

# Eckhard Meinrenken

## University Address:

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## Degrees

Ph.D. (Physics), *summa cum laude*, December 1994, Albert-Ludwig Universität Freiburg.  
Title: *Vielfachheitsformeln für die Quantisierung von Phasenräumen.*

## Employment

**University of Toronto**, July '04 – present. Professor.  
**University of Toronto**, July '00 – June '04. Associate Professor.  
**University of Toronto**, January '98 – July '00. Assistant Professor.  
**Massachusetts Institute of Technology**, February '95 – December '97. Pure Mathematics Instructor/ Postdoctoral Research Fellow.  
**Massachusetts Institute of Technology**, September '93 – July '94. Visiting Scholar at the M.I.T. Mathematics Department.

## Research interests

Symplectic Geometry, Lie Theory, Mathematical Physics.

## Honors

Fellowship of the Royal Society of Canada, 2008  
NSERC Steacie Fellowship, 2007  
McLean Award, 2003  
Invited speaker, ICM 2002 Beijing  
Andre Aisenstadt Prize, 2001  
Premier Research Excellence Award, 2000  
Invited speaker, “50th Anniversary of Postdoctoral Instructorship ”, 1999 M.I.T., Cambridge  
Invited speaker, Chern Symposium 1998 Berkeley

## Research articles

- (1) E. Meinrenken: Semiclassical principal symbols and Gutzwiller's trace formula. *Rep. Math. Phys.* **31** (1992), 279-295.
- (2) E. Meinrenken: Trace formulas and the Conley-Zehnder index. *Journal of Geometry and Physics* **13** (1994), 1-15.
- (3) E. Meinrenken: Coherent states and classical limits. *Journal of Physics A* **27** (1994), 3257-3265.
- (4) M. Bordemann, E. Meinrenken, M. Schlichenmaier: Toeplitz quantization of Kähler manifolds. *Communications in Mathematical Physics* **165** (1994), 281-296.
- (5) E. Meinrenken: On Riemann-Roch formulas for multiplicities. *Journal of the American Mathematical Society* **9** (1996), 373-390.
- (6) H. Duistermaat, V. Guillemin, E. Meinrenken, S. Wu: Symplectic reduction and Riemann-Roch for circle actions. *Mathematical Research Letters* **2** (1995), 259-266.
- (7) E. Meinrenken: Symplectic surgery and the Spin-c Dirac operator. *Advances in Mathematics* **134** (1998), 240-277.
- (8) E. Lerman, E. Meinrenken, S. Tolman, C. Woodward: Non-abelian convexity by symplectic cuts. *Topology* **37** (1998), 245-259.
- (9) E. Meinrenken, R. Sjamaar: Singular reduction and quantization. *Topology* **38** (1999), 699-763.
- (10) E. Meinrenken, C. Woodward: Moduli spaces of flat connections on 2-manifolds, cobordism, and Witten's volume formulas. *Advances in geometry*, 271-295, *Progr. Math.* **172**, Birkhäuser Boston, Boston, MA, 1999.
- (11) A. Alekseev, A. Malkin, E. Meinrenken: Lie group valued moment maps. *Journal of Differential Geometry* **48** (1998), 445-495.
- (12) E. Meinrenken, C. Woodward: "Cobordism for Hamiltonian loop group actions and flat connections on the punctured two-sphere". *Mathematische Zeitschrift* **231** (1999), 133-168.
- (13) E. Meinrenken, C. Woodward: Hamiltonian loop group actions and Verlinde factorization, *Journal of Differential Geometry* **50** (1999), 417-470.
- (14) A. Alekseev, E. Meinrenken: An elementary derivation of certain classical dynamical r-matrices. *Advances in the Mathematical Sciences* **201**, L. D. Faddeev's Seminar on Mathematical Physics. A.M.S., 2000.
- (15) E. Meinrenken, C. Woodward: Canonical bundles for Hamiltonian loop group manifolds. *Pacific Journal of Mathematics* **198** (2001), 477-489.
- (16) A. Alekseev, E. Meinrenken: The non-commutative Weil algebra. *Inventiones Mathematicae* **139** (2000), 135-172.
- (17) A. Alekseev, E. Meinrenken, C. Woodward: Group-valued equivariant localization. *Inventiones Mathematicae* **140** (2000), 327-350.
- (18) A. Alekseev, E. Meinrenken, C. Woodward: The Verlinde formulas as fixed point formulas, *Journal of Symplectic Geometry*, **1** (2001), 1-46.
- (19) A. Alekseev, E. Meinrenken, C. Woodward: Duistermaat-Heckman measures and moduli spaces of flat bundles over surfaces. *Geometric and Functional Analysis (GAFA)*, **12** (2002), 1-31.
- (20) A. Alekseev, Y. Kosmann-Schwarzbach, E. Meinrenken: Quasi-Poisson manifolds. *Canadian Journal of Mathematics* **54** (2002), 3-29.
- (21) A. Alekseev, E. Meinrenken, C. Woodward: Linearization of Poisson actions and singular values of matrix products. *Annales de l'Institut Fourier*, **51** (2001), 1691-1717.
- (22) A. Alekseev, E. Meinrenken: Poisson Geometry and the Kashiwara-Vergne conjecture. *C. R. Acad. Sci. Paris*, **335** (2002), 723-728.

