RESEARCH STATEMENT

EUGENE GORSKY

My research is mainly focused on algebraic and algebro-geometric aspects of knot theory. A knot is a closed loop in three-dimensional space, a link is a union of several such loops, possibly linked with each other. Besides the immediate mathematical applications, knot theory has implications in physics of quantum systems and in the study of chemical and biological properties of long knotted molecules (such as DNA).

The central questions in knot theory are the classification problem (Can a knot be transformed to another knot without tearing its strands? Can it be pulled apart to look like an ordinary circle?) and the study of the geometric properties of knots or links, such as finding the minimal number of handles of a surface with boundary on a given link. Both of these questions can be partially answered with the help of **knot invariants**: two knots are different if their invariants are different; the minimal genus is bounded by by certain values of knot invariants. Among the classical knot invariants are the Alexander, Jones and HOMFLY polynomials.

More recently, the concept of **link homology theory** was developed and led to new powerful knot invariants. To a given knot or link, such a theory associates a collection of vector spaces (knot homology groups) whose dimensions are encoded in the coefficients of a given knot polynomial. In my research I use a variety of methods from algebraic geometry, representation theory, topology and combinatorics to study the structure of link homology. The central questions are:

(1) **Computing** link homology: in a series of papers [16, 32, 31, 36, 41], my collaborators and I proposed a series of conjectures describing HOMFLY homology of torus links and relating it to combinatorics of **Rational Shuffle Conjecture**. These conjectures were later confirmed by Elias, Hogancamp and Mellit [10, 46, 56]. In [40], Némethi and I have computed the Heegaard Floer homology for algebraic links with arbitrary number of components.

(2) Building **geometric models** for link homology: these include sheaves on **Hilbert schemes of points on the plane** [36, 37], **braid varieties** [6, 7, 8, 57] and **affine Springer fibers** [26, 34, 41, 47, 48, 67]. We describe these models in more details below. In many cases, they lead to explicit computations and predictions of link invariants.

(3) **Operations** in link homology: various flavors of link homology are modules over some polynomial rings. In [21], Hogancamp and I proposed a deformation, or **"y-ification" of link homology**, and used it to compute both deformed and undeformed homology of many links as modules over the corresponding rings. Furthermore, in [22] the y-ification was used to define a family of interesting operators in link homology, parallel to the action of **tautological classes** in some of the above geometric models. The study of these operators opens up a plethora of questions on the structure of link homology.

(4) **General properties** of link homology: while [23] explains the relation between the "top" and "bottom" HOMFLY homology, in [22] Hogancamp, Mellit and I recently proved the **symmetry** property for this homology. This resolved a long-standing conjecture. In a more categorical direction, in [24, 43] I have studied

the homological invariants of links in the annulus, and their relation to symmetric functions and categorical traces.

(5) **Applications** of link homology: my collaborators and I have used Heegaard Floer homology to study splitting numbers [2], Sato-Levine and Milnor invariants [28, 29], and Dehn surgeries [38] for links with several components. In particular, Lidman, Liu, Moore and I recently proved that Heegaard Floer homology detects Whitehead link and Borromean rings [29].

(6) **Using topological ideas** to obtain new results in algebraic geometry and representation theory: the most significant result is the construction of **cluster structure on braid varieties** [8] (joint with Casals, my brother M. Gorsky, Le, Shen and Simental) which, in particular, resolves a conjecture of Leclerc about the existence of cluster structure on Richardson varieties.

I elaborate on the details of some of these results and research directions below. A more complete picture and more examples and references are described in the lecture notes [27] from my course at the 2021 IHES summer school.

In recent years, I have actively organized working groups, conferences and research communities to share and discuss all these results and ideas. These brought together both the leading experts in categorification, algebra, geometry and combinatorics, and the graduate students and early career researchers from all over the world. These activities include NSF Focused Research Group "Algebra and Geometry Behind Link Homology":

`https://www.math.ucdavis.edu/~egorskiy/FRG/index.html`

An online seminar on torus knots homology:

`https://www.math.ucdavis.edu/~egorskiy/TorusKnots/`

AIM research community on link homology:

`https://aimath.org/programs/researchcommunities/linkhom/`

1. Khovanov–Rozansky homology

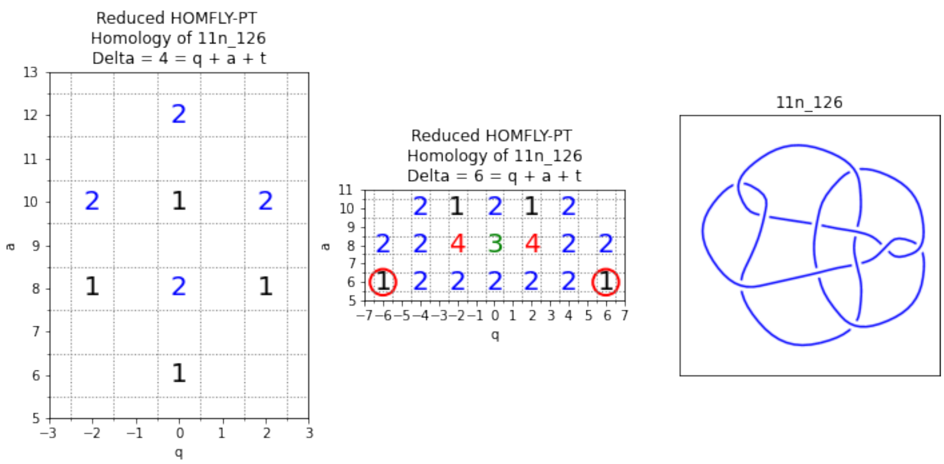
1.1. Let L be a link with r components. Khovanov and Rozansky defined [50] the triply graded link homology

$$\mathrm{HHH}(L) = \bigoplus_{i,j,k} \mathrm{HHH}^{i,j,k}(L)$$

and proved that it is a link invariant which categorifies the HOMFLY polynomial:

$$\sum (-1)^j q^i a^k \dim \mathrm{HHH}^{i,j,k}(L) = \mathcal{P}_L(a,q).$$

For example, the Khovanov-Rozansky homology of the knot $11n_{126}$ is shown in the following figure:



It is visualized by slicing the three-dimensional lattice of gradings using so called Δ-grading, and (q, a)-gradings are represented by vertical and horizontal axis in each slice. The numbers indicate the rank of homology group in each degree, so the total dimension equals 51.

It is clear in this example that the ranks of homology are **symmetric** around the vertical axis in each Δ-grading, and a more careful inspection reveals that they are **unimodular** in each horizontal line and each remaider of q-grading modulo 4. This motivates the following result which was conjectured by Dunfield, Gukov and Rasmussen in [9] and remained open for over 15 years:

Theorem 1 ([22]). *For any knot K, there is an action of the Lie algebra $\mathfrak{sl}(2)$ on $\mathrm{HHH}(K)$ which implies this symmetry and unimodality.*

For links with $r > 1$ components, $\mathrm{HHH}(L)$ is infinite-dimensional and naturally a module over the polynomial ring $\mathbb{C}[x_1, \ldots, x_r]$. In [21] Hogancamp and I defined a deformation, or "y-ification" of this construction denoted by $\mathrm{HY}(L)$. which is a module over a larger polynomial ring $\mathbb{C}[x_1, \ldots, x_r, y_1, \ldots, y_r]$. The results of [21] prove that $\mathrm{HY}(L)$ often behaves better than $\mathrm{HHH}(L)$ and is easier to compute. For example:

Theorem 2 ([21]). *(a) Let $L = T(n, kn)$ be the torus link with n unknotted components, which have pairwise linking number $k \geq 0$. Then*

$$\mathrm{HY}(T(n, kn)) \simeq \bigcap_{i \neq j} (x_i - x_j, y_i - y_j, \theta_i - \theta_j)^k \subset \mathbb{C}[x_1, \ldots, x_n, y_1, \ldots, y_n, \theta_1, \ldots, \theta_n]$$

where the variables x_i and y_i are even and the variables θ_i are odd. The isomorphism preserves the three gradings and agrees with the action of $\mathbb{C}[x_1, \ldots, x_n, y_1, \ldots, y_n]$.

(b) Furthermore,

$$\mathrm{HHH}(T(n, kn)) \simeq \frac{\mathrm{HY}(T(n, kn))}{(\mathbf{y})\,\mathrm{HY}(T(n, kn))}$$

where $(\mathbf{y}) = (y_1, \ldots, y_n)$. This isomorphism agrees with the action of $\mathbb{C}[x_1, \ldots, x_n]$.

Theorem 2 demonstrates that sometimes the easiest way to compute and describe $\mathrm{HHH}(L)$ would be to present it as a quotient of $\mathrm{HY}(L)$. Another striking feature of this result is the symmetry between x_i and y_i which becomes transparent only after y-ification. This symmetry is not a coincidence, and is, in fact, a general phenomenon.

Theorem 3 ([22]). *There exist operators F_k on $\mathrm{HY}(L)$ such that the following equations hold:*

(a) We have $[F_k, F_l] = 0,\ [F_k, x_i] = 0,\ [F_k, y_i] = kx_i^{k-1}$. In particular, F_k define a family of commuting operators on $\mathrm{HY}(L)$.

