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Cyclic topology in polymer networks RUI WANG, ALFREDO ALEXANDER-KATZ, JEREMIAH JOHNSON, BRADLEY OLSEN, Massachusetts Institute of Technology — Despite the ubiquity of applications, much of our fundamental knowledge about polymer networks is based on an assumption of ideal end-linked structure. However, polymer networks invariably possess topological defects: loops of different orders which have profound effects on network properties. Here, we demonstrate that all different orders of cyclic topologies are a universal function of a single dimensionless parameter characterizing the conditions for network formation. The theory is in excellent agreement with both experimental measurements of hydrogel loop fractions and Monte Carlo simulations without any fitting parameters. We demonstrate the superposition of the dilution effect and chain-length effect on loop formation. The one-to-one correspondence between the network topology and primary loop fraction demonstrates that the entire network topology is characterized by measurement of just primary loops, a single chain topological feature. Different cyclic defects cannot vary independently, in contrast to the intuition that the densities of all topological species are freely adjustable.

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