Universal equation of state for polymer solutions

J. Paturej[abc] J.-U. Sommer[a] and T. Kreer[d]

[a] *Leibniz Institute for Polymer Research, Dresden, Germany*
[b] *University of Szczecin, Institute of Physics, Szczecin, Poland*
[c] *University of Silesia, Institute of Physics, Katowice, Poland*
  E–mail: jpaturej@univ.szczecin.pl
[d] *Johannes Gutenberg-Universität, Institute of Physics, Mainz Germany*

We reconsider the isothermal equation of state (EoS) for linear homopolymers in good solvents, $p = p(c, T)$, which relates the osmotic pressure, p, of polymers with the bulk concentration, c, and the temperature, T. The classical scaling theory predicts the EoS in dilute and semi-dilute regimes [1, 2]. We suggest a generalized EoS which extends the universal behavior of polymer solutions up to the highly concentrated state and confirmed it by molecular dynamics simulations and using available experimental data. Our conjecture implies that properties of polymer chains dominate the EoS in the presence of many-body interactions. Our theoretical approach is based on a viral expansion in terms of concentration blobs leading to a superposition of two power laws in the regime of concentrated solutions [3].

References

[1] P.-G. de Gennes, *Scaling concepts in polymer physics* (Cornell Univ. Press, New York, 1979).

[2] J. des Cloizeaux and G. Jannink, *Polymers in solution* (Clarendon Press, Oxford, 1990).

[3] J. Paturej, J.-U. Sommer and T. Kreer, *Phys. Rev. Lett.* **122**, 087801 (2019).