Phase Transitions and Critical Phenomena

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Exercise Sheet 12

HS 14
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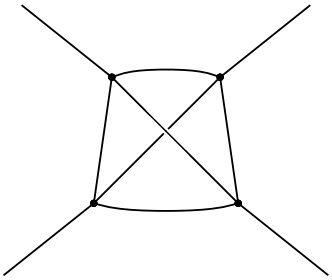
Problem 1 Summation of the "parquet" diagrams

In the lecture we discussed that the so-called "parquet" diagrams with n loops give a divergent contribution to the four point correlation function

$$\sim u^{n+1} \log^n \frac{\Lambda}{p} \tag{1}$$

where Λ is a short distance cut-off and p is a typical value of momentum on the external legs, corresponding to the scale we are interested in. We ignored the other diagrams because they contribute to the four-point correlation function in sub-leading orders.

To see an example, consider the following diagram



and show that its contribution diverges as

$$\sim u^4 \log \frac{\Lambda}{p}. \tag{2}$$

Problem 2 Gradient term in the Landau theory

Find RG equation for the gradient term in the Landau theory. Show that is is not renormalized. For this look on the contribution to $\Sigma(\boldsymbol{k})$ given by the following diagram: