Logarithmic corrections arising from non-linear integral equations with singular kernels

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We present recent results for the computational treatment of the spectra of the integrable staggered six-vertex model and the integrable $3-\bar{3}$ superspin chain.

The staggered six-vertex model has attracted the interest of several groups of authors who derived a wealth of results (e.g. Ikhlef, Jacobsen, Saleur 08, 12; Frahm, Martins 12; Candu, Ikhlef 13; Frahm, Seel 14; Bazhanov, Kotousov, Koval, Lukyanov 20). A remaining problem is how to compute the low-lying eigenvalues for arbitrary system sizes.

We derive by proven means a set of non-linear integral equations (NLIE) with the unpleasant property of singular terms in the kernel. Due to this fact these equations do not lend themselves to an iterative treatment. However, we have succeeded in deriving from the singular NLIE an equivalent set of NLIE with purely regular kernel. This set can be solved for the lowest lying excitations for system sizes $L = 10, 10^2, 10^3, ..., 10^9, ...10^{24}$.. Interestingly, the singular NLIE can be used to derive the CFT data with logarithmic corrections $\mathcal{O}\left(1/(\log L)^2\right)$.

Finally, we present results for the $3-\bar{3}$ superspin chain intensively investigated by Essler, Frahm, Saleur (2005). Here we show how to derive two sets of NLIE, a singular one and a regular one. From the singular NLIE we derive the type of corrections to the CFT data, $\mathcal{O}\left(1/\log L\right)$. The numerical iteration of the regular NLIE is not yet successfully convergent: for the $3-\bar{3}$ model not only is the genuine NLIE singular, but here some of the solutions also have singular properties.