(b) The operator F_2 satisfies a "hard Lefschetz" condition and lifts to an action of $\mathfrak{sl}_2$ on $\mathrm{HY}(L)$. As a corollary, $\mathrm{HY}(L)$ is symmetric.

(c) The symmetry exchanges the actions of x_i and y_i in $\mathrm{HY}(L)$.

The construction of the operators F_k opens up a natural problem:

Problem 4. *Describe the action of F_k explicitly for knots and links where $\mathrm{HHH}(K)$ and $\mathrm{HY}(L)$ are known, in particular, for all torus links.*

It is worth to mention that several other interesting operators in link homology were recently constructed. In particular, Khovanov and Rozansky defined a Witt algebra action [51] while Elias and Qi defined [11] an action of $\mathfrak{sl}_2$ which is different from the one in Theorem 3.

Problem 5. *Find a precise relation between the operators F_k and the actions of Witt algebra and $\mathfrak{sl}_2$ from [11, 51].*

1.2. The above results are motivated by the ongoing work in building algebro-geometric models for link homology. The first one uses the **Hilbert scheme of points on the plane**. It is a complex manifold which plays a prominent role in modern geometric representation theory, algebraic combinatorics and mathematical physics. I have been working on a large collaborative project focused on understanding the relations between the knot homology and Hilbert scheme. It started with the following conjecture that I first formulated in 2010.

Conjecture 6. [16] *The bigraded dimensions of Khovanov-Rozansky homology of the* $(n, n+1)$ *torus knot are described by the* q,t*-Catalan numbers* $c_n(q,t)$.

The conjecture was proved by Matthew Hogancamp in 2017 [45]. The q,t-Catalan numbers were introduced by Garsia and Haiman in their work on combinatorics of Macdonald polynomials. They are closely related to the spaces of sections of certain line bundles on the Hilbert scheme of points. More precisely, let T denote the tautological vector bundle of rank n on $\mathrm{Hilb}^n(\mathbb{C}^2)$ and let $\mathcal{O}(1) = \wedge^n(T)$. Let $\mathrm{Hilb}^n(\mathbb{C}^2, 0)$ denote the punctual Hilbert scheme of points, then

$$c_n(q,t) = H^0(\mathrm{Hilb}^n(\mathbb{C}^2, 0), \mathcal{O}(1)).$$

This was generalized in [36, 56, 46] to other torus links, where the Poincaré polynomial of HOMFLY homology can be expressed in terms of Elliptic Hall Algebra and rational Catalan combinatorics.

In a joint work with Andrei Neguț and Jacob Rasmussen, we have developed a blueprint for a more general framework which includes all of the above results as special cases. In short, our main conjecture reads as follows:

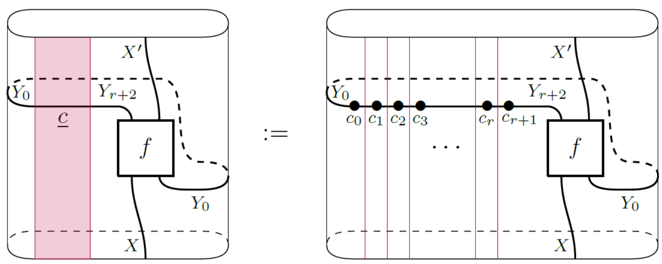
Conjecture 7. [37] *Given a braid* β *on* n *strands, there exists a vector bundle (or a coherent sheaf)* $\mathcal{F}_\beta$ *on the Hilbert scheme of* n *points such that the Khovanov-Rozansky homology* $\mathrm{HHH}(\beta)$ *of the closure of* β *is isomorphic to*

$$\mathrm{HHH}(\beta) = H^*(\mathrm{Hilb}^n(\mathbb{C}^2), \mathcal{F}_\beta \otimes \wedge^\bullet T^*),$$

where T, *as above, denotes the tautological bundle on the Hilbert scheme. Furthermore, adding a full twist to* β *corresponds to the tensor product of* $\mathcal{F}_\beta$ *with* $\mathcal{O}(1)$.

There is also a similar conjecture for the y-ified link homology. Note that the action of x_i and y_i in link homology is very clear in this model as $(x_1, y_1), \ldots, (x_n, y_n)$ are the coordinates of n points on $\mathbb{C}^2$. The linear action of the Lie group $SL(2)$ on $\mathbb{C}^2$ yields an action of the Lie algebra $\mathfrak{sl}_2$ in link homology from Theorem 3. The ideals appearing in Theorem 2 also have a natural interpretation in terms of the Procesi bundle on the Hilbert scheme [44].

