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TOPOLOGICAL POLYMERS AND RANDOM EMBEDDINGS OF GRAPHS

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ABSTRACT

Over the last few decades, substantial progress has been made is developing a rigorous mathematical theory of ring polymers (like DNA minicircles and mitochondrial DNA), mostly be researchers at the interface between knot theory and biology. Recently, chemists working on developing novel materials have made substantial progress in synthesizing so-called "topological polymers" which are modeled on more complicated graphs, including lassos, θ-curves, and even $K_{3,3}$ and K_4. Predicting the material properties of these polymers in solution requires a mathematical theory of random embeddings of graphs. Such a theory was developed by James, Guth, and Flory [1,2,3] in the 20th century to study elasticity, but only with simple Gaussian interactions between monomers. This talk describes a generalization of that theory [4] which can handle arbitrary interaction potentials, including freely-jointed networks and steric interactions.

Joint with Jason Cantarella, Tetsuo Deguchi, and Erica Uehara.

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[2] James, H.M. 1947 Statistical properties of networks of flexible chains. *J. Chem. Phys.* **15**, 651–668.
[3] Flory, P.J. 1976 Statistical thermodynamics of random networks. *Proc. R. Soc. Lond. A* **351**, 351–380.
[4] Cantarella, J., Deguchi, T., Shonkwiler, C., Uehara, E. 2022 Random graph embeddings with general edge potentials. arXiv: 2205.09049.