Erratum: Dynamics of topological defects in type-II superconductors in the presence of gradients of temperature and spin density [Phys. Rev. B 114, 084513 (2026)]

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Equation (90) is incorrect. In its derivation, the term containing ∇P_1 was neglected, where P_1 is the gauge-invariant scalar potential. In fact, P_1 is singular at the vortex core, and this term cancels the singular contribution of the translational zero mode. Consequently, the denominator of the published Eq. (91) diverges at the core. It should be replaced by the finite and positive quantity η in Eq. (E3). The numerator is unchanged. The same applies to Eq. (99). The numerical results in Figs. 10 and 11 are not affected, because they were obtained by solving Eqs. (75) and (93) directly without expansion in v. Sections II and III treat a domain wall without gauge fields and are not affected either. Thus the correction changes the expressions for the vortex velocity in Eqs. (91) and (99), but not the conclusion regarding the direction of the vortex motion. The corrected equations are given below.

Equation (79b) remains valid for $r \neq 0$, but it must be supplemented by the condition at the core. By Eq. (74a), P contains $\partial_t \chi$. The phase winding of the moving vortex gives $\partial_t \chi = v \sin\theta/r$, and the scalar potential Φ is regular at the core. Hence $P_1 = v \sin\theta/r + O(1)$ for $r \to 0$, and $P_1 \to 0$ for $r \to \infty$. Only the component proportional to $\sin\theta$ can be singular at the core. The singular solutions of other angular components diverge at the core, and their regular solutions grow at large r. Neither is compatible with the conditions above. Therefore these components vanish, and $P_1 = v\mathcal{P}(r)\sin\theta$ with

$$\mathcal{P}'' + \frac{\mathcal{P}'}{r} - \frac{\mathcal{P}}{r^2} - \frac{\tilde{\gamma}\kappa^2}{\sigma_n} f_0^2(r)\mathcal{P} = 0, \quad \mathcal{P} \to \frac{1}{r}\ (r \to 0). \tag{E1}$$

Equation (87) then gives

$$\begin{aligned} \boldsymbol{E}_1 &= v[\mathcal{E}_r \sin\theta\, \boldsymbol{e}_r + \mathcal{E}_\theta \cos\theta\, \boldsymbol{e}_\theta], \\ \mathcal{E}_r &= \frac{Q_0}{r} - \frac{\mathcal{P}'}{\kappa}, \quad \mathcal{E}_\theta = Q_0' - \frac{\mathcal{P}}{\kappa r}. \end{aligned} \tag{E2}$$

The singularity of P_1 cancels that of $v\partial_x \boldsymbol{Q}_0$, because $\partial_x \boldsymbol{Q}_0 \simeq \kappa^{-1}\nabla(\sin\theta/r)$ near the core. The same cancellation was found in the Supplemental Material of Ref. [19]. Since $\mathcal{P} + \kappa Q_0 = O(r)$, which follows from Eq. (E1), we have $\mathcal{E}_r(0) = \mathcal{E}_\theta(0)$, and the physical electric field $\boldsymbol{E}_1$ is finite at the core.

Equation (90) should therefore be deleted. The term with ∇P_1 cancels the divergence of $\int d\boldsymbol{r}|\boldsymbol{Q}_d|^2$ at the core. To isolate the singular part of $\boldsymbol{Q}_d$, we write $\boldsymbol{Q}_d = \nabla Q_{0x} + \boldsymbol{h}$ with $\boldsymbol{h} = B_0(r)\boldsymbol{e}_y$ and $B_0 = Q_0' + Q_0/r$. The singular part is a pure gradient, and $\boldsymbol{h}$ is smooth at $r = 0$. We multiply Eq. (79c) by $\boldsymbol{h}$ instead of $\boldsymbol{Q}_d$. The terms with ∇Q_{0x} are integrated by parts by using the first-order continuity equation. Equations (88) and (89) are then replaced by

$$\int_C d\boldsymbol{r}\left[\tilde{\gamma} v\left(\frac{\partial f_0}{\partial x}\right)^2 + \kappa\tilde{\gamma} f_0^2(r) Q_{0x} P_1 + \sigma_n B_0(r) E_{1y}\right] = \frac{1}{1-\tau_L}\int_C d\boldsymbol{r}\,\tau_1(\boldsymbol{r}) f_0(r)\frac{\partial f_0}{\partial x}. \tag{88}$$

No boundary term remains.

Equation (91) should read

$$v = \frac{F}{\eta}, \tag{91}$$

where F is the numerator of the published Eq. (91) and

$$\eta = \pi\int_0^{R_c} dr\, r\left[\tilde{\gamma} f_0'^2 + \tilde{\gamma} f_0^2\mathcal{P}^2 + \sigma_n\mathcal{E}_r^2 + \sigma_n\mathcal{E}_\theta^2\right]. \tag{E3}$$

Near the core, $f_0 = O(r)$, $\mathcal{P} = O(1/r)$, and $\mathcal{E}_r$ and $\mathcal{E}_\theta$ are finite. Hence the integrand of η is $O(r)$ and η is finite. All the terms are non-negative and the first term is positive, so that $\eta > 0$.

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In Sec. V, Eqs. (93b) and (93c) are the same as Eqs. (75b) and (75c). Thus Eq. (98) should be replaced by

$$\int_{\mathrm{C}} d\boldsymbol{r}\left[\tilde{\gamma}\, v\left(\frac{\partial f_0}{\partial x}\right)^2 + \kappa\tilde{\gamma} f_0^2(r) Q_{0x} P_1 + \sigma_{\mathrm{n}} B_0(r) E_{1y}\right] = -b\int_{\mathrm{C}} d\boldsymbol{r}\,\mu_1^2(\boldsymbol{r}) f_0(r)\frac{\partial f_0}{\partial x}, \tag{98}$$

and the denominator of Eq. (99) should be replaced by η in Eq. (E3). The numerator of Eq. (99) is unchanged.