A series of papers by Oblomkov and Rozansky [59, 60, 61, 62, 63, 64, 65, 66] proved Conjecture 7 on the level of link homology, the comparison of various more subtle structures (such as the tautological classes F_k) remains an important open direction of research. Another approach was proposed in my joint work with Hogancamp and Wedrich [24, 43] which uses the formalism of derived categorical traces illustrated by the following figure:



1.3. Another model of HOMFLY homology uses **braid varieties** $X(\beta)$ which can be defined for arbitrary positive braids β. These varieties were first defined by Mellit in [57], my collaborators and I have further studied them in [6, 7, 8]. They are also closely related to other varieties appearing earlier in Deligne-Lusztig theory. As shown in [7], examples of braid varieties include all open Richardson and positroid varieties [52]. For example, torus links correspond to the maximal positroid cells in the Grassmannians.

In the examples of interest, the braid varieties are smooth but noncompact, and hence carry an interesting weight structure in cohomology. They also admit a natural torus action, and the equivariant cohomology with weight filtration $\mathrm{gr}_W H^*_T(X(\beta))$ is isomorphic to the subspace of $\mathrm{HHH}(\beta)$ of maximal a-degree [69]. An extension of this construction to all a-degrees was recently proposed by Trinh [69]. Finding an explicit basis in this cohomology remains an important open problem.

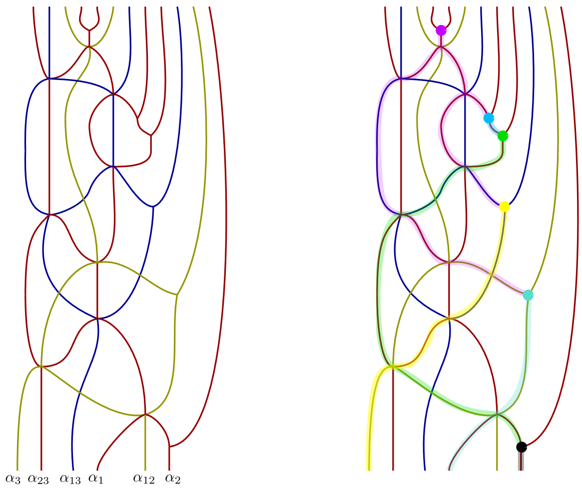
The action of the operators x_i corresponds to the equivariant parameters $H^*_T(\mathrm{pt})$. The tautological operators F_k from Theorem 3 correspond to differential forms on $X(\beta)$ which have been constructed by Mellit [57].

In a different direction, braid varieties turn out to have remarkable geometric properties:

Theorem 8 ([8])**.** *For any positive braid β the braid variety $X(\beta)$ has a structure of a cluster variety.*

Geometrically, a cluster structure provides $X(\beta)$ with a (possibly infinite) collection of open algebraic tori with a specific choice of coordinates, and the transition functions between them are given by **cluster mutations**. Combinatorally ,the cluster structure assigns a **quiver** to each of these tori, and the quivers for different charts are related by **quiver mutations**.

The construction of these tori is motivated by topology and is represented by planar diagrams (called **weaves**):



The egdes in such a weave correspond to generators of the braid group, while the vertices correspond to various ways to simplify a braid. Namely, the 6-valent and 4-valent vertices correspond to braid relations while 3-valent vertices correspond to moves $\sigma_i\sigma_i \to \sigma_i$. Said differently, a weave encodes a "movie" of braids which corresponds to a 2-dimensional surface in $\mathbb{R}^4$. In [8] we define a collection of 1-cycles in a surface (colored on the right), and the quiver encodes the intersections between these cycles:

$$\begin{tikzcd}
A_1 \arrow[rr] \arrow[dr] \arrow[rrrd] & & A_2 \arrow[rr] & & A_3 \arrow[llll, bend right, "2"'] \arrow[dr] & \\
& A_4 \arrow[rrru] & & A_5 \arrow[ru] & & A_6.
\end{tikzcd}$$

For example,the vertices A_1 and A_3 in the quiver correspond, respectively, to purple and green cycles in the weave, which intersect twice.

Problem 9. *How does the cluster structure on $X(\beta)$ influence its homology (and hence* $\mathrm{HHH}(\beta)$*)?*

As an example of such a relation, the cluster structure yields a natural 2-form on $X(\beta)$. It turns out that this form is closed and hence define a class in $H^2(X(\beta))$ which agrees with the tautological class F_2 from Theorem 3.

