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Erratum: "The Role of Alfvén Wave Dynamics on the Large-scale Properties of the Solar Wind: Comparing an MHD Simulation with *Parker Solar Probe* E1 data" (2020, ApJS, 246, 24)

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1. Equation of Energy Conservation

In the published article, the source term of the total energy equation included an additional and unintended term Q_w. In fact, following the original notations, the conservation of the system's energy can be written equivalently in two ways:

$$\frac{\partial}{\partial t}(E + \mathcal{E} + \rho\Phi) + \nabla \cdot [(E + p + \rho\Phi)\boldsymbol{v} - \boldsymbol{B}(\boldsymbol{v} \cdot \boldsymbol{B}) + \boldsymbol{v}_g^+ \mathcal{E}^+ + \boldsymbol{v}_g^- \mathcal{E}^-] = Q - Q_w = Q_h - Q_c - Q_r, \quad (1)$$

or

$$\frac{\partial}{\partial t}(E + \rho\Phi) + \nabla \cdot [(E + p - p_w + \rho\Phi)\boldsymbol{v} - \boldsymbol{B}(\boldsymbol{v} \cdot \boldsymbol{B})] = Q - \boldsymbol{v} \cdot \nabla\frac{\mathcal{E}}{2}. \quad (2)$$

The form of these two equivalent equations can be understood as follows: when accounting for the conservation of both the wind energy and the waves (Equation (1)), the wave heating does not appear as a source but is instead hidden in the decay of the wave amplitude and energy. However, this term should appear when one only considers the fluid energy, as it is in Equation (2). Then, a term compensating for the wave pressure must be included. We chose to implement Equation (1).

2. New Simulation of *Parker Solar Probe* Encounter 1

As a consequence of this redundant term, the wave heating was twice what it was meant to be. We consequently ran a new simulation using the correct energy equation. We chose to change slightly the input parameters to obtain a heating and wave amplitude very close to the original simulation. We increased the base velocity perturbation by 20%, reaching the value:

$$\delta v_\odot = 36 \text{ km s}^{-1}, \quad (3)$$

so that the total average input of Alfvén wave energy is $\langle \rho_\odot v_{A,\odot} \delta v_\odot^2 \rangle = \rho_\odot \langle v_{A,\odot} \rangle \delta v_\odot^2 \approx 1.5 \times 10^5$ erg cm^{-2} s^{-1}, with $\rho_\odot = 5 \times 10^{-16}$ g cm^{-3} and $\langle B_\odot \rangle \approx 1.8$ G (the Alfvén wave flux at a given latitude and longitude depends on the precise value of the radial field).

