

Erratum: Collisionless magnetic reconnection with arbitrary guide-field [Phys. Plasmas 11, 4713 (2004)]

Richard Fitzpatrick

Institute for Fusion Studies, Department of Physics, University of Texas at Austin, Austin, Texas 78712

Franco Porcelli

Burning Plasma Research Group, Dipartimento di Energetica, Politecnico di Torino, 10129 Torino, Italy

(Received 16 February 2007; accepted 16 February 2007; published online 9 April 2007)

[DOI: 10.1063/1.2715576]

This paper is in error due to the neglect of the gyroviscous contribution to the electron equation of motion. Adopting the normalization described in the paper, the electron fluid velocity takes the form

$$\mathbf{V}_e = \mathbf{V}_E + \mathbf{V}_* + V_{ez}\hat{\mathbf{z}}, \quad (1)$$

where \mathbf{V}_E is the $\mathbf{E} \times \mathbf{B}$ velocity, and

$$\mathbf{V}_* = d_i \frac{\hat{\mathbf{z}} \times \nabla P}{B_0}. \quad (2)$$

The electron equation of motion can be written¹

$$\begin{aligned} \epsilon d_i \left[\left(\frac{\partial}{\partial t} + \mathbf{V}_e \cdot \nabla \right) \mathbf{V}_E + \left(\frac{\partial}{\partial t} + \mathbf{V}_E \cdot \nabla \right) (V_{ez}\hat{\mathbf{z}}) \right] \\ = -d_i \nabla P - (\mathbf{E} + \mathbf{V}_e \times \mathbf{B}). \end{aligned} \quad (3)$$

This equation differs from Eq. (1) in our paper due to the inclusion of addition terms arising from the *electron gyroviscous tensor*. These terms are of order $d_i \nabla P$, and *must*, therefore, be included in any treatment of electron motion that takes pressure into account. As is well known, the net effect of the inclusion of the gyroviscous terms in the electron equation of motion is to cancel out part of the inertial term.

Redoing the analysis of Secs. II.B and II.C in our paper, our modified set of reduced equations take the form

$$\frac{\partial \psi_e}{\partial t} = [\phi, \psi_e] + d_\beta [\psi, Z], \quad (4)$$

$$\frac{\partial Z}{\partial t} = [\phi, Z] + c_\beta [V_z, \psi] + d_\beta [\nabla^2 \psi, \psi], \quad (5)$$

$$\frac{\partial U}{\partial t} = [\phi, U] + [\nabla^2 \psi, \psi], \quad (6)$$

$$\frac{\partial V_z}{\partial t} = [\phi, V_z] + c_\beta [Z, \psi], \quad (7)$$

where $\nabla^2 \psi = U$ and $\psi_e = \psi - d_e^2 \nabla^2 \psi$. These equations only differ from Eqs. (25)–(28) in our paper in the respect that Z_e

$= Z - c_\beta^2 d_\beta^2 \nabla^2 Z$ has simply become Z . In the paper, the $-c_\beta^2 d_\beta^2 \nabla^2 Z$ component of Z_e ultimately derives from the $[\partial/\partial t + (\mathbf{V}_e \cdot \nabla)] \mathbf{V}_*$ component of the inertial term in the electron equation of motion. However, it turns out that this component is *canceled out* by the gyroviscous contribution to the equation of motion. Hence, the $-c_\beta^2 d_\beta^2 \nabla^2 Z$ correction to Z , appearing in Eqs. (25)–(28) of our paper, is *spurious*.

Redoing the remainder of the analysis in our paper, our modified general dispersion relation takes the form

$$\lambda_H = \frac{\pi}{2} \frac{g^2}{d_\beta G(g/c_\beta d_\beta)} - \frac{d_e d_\beta}{g}. \quad (8)$$

This differs from Eq. (95) in our paper due to the absence of a $G(g/c_\beta d_\beta)$ factor in the second term on the right-hand side. In the large- Δ' limit, the above dispersion relation yields³

$$g = \left(\frac{2}{\pi} \right)^{1/3} d_e^{1/3} d_\beta^{2/3} \quad (9)$$

for $\beta \ll (m_e/m_i)^{1/4}$, and⁴

$$g = \left(\frac{\Gamma(1/4)}{\pi \Gamma(3/4)} \right)^{2/5} d_e^{2/5} d_i^{3/5} c_\beta^{2/5} \quad (10)$$

for $\beta \gg (m_e/m_i)^{1/4}$. In the small- Δ' limit, we obtain³

$$g = \frac{d_\beta}{\pi} \Delta' d_e \quad (11)$$

for all β values. Note that our modified results are now *not* in agreement with Mirnov *et al.*,² since this paper also neglects to take the electron gyroviscous contribution to the electron equation of motion into account.

The importance of gyroviscous terms in the electron equation of motion was pointed out to the authors by Prof. F. Pegoraro.

¹R. D. Hazeltine and J. D. Meiss, *Plasma Confinement* (Dover, Mineola, 2003).

²V. V. Mirnov, C. C. Hegna, and S. C. Prager, *Phys. Plasmas* **11**, 4468 (2004).

³F. Porcelli, *Phys. Rev. Lett.* **66**, 425 (1991).

⁴A. Y. Aydemir, *Phys. Fluids B* **3**, 3025 (1991).