometry and newer results in string theory, like D-branes.

Heterotic $N = 1$ Compactifications

Understanding compactifications with $N = 1$ supersymmetry is one of the top priorities today. Most model building efforts are based on Type II orientifolds, however to use this approach on general Calabi-Yau manifolds one would need to know more about supersymmetric cycles than what is available today. More to the point, the lack of a deformation theory of special Lagrangian cycles is a severe problem.

One way to overcome this obstacle is to work in a different string theory, the heterotic string. Within this framework the aforementioned problem translates to finding stable holomorphic vector bundles. While still difficult, this is now mathematically well under control.

In particular during the last year, I have constructed examples of Calabi-Yau manifolds with suitable E_8 gauge bundles that come very close to phenomenologically viable low energy physics. Especially demanding a realistic Higgs sector is rather restrictive for the model. It would be very interesting to further investigate this and maybe find general patterns for the Higgs sector in string compactifications. This is all the more pressing since we can expect experimental data on the Higgs particle around 2007.

In addition, I hope that it will shed light on the general "landscape of string theory". Maybe using statistical tools, I would like to investigate generic properties of heterotic compactifications. So far, this has only been

done for simple type II compactifications.

K-Theory and D-Branes

K-theory is a generalized cohomology theory that naturally incorporates anomaly cancellation conditions for D-branes. Furthermore Sen's conjecture that every D-brane can be generated as the decay product of spacetime filling D-branes is literally a concrete realisation of K-theory, so there is little doubt that it is the correct description of D-brane charges.

For Type II string theory the implications are now quite well understood. For WZW models and cosets the situation is also fairly clear, in part due to my computation of the twisted K-theory of Lie groups. However, there still are unanswered questions. For example, orientifolds of compact Calabi-Yau manifolds are still somewhat undeveloped, both from the CFT and K-theory point of view.

The cosets are one way to realize $N = 2$ minimal models. Another way are Landau-Ginzburg models, for which there is a very explicit description of the D-branes as a certain category of matrix factorizations. Using the K-theory of the D-brane category, one can differentiate between otherwise indistinguishable CFTs. This provides as nice resolution to the apparent paradox of whether or not minimal models have torsion charged D-branes.

With this improved understanding of minimal models, I want to better understand Gepner models in the future. I am trying to find a way to describe their D-brane category well enough so that we can compute the torsion invariants of its K-theory. Especially I would like to see a description which does not involve an abstract A_∞-deformation of another category (the latter being the gauged linear sigma model). This will yield a better understanding of the Gepner models and their possible description as non-linear sigma models.