

Response to Reviewer 1

Article reference: entropy-1991562

Title: What does it take to solve the 3D Ising model? Minimal necessary conditions for a valid solution

Below we address the points raised by Reviewer 1.

Reviewer 1 (Remarks to the author):

The paper deals with the minimum set of necessary conditions for an exact partition function of the 3D Ising model. The model was proposed by Wilhelm Lenz, and first analyzed by his then student Ernst Ising, who presented an exact solution for the 1D case in his thesis.

The paper brings new light to an old problem, as well as summarize several previous results in a simple and straightforward way.

Of the six necessary conditions presented in the manuscript, some of them are well known, like condition 2 (“The claimed partition function per site of the 3D model must reduce to Onsager’s solution whenever one of the three reduced temperatures vanishes”), while others are often overlooked, like condition 1 regarding independence, in the thermodynamic limit, of the per-site partition function independent on the boundary conditions.

Section 4 in particular (“Some Previously Claimed Solutions in the Literature”) is very interesting, mainly when one remembers that the first false conclusions regarding the model was due to Ising himself, who extended his 1D results to two and three dimensions (no phase transition at finite temperature of a two-state spins, which Onsager proved wrong some decades later). Also, the failed attempt of John Maddox, who presented his 3D solution at the StatPhys conference in Paris in 1952 is well known by everybody, but very few people actually know why the Maddox solution fails, and the present paper brings a digression on the matter.

I recommend the paper as it is, although it is always a good practice to entice the authors to check their manuscript for typos or grammar errors.

Our response: We thank the referee for the helpful comments. We are very pleased that the reviewer recommends our paper for publication. We have improved the revised text by explicitly mentioning the observation of the reviewer about how Ising himself (incorrectly) generalized his 1D results to 2D and 3D.

— END —