

# The condensation phase transition in random graph coloring

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Based on a non-rigorous formalism called the “cavity method”, physicists have put forward intriguing predictions on phase transitions in discrete structures. One of the most remarkable ones is that in problems such as random  $k$ -SAT or random graph  $k$ -coloring, very shortly before the threshold for the existence of solutions there occurs another phase transition called *condensation* [Krzakala et al., PNAS 2007]. The existence of this phase transition appears to be intimately related to the difficulty of proving precise results on, e.g., the  $k$ -colorability threshold as well as to the performance of message passing algorithms. In random graph  $k$ -coloring, there is a precise conjecture as to the location of the condensation phase transition in terms of a distributional fixed point problem. Here we prove this conjecture for  $k$  exceeding a certain constant  $k_0$ .