Prepared for submission to JHEP

Erratum to: Fermions and Fractons in 2+1-D Quantum Field Theory

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We have found a minor error in the computation for the scalar self-energy diagram Σ_ϕ. This error has **no material change** in the conclusion of our paper regarding the vanishing RG flow of the coupling constant λ, nor does difference change the forms of the remaining counter-terms.

The error in the computation of the diagram arose from a relative minus sign error of the fermion propagator Eq (4.1). Specifically, the temporal component of the first propagator within Eq. (4.1) should be positive rather than negative. This leads to a contour integral in which both poles from the propagators are on the same side of the real axis. Due to this, by the residue theorem the associated integral will trivially be zero.[1] Therefore, any diagram which possess any internal fermion loop will be zero. In particular, the associated counter-term for $\delta_{1/\mu}$ will vanish to all orders in perturbation theory, and so does the potential anomaly of the exotic symmetry discussed in the conclusions of our main paper.

The implications of this result to the paper are the following:

1. Equation (4.1) now reads:

$$\Sigma_\phi = \frac{\lambda^2 k_x'^2 k_y'^2}{(2\pi)^3} \int d\omega \int d^2k \left(\frac{1}{+i\omega + \frac{k^2}{2m} + \gamma}\right)\left(\frac{1}{-i(\omega' - \omega) + \frac{(k'-k)^2}{2m} + \gamma}\right). \tag{4.1}$$

2. The associated beta function for $1/\mu$ will be zero, $\frac{\partial(1/\mu)}{\partial \log(\Lambda)} = \beta(1/\mu) = 0$, Eq. (5.2) in the paper.

3. A new solution to the RG flow for the mass $m(\log(\Lambda))$, given by figure 5 in the modified paper. Please see figure 1 of this erratum to see the modified RG flow found within the paper.

4. A modification to the finite temperature calculation of the scalar self-energy in section 6.1 of the new paper. Specifically the the 1-loop scalar self energy at finite temperature, equation (6.7), is now

$$\begin{aligned}\Sigma_\phi = \frac{\lambda^2 k_x'^2 k_y'^2}{2(2\pi)^2} \int d^2k &\left[\tanh\left(\frac{\beta}{2}\left(\frac{k^2}{2m} + \gamma\right)\right) - \tanh\left(\frac{\beta}{2}\left(\frac{(k-k')^2}{2m} + \gamma - i\omega'\right)\right)\right] \\ &\times \frac{1}{-i\omega' + \frac{(k-k')^2 - k^2}{2m}}.\end{aligned} \tag{6.7}$$

5. The removal of Appendix A of the original paper in which the incorrect scalar self-energy to first loop order was computed.

The corrected version of this paper has also been posted to the ArXiv.

Acknowledgments

We would also like thank D. T. Son for pointing out this error in the previous version.

[1] Equivalently, due to causality, any non-relativistic fermion loop must always be zero, as the pole singularities, enforced by the form of the retarded Green's function will always lie on the same side of the real axis at zero fermion density.

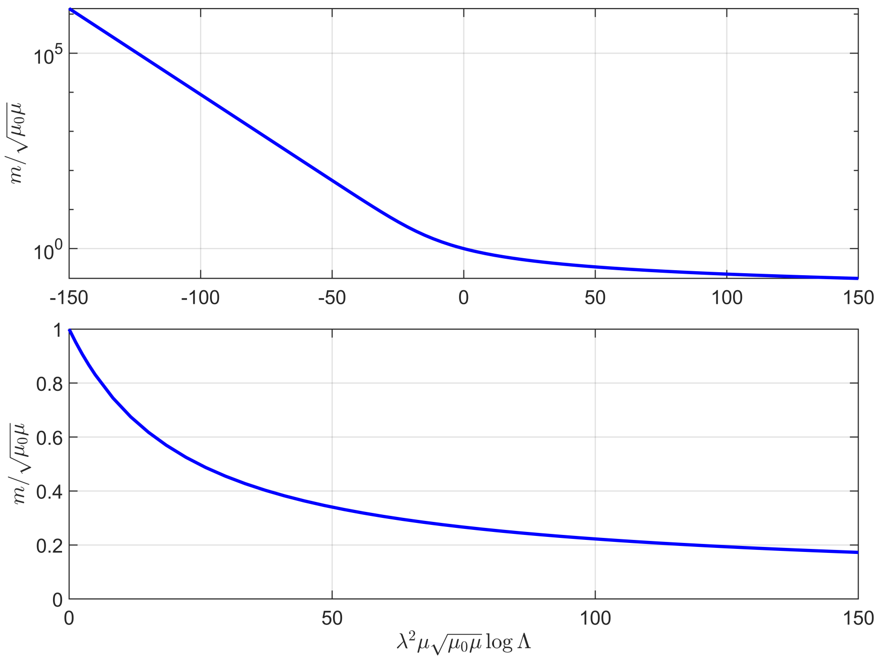

Figure 1. New RG flow of the the fermion mass m.