

LIST OF PUBLICATIONS, WITH ABSTRACTS

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As of April 2011. Papers are available at <http://www.math.duke.edu/~ng/math/>.

- An atlas of Legendrian knots (with W. Chongchitmate), submitted, arXiv:1010.3997.
Abstract: We present an atlas of Legendrian knots in standard contact three-space. This gives a conjectural Legendrian classification for all knots with arc index at most 9, including alternating knots through 7 crossings and nonalternating knots through 9 crossings. Our method involves a computer search of grid diagrams and applies to transverse knots as well. The atlas incorporates a number of new, small examples of phenomena such as transverse nonsimplicity and non-maximal non-destabilizable Legendrian knots, and gives rise to new infinite families of transversely nonsimple knots.
- Combinatorial knot contact homology and transverse knots, *Adv. Math.*, to appear; arXiv:1010.0451.
Abstract: We give a combinatorial treatment of transverse homology, a new invariant of transverse knots that is an extension of knot contact homology. The theory comes in several flavors, including one that is an invariant of topological knots and produces a three-variable knot polynomial related to the A -polynomial. We provide a number of computations of transverse homology that demonstrate its effectiveness in distinguishing transverse knots, including knots that cannot be distinguished by the Heegaard Floer transverse invariants or other previous invariants.
- Filtrations on the knot contact homology of transverse knots (with T. Ekhholm, J. Etnyre, and M. Sullivan), preprint, 2010, arXiv:1010.0450.
Abstract: We construct a new invariant of transverse links in the standard contact structure on \mathbb{R}^3 . This invariant is a doubly filtered version of the knot contact homology differential graded algebra (DGA) of the link. Here the knot contact homology of a link in \mathbb{R}^3 is the Legendrian contact homology DGA of its conormal lift into the unit cotangent bundle $S^*\mathbb{R}^3$ of \mathbb{R}^3 , and the filtrations are constructed by counting intersections of the holomorphic disks of the DGA differential with two conormal lifts of the contact structure. We also present a combinatorial formula for the filtered DGA in terms of braid representatives of transverse links and apply it to show that the new invariant is independent of previously known invariants of transverse links.
- Legendrian and transverse twist knots (with J. Etnyre and V. Vértesi), submitted, arXiv:1002.2400.
Abstract: In 1997, Chekanov gave the first example of a Legendrian nonsimple knot type: the $m(5_2)$ knot. Epstein, Fuchs, and Meyer extended his result by showing that there are at least n different Legendrian representatives of the $m((2n + 1)_2)$ knot with maximal

Thurston–Bennequin number. In this paper we give a complete classification of Legendrian and transverse representatives of twist knots. In particular, we show that the $m((2n + 1)_2)$ knot has exactly $\lceil \frac{n^2}{2} \rceil$ Legendrian representatives with maximal Thurston–Bennequin number, and $\lceil \frac{n}{2} \rceil$ transverse representatives with maximal self-linking number. Our techniques include convex surface theory, Legendrian ruling invariants, and Heegaard Floer homology.

- Grid diagrams, braids, and contact geometry (with D. Thurston), *Proceedings of 15th Gökova Geometry–Topology Conference 2008*, 120–136 (Gökova Geometry–Topology Conference (GGT), Gökova, 2009).

Abstract: We use grid diagrams to present a unified picture of braids, Legendrian knots, and transverse knots.

- Rational Symplectic Field Theory for Legendrian knots, *Invent. Math.* **182** (2010), no. 3, 451–512; arXiv:0806.4598.

Abstract: We construct a combinatorial invariant of Legendrian knots in standard contact three-space. This invariant, which encodes rational relative Symplectic Field Theory and extends contact homology, counts holomorphic disks with an arbitrary number of positive punctures. The construction uses ideas from string topology.

- A family of transversely nonsimple knots (with T. Khandhawit), *Algebr. Geom. Topol.* **10** (2010), no. 1, 293–314; arXiv:0806.1887.

Abstract: We apply knot Floer homology to exhibit an infinite family of transversely nonsimple prime knots starting with 10_{132} . We also discuss the combinatorial relationship between grid diagrams, braids, and Legendrian and transverse knots in standard contact \mathbb{R}^3 .

- A skein approach to Bennequin type inequalities, *Int. Math. Res. Not.* **2008**, Art. ID rnn116, 18 pp.

Abstract: We give a simple unified proof for several disparate bounds on Thurston–Bennequin number for Legendrian knots and self-linking number for transverse knots in \mathbb{R}^3 , and provide a template for possible future bounds. As an application, we give sufficient conditions for some of these bounds to be sharp.

- Transverse knots distinguished by knot Floer homology (with P. Ozsváth and D. Thurston), *J. Symplectic Geom.* **6** (2008), no. 4, 461–490.

Abstract: We exhibit pairs of transverse knots with the same self-linking number that are not transversely isotopic, using the recently defined knot Floer homology invariant for transverse knots and some algebraic refinements of it.

- On arc index and maximal Thurston–Bennequin number, submitted; math.GT/0612356.

Abstract: We discuss the relation between arc index, maximal Thurston–Bennequin number, and Khovanov homology for knots. As a consequence, we calculate the arc index and maximal Thurston–Bennequin number for all knots with at most 11 crossings. For some

of these knots, the calculation requires a consideration of cables which also allows us to compute the maximal self-linking number for all knots with at most 11 crossings.

- Framed knot contact homology, *Duke Math. J.* **141** (2008), no. 2, 365–406.

Abstract: We extend knot contact homology to a theory over the ring $\mathbb{Z}[\lambda^{\pm 1}, \mu^{\pm 1}]$, with the invariant given topologically and combinatorially. The improved invariant, which is defined for framed knots in S^3 , can distinguish many pairs of knots, including mutants, and can also be defined for knots in arbitrary manifolds. It contains the Alexander polynomial and naturally produces a two-variable polynomial knot invariant which is related to the A -polynomial.

