

Publications List for Dror Bar-Natan.

Up to 5 publications from the past five years:

The last five years had been an unusual period of time for me. I have been very active doing mathematical research, yet with the phenomenal advance of the internet, much of my output was channelled into non-traditional directions (which I sincerely hope will become the established tradition, or the root of a new established tradition, by the next time I will be applying for this fellowship). Thus much of my output had taken the form of web documents and highly documented and mostly videotaped lectures (all available online). Sorry, referees. This will make evaluating my top three "publications" below a bit of a challenge. [Indeed, a part of my need for a long sabbatical is to allow my formal publications to catch up with my research and my informal publications].

1. A large mass of lectures and lecture series accompanied by many detailed handouts, videos, and other materials, all available online at <http://www.math.toronto.edu/~drorbn/Talks/> and more graphically at <http://www.math.toronto.edu/~drorbn/Talks/Portfolio/>.
2. "Finite Type Invariants of w-Knotted Objects: From Alexander to Kashiwara and Vergne", joint with Zsuzsanna Dancso. This is still unfinished as a formal journal article, yet it is available on the web as a series of 22 videotaped lectures; see <http://drorbn.net/index.php?title=WKO>.
3. "The Knot Atlas", joint with Scott Morrison and many other contributors, is an online knot theory atlas and (I believe) presently one of the most comprehensive online knot theory databases. See http://katlas.org/wiki/Main_Page.
4. "Some Dimensions of Spaces of Finite Type Invariants of Virtual Knots", joint with Iva Halacheva, Louis Leung, and Fionntan Roukema, Experimental Mathematics 20-3 (2011) 282-287 and <http://www.math.toronto.edu/~drorbn/papers/v-Dims/>.
5. "Homomorphic Expansions for Knotted Trivalent Graphs", joint with Zsuzsanna Dancso, to appear in the Journal of Knot Theory and its Ramifications. See also <http://www.math.toronto.edu/~drorbn/papers/ktgs/>.

Up to 5 other publications:

1. "Khovanov Homology for Tangles and Cobordisms", Geometry and Topology 9 (2005) 1443-1499 and <http://www.math.toronto.edu/~drorbn/papers/Cobordism/>.
2. "Solving the Bible Code Puzzle", joint with Brendan McKay, Gil Kalai, and Maya Bar-Hillel, Statistical Science 14-2 (1999) 150-173 and <http://cs.anu.edu.au/~bdm/dilugim/StatSci/>.
3. "The Århus Integral of rational homology 3-spheres", joint with Stavros Garoufalidis, Lev Rozansky, and Dylan Thurston. Selecta Mathematica (New Series) in 3 parts: 8 (2002) 315-339, 8 (2002) 341-371, and 10 (2004) 305-324.
4. "On Associators and the Grothendieck-Teichmüller Group, I", Selecta Mathematica (New Series) 4 (1998) 183-212.
5. "On the Vassiliev Knot Invariants", Topology 34 (1995) 423-472.

Current or Recent (past 5 years) Post Docs and PhD students supervised:

1. Gad Naot, Ph.D., 2007. Thesis title: The Universal $sl(2)$ Link Homology Theory. See also <http://www.math.toronto.edu/~drorbn/Students/index.html#Naot>.
2. Hernando Burgos, Ph.D., 2009. Thesis title: The Jones Polynomial and the Planar Algebra of Alternating Links. See also <http://www.math.toronto.edu/~drorbn/Students/index.html#Burgos>.

3. Jana Archibald, Ph.D., 2010. Thesis title: The Multivariable Alexander Polynomial on Tangles. See also <http://www.math.toronto.edu/~drorbn/Students/index.html#Archibald>.
4. Louis Leung, Ph.D., 2010. Thesis title: Classical Lie Algebra Weight Systems of Arrow Diagrams. See also <http://www.math.toronto.edu/~drorbn/Students/index.html#Leung>.
5. Zsuzsanna Dancso, Ph.D., 2011. Thesis title: On a Universal Finite Type Invariant of Knotted Trivalent Graphs. See also <http://www.math.toronto.edu/~drorbn/Students/index.html#Dancso>.
6. Peter Lee, Ph.D., 2011. Thesis title: The Pure Virtual Braid Group is Quadratic. See also <http://www.math.toronto.edu/~drorbn/Students/index.html#LeeP>.
7. Karene Chu, Ph.D., 2012. Thesis title: Flat Virtual Pure Tangles. See also <http://www.math.toronto.edu/~drorbn/Students/index.html#Chu>.
8. Daniel Moskovitch, Postdoctoral Fellow, 2010-2011.
9. David Penneys, Postdoctoral Fellow since 2012.
10. Peter Samuelson, Postdoctoral Fellow since 2012.


Dror Bar-Natan at the University of Tennessee
March 4, 2011, <http://www.math.toronto.edu/~drorbn/Talks/Tennessee-1103/>

Cosmic Coincidences and Several Other Stories, 1

Abstract. In the first half of my talk I will tell a cute and simple story — how given a knot in \mathbb{R}^3 one may count all possible “cosmic coincidences” associated with that knot, and how this count, appropriately packaged, becomes an invariant Z with values in some space \mathcal{A} of linear combinations of certain trivalent graphs.