- (23) E. Meinrenken: The basic gerbe over a compact simple Lie group. *L'Enseignement Mathématique*, **49** (2003), 307–333.
- (24) A. Alekseev, E. Meinrenken: Clifford algebras and the classical dynamical Yang-Baxter equation. *Math. Res. Lett.* **10** (2003), no. 2-3, 253–268.
- (25) A. Alekseev, E. Meinrenken: Lie theory and the Chern-Weil homomorphism. *Ann. Sci. Ecole Norm. Sup.*, **38**, (2005), 303–338.
- (26) E. Meinrenken: A proof of Witten's formulas for intersection pairings on moduli spaces of flat connections. *Advances in Mathematics*, **197** (1) (2005), 140–197.
- (27) A. Alekseev, E. Meinrenken: Equivariant cohomology and the Maurer-Cartan equation. *Duke Mathematical Journal* **130** (3) (2005), 479–522
- (28) A. Alekseev, E. Meinrenken: On the Kashiwara-Vergne conjecture. *Inventiones Mathematicae* **164** (2006), 615–634.
- (29) A. Alekseev, E. Meinrenken: Ginzburg-Weinstein via Gelfand-Zeitlin. *Journal of Differential Geometry* **76** (2007), 1–34.
- (30) E. Meinrenken: Lectures on pure spinors and moment maps. *Poisson Geometry in Mathematics and Physics* (ed. G. Dito), *Contemp. Math.* **450** (2008), 199–222.
- (31) E. Meinrenken: On the quantization of conjugacy classes. *L'Enseignement Mathématique* **55** (2009), 33–75.
- (32) A. Alekseev, H. Bursztyn, E. Meinrenken: Pure spinors on Lie groups, *Asterisque* **327** (2009), 131–199.
- (33) E. Meinrenken: Quantization of q-Hamiltonian SU(2)-spaces, *Geometric Aspects of Analysis and Mechanics: In Honor of the 65th birthday of J.J. Duistermaat*, Birkhäuser, 2011, 257–294.
- (34) A. Alekseev, E. Meinrenken: The Atiyah algebroid of the path fibration over a Lie group, *Letters in Mathematical Physics* **90** (2009), 23–58.
- (35) E. Meinrenken: Tilings defined by affine Weyl groups, *Pacific Journal of Mathematics* **2** (2009), 333–343.
- (36) D. Li-Bland, E. Meinrenken: Courant algebroids and Poisson geometry, *International Mathematics Research Notices* **11** (2009), 2106–2145.
- (37) A. Alekseev, E. Meinrenken: Dirac structures and Dixmier-Douady bundles, *International Mathematics Research Notices* Volume **2012** (2012), Issue 4, 904–956.
- (38) E. Meinrenken: The cubic Dirac operator for infinite-dimensional Lie algebras. *Canadian Journal of Mathematics*, **63** (2011) Issue 6, 1–24.
- (39) E. Meinrenken: Twisted K-homology and group-valued moment maps. *International Mathematics Research Notices* (2012) 2012 (20), 4563–4618.
- (40) D. Krespki, E. Meinrenken: On the Verlinde formulas for SO(3)-bundles. *Quarterly Journal of Mathematics* **64**(1) (2013) 64, 235–252.
- (41) D. Li-Bland, E. Meinrenken: Dirac Lie groups. Preprint (submitted), 46 pages, October 2011. To appear in *Asian Journal of Mathematics*
- (42) A. Alekseev, E. Meinrenken: Linearization of Poisson Lie group structures. Preprint (2013).
- (43) D. Li-Bland, E. Meinrenken: On the Van Est homomorphism for Lie groupoids. Preprint (2014).

