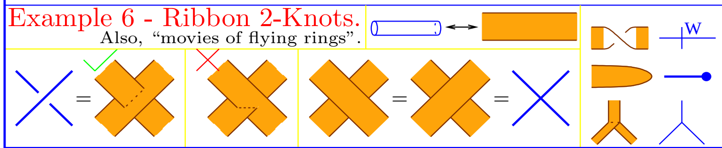
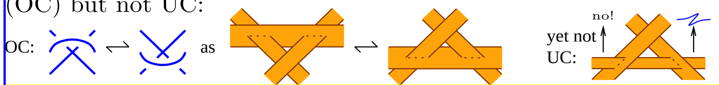
Facts and Dreams About v−Knots and Etingof−Kazhdan, 2

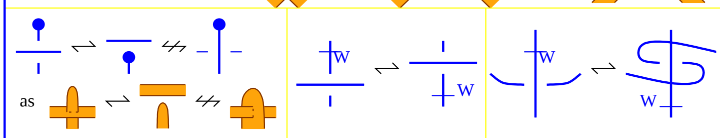
Example 6 - Ribbon 2-Knots.

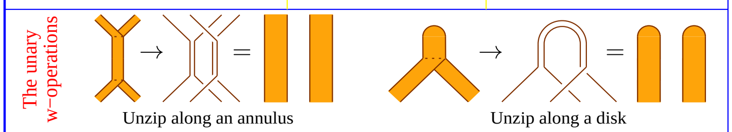
Also, "movies of flying rings".



The w-relations include R234, VR1234, D, Overcrossings Commute (OC) but not UC:



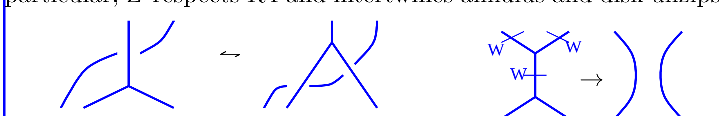




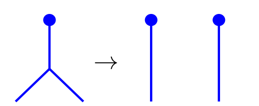
Trivalent w-Tangles. 30

$$wTT = PA\left\langle \text{w-generators} \middle| \text{w-relations} \middle| \text{unary w-operations} \right\rangle = CA\left\langle \begin{matrix}\text{same}\\ \text{w/o} \times\end{matrix}\right\rangle$$

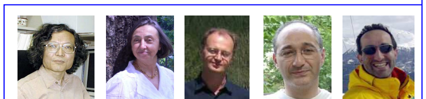
Theorem. There exists a homomorphic expansion Z for wTT. In particular, Z respects $R4$ and intertwines annulus and disk unzips:



$V\cdot(\Delta\otimes 1)(R) = R^{13}R^{23}V$ in $\mathcal{A}^w(\uparrow_3)$ $\qquad VV^* = I$ in $\mathcal{A}^w(\uparrow_2)$



$V\cdot\Delta(\omega) = \omega\otimes\omega$ in $\mathcal{A}^w(\uparrow_2)$



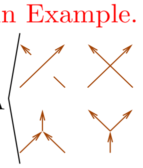
Kashiwara-Vergne-Alekseev-Enriquez-Torrosian

Alekseev-Torossian [AT] (equivalent to Kashiwara-Vergne [KV]). There are elements $F\in \mathrm{TAut}_2$ and $a\in \mathfrak{tr}_1$ such that

$$F(x+y) = \log e^x e^y \quad\text{and}\quad jF = a(x) + a(y) - a(\log e^x e^y). \quad 33$$

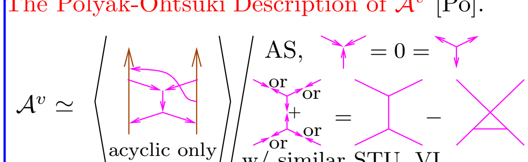
Theorem. That's equivalent to a homomorphic expansion for wTT.

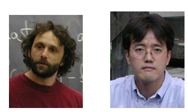
The Main Example.



$$vTT = PA\left\langle \cdots \middle| \begin{matrix}\text{R234, VR234, D,}\\ \text{yet not UC, OC}\end{matrix} \middle| \text{unzips}\right\rangle = \widetilde{CA}\left\langle \begin{matrix}\text{same}\\ \text{w/o} \times\end{matrix}\right\rangle$$

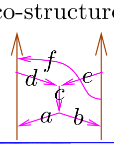
The Polyak-Ohtsuki Description of $\mathcal{A}^v$ [Po].





