Erratum

Swelling of two-dimensional polymer rings by trapped particles

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We have found a technical error in Appendix A. This error affects equations (25–27) in the body of the paper and the resulting asymptotic curve in Figure 3. There is no effect on any of the qualitative results and conclusions as presented in the original paper.

The error lies in the stationary-phase approximation leading from equation (A.5) to equation (A.6). The second term in the exponent, arising from the second term in the asymptotic expansion of the modified Bessel function (Eq. (A.3)), is actually negligible compared to the $(pN)^{-N/2}$ factor. We rewrite equation (A.5) as

$$Z^{\text{FJ}}(N, A \lesssim A_{\text{max}}) \sim \int dp e^{ip(A_{\text{max}}-A)} (pN)^{-N/2}, \quad (\text{A.5})$$

which, upon a simple change of variables (or, alternatively, a stationary-phase approximation), readily yields

$$Z^{\text{FJ}}(N, A \lesssim A_{\text{max}}) \sim (A_{\text{max}} - A)^{N/2}. \quad (\text{A.6})$$

Thus, the $N/4$ exponent appearing in equations (A.6) and (A.7) of the original paper should be replaced with $N/2$. The same holds for equation (25) of Section 4.1.3,

$$P_0^{\text{FJ}}(N, A \lesssim A_{\text{max}}) \sim (A_{\text{max}} - A)^{N/2}. \quad (25)$$

This leads to the following corrected versions of equations (26) and (27):

$$Z^{\text{FJ}}(N, Q \gg N) = (A_{\text{max}})^{Q+N/2} \frac{\Gamma(1+N/2)}{\Gamma(1+N/2+Q)}, \quad (26)$$

$$\langle A^{\text{FJ}}(N, \hat{Q} \gg 1) \rangle \simeq A_{\text{max}} \frac{\hat{Q}}{\hat{Q} + 1/2} \simeq A_{\text{max}} \left(1 - \frac{1}{2\hat{Q}} \right). \quad (27)$$

Thus, the exact approach of the mean area to its maximum value differs from the mean-field result, equation (22), by a factor of $1/2$ (not $1/4$). Finally, Figure 3 is redrawn on the following page with the correct asymptote (corrected Eq. (27)).

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Fig. 3. Mean area of a freely jointed ring, scaled by $A_{\max}$, as a function of the rescaled particle number, as obtained by Monte Carlo simulations for $N = 50$ (symbols with error bars). The solid line shows the exact asymptote for a highly swollen ring (Eq. (27)). The dashed line presents the mean-field result (Eq. (22)).