## Review articles, Surveys

- (44) E. Meinrenken: Lectures on group-valued moment maps and Verlinde formulas. *Contemp. Math.* **583** (2012), 175–210.

- (45) E. Meinrenken: Clifford algebras and the Duflo isomorphism. In: Proceedings of the ICM Beijing 2002, Vol. II (Invited lectures), 637–642
- (46) E. Meinrenken: Equivariant cohomology and the Cartan model. “Encyclopedia of mathematical physics”, 242–250, Elsevier 2006.

## Books

- (47) E. Meinrenken: Clifford algebras and Lie theory. 330 pages. Ergebnisse der Mathematik und ihrer Grenzgebiete. 3. Folge / A Series of Modern Surveys in Mathematics, Vol. 58, Springer 2013.

## Editorial Boards

2004 – present: *Documenta Mathematica*

2008 – present: *Comptes rendus mathématiques/ Mathematical Reports*. (Co-editor-in-chief until 2/2014.)

## Conferences/programs organized

Member of scientific committee: Poisson 2014, Urbana-Champaign, July/August 2014.

Chair of scientific committee: Poisson 2012, Utrecht, July 2012.

Member of scientific committee: Poisson 2010, IMPA, Rio de Janeiro, August 2010.

Member of scientific committee: Poisson 2008, Lausanne, July 2008.

Co-organizer: Conference on ‘Geometric Analysis and Mathematical Physics’, Fields Institute, January 2008.

Co-organizer: Workshop on ‘Poisson Geometry and Applications’, Oberwolfach, April 2007.

Organizer: Special Session on Poisson geometry, CMS Winter meeting, Toronto December 2006

Co-organizer: Conference ‘Moment maps in various geometries’, Banff International Research Station, May 2005

Co-organizer: Special Session on symplectic geometry, CMS Winter meeting, Ottawa December 2002

Co-organizer: Program on symplectic geometry at Fields Institute, Toronto, January-June 2001

Co-organizer: Conference in honor of Victor Guillemin, MIT Cambridge, October 1998

## Conference Talks

### **On the Van-Est homomorphism for Lie groupoids**

– Fields Institute, Toronto, December 2013

### **On the linearization of Poisson Lie groups**

– Conference in honor of Alan Weinstein, Lausanne, July 2013.

– AMS meeting at Washington University, October 2013.

– Workshop “Higher Geometric Structures along the Lower Rhine” on Wednesday, Bonn, January 2014.

**Twisted Spin-c structures** – Workshop on Noncommutative Geometry and Algebraic Geometry, University of New Brunswick, Fredericton, September 2012.

**Twisted K-homology and group-valued moment map** – INI-WIMCS Meeting 2012: Noncommutative Geometry, Cardiff, April 2012.

