A New Way to Study the Solar Wind?

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What is the science question?

How are particles energized across shockwaves in the solar wind?

What were your findings?

This study challenges traditional solar wind models that use elastic collisions (e.g. billiard balls hitting each other) in shockwaves in the solar wind, where there is no change in energy, by suggesting evidence that there actually are inelastic collisions (e.g. a squishy/bouncy ball hitting a wall), where there is a change in energy.

What was the impact?

Evidence of inelastic collisions is a paradigm-shifting result that has implications for the acceleration and evolution of the solar wind and the fundamentals of theory used to model the solar wind. The presence of inelasticity could fundamentally change how we model certain space plasmas, such as the solar wind, and our understanding of them overall.

Why does it matter?

Adding inelastic collisions in models of plasmas could improve our ability to predict solar flares, the arrival times of coronal mass ejections, or generate a stable fusion reaction, potentially protecting our instruments, astronauts, and planet.

Although the issue of elastic versus inelastic may seem very nuanced and too subtle, if the study is correct, this finding could be huge. This is on the level of the first observation of the solar wind or the discovery of the Earth's bow shock. It's a fundamentally critical problem that would completely alter our interpretation and modeling of plasma processes close to home or in the far reaches of the universe.

On the top is a more common shock on Earth, a sonic boom. The bottom image shows a supernova remnant produced by shock waves from an exploding star. Shocks are everywhere in the universe.

Wilson III, L.B. (672), Chen, L.-J. (673), Wang, S. (University of Maryland, College Park), Schwartz, S.J. (University of Colorado, Boulder LASP), Turner, D.L. (Aerospace Corp.), Stevens, M.L. (Harvard Smithsonian Center for Astrophysics), Kasper, J.C. (University of Michigan), Osmane, A. (University of Helsinki), Caprioli, D. (University of Chicago), Bale, S.D. (University of California, Berkeley SSL), Pulupa, M.P. (University of California, Berkeley SSL), Salem, C.S. (University of California, Berkeley SSL), and Goodrich, K.A. (University of California, Berkeley SSL), 2019: "Electron energy partition across interplanetary shocks: I. Methodology and Data Product," The Astrophysical Journal Supplement Series, doi:10.3847/1538-4365/ab22bd