1.4. Finally, yet another model for HOMFLY homology is related to Hilbert schemes of points on singular curves and **affine Springer fibers**. These can be defined for arbitrary algebraic links, that is, intersections of (complex) plane curve singularities with a small sphere. For example, the curve $x^2 = y^2$ corresponds to a pair of linked circles, and the curve $x^2 = y^3$ corresponds to the trefoil knot. The number of connected components of a link equals the number of (local) irreducible components of a curve.

A conjecture of Oblomkov, Rasmussen and Shende [67] relates the Khovanov-Rozansky homology of an algebraic link to the cohomology of Hilbert schemes of points on the corresponding curve $\mathrm{Hilb}^\bullet(C)$. These are compact, but usually singular varieties. In many examples of interest (for example, for all torus knots) the Hilbert schemes can be paved by affine cells, and hence their homology can be described combinatorially. In [32, 31, 34] my collaborators and I have compared the combinatorics of this cell decomposition to q,t-Catalan numbers which allowed us to compare it with link homology [33].

A related variety is the affine Springer fiber Sp_γ in the affine Grassmannian, which can be associated to an arbitrary $\mathbb{C}[[x]]$-valued matrix γ. The characteristic polynomial of such matrix then depends on two variables and defines a plane curve singularity as above. The homology of the varieties $\mathrm{Hilb}^\bullet(C)$ and of Sp_γ are closely related, while the latter has a natural pair of commuting actions of a torus and of a lattice, both of rank equal to the number of components of the curve. This allows one to define the action of two polynomial algebras in cohomology similar to y-ification. The case of the full twist corresponds to the so-called unramified affine Springer fiber, see [47, 48] for details and comparison with Theorem 2.

Both $\mathrm{Hilb}^\bullet(C)$ and of Sp_γ have deep connections to geometric representation theory. In particular, Garner and Kivinen proved in [13] that $\mathrm{Hilb}^\bullet(C)$ has an action of the *Coulomb branch algebra* defined by Braverman, Finkelberg and Nakajima [4]. The combinatorics of this action for torus links was studied in my paper with Simental and Vazirani [42] (see also [12, 41]).

Problem 10. *Describe the action of the Coulomb branch algebra in HOMFLY homology of algebraic links. Describe its relation with the operators F_k from Theorem 3.*

Furthermore, in a paper with Kivinen and Oblomkov [26] I have studied the family of affine Springer fibers $\mathrm{Sp}_\gamma, \mathrm{Sp}_{t\gamma}, \mathrm{Sp}_{t^2\gamma}\ldots$ which correspond to a sequence of algebraic links related by powers of the full twist. We have proved that their homology together form a graded module over a graded version of the Coulomb branch algebra, and a sheaf on the associated projective variety. In type A, we identified the variety with the Hilbert scheme of points on $\mathbb{C}\times\mathbb{C}^*$, and expect the sheaf to be closely related to the one from Conjecture 7. This expectation is confirmed in many examples.

2. Heegaard–Floer homology

Unlike HOMFLY homology, Heegaard Floer homology [68] is defined in geometric terms using the Heegaard decompositions of 3-manifolds and Lagrangian Floer homology. It categorifies the Alexander polynomial. In a series of joint papers with András Némethi we have computed the Heegaard Floer homology of all algebraic links and related them to certain hyperplane arrangements in the space of algebraic functions on C and to the multi-dimensional semigroup of C.

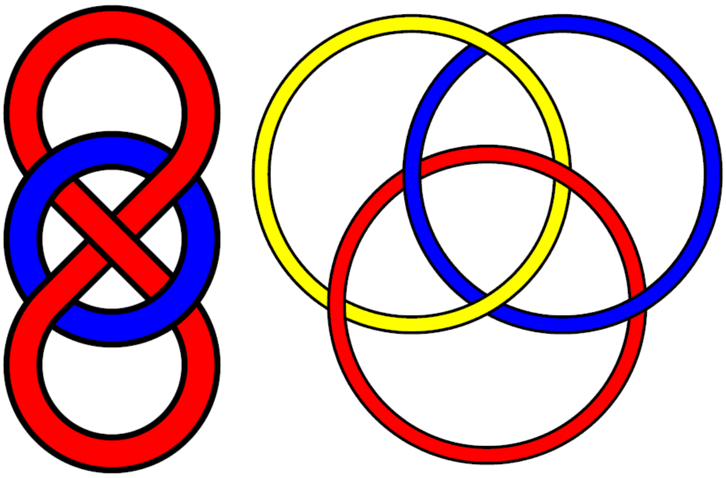
Theorem 11. [40] *Let $\mathcal{H}(v_1, \ldots, v_n)$ be the space of algebraic functions on C which have order v_1 on the component C_1, order v_2 on the component C_2 etc. Then:*

(a) The space $\mathcal{H}(v_1, \ldots, v_n)$ is either empty or it is a complement to a hyperplane arrangement.

(b) The homology of $\mathcal{H}(v_1, \ldots, v_n)$ is isomorphic to the (minus-version of) Heegaard Floer homology of the link L in Alexander grading $(v_1, \ldots, v_n)$.

Since the homology of a hyperplane arrangement is determined by its combinatorics, this theorem combined with the results of [17] provides an explicit method of computing the Heegaard Floer homology of algebraic link. In particular, in [25] Hom and I proved a conjecture of Joan Licata on the structure of this homology for (n, n) torus links. Némethi and I also studied a surprising connection between the links of plane curve singularities and of rational surface singularities via Dehn surgery [38, 39].

In a joint work with Maciej Borodzik [2], we used Heegaard Floer homology to bound the splitting numbers of links (minimal number of crossings that should be changed to separate the components of a link). In joint papers with Lidman, Liu and Moore [28, 29] we described the relation between the Heegaard Floer homology and higher analogues of the linking number such as Sato-Levine and Milnor triple linking invariants. We also studied the Heegaard Floer homology of Dehn surgeries on links with several components and proved that Heegaard Floer homology detects the Whitehead link and the Borromean rings:



3. Further results

1) I have obtained an explicit formula for the generating function of S_n–equivariant Euler characteristics of the moduli spaces $\mathcal{M}_{g,n}$ of genus g curves with n marked points [14]. I have also obtained a similar formula for the moduli spaces of hyperelliptic curves [18, 19].

2) In a joint work with Andrei Neguț [35] we studied K-theoretic stable bases (in the sense of Maulik-Okounkov [58]) for the Hilbert schemes of points, and conjectured a precise relation between the wall-crossing matrices for these bases and the involutions on the q-Fock space studied by Leclerc and Thibon [54]. The conjecture has been recently verified by Kononov and Smirnov [53].

3) In a joint work with Erik Carlsson and Anton Mellit [5] we gave a geometric interpretation of the Dyck path algebra $\mathbb{A}_{q,t}$, which appeared in their proof of Shuffle Conjecture [3], using parabolic Hilbert schemes of points on the plane.

4) In a joint work with Anna Beliakova [1] we have related Habiro's cyclotomic expansion of colored link invariants to the interpolation Macdonald polynomials and presented explicit formulas for these invariants.

References

[1] A. Beliakova, E. Gorsky. Cyclotomic expansions for $gl(N)$ knot invariants via interpolation Macdonald polynomials. arXiv:2101.08243

[2] M. Borodzik, E. Gorsky. Immersed concordances of links and Heegaard Floer homology. Indiana Univ. Math. J. 67 (2018), 1039–1083.

[3] E. Carlsson, A. Mellit. A proof of the shuffle conjecture. J. Amer. Math. Soc. 31 (2018), no. 3, 661–697.

[4] A. Braverman, M. Finkelberg, H. Nakajima. Towards a mathematical definition of Coulomb branches of 3-dimensional $N = 4$ gauge theories, II. Adv. Theor. Math. Phys. 22 (2018), no. 5, 1071–1147.

[5] E. Carlsson, E. Gorsky, A. Mellit. The $\mathbb{A}_{q,t}$ algebra and parabolic flag Hilbert schemes. Mathematische Annalen 376 (2020), 1303–1336.

[6] R. Casals, E. Gorsky, M. Gorsky, J. Simental. Algebraic weaves and braid varieties. arXiv:2012.06931

[7] R. Casals, E. Gorsky, M. Gorsky, J. Simental. Positroid Links and Braid varieties. arXiv:2105.13948

[8] R. Casals, E. Gorsky, M. Gorsky, I. Le, L. Shen, J. Simental. Cluster structures on braid varieties. arXiv:2207.11607

[9] N. Dunfield, S. Gukov, J. Rasmussen, The superpolynomial for knot homologies, Experiment. Math. 15 (2006), no. 2, 129–159.

[10] B. Elias, M. Hogancamp. On the computation of torus link homology. Compos. Math. 155 (2019), no. 1, 164–205.

[11] B. Elias, Y. Qi. Actions of $\mathfrak{sl}_2$ on algebras appearing in categorification. arXiv:2103.00048

[12] P. Etingof, E. Gorsky, I. Losev. Representations of Rational Cherednik algebras with minimal support and torus knots. Advances in Mathematics 277 (2015), 124-180.

[13] N. Garner, O. Kivinen. Generalized affine Springer theory and Hilbert schemes on planar curves. Internat. Math. Res. Notices rnac038, DOI 10.1093/imrn/rnac038

[14] E. Gorsky. The equivariant Euler characteristic of moduli spaces of curves. Advances in Mathematics 250 (2014), 588–595.

[15] E. Gorsky. Arc spaces and DAHA representations. Selecta Mathematica, New Series, 19 (2013), no. 1, 125–140.

[16] E. Gorsky. q,t-Catalan numbers and knot homology. Zeta Functions in Algebra and Geometry, 213–232. Contemp. Math. 566 , Amer. Math. Soc., Providence, RI, 2012.

[17] E. Gorsky. Combinatorial computation of the motivic Poincaré series. Journal of Singularities, 3 (2011), 48–82.

[18] E. Gorsky. Adams Operations and Power Structures. Moscow Mathematical Journal, 9 (2009), no. 2, 305–323.

[19] E. Gorsky. On the S_n-equivariant Euler characteristic of moduli spaces of hyperelliptic curves. Mathematical Research Letters, 16 (2009), no. 4, pp. 591–603.

[20] E. Gorsky, S. Gukov and M. Stošić. Quadruply-graded colored homology of knots. Fundamenta Mathematicae 243 (2018) , 209–299.

[21] E. Gorsky, M. Hogancamp. Hilbert schemes and y-ification of Khovanov-Rozansky homology. Geometry & Topology 26 (2022) 587–678.

[22] E. Gorsky, M. Hogancamp, A. Mellit. Tautological classes and symmetry in Khovanov-Rozansky homology. arXiv:2103.01212

[23] E. Gorsky, M. Hogancamp, A. Mellit, K. Nakagane. Serre duality for Khovanov-Rozansky homology. Selecta Mathematica, 25 (2019), no. 5, Article 79.

[24] E. Gorsky, M. Hogancamp, P. Wedrich. Derived traces of Soergel categories. Internat. Math. Res. Notices 2022 (2022), no.15, 11304–11400.

[25] E. Gorsky, J. Hom. Cable links and L-space surgeries. Quantum Topology 8 (2017), no.4, 629–666.

[26] E. Gorsky, O. Kivinen, A. Oblomkov. The affine Springer fiber - sheaf correspondence. arXiv:2204.00303

