

# ***Interactive comment on “Dynamics Geomagnetic Storm on 7–10 September 2015 as Observed by TWINS and Simulated by CIMI” by Joseph D. Perez et al.***

**Anonymous Referee #1**

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My comment is simple: How did the authors calculate the plasma pressure?

The following is the procedure that I am currently understanding. First of all, please make sure if my understanding is correct.

1. For the TWINS results, the authors obtained the differential flux  $F$  from ENA images. For CIMI, the authors calculated the differential flux  $F$ .  $F$  has units of the number of ions/(unit energy · unit time · unit area · unit solid angle).
2. The authors calculated the pressure terms by integrating  $F$  with respect to energy

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and pitch angle.

$$P_{\perp} = \int d\cos\alpha \sin^2\alpha \int dE \sqrt{\frac{2E}{m}} F, \quad (1)$$

$$P_{\parallel} = 2 \int d\cos\alpha \cos^2\alpha \int dE \sqrt{\frac{2E}{m}} F. \quad (2)$$

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Now, I realized that the confusion comes from the definition of  $F$ . Eqs. (1) and (2) will be understandable if  $F$  is the velocity distribution function, NOT differential flux! The velocity distribution function, which is the number of particles in 6-dimensional space, is defined by

$$F \equiv \frac{dN}{d^3\mathbf{x} d^3\mathbf{v}},$$

where  $N$  is the number of particles, and  $\mathbf{v}$  is velocity. The relationship between the velocity distribution function  $F$  and the differential flux  $j$  is given by

$$F = \frac{m^2}{2E} j.$$

Using this relationship, Eqs. (1) and (2) yield

$$P_{\perp} = \int d\cos\alpha \sin^2\alpha \int dE \sqrt{2Em} j, \quad (3)$$

$$P_{\parallel} = 2 \int d\cos\alpha \cos^2\alpha \int dE \sqrt{2Em} j. \quad (4)$$

Eqs. (3) and (4) are consistent with Eqs. (7) and (8) of De Michelis et al. (1997) who use the symbol  $J$  to represent the differential flux. Hereinafter,

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I would like to define the terms  $F$  and  $j$  to be the velocity distribution function and the differential flux, respectively, to avoid confusion. I would appreciate if the authors make sure which equations, (1)-(2), or (3)-(4), the authors used to calculate the pressure.

In the second reply, the authors stated that the plasma pressure was calculated by

$$P_{\perp} = \int p_{eq} d \cos \alpha \sin^2 \alpha, \quad (5)$$

$$P_{||} = 2 \int p_{eq} d \cos \alpha \cos^2 \alpha, \quad (6)$$

$$p_{eq} = \frac{2\pi}{m} \int E j dE. \quad (7)$$

Although Eqs. (5)-(7) are different from Eqs. (1)-(2) and Eqs. (3)-(4), the authors state that the change of the equations does not affect the results. Why? Does it mean that the authors did not use these equations to calculate the pressure? Does Eqs. (5)-(7) include typographical error? I may misunderstand something, but I would appreciate very much if the authors answer these questions.

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