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Turbulence driven magnetic reconnection causing long magnetic islands

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Magnetic reconnection due to turbulence in a current sheet is investigated by means of fluid simulations. It is found that long magnetic islands are produced by turbulence driven by pressure gradient, even if the current sheet is so thick that there is no spontaneous magnetic reconnection. Thus, the turbulence modifies the threshold of magnetic island formation predicted by the conventional theory of spontaneous magnetic reconnection. The long magnetic islands are formed by merging of small-scale magnetic islands.

Our results suggest a new mechanism of long magnetic islands formation in a current sheet in addition to spontaneous and driven magnetic reconnections. When the width of a current sheet is decreasing during a current sheet formation from a smooth magnetic configuration, turbulence produces long magnetic islands at the very beginning of the formation before spontaneous or driven magnetic reconnection takes place.

The length of magnetic islands is the same order as the system size and the width is several times as large as the ion Larmor radius, and stronger turbulence causes wider magnetic islands. This width of magnetic island is important for magnetically confined plasmas because the destabilization of neoclassical tearing modes (NTMs) is controlled by the appearance of seed magnetic islands. The typical width of seed island is evaluated to be several times ion Larmor radius by using experimental data. Thus, the turbulence can produce seed magnetic islands and trigger NTMs.

Keywords: magnetic reconnection, turbulence, magnetic islands