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Erratum: Asymptotic safety in an interacting system of gravity and scalar matter [Phys. Rev. D 93, 044049 (2016)]

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In the following all equations have the same number as in the paper. There is a typo in the result for the anomalous dimension of the transverse traceless mode, which should read

$$\eta_{\mathrm{TT}} = N_S \frac{1}{24\pi} g_3 + \frac{1}{1728\pi} G_3(-2928 + 455\eta_{\mathrm{TT}} - 35\eta_\sigma) - \frac{29}{648\pi} G_4(-18 + 5\eta_{\mathrm{TT}} - 2\eta_\sigma). \tag{34}$$

There was also an error in the derivation of the beta function of g_3, which did not correspond to a symmetric external momentum configuration, as stated. For the symmetric momentum configuration, we obtain the following results leading to β_{g_3}. The three-vertex-diagrams yield

$$\beta_{\sqrt{g_3}}|_{\mathrm{TT3\text{-}vertex}} = 0, \tag{40}$$

$$\beta_{\sqrt{g_3}}|_{\sigma 3\text{-vertex}} = \frac{1}{80\pi} g_3^{3/2}(30 - \eta_\sigma - 2\eta_S). \tag{41}$$

From the tadpoles, we obtain

$$\beta_{\sqrt{g_3}}|_{\mathrm{TT\,tadpole}} = -\frac{95}{648\pi} g_5^{3/2}(6 - \eta_{\mathrm{TT}}), \tag{42}$$

$$\beta_{\sqrt{g_3}}|_{\sigma\,\mathrm{tadpole}} = \frac{19}{324\pi} g_5^{3/2}(6 - \eta_\sigma). \tag{43}$$

The two-vertex diagrams with only gravity-matter vertices are given by

$$\beta_{\sqrt{g_3}}|_{\substack{\mathrm{TT,S}\\ \text{two-vertex}}} = 0, \tag{44}$$

$$\beta_{\sqrt{g_3}}|_{\substack{\sigma,\mathrm{S}\\ \text{two-vertex}}} = -\frac{5}{72\pi}\sqrt{g_3}\, g_4(16 - \eta_\sigma - \eta_S). \tag{45}$$

Finally, the two- and three-vertex diagrams which also contain pure-graviton vertices give

$$\beta_{\sqrt{g_3}}|_{\substack{\mathrm{TT,TT}\\ \text{two-vertex}}} = -\frac{5}{216\pi} g_4\sqrt{G_3}(8 - \eta_{\mathrm{TT}}), \tag{46}$$

$$\beta_{\sqrt{g_3}}|_{\substack{\sigma,\sigma\\ \text{two-vertex}}} = -\frac{1}{54\pi} g_4\sqrt{G_3}(8 - \eta_\sigma), \tag{47}$$

$$\beta_{\sqrt{g_3}}|_{\substack{\sigma,\mathrm{TT}\\ \text{two-vertex}}} = 0, \tag{48}$$

$$\beta_{\sqrt{g_3}}|_{\substack{\sigma,\sigma,\mathrm{S}\\ \text{3-vertex}}} = \frac{1}{80\pi} g_3\sqrt{G_3}(30 - 2\eta_\sigma - \eta_S), \tag{49}$$

$$\beta_{\sqrt{g_3}}|_{\substack{\mathrm{TT,TT,S}\\ \text{3-vertex}}} = 0, \tag{50}$$

TABLE I. Coordinates and critical exponents at an interacting fixed point for vanishing scalar fluctuations.

approximation	g_{3*}	θ	η_{TT}	η_σ
full	2.204	2.17	−0.62	0.50
semi-pert.	2.203	2.17	−0.62	0.37
pert. ($\eta_{\mathrm{TT}} = 0 = \eta_\sigma$)	3.65	2	-	-

TABLE II. Coordinates and critical exponents at an interacting fixed point at selected values of N_S. In this approximation, the fixed point disappears into the complex plane at $N_S = 28$.

N_S	g_{3*}	θ	η_{TT}	η_σ
1	1.82	2.09	−0.48	0.49
2	1.85	2.08	−0.46	0.59
5	1.95	2.05	−0.39	0.91
10	2.14	1.99	−0.26	1.54
15	2.40	1.90	−0.08	2.31.

$$\beta_{\sqrt{g_3}}\big|_{\substack{\sigma,\mathrm{TT,S}\\ \text{3-vertex}}} = 0. \tag{51}$$

By summing Eqs. (41) and (51), we obtain the beta function for $\sqrt{g_3}$, from which we derive the beta function for the dimensionless g_3 as

