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Corrigendum

Steady MHD flows with an ignorable coordinate and the potential transonic flow equation

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In this corrigendum, we point out some algebraic errors in Webb et al. [*J. Plasma Phys.* **52**, 141–188 (1994); hereinafter referred to as W94], concerning the characteristics of the generalized Grad–Shafranov equation for flows with an ignorable coordinate z, where x, y and z are the Cartesian spatial coordinates. The coefficients a, b and c and Δ in (3.18) of W94 should read

$$\left.\begin{aligned} a &= \Delta - V_{py}^2 V_p^2, \qquad b = 2V_{px}V_{py}V_p^2, \\ c &= \Delta - V_{px}^2 V_p^2, \qquad \Delta = V_p^4 - V_p^2(V_A^2 + a_g^2) + V_{Ap}^2 a_g^2. \end{aligned}\right\} \tag{1}$$

With these modifications, (3.21) of W94 becomes

$$\zeta_{\pm} = \frac{-V_{px}V_{py}V_p^2 \pm [\Delta(V_p^4 - \Delta)]^{1/2}}{\Delta - V_{px}^2 V_p^2}. \tag{2}$$

In (1), $\mathbf{V}_p = (V_x, V_y, 0)^T$ denotes the projection of the fluid velocity $\mathbf{V} = (V_x, V_y, V_z)^T$ onto the (x, y) plane, $\mathbf{V}_A = \mathbf{B}/(\mu\rho)^{1/2}$ is the Alfvén velocity and $\mathbf{V}_{Ap}$ its projection onto the (x, y) plane, and a_g is the gas sound speed. On the characteristics $\xi(x, y) = \text{const}$, $(dx, dy) = dy(-\zeta_{\pm}, 1)$. For field-aligned flow restricted to the (x, y) plane, the characteristic equation $dy/dx = -1/\zeta_{\pm}$ agrees with that obtained by Kogan (1960) for the case of field-aligned flow (two of the solutions of Kogan's fourth-order equation for dy/dx reduce to $dy/dx = 0$ in this case). Kogan considers the general case of steady, non-field-aligned, plane flow for which the Grad–Shafranov equation does not in general apply. The characteristics for plane flow are also discussed by Cabannes (1970, Chap. 6). It is of interest to note that the assumption that the z component of the electric field, $E_z = 0$, used in the derivation of the Grad–Shafranov equation, leads to loss of two of the MHD characteristics (see also Contopoulos 1996). Equation (3.26) of W94 should read

$$\sin^2 \mathscr{A} = \frac{|d\mathbf{r} \times \mathbf{V}_p|^2}{V_p^2 |d\mathbf{r}|^2}, \tag{3}$$

where $d\mathbf{r} = (dx, dy)^T$ is the differential line element along the characteristics in the

(x, y) plane and $\mathscr{A}$ is the Mach cone angle. Equation (3.27) of W94 should read

$$F = (\Delta - V_p^4)|d\mathbf{r}|^2 + V_p^2|d\mathbf{r} \times \mathbf{V}_p|^2 = 0. \qquad (4)$$

Equations (3.28) and (3.29) of W94, for the Mach cone angle $\mathscr{A}$ and the effective Mach number M, are correct.

References

Cabannes, H. 1970 *Theoretical Magnetofluiddynamics*, Academic Press, New York.

Contopoulos, J. 1996 General axisymmetric magnetohydrodynamic flows: theory and solutions. *Astrophys. J.* **460**, 185–198.

Kogan, M. N. 1960 Plane flows of an ideal gas with infinite electrical conductivity, in a magnetic field not parallel to the flow velocity. *J. Appl. Math. Mech.* **24**, 129–143.