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3D sigma models with defects and knot homology

Talk is based on the joint work with Lev Rozansky. In our work we construct a mathematical model for the gauged Kapustin-Rozansky-Saulina 3D sigma model with defects. The targets of the sigma model are the cotangent bundles to Lie algebras $\mathfrak{gl}_n$. The source of the sigma models is $\mathbb{R}^2 \times S^1$. In the case when the surface defect is of the form $C \times S^1 \subset \mathbb{R}^2 \times S^1$ the value of the partition function on the surface $\mathbb{R}^2 \times$ point is equal to the Khovanov-Rozansky homology of the knot that projects to C. Physics leads us to a geometric realisation of the Ocneanu-Jones trace in terms of sheaves on the Hilbert scheme of points on the plane. We use our constructions to explicitly compute the homology of torus knots. We also prove Poincare duality for the homology of knots, the duality that was conjectured by Dunfield-Gukov-Rasmussen in 2005.