Asymptotics of Toeplitz determinants and the emptiness formation probability for the *XY* spin chain

2006 J. Phys. A: Math. Gen. 39 14533

(http://iopscience.iop.org/0305-4470/39/46/C01)

INSTITUTE OF PHYSICS PUBLISHING JOURNAL OF PHYSICS A: MATHEMATICAL AND GENERAL

J. Phys. A: Math. Gen. **39** (2006) 14533–14534 doi:10.1088/0305-4470/39/46/C01

Corrigendum

Asymptotics of Toeplitz determinants and the emptiness formation probability for the *XY* spin chain

Fabio Franchini and Alexander G Abanov 2005 *J. Phys. A: Math. Gen.* **38** 5069–96

In this corrigendum, we correct several numerical mistakes in the bozonization formulae of the original paper (2005 *J. Phys. A: Math. Gen.* **38** 5069). These errors were localized in section 8 and in appendix C and change the result of the bozonization treatment and of the stationary action quantitatively, while not affecting its qualitative interpretation, nor the rest of the paper's results.

In section 8, page 5085, the Lagrangian (90) should be

$$\mathcal{L} = \frac{1}{2}\left[(\partial_\mu \vartheta)^2 - \frac{2\gamma}{\pi}\cos(\sqrt{4\pi}\vartheta)\right], \tag{90}$$

where we also use the rescaled time $\tau' = v_F \tau$ (omitting the prime for brevity from now on), with $v_F \equiv 2\sqrt{1-h^2}$, the Fermi velocity at $\gamma = 0$. In terms of ϑ the density of fermions is given by $\rho = \frac{1}{\sqrt{\pi}}\partial_\tau\vartheta + \rho_0$.

Correspondingly, equations (91) and (92) should read

$$\rho|_{\tau=0,0<x<n} = \rho_0 + \frac{1}{\sqrt{\pi}}\,\partial_\tau\vartheta(x,\tau)|_{\tau=0,0<x<n} = \rho_0 - \bar{\rho}, \tag{91}$$

$$-\frac{1}{\sqrt{\pi}}\,\partial_\tau\vartheta(x,\tau)|_{\tau=0,0<x<n} = \bar{\rho} \ll \rho_0, \tag{92}$$

and the linearized action (93) is

$$\mathcal{S} \approx \frac{1}{2}\int \mathrm{d}x\,\mathrm{d}\tau[(\partial_\mu\vartheta)^2 + 4\gamma\vartheta^2]. \tag{93}$$

In appendix C, starting on page 5092, after equation (C.2), we redefine $m^2 \equiv 4\gamma$, reflecting the change in (93). Moreover, one should replace $\bar{\rho} \to \sqrt{\pi}\bar{\rho}$ on the right-hand side of equations (C.1), (C.4), (C.5), (C.7), (C.11) and (C.13).

Finally, the action in equations (C.9) and (C.14) becomes

$$\mathcal{S}_0 = \frac{\sqrt{\pi}\bar{\rho}}{2}\int_0^n f(y)\,\mathrm{d}y, \tag{C.9}$$

$$\mathcal{S}_0 = n^2\frac{\pi^2\bar{\rho}^2}{8}\left[1 + \frac{m^2n^2}{16}\left(\ln\frac{mn}{8} + G - 2\right)\right]. \tag{C.14}$$

Compared to the result originally published, the action is rescaled $\mathcal{S}_0 \to \frac{\pi}{4v_s}\mathcal{S}_0$ and the mass is now defined as $m = 2\sqrt{\gamma}$. We reprint figures 7–9 to show the rescaled vertical axis. The complete corrected version of these results can be found in Fabio Franchini's PhD graduation thesis, at Stony Brook University, soon available online.

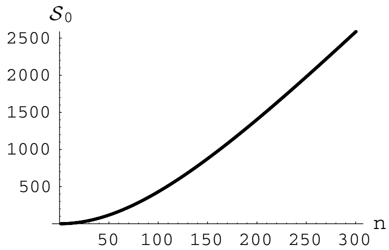

Figure 7. Plot of the value of the stationary action $\mathcal{S}_0$ versus the string length n. The action $\mathcal{S}_0$ is obtained from (C.9) with $f(y)$ given by the numerical solution of the singular integral equation (C.7). The graph depicts $\mathcal{S}_0(n)$ for $m = 2\sqrt{\gamma} = 0.01$, $\bar{\rho} = 0.2$. The crossover takes place around $n \sim 2/m = \sqrt{1/\gamma} = 200$.

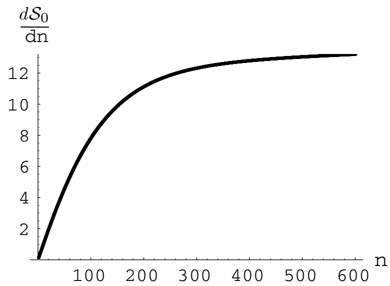

Figure 8. Plot of the derivative $\mathrm{d}\mathcal{S}_0/\mathrm{d}n$ with $\mathcal{S}_0$ from (C.9). The plot corresponds to $m = 0.01$, $\bar{\rho} = 0.2$ and clearly shows a crossover from the quadratic to the linear behaviour at $n \sim 2/m = \sqrt{1/\gamma} = 200$.

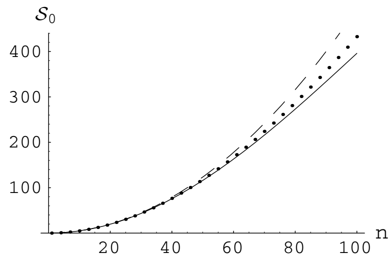

Figure 9. The solid line is the plot of the stationary action (C.14) against n. This analytical solution is valid for $n \ll 1/m$ and corresponds to $m = 0.01$ and $\bar{\rho} = 0.2$. The dotted line represents the value of the action (C.9) with the source given by numerical solution of the singular integral equation (C.7). The dashed line corresponds to the zeroth-order, pure Gaussian, solution, i.e. (C.14) with $m \equiv 0$, which we include for comparison. We see that the inclusion of the first-order correction almost doubles the range in which the analytical solution is accurate.