**Group-valued moment maps and moduli spaces of flat G-bundles** – IGA Lecture series (5 two-hour lectures), Adelaide, September 2011.

**Group-valued moment maps and Verlinde formulas** – Lecture series (3 one-hour lectures), Notre Dame University, June 2011

- Group-valued moment maps revisited** — *Joint Cornell-Penn State symplectic seminar*, Cornell, October 2011. — ‘*Gone fishing*’ conference on *Poisson geometry*, St Louis, October 2011.
- Verlinde Formulas for non-simply connected groups** – *Workshop on Geometric Quantization in the Non-compact Setting*, Oberwolfach February 2011.
- Dirac structures and Dixmier-Douady theory** – *Conference Poisson 2012*, Rio de Janeiro, July 2010
- Twisted Spin-c structures on conjugacy classes** – *Workshop on generalized complex and holomorphic Poisson geometry*, BIRS, April 2010.
- Dirac geometry and moment maps** – *CRCG Workshop - Higher Structures in Topology and Geometry III*, 3 one-hour lectures, Göttingen, May 2009.
- Twisted K-homology and group-valued moment maps** – *Conference Poisson 2008*, Lausanne, July 2008.
- On the quantization of  $\mathfrak{q}$ -Hamiltonian  $SU(2)$ -spaces** – *Conference on Moment Maps*, Barcelona, July 2008.
- Twisted K-homology and Verlinde formulas** – *Geometric Aspects of Analysis and Mechanics*, Conference in honour of H. Duistermaat, Utrecht, August 2007. – *Analysis and Topology in Interaction*, Cortona, June 2008
- Pure spinors and group-valued moment maps**  
– *Summer School on Poisson Geometry*, 2 one-hour lectures. Keio University, July 2006.
- Poisson Lie groups and the Gelfand-Zeitlin system**  
– Keio University (Yokohama), *CEO meeting*, March 2005.
- Small models and twisted differentials**  
– Perimeter Institute (Waterloo), *Great Lakes Geometry Conference*, April 2004.
- Chern-Weil homomorphism for non-commutative differential algebras**  
– Fields Institute (Toronto), *Noncommutative Geometry, the Local Index Formula and Hopf Algebras*, September 2004.
- The basic gerbe over a compact simple Lie group**  
– Ascona, *Mathematical and physical aspects of string theory*, July 2004
- The small Cartan model**  
– Oberwolfach, *Geometry of Hamiltonian group actions*, May 2004  
– Luminy, *Groupoids and Stacks*, June 2004
- A proof of Witten’s formulas for moduli spaces of flat bundles**  
– ESI conference *Moment maps and symplectic geometry*, Vienna, August 2003.
- Clifford algebras and the Duflo isomorphism**  
– International congress of mathematicians (ICM), Beijing, August 2002.
- The basic gerbe over a compact simple Lie group.**  
– Conference *Poisson 2002*, Lisbon, September 2002.  
– Conference *String theory and geometry*, Ascona, July 2004.
- Pre-quantization of group-valued moment maps.**  
– Conference “Symplectic and contact geometry and group actions”, MIT, April 2002.
- Clifford algebras and the classical dynamical Yang-Baxter equation**  
– AMS sectional meeting Ann Arbor, March 2002.
- Clifford algebras and the Duflo map**  
– Workshop on the geometry of infinite dimensional Lie groups, CRM (Montreal), November 2001.
- The Duflo homomorphism for subalgebras** 2001 Canada-China Math Congress, Vancouver, August 2001.
- Poisson actions and the hyperbolic Duflo theorem**  
– Toronto, Fields Institute, Conference on “Quasiclassical and quantum structures”, January 2001.
- Equivariant cohomology and the Duflo theorem**  
– Colloques de mathématiciens, Concordia University, Montreal, November 2000.
- Verlinde formulas for non-simply connected groups**

