Erratum: Long-Range Frustration in a Spin-Glass Model of the Vertex-Cover Problem [Phys. Rev. Lett. 94, 217203 (2005)]

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Some mistakes in the Letter [H. Zhou, Phys. Rev. Lett. 94, 217203 (2005)] are corrected.

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We found several mistakes in the Letter [1], which significantly affect the quantitative theoretical results.

The expression (5) for the long-range frustration order parameter R was wrong. For an unfrozen vertex i to be type-I unfrozen in graph G, one of its nearest neighbors (say j) must be positively frozen and facing the local environment of type (ii) in G' (the graph obtained by removing i and its edges from G). The correct formula for R is

$$R = \frac{c q_+^2}{q_0} \Big(1 - \frac{1}{q_+} e^{-c q_+ - c q_0 R} \Big).$$

R as a function of the mean vertex degree c is shown in the corrected Fig. 1. It is positive for $c > e = 2.718\ldots$ and its maximum is reached at $c \simeq 14.85$.

The self-consistent equation (4) for the size distribution $f(s)$ was wrong. The quantity p_1 of this expression should be replaced by $p_1' = p_1/(1-R)$, which is the conditional probability that a vertex i faces the environment of type (iii) given that i is a type-II unfrozen vertex in G. The function $f(s)$ satisfies $\sum_{s=0}^{\infty} f(s) = 1$.

Equation (6) for the fraction of covered vertices $X_{\rm min}$ was also wrong. According to the analysis in [2], the correct formula should be

$$X_{min} = \frac{1}{c} \int_0^c \big[1 - q_+(c') \big] {\rm d}c',$$

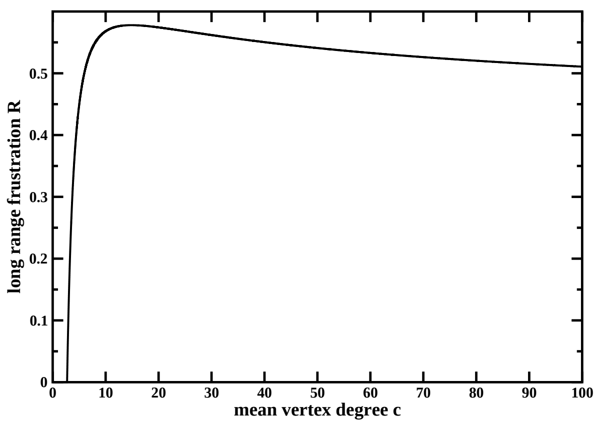

FIG. 1: The long-range frustration order parameter R.

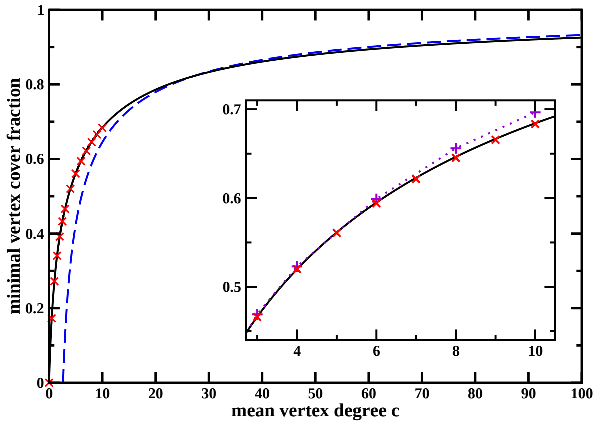

FIG. 2: (color online). The minimal vertex-cover fraction $X_{\rm min}$ (solid line) and its comparison with the asymptotic formula of Ref. [3] (dashed line), the numerical results of Ref. [4] ('+' symbols) and Ref. [5] ('×' symbols).

where $q_+(c)$ is the fraction of positively frozen vertices at mean vertex degree c. $X_{\rm min}$ as a function of c is shown in the updated Fig. 2. The theoretical prediction is in agreement with simulation results obtained on single large graphs [5], it is slightly lower than the enumeration result obtained on single small graphs [4]. When the mean vertex degree c is large, the value of $X_{\rm min}$ is slightly lower than the asymptotic result of [3].

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