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A Most Unusual and Informative Super-Fast ICME on July 23, 2012

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The superstrong, superfast interplanetary coronal mass ejection (ICME) detected by STEREO A on July 23, 2012, well away from Earth, reached 1 AU without a leading fast-mode shock despite its 17-hr transit time. The reason for the absence of a fast mode shock appears to be that the enormous pressure contained in the energetic particles produced a fast magnetosonic wave speed above the relative speed of the ICME and the solar wind at 1 AU where STEREO A is located, obviating the need for a shock. With a maximum interplanetary magnetic field strength of 109 nT and a southward magnetic field of over 50 nT, our classical understanding of the generation of a geomagnetic storm would imply that this event would have reached historic levels of activity. But would it? The same factors that mitigated shock formation might have altered the rate of reconnection of the ICME field with the terrestrial field and hence weakened the magnetosphere's response. We would need a direct hit on the Earth to test our understanding. In this presentation we examine the magnetic field and energetic particle data observed by STEREO during this event and interpret the physical processes at work.