- Oberwolfach, Conference on “Singular Spaces and Geometric Analysis”, June 2000
- The non-commutative Weil algebra**
- M.I.T. Conference “50th Anniversary of Postdoctoral Instructorship”, October 1999
- Equivariant cohomology and the center of  $U(g)$**
- Obernai, European Research Conference “Analysis and Geometry”, June 1999
- A new localization formula**
- Buffalo, AMS sectional meeting, April 1999
- A Lefschetz formula for Hamiltonian loop group spaces**
- Vienna, Conference on “Spectral theory and Schroedinger operators”, June 1998
- Oberwolfach, Conference on “Singular Spaces and Geometric Analysis”, June 1998
- Lie group valued moment maps and moduli spaces,**
- Chern Symposium, M.S.R.I., March 1998. (Lecture available on CD-ROM published by M.S.R.I.)
- Symplectic cobordism and Witten’s volume formulas,**
- AMS sectional meeting, Montreal, September 1997.
- Lie group valued moment maps,**
- Fields Institute, Toronto, Conference in honor of V. Arnold, July 1997.
- Convexity theorems for Hamiltonian loop group actions,**
- Luminy (France), Conference “Symplectic Geometry and Multiplicities”, August 1996.
- Riemann-Roch numbers for singular symplectic quotients,**
- Penn State University, Conference “Symplectic Geometry”, March 1996.
- Oberwolfach, Conference “Geometric Analysis on Singular Spaces”, July 1996.
- Maslov indices for periodic orbits,**
- Grenoble (France), Conference “Periodic Orbits and Quantum Chaos”, November 1995,
- Salamanca (Spain), Conference on Geometry and Physics, June 1992.
- Riemann-Roch formulas for multiplicities**
- Isaac Newton Institute, Workshop “Hamiltonian Group Actions”, November 1994,
- Ecole Normale Supérieure Paris (France), Geometric Quantization Seminar, October 1994,
- University of Georgia in Athens, Conference “Symplectic Topology”, June 1994.
- Coherent states and classical limits**
- Leipzig (Germany), Workshop “Geometric Methods in Physics”, April 1993.

## Invited Lectures

- On the Van-Est homomorphism for Lie groupoids**
- Keio University, March 2014
- Twisted K-homology and group-valued moment map**
- Kyoto University, March 2014
- Linearization of Poisson Lie groups**
- Colloquium, Urbana-Champaign, April 2013.
- Colloquium, Orsay, May 2013.
- Twisted Spin-c structures**
- Geometry seminar, Orsay, May 2013.
- Dirac Lie groups**
- Geometry seminar, Oxford, April 2012.
- Dirac structures and group-valued moment maps** – 2.5-hour lecture, Northeastern University, November 2011.
- Twisted K-homology and group-valued moment map**
- Colloquium, University of Western Ontario, April 2011.
- Twisted Spin-c structures on conjugacy classes**
- Algebraic geometry seminar, Queens University, November 2010,
- Colloquium, Northeastern University, March 2010.

**The level  $k$  fusion ring**

- Introductory Lecture, Northeastern University, March 2010.

**Dirac structures and Dixmier-Douady theory**

- Colloquium, University of Colorado at Boulder, August 2009.

**Volume forms on conjugacy classes**

- Colloquium, University of Arizona at Tucson, December 2008
- Symposium for new Fellows of the RSC, Fields Institute, March 2009

**Twisted K-Homology and Group-Valued Moment Maps**

- Penn State, October 2008

**Twisted K-homology and Verlinde formulas**

- University of California at Berkeley, April 2008
- Notre Dame University, February 2008
- Concordia University, December 2007

**Twisted K-homology and group-valued moment maps**

- University of Texas at Austin, February 2007.
- M.I.T., March 2007

**Pure spinors on Lie groups**

- Cornell University, Colloquium, April 2006.
- Northeastern University, March 2007

**Twisted K-homology and Lie groups**

- University of Toronto, differential geometry seminar, February 2006
- IMPA (Rio de Janeiro), differential geometry seminar, February 2006
- UC San Diego, topology colloquium, March 2006

**Moduli spaces of flat bundles**

- Keio University, *Pathway Lecture series*, 3 one-hour lectures. March 2005

**Verlinde formulas and gerbes**

- MIT, November 2004

**A proof of Witten's formulas for moduli spaces of flat bundles**

- University of Geneva, July 2004

**The small Cartan model**

- Cornell University, April 2004.