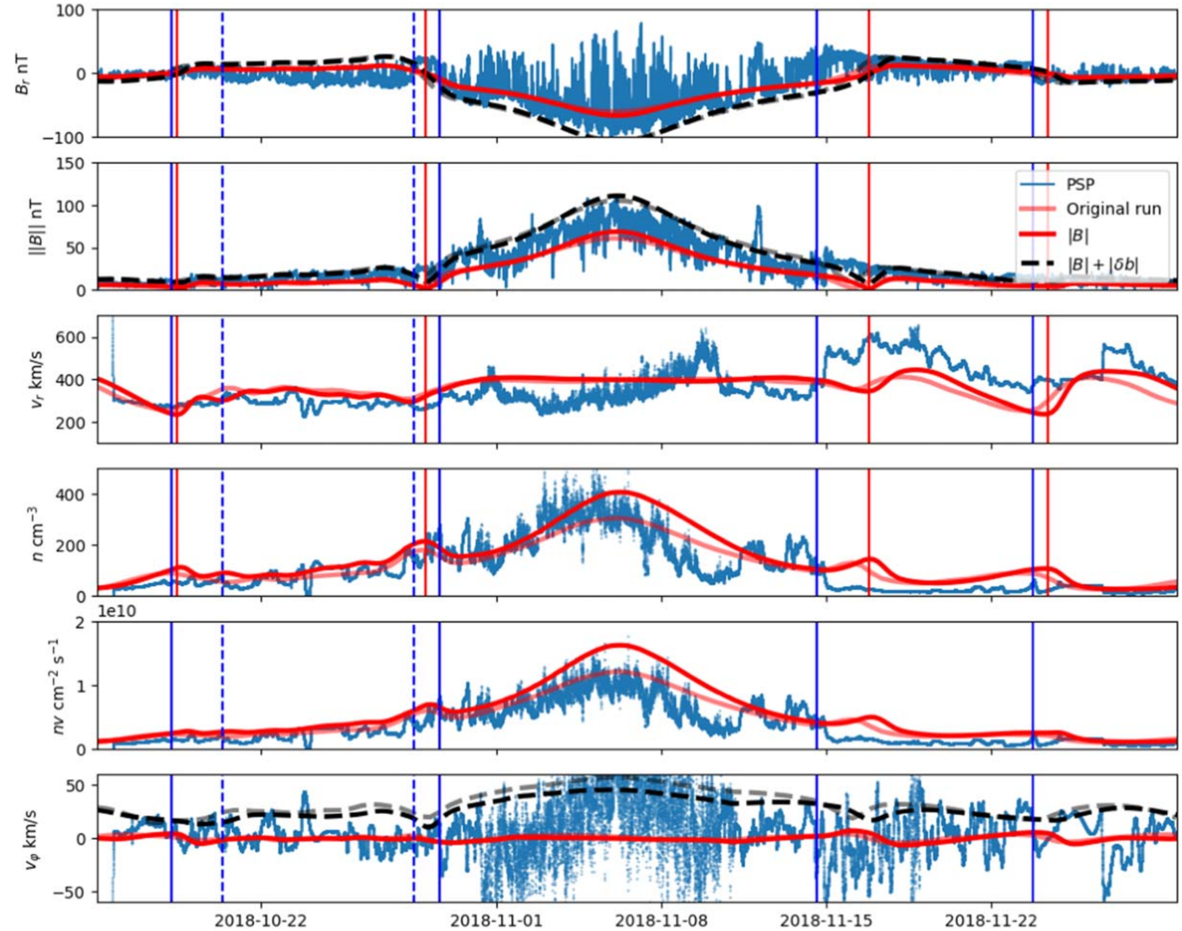

Figure 2. Comparison of the in situ measurements of PSP and the results of the new and original simulations. The original simulation results are displayed with transparency (both in red and dashed black). The vertical lines correspond to HCS crossings of the new simulation (in blue) and in the data (in red). The results of both simulations are very close, except for a slight increase in the solar wind density.

We also decreased slightly the correlation length parameter to

$$\lambda_\odot = 0.020 R_\odot \sqrt{\mathrm{G}} \approx 14{,}000\ \mathrm{km}\sqrt{\mathrm{G}}. \tag{4}$$

We now reproduce the figures that could have been modified using this new simulation. In Figure 2 we reproduce the in situ observations of *Parker Solar Probe* (*PSP*) E1 and compare with the results of the MHD simulations. We left the original run, playing with the transparency of the curve (alpha of 0.5). We see that the in situ variables are only very slightly modified. The only notable difference is in the density, which can be up by 25% at the perihelion compared to the original run. Both the original and the new runs nonetheless remain compatible with the span in the observed density. The heliospheric current sheet (HCS) crossings (vertical lines) remain similar, and the solar wind sources are thus not significantly modified.

In Figure 4 we show the amplitude of the magnetic field as a function of distance in the data and the simulations. Again both simulations are very close, and as in the published article, the amplitude of the radial magnetic field perturbations (switchbacks) fits with the amplitude of the waves in the simulation.

Consequently, as shown with the novel simulation, the main conclusions of the original paper are unchanged:

1. Alfvén wave–driven models of the solar corona can reproduce most in situ observables of the first *PSP* encounter of 2018 November, to the notable exception of the tangential velocities.
2. The amplitude of the perturbations necessary to power such a model are consistent with observations down to $35 R_\odot$.
3. This includes perturbations in the radial magnetic field, i.e., switchbacks, that must then be a significant component of solar wind turbulence.

Two following works have been impacted: Hazra et al. (2021) and Réville et al. (2020). In both cases, a similar small parameter shift should yield results very close to the one published.