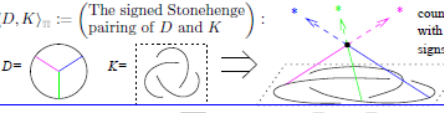
In the second half of my talk I will describe (rather sketchily, I’m afraid) a part of the story surrounding Z and \mathcal{A} : How the same Z also comes from quantum field theory, Feynman diagrams, and configuration space integrals. How \mathcal{A} is a space of universal formulas which make sense in every metrized Lie algebra and how specific choices for that Lie algebra correspond to various famed knot invariants. How Z solves a universal topological problem, and how solving for Z is solving some universal Lie-algebraic problem. All together, this is the u -story.

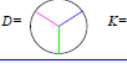
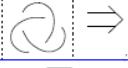
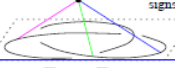
In the remaining time I will mention several other Z ’s and \mathcal{A} ’s and the parallel (yet sometimes interwoven) stories surrounding them — the v -story, and w -story, and perhaps also the p -story. Each of these stories is clearly still missing some chapters.

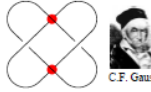


Creation of Adam
Michelangelo

Disclaimer
We’ll concentrate on the beauty and ignore the cracks.

$(D, K)_n := (\text{The signed Stonehenge pairing of } D \text{ and } K)$: 

$D =$  $K =$  \Rightarrow  count with signs

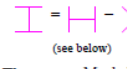
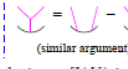
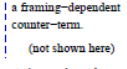
The Gaussian linking number $lk(\bigcirc) = \sum (\text{signs})$ of vertical chopsticks  C.F. Gauss

The generating function of all cosmic coincidences:

$Z(K) := \lim_{N \rightarrow \infty} \sum_{\text{3-valent } D} \frac{(D, K)_n \cdot D}{2^e \text{cl}(N_e)} \cdot \left(\begin{matrix} \text{framing-dependent} \\ \text{counter-term} \end{matrix} \right) \in \mathcal{A}(\bigcirc)$ D. Thurston

$N := \#$ of stars $\mathcal{A}(\bigcirc) := \text{Span} \left(\begin{matrix} \square \\ \square \end{matrix} \right)$ oriented vertices
 $c := \#$ of chopsticks AS: $\uparrow + \uparrow = 0$ & more relations
 $e := \#$ of edges of D

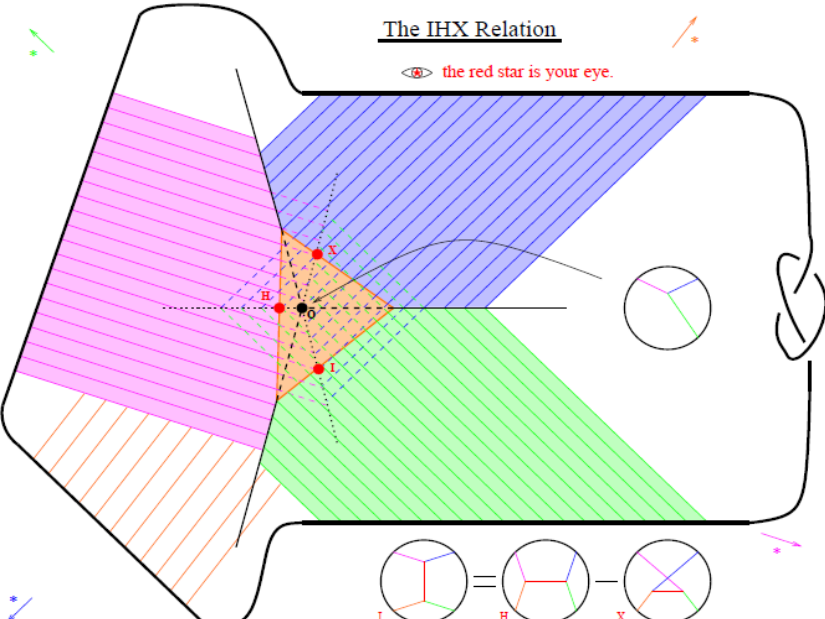
When deforming, catastrophes occur when:




A plane moves over an intersection point – Solution: Impose IHX.	An intersection line cuts through the knot – Solution: Impose STU.	The Gauss curve slides over a star – Solution: Multiply by a framing-dependent counter-term.
 (see below)	 (similar argument)	 (not shown here)

Theorem. Modulo Relations, $Z(K)$ is a knot invariant!


The IHX Relation

👁️ the red star is your eye.





The Cast in rough historical order




The Neolithic People




Carl Friedrich Gauss




Edmond Weiss




Victor Vassiliev




Mikhail Goussarov




Maxim Kontsevich




Raoul Bott




Clifford Taubes



Thang Le



Jun Murakami



Tomonori Ohtsuki

Video and more at <http://www.math.toronto.edu/~drorbn/Talks/Tennessee-1103/> and at <http://www.math.toronto.edu/~drorbn/Talks/Caen-1206/#Colloquium>