**Chern-Weil theory and Lie algebras**

- MIT, December 2003
- Concordia University / CRM, colloquium, January 2004

**Moduli spaces of flat bundles**

- University of Chicago, 'Geometric Langlands' seminar, January 2003. (Two 2-hour lectures.)

**Chern-Weil constructions in Lie theory**

- McMaster University, Hamilton, colloquium, March 2003
- University of California at San Diego, geometry/topology seminar, March 2003
- Queens University, Kingston, colloquium, February 2003

**The Verlinde formulas as fixed point formulas**

- University of Texas at Austin, geometry/topology seminar, December 2002
- Penn State, State College, CGMP geometry seminar, October 2002

**Group-valued moment maps and moduli spaces of flat bundles**

- University of Michigan at Ann Arbor, colloquium, March 2002

**The Duflo homomorphism for subalgebras**

- Cornell University, September 2001

**Matrices, moment maps, and moduli spaces**

- CRM Montreal, February 2001
- University of London (Ontario), February 2001

**Verlinde formulas for non-simply connected groups**

- University of Stockholm, August 2000
- Cornell University, April 2000

**The non-commutative Weil algebra**

- Cornell University, April 2000

**Group valued moment maps, localization, and moduli spaces of flat connections (Lecture series, 3 parts)**

- Orsay, France, May/June 1999

**Group valued equivariant localization**

- Berkeley, April 1999
- Ecole Normale Superieure, Paris, May 1999

**Group valued localization and moduli spaces**

- Johns Hopkins University, February 1999

**Non-commutative aspects of equivariant cohomology**

- Colloquium, Ohio State, February 1999
- M.I.T., November 1998

**Group valued equivariant cohomology**

- M.I.T., July 1998

**Lie group valued moment maps and moduli spaces,**

- University of Wisconsin at Madison, April 1998
- Tokyo University, May 1998
- Kyoto University, May 1998
- Humboldt University, Berlin, June 1998
- Geometry and Topology seminar, McMaster University, March 1998.
- Mathematical Physics seminar, M.I.T., December 1997.

**Geometric quantization and multiplicity formulas,**

- University of Toronto, Colloquium, March 1997.
- Northwestern University, Colloquium, March 1997.
- University of Washington in Seattle, Colloquium, March 1997.
- Purdue University, Colloquium, March 1997.
- University of Arizona in Tucson, Colloquium, March 1997.
- Duke University, Colloquium, March 1997.

**The symplectic geometry of Verlinde factorization,**

- Berlin, Freie Universität, Seminar des Sonderforschungsbereichs, July 1996.
- Penn State University, Differential Geometry Seminar, February 1997.
- University of Washington in Seattle, March 1997

**Symplectic surgery and the Spin-c Dirac operator,**

- Cornell University, Lie Groups Seminar, October 1995
- Ecole Normale Superieure Paris (France), Geometric Quantization Seminar, November 1995,
- Lille (France), Differential Geometry Seminar, November 1995.

**Riemann-Roch formulas for multiplicities**

- Ecole Normale Superieure Paris (France), Geometric Quantization Seminar, October 1994,
- Universität Mannheim (Germany), Differential Geometry Seminar, October 1994,
- Princeton University, Differential Geometry Seminar, March 1995.

**Toeplitz quantization of Kähler manifolds and classical limits**

- Harvard University, Mathematical Physics Seminar, October 1993.