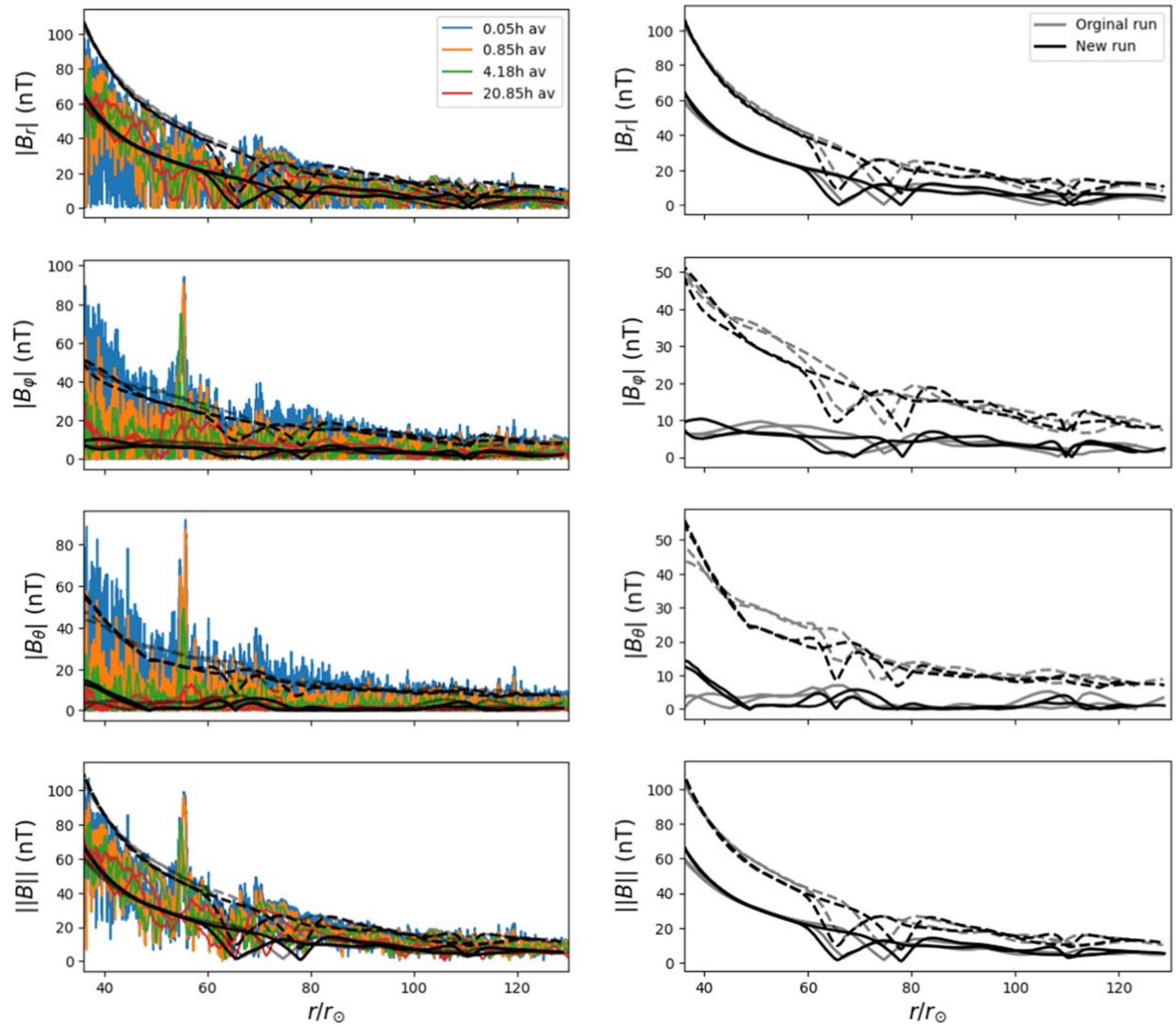

Figure 4. Left panel: magnetic field measurements, with various running average timescales, as a function of the radial distance. The largest time average fits fairly well with the radial dependency of the field obtained in the simulation, shown in black. The dashed line illustrates the amplitude of the field when the Alfvén waves are accounted for. The original simulation results are displayed in transparency. In the right panel, we removed the data to better allow a comparison between the original and the new simulation.

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