Polyak Ohtsuki 36

$\mathcal{A}^v$ pairs with Lie bialgebras. Let $\mathfrak{g}_+$ be a Lie bialgebra with basis X_a, bracket $[\cdot,\cdot]$, cobracket δ, dual $\mathfrak{g}_- = \mathfrak{g}_+^\star$, dual basis X^a for $\mathfrak{g}_-$, double $\mathfrak{g} = \mathfrak{g}_+\oplus\mathfrak{g}_-$, structure constants $[X_a,X_b] = \sum b_{ab}^c X_c$ and co-structure constants $\delta(X_a) = \sum c_a^{bc} X_b\otimes X_c$. Then



$$\longrightarrow \sum_{a,b,c,d,e,f=1}^{\dim\mathfrak{g}} b_{de}^c c_c^{ba} X_a X^d X_f \otimes X_b X^f X^e \in \mathcal{U}(\mathfrak{g})^{\otimes 2} \quad 39$$

Forbidden Theorem [EK, Ha, ?]. There exists a homomorphic expansion Z for vTT.

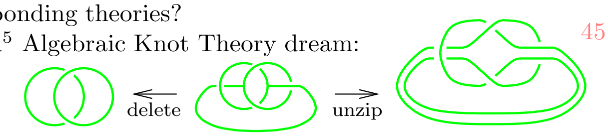
Etingof Haviv Kazhdan

Why Forbidden (to me)?

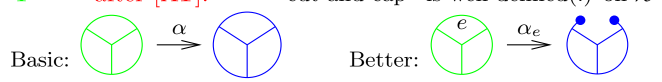
- Minor statement details may be off.
- No fully written proof.
- I don't understand the proof.
- There isn't yet a knot-theoretic view of the proof, like there is in the w-case. 42

Why Should We Care?

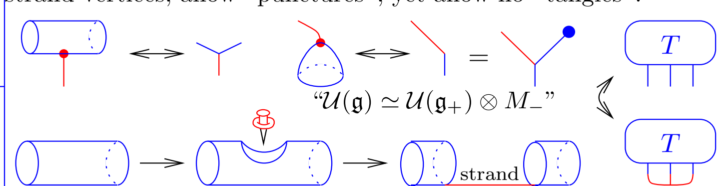
- A gateway into the forbidden territory of "quantum groups".
- Abstractly more pleasing: We study the things, and not just their representations.
- $\mathcal{A}^v$ is sometimes easier than $\mathcal{A}^u$: Alexander, say, arises easily from the 2D Lie algebra[4].
- Potentially, $\mathcal{A}^v$ has many more "internal quotients" than there are Lie bialgebras. What are they and what are the corresponding theories?
- My old[5] Algebraic Knot Theory dream: 45



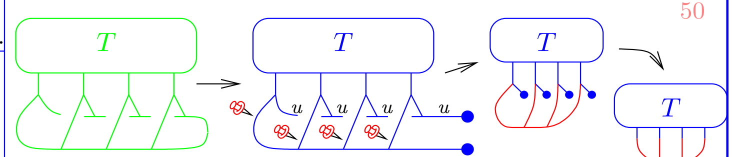
$V\to\Phi^{\text{1-loop}}$ after [AT]. "cut and cap" is well-defined(!) on $\mathcal{K}^u$

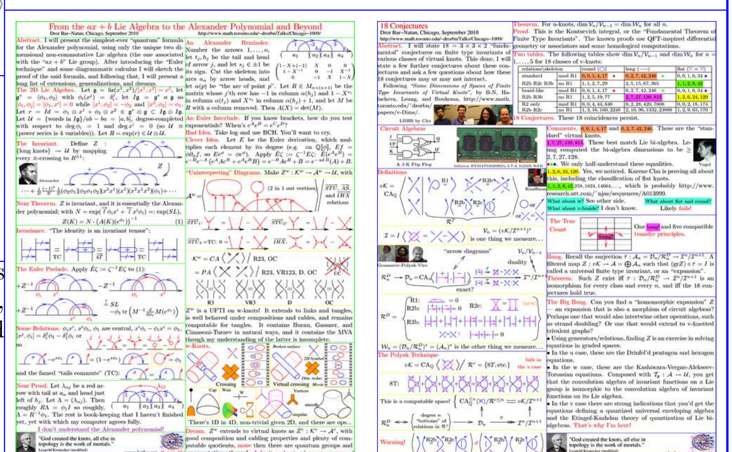


$\Phi\to V$ after [AET]. In $\mathcal{K}^{\overline{w}}$ allow tubes and strands and tube-strand vertices, allow "punctures", yet allow no "tangles".

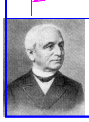


The generators of $\mathcal{K}^{\overline{w}}$ can be written in terms of the generators of $\mathcal{K}^u$ (i.e., given Φ, can write a formula for V). With T any classical tangle, esp. [diagram] or [diagram], consider the "sled" 50





Alexander is easy! In Chicago, [BN4] Many kinds of virtuals!



"God created the knots, all else in topology is the work of mortals."
Leopold Kronecker (modified)

www.katlas.org

Help Needed!

Video and more at http://www.math.toronto.edu/~drorbn/Talks/SwissKnots-1105/