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**Magnetic reconnection in three-dimensional magnetohydrodynamic Taylor-Green flows**[1] JINHUA HAO, YUE YANG, State Key Laboratory for Turbulence and Complex Systems, College of Engineering, Peking University, Beijing 100871, China — We develop the magnetic-surface field (MSF), a Lagrangian-based structure identification method, to study the evolution of magnetic surfaces in magnetohydrodynamics (MHD). Every isosurface of the MSF defines a magnetic surface consisting of magnetic lines. This method is rooted in the Alfven theorem, which is the analogue of the Helmholtz vorticity theorem to illustrate the frozen-in nature of magnetic fields. A two-time approