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Dynamic magnetic island coalescence and associated electron acceleration

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System size dependence of the electron acceleration during a large-scale magnetic island coalescence is studied via two-dimensional particle-in-cell simulation. In the simulation box that is larger than the ones used in previous studies, injection by the merging line acceleration and a subsequent re-acceleration inside a larger merged island are found to be the mechanism for producing the most energetic electrons in a large-scale system. This finding and the solid knowledge of the re-acceleration process also enable us to predict that the high energy end of the electron energy spectrum continues to expand as the merged island size increases. Both the merging line acceleration and the re-acceleration within a merged island are available if the island coalescence process is so dynamic as to involve fast in-flow toward the center of a merging island. Once this condition is met in an early stage of the coalescence, it is likely to stay in the subsequent phase. In other words, if the initial thin elongated current sheet is entitled to host the dynamic magnetic island coalescence process, it will be a site where chained upgrades in the maximum energy of electrons occur in a systematic manner.