Errata for *AfciMHD*

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Errors found in *A First Course in Magnetohydrodynamics* since publication in June, 2025. All corrections are highlighted in red.

1. Page 8, first complete paragraph:

When the particle collides with the wall, both the particle and cube suffer a change in momentum in a direction normal to the surface of the cube. Moments later, the particle collides with a different wall, and the particle and cube suffer changes in momentum in a direction normal to that wall. A change in momentum is an impulse, J, which when divided by the time over which the collision occurs, Δt, constitutes the average force. Thus formally, the "pressure", p, the collision exerts on the wall of the box is this average force divided by the area of the wall:

$$p \sim \frac{J}{\Delta t(\Delta l)^2}.$$

In this scenario, the "pressure" is highly variable in time, and by no means could the "pressure" be construed as isotropic. At a given time, the "pressure" one wall feels will have nothing to do with the "pressures" felt by the other walls.

2. Page 29, last paragraph before §2.1.2:

Finally, on comparing Eq. (2.15) and (1.13), we find:

$$\frac{v_{\rm rms}}{c_{\rm s}} = \sqrt{\frac{2}{\gamma(\gamma-1)}},$$

which is about 1.34 (1.89) for a monatomic (diatomic) gas. Thus, the sound speed is less than, but on the order of, the rms speed of the gas particles. That the two speeds should be so closely related makes sense since, at the particle level, it is only through particle–particle collisions that information of the passage of a wave may be propagated.

3. Page 44, between Eq. (2.61) and (2.62):

Next, in steady state, the x-component of the momentum equation (Eq. 1.27) is:

$$\cancelto{0}{\frac{\partial s_x}{\partial t}} + \nabla\cdot(s_x\vec{v} + p\hat{x}) = 0,$$

which, when integrated over the C.V., gives:

4. Page 118, Problem 4.3c)

c) The integral form of Gauss' law for an electric field in free space is (first of Eq. B.2),

$$\Phi_E = \oint_S \vec{E} \cdot d\vec{\sigma} = \frac{q_{\text{enc}}}{\epsilon_0},$$

where q_{enc} is the free charge enclosed within a closed surface S. If q_{enc} is constant and thus $d\Phi_E/dt = 0$, why doesn't Theorem 4.1 apply, and thus why can't we immediately write,

$$\frac{\partial \vec{E}}{\partial t} = \nabla \times (\vec{v} \times \vec{E})\,?$$

(Hint: One sentence is sufficient to answer this part.)