Plan

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Keyword. SolvApp (170126c) In gl_n^ϵ: $[U,U]=U$, $[L,L]=\epsilon L$, $[L,U]=L+\epsilon U$.

Title. What else can you do with solvable approximations?

Abstract. Recently, Roland van der Veen and myself found that there are sequences of solvable Lie algebras "converging" to any given semi-simple Lie algebra (such as sl(2) or sl(3) or E8). Certain computations are much easier in solvable Lie algebras; in particular, using solvable approximations we can compute in polynomial time certain projections (originally discussed by Rozansky) of the knot invariants arising from the Chern-Simons-Witten topological quantum field theory. This provides us with the first strong knot invariants that are computable for truly large knots.

But sl(2) and sl(3) and similar algebras occur in physics (and in mathematics) in many other places, beyond the Chern-Simons-Witten theory. Do solvable approximations have further applications?

Sketch.

1. Thanks for the invitation, sorry for being sketchy.
2. Half of gl(n) is enough!
3. The more down-to-Earth view of same.
4. gl(n)^\epsilon, gl(n)^k.
5. Not our issue, but analogous to it: MatrixExp, BCH is impossible for gl(n), yet possible for gl(n)^k (though the complexity increases rapidly in n,k). Include a Mathematica Demo with pop-up evaluations.
6. Chern-Simons-Witten, invariants from algebras.
7. The failure of representation theory.
8. My success with VDV.
9. What else can you do with this?
10. Include the GWU handout.