- Conormal bundles, contact homology, and knot invariants, in *The interaction of finite type and Gromov–Witten invariants at the Banff International Research Station (2003)*, *Geom. Topol. Monogr.* **8** (2006), 129–144.

Abstract: We summarize recent work on a combinatorial knot invariant called knot contact homology. We also discuss the origins of this invariant in symplectic topology, via holomorphic curves and a conormal bundle naturally associated to the knot.

- The correspondence between augmentations and rulings for Legendrian knots (with J. Sabloff), *Pacific J. Math.* **224** (2006), no. 1, 141–150.

Abstract: We strengthen the link between holomorphic and generating-function invariants of Legendrian knots by establishing a formula relating the number of augmentations of a knot's contact homology to the complete ruling invariant of Chekanov and Pushkar.

- Plane curves and contact geometry, in *Proceedings of 12th Gökova Geometry–Topology Conference*, 162–171.

Abstract: We apply contact homology to obtain new results in the problem of distinguishing immersed plane curves without dangerous self-tangencies.

- A Legendrian Thurston–Bennequin bound from Khovanov homology, *Algebr. Geom. Topol.* **5** (2005), 1637–1653.

Abstract: We establish an upper bound for the Thurston–Bennequin number of a Legendrian link using the Khovanov homology of the underlying topological link. This bound is sharp in particular for all alternating links, and knots with nine or fewer crossings.

- Legendrian solid-torus links (with L. Traynor), *J. Symplectic Geom.* **2** (2005), no. 3, 411–443.

Abstract: Differential graded algebra invariants are constructed for Legendrian links in the 1-jet space of the circle. In parallel to the theory for \mathbb{R}^3 , Poincaré–Chekanov polynomials and characteristic algebras can be associated to such links. The theory is applied to distinguish various knots, as well as links that are closures of Legendrian versions of rational tangles. For a large number of two-component links, the Poincaré–Chekanov polynomials agree with the polynomials defined through the theory of generating functions. Examples are given of knots and links which differ by an even number of horizontal

flypes that have the same polynomials but distinct characteristic algebras. Results obtainable from a Legendrian satellite construction are compared to results obtainable from the DGA and generating function techniques.

- Knot and braid invariants from contact homology II, *Geom. Topol.* **9** (2005), 1603–1637.

Abstract: We present a topological interpretation of knot and braid contact homology in degree zero, in terms of cords and skein relations. This interpretation allows us to extend the knot invariant to embedded graphs and some higher-dimensional knots. We give a related presentation for knot contact homology in terms of plats, including a calculation for all two-bridge knots.

- Knot and braid invariants from contact homology I, *Geom. Topol.* **9** (2005), 247–297.

Abstract: We introduce topological invariants of knots and braid conjugacy classes, in the form of differential graded algebras, and present an explicit combinatorial formulation for these invariants. The algebras conjecturally give the relative contact homology of certain Legendrian tori in five-dimensional contact manifolds. We present several computations and derive a relation between the knot invariant and the Alexander polynomial.

- Problems in low dimensional contact geometry (with J. Etnyre), in *Topology and Geometry of Manifolds, Proc. Sympos. Pure Math.* **71** (2003), 337–357.
- Invariants of Legendrian links and coherent orientations (with J. Etnyre and J. Sabloff), *J. Symplectic Geom.* **1** (2002), no. 2, 321–367.

Abstract: We provide a translation between Chekanov’s combinatorial theory for invariants of Legendrian knots in the standard contact \mathbb{R}^3 and a relative version of Eliashberg and Hofer’s Contact Homology. We use this translation to transport the idea of “coherent orientations” from the Contact Homology world to Chekanov’s combinatorial setting. As a result, we obtain a lifting of Chekanov’s differential graded algebra invariant to an algebra over $\mathbb{Z}[t, t^{-1}]$ with a full \mathbb{Z} grading.

- Computable Legendrian invariants, *Topology* **42** (2003), no. 1, 55–82.

Abstract: We establish tools to facilitate the computation and application of the Chekanov–Eliashberg differential graded algebra (DGA), a Legendrian-isotopy invariant of Legendrian knots in standard contact three-space. More specifically, we reformulate the DGA in terms of front projection, and introduce the characteristic algebra, a new invariant derived from the DGA. We use our techniques to distinguish between several previously indistinguishable Legendrian knots and links.

- Maximal Thurston–Bennequin number of two-bridge links, *Algebr. Geom. Topol.* **1** (2001), 427–434.

Abstract: We compute the maximal Thurston–Bennequin number for a Legendrian two-bridge knot or oriented two-bridge link in standard contact \mathbb{R}^3 , by showing that the upper bound given by the Kauffman polynomial is sharp. As an application, we present a table of maximal Thurston–Bennequin numbers for prime knots with nine or fewer crossings.

- Heisenberg model, Bethe *ansatz*, and random walks, Harvard senior honors thesis, 1996.

Summary: A connection discovered between the Heisenberg ferromagnet model and a problem in the theory of random walks allows us to verify the Bethe *ansatz* from physics in a special case, and to apply this case to solve the random walks problem.

- The rook on the half-chessboard, or how not to diagonalize a matrix (with K. Kedlaya), *Amer. Math. Monthly* **105** (1998), 819–824.
- Hamiltonian decomposition of lexicographic products of digraphs, *J. Combin. Theory Ser. B* **73** (1998), 119–129.
- Hamiltonian decomposition of complete regular multipartite digraphs, *Discrete Math.* **177** (1997), 279–285.
- k -ordered hamiltonian graphs (with M. Schultz), *J. Graph Theory* **24** (1997), 45–57.