[27] E. Gorsky, O. Kivinen, J. Simenal. Algebra and geometry of link homology. To appear in Bulletin of the London Mathematical Society. arXiv:2108.10356
[28] E. Gorsky, B. Liu and A. Moore. Surgery on links of linking number zero and the Heegaard Floer d-invariant. Quantum Topology 11 (2020), 323–378.
[29] E. Gorsky, T. Lidman, B. Liu, A. Moore. Triple linking numbers and Heegaard Floer homology. Internat. Math. Res. Notices. DOI 10.1093/imrn/rnab368
[30] E. Gorsky, M. Mazin. Rational Parking Functions and LLT Polynomials. Journal of Combinatorial Theory, Series A, 140 (2016), 123-140.
[31] E. Gorsky, M. Mazin. Compactified Jacobians and q, t-Catalan numbers, II. Journal of Algebraic Combinatorics, 39 (2014), no. 1, 153–186.
[32] E. Gorsky, M. Mazin. Compactified Jacobians and q, t-Catalan Numbers, I. Journal of Combinatorial Theory, Series A, 120 (2013) 49–63.
[33] E. Gorsky, M. Mazin, M. Vazirani. Recursions for rational q, t-Catalan numbers. J. Combin. Theory Ser. A 173 (2020), 105237, 28 pp.
[34] E. Gorsky, M. Mazin and M. Vazirani. Affine permutations and rational slope parking functions. Trans. Amer. Math. Soc. 368 (2016), 8403–8445.
[35] E. Gorsky, A. Neguț. Infinitesimal change of stable basis. Selecta Mathematica, New Series. Selecta Mathematica, New Series, 23 (2017), no. 3, 1909–1930.
[36] E. Gorsky, A. Neguț. Refined knot invariants and Hilbert schemes. Journal de Mathématiques Pures and Appliquées 104 (2015), 403–435.
[37] E. Gorsky, A. Neguț and J. Rasmussen. Flag Hilbert schemes, colored projectors and Khovanov-Rozansky homology. Advances in Mathematics 378 (2021) 107542.
[38] E. Gorsky, A. Némethi. On the set of L-space surgeries for links. Advances in Mathematics 333 (2018), 386–422.
[39] E. Gorsky, A. Némethi. Links of plane curve singularities are L-space links. Algebraic and Geometric Topology 16 (2016) 1905–1912.
[40] E. Gorsky, A. Némethi. Lattice and Heegaard-Floer homologies of algebraic links. Int. Math. Res. Not. IMRN 2015, no. 23, 12737–12780.
[41] E. Gorsky, A. Oblomkov, J. Rasmussen and V. Shende. Torus knots and the rational DAHA. Duke Math. J. 163 (2014), no. 14, 2709–2794.
[42] E. Gorsky, J. Simental, M. Vazirani. Parabolic Hilbert schemes via the Dunkl-Opdam subalgebra. Transformation Groups. DOI 10.1007/s00031-022-09743-7
[43] E. Gorsky, P. Wedrich. Evaluations of annular Khovanov-Rozansky homology. arXiv:1904.04481
[44] M. Haiman. Hilbert schemes, polygraphs and the Macdonald positivity conjecture. J. Amer. Math. Soc. 14 (2001), no. 4, 941–1006.
[45] M. Hogancamp. Khovanov-Rozansky homology and higher Catalan sequences. arXiv:1704.01562
[46] M. Hogancamp, A. Mellit. Torus link homology. arXiv:1909.00418
[47] O. Kivinen. Hecke correspondences for Hilbert schemes of reducible locally planar curves. Algebr. Geom. 6 (2019), no. 5, 530–547.
[48] O. Kivinen. Unramified affine Springer fibers and isospectral Hilbert schemes. Selecta Math. (N.S.) 26 (2020), no. 4, Paper No. 61, 42 pp.
[49] M. Khovanov. A categorification of the Jones polynomial. Duke Math. J. 101 (2000), no. 3, 359–426.
[50] M. Khovanov, L. Rozansky. Matrix factorizations and link homology. II. Geom. Topol. 12 (2008), no. 3, 1387–1425.
[51] M. Khovanov, L. Rozansky. Positive half of the Witt algebra acts on triply graded link homology. Quantum Topol. 7 (2016), no. 4, 737–795.
[52] A. Knutson, T. Lam, D. Speyer. Positroid varieties: juggling and geometry. Compos. Math. 149 (2013), no. 10, 1710–1752.
[53] Ya. Kononov, A. Smirnov. Pursuing Quantum Difference Equations II: 3D mirror symmetry. Internat. Math. Res. Notices rnac196, DOI 10.1093/imrn/rnac196.
[54] B. Leclerc, J.-Y. Thibon. Canonical bases of q-deformed Fock spaces. Internat. Math. Res. Notices 1996, no. 9, 447–456.
[55] A. Mellit. Toric braids and (m, n)-parking functions. Duke Math. J. 170 (2021), no. 18, 4123–4169.
[56] A. Mellit. Homology of torus knots. Geom. Topol. 26 (2022), no. 1, 47–70.
[57] A. Mellit. Cell decompositions of character varieties. arXiv:1905.10685
[58] D. Maulik, A. Okounkov. Quantum Groups and Quantum Cohomology. Astérisque No. 408 (2019), ix+209 pp.

[59] A. Oblomkov, L. Rozansky. Knot homology and sheaves on the Hilbert scheme of points on the plane. Selecta Math. (N.S.) 24 (2018), no. 3, 2351–2454.
[60] A. Oblomkov, L. Rozansky. Affine braid group, JM elements and knot homology. Transform. Groups 24 (2019), no. 2, 531–544.
[61] A. Oblomkov, L. Rozansky. HOMFLYPT homology of Coxeter links. arXiv:1706.00124
[62] A. Oblomkov, L. Rozansky. A categorification of a cyclotomic Hecke algebra. arXiv:1801.06201
[63] A. Oblomkov, L. Rozansky. Categorical Chern character and braid groups. arXiv:1811.03257
[64] A. Oblomkov, L. Rozansky.3D TQFT and HOMFLYPT homology. arXiv:1812.06340
[65] A. Oblomkov, L. Rozansky. Dualizable link homology. arXiv:1905.06511
[66] A. Oblomkov, L. Rozansky. Soergel bimodules and matrix factorizations. arXiv:2010.14546
[67] A. Oblomkov, J. Rasmussen and V. Shende. The Hilbert scheme of a plane curve singularity and the HOMFLY homology of its link. With appendix by E. Gorsky. Geometry & Topology 22 (2018) 645-691.
[68] P. Ozsváth, Z. Szabó. Holomorphic disks and knot invariants. Adv. Math. 186 (2004), no. 1, 58–116.
[69] M.-T. Trinh. From the Hecke Category to the Unipotent Locus. arXiv:2106.07444