STEPS Students Report

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In the critical region thermal fluctuations of the magnetization may change the effective anisotropy of the cubic ferromagnets. Here we are talking about the anisotropy of the nonlinear susceptibilities of these crystals. There are different modes of critical behavior which are realized in the cubic ferromagnets. It depends on the value of the order parameter dimension N. If N is bigger than some marginal dimension then approaching to the critical point the ferromagnets remain anisotropic. Multiloop 3D renormalization group analysis had shown that the marginal dimensionality is bigger than physical value 3. It means that in the real cubic ferromagnets we will observe the anisotropic critical behavior.

So, working on the problem of theoretical estimation of the value of the high order anisotropy and also high order coupling constants of cubic ferromagnets by means of pseudo-epsilon expansion approach in the group of Professor Oshikawa, as planned, we had achieved the following results:

1. the pseudo-epsilon expansions for coupling constants u_6, v_6, q_6 for arbitrary dimension of order parameter n were obtained(in physical case):
   u_6=0.938673 t^3+0.246892 t^4-0.161505 t^5-0.165478 t^6,
   q_6=-0.758159 t^3+0.285455 t^4+0.45298 t^5+0.295997 t^6,
   v_6=0.180514 t^3 - 0.18436 t^4 - 0.108836 t^5 - 0.0310673 t^6,
   these results have an original character;
2. the numerical estimates of these couplings by use of Pade-Borel resummation technique applied to these expansions were obtained: u_6=1.0153, v_6=0.0058, q_6=-0.3217;
3. also the numerical estimates of these couplings by use of Conformal mapping technique were calculated: u_6=1.0282, v_6=0.0604, q_6=-0.4318;
   these results were compared with their analogues which were found within other field-theoretical approaches;
4. the pseudo-epsilon expansion for corresponding anisotropy parameter(of the sixth order) was derived:
   delta_6=-7/9 + 67t/81 + 0.0487054 t^2 + 0.102495 t^3 - 0.11517 t^4;
5. the numerical assessments by means of Pade-Borel and Conformal mapping resummation techniques were estimated: delta_6(PB)=0.1696, delta_6(CM)=0.1419;

6. two talk regarded to this topic were presented to the group of Professor Oshikawa;
7. based on these results, we can conclude that the anisotropy of cubic ferromagnets is strong enough to be measured in real and computer experiments;
8. it is planned to publish these results;

However, studying of the critical behavior is not only one activity which took place at the group of Professor Oshikawa. Apart of that we started to explore the problem connected with finding of universality of Shannon-Renyi entropy for phi 4 model. In this research we use epsilon-expansion technique. This work is only begun and we are planning to continue our collaboration.