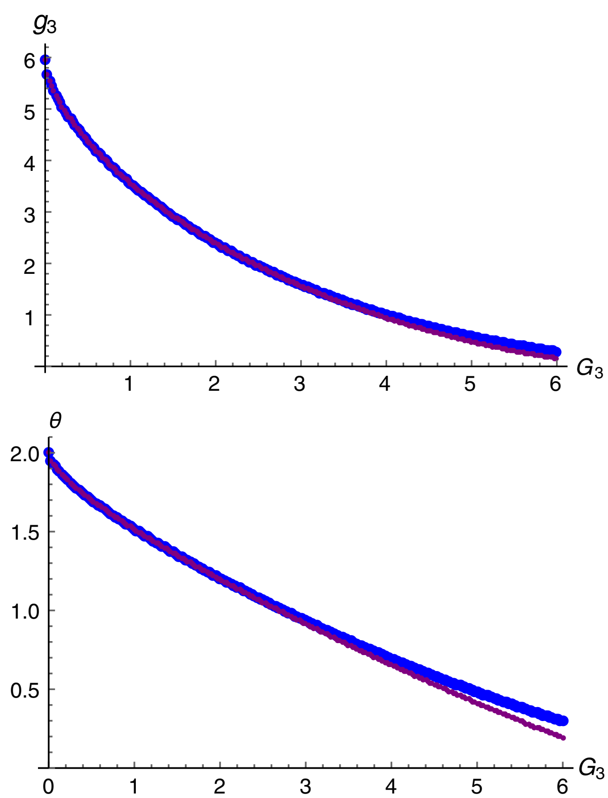

FIG. 8. We show the fixed-point value for g_3 (upper panel) and the critical exponent θ (lower panel) as a function of $G_3 = G_4$. The larger blue dots denote the full result and the smaller purple dots denote the semiperturbative approximation.

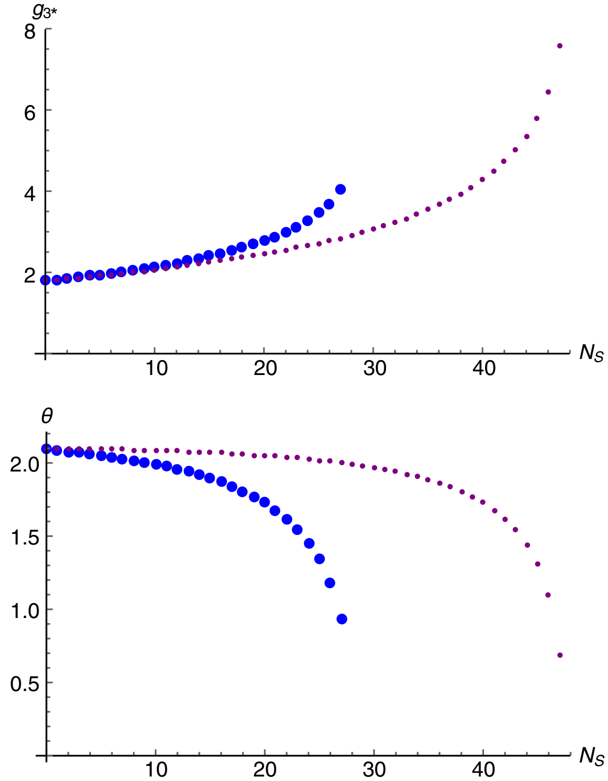

FIG. 10. We show the fixed-point value for g_3 (upper panel) and the critical exponent θ (lower panel) as a function of N_S. The larger blue dots denote the full result and the smaller purple dots denote the semiperturbative approximation.

$$\begin{aligned}
\beta_{g_3} = {} & (2+\eta_{\mathrm{TT}}+2\eta_S)g_3 + \frac{3}{4\pi}g_3^2 + \frac{3}{4\pi}g_3^{3/2}\sqrt{G_3} \\
& - \frac{20}{9\pi}g_3 g_4 - \frac{2}{3\pi}\sqrt{g_3}\sqrt{G_3}g_4 - \frac{19}{18\pi}g_5^{3/2}\sqrt{g_3} \\
& + \left(\frac{5}{108\pi}g_4\sqrt{G_3} + \frac{95}{324\pi}g_5^{3/2}\right)\sqrt{g_3}\eta_{\mathrm{TT}} \\
& + \left(-\frac{1}{40\pi}g_3^{3/2} - \frac{1}{20\pi}g_3\sqrt{G_3} + \frac{5}{36\pi}\sqrt{g_3}g_4 \right. \\
& \left. + \frac{1}{27\pi}g_4\sqrt{G_3} - \frac{19}{162\pi}g_5^{3/2}\right)\sqrt{g_3}\eta_\sigma \\
& + \left(-\frac{1}{20\pi}g_3^{3/2} - \frac{1}{40\pi}g_3\sqrt{G_3} + \frac{5}{36\pi}\sqrt{g_3}g_4\right)\sqrt{g_3}\eta_S. \qquad (52)
\end{aligned}$$

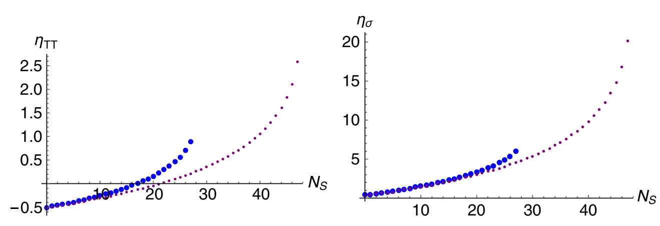

FIG. 11. We show the fixed-point value for η_{TT} (left panel) and η_σ (right panel) as a function of N_S. The larger blue dots denote the full result and the smaller purple dots denote the semi perturbative approximation.

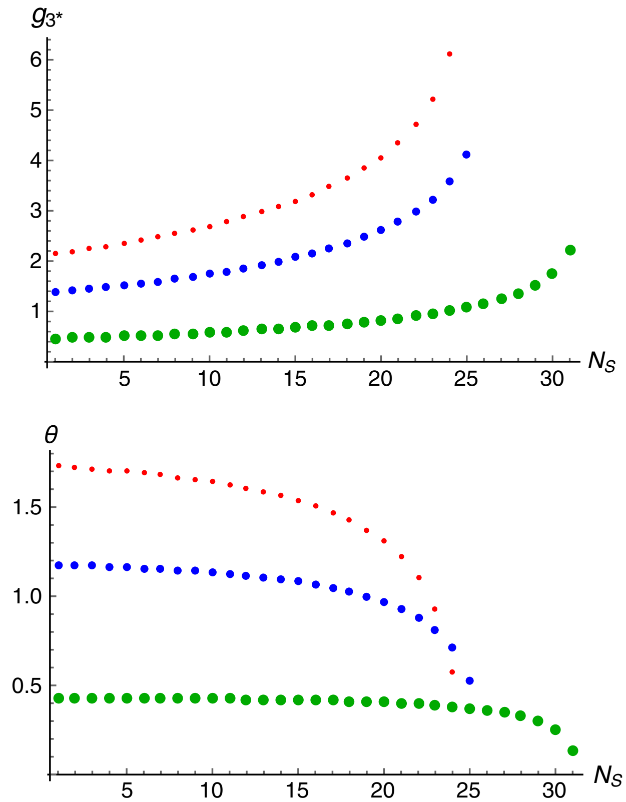

FIG. 12. We show the fixed-point value for g_3 (upper panel) and the critical exponent θ (lower panel) as a function of N_S. The small red dots are for $G_3 = G_4 = 1$, the medium blue ones are for $G_3 = G_4 = 3$ and the large green ones are for $G_3 = G_4 = 6$.

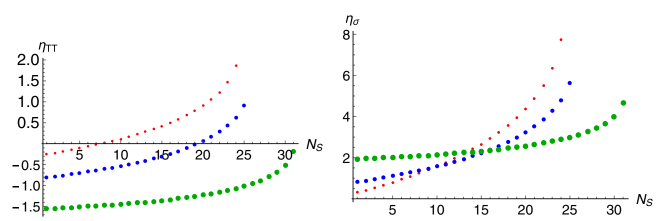

FIG. 13. We show the fixed-point value for η_{TT} (left panel) and for η_σ (right panel) as a function of N_S. The small red dots are for $G_3 = G_4 = 1$, the medium blue ones are for $G_3 = G_4 = 3$ and the large green ones are for $G_3 = G_4 = 6$.

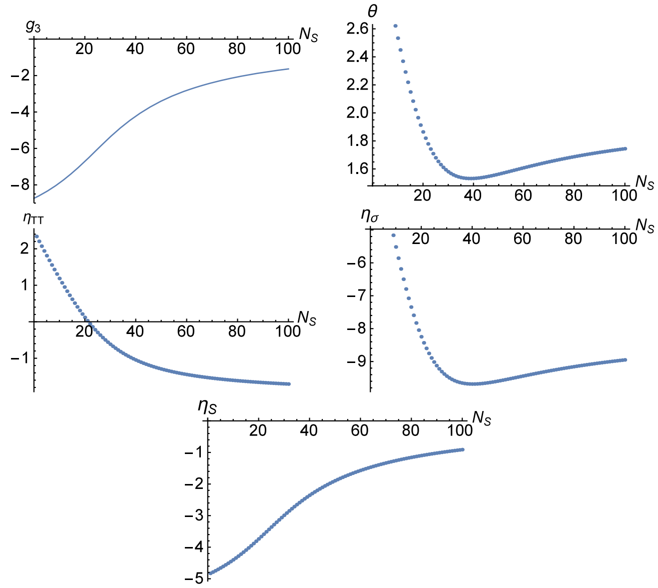

FIG. 14. We show results in the semiperturbative approximation: We plot the fixed-point value for g_3 as a function of N_S (left upper panel) and the value of the critical exponent θ (right upper panel), as well as the anomalous dimensions.

The correct beta function leads to slightly different results for the fixed points. In the pure-gravity case, where all internal scalar lines are set to zero, and where we also set $\eta_S = 0$, cf. Table I.

Including scalar fluctuations but keeping $\eta_S = 0$, we obtain the fixed-point results in Table II in the approximation $G_4 = G_3 = g_5 = g_4 = g_3$.

The changes in the beta function reflect themselves in the figures, except for Fig. 9 which is not affected. We report below all the corrected figures.