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Erratum: Gauge invariant cosmological perturbation equations with corrections from loop quantum gravity [Phys. Rev. D 79, 043505 (2009)]

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There is a typographical error in Eq. (82) and its duplicate Eq. (102): In the first term, Φ should be Ψ. With this correction, one can explicitly check that all governing equations for scalar modes are consistent.

Consequently, in Eqs. (91) and (93) the factor of $(1 + h)$ in front of the $\Delta\Psi$-term must be omitted. A similar remark applies to the numerator of the fraction on the right-hand side of Eq. (95). This affects some of the later equations in the paper. A detailed analysis of the final Eqs. (101)–(105) and their phenomenological implications will be presented elsewhere. Here we point out corrections to the conclusions after Eq. (95).

(i) The speed of sound for the scalar perturbations, up to the leading order, is given by

$$c_s^2 = \bar{\alpha}^2(1 - f_3). \tag{1}$$

As follows from Eqs. (81) and (B4), $f_3 \propto \frac{+1}{\bar{p}^{n_\alpha}} > 0$ (for $n_\alpha > 3/2$) leading to $c_s^2 < \bar{\alpha}^2$, which implies subluminal propagation according to [20].

(ii) Following (B2), Eq. (90) [and Eq. (101)] can be rewritten in a compact form

$$(\bar{\alpha} a \Psi)^{\cdot} = 4\pi G \frac{\bar{\alpha}^2}{\bar{\nu}} a \dot{\bar{\varphi}} \delta\varphi^{\mathrm{GI}}. \tag{2}$$

Therefore, in the absence of matter fields, the metric perturbation behaves as

$$\Psi \propto \frac{1}{\bar{\alpha} a}.$$

Since $\bar{\alpha} > 1$ and $\mathrm{d}\bar{\alpha}/\mathrm{d}a < 0$ in the regime we consider, the perturbation decays more slowly than classically; we have

$$|\dot{\Psi}| = \frac{1}{\bar{\alpha}} |(\dot{\Psi})_{\mathrm{class}} - \dot{\bar{\alpha}}\Psi| < |(\dot{\Psi})_{\mathrm{class}}|$$

when $(\dot{\Psi})_{\mathrm{class}} < 0$.

Note that in general, the anomaly cancellation conditions derived in [2] and summarized in Appendix B are very sensitive to the matter content. In other words, the explicit restrictions on the counterterms may be different for different types of matter. In particular, some of the equations in the appendix are different in the absence of matter fields. It turns out, however, that the relevant anomaly free condition (B2) is the same for matter represented by a scalar field, vacuum, or a cosmological constant [2]. Thus it is consistent to set the right-hand side of Eq. (2) above to zero without affecting the relation (B2).

