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Evidence for substantial increases in energetic particle intensity associated with reconnecting current sheets in the solar wind

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We provide evidence for particle acceleration up to ∼5 MeV at reconnecting current sheets in the solar wind based on both case studies and a statistical analysis of the energetic ion and electron flux data from the five ACE EPAM detectors. The case study of a typical reconnection exhaust event reveals (i) a small-scale peak of the energetic ion flux observed in the vicinity of the reconnection exhaust, (ii) a long-time-scale atypical energetic particle event (AEPE) encompassing the reconnection exhaust. AEPEs associated with reconnecting strong current sheets last for many hours, even days, as confirmed by statistical studies. The case study shows that time-intensity profiles of the ion flux may vary significantly from one EPAM detector to another partially because of the local topology of magnetic fields, but mainly because of the impact of upstream magnetospheric events; therefore the occurrence of particle acceleration can be hidden. The finding of significant particle energization within a time interval of +/- 30 hours around reconnection exhausts is supported by a superposed epoch analysis of 126 reconnection exhaust events. We suggest that energetic particles initially accelerated via prolonged magnetic reconnection are trapped and re-accelerated in small-scale magnetic islands surrounding the reconnecting current sheet, as predicted by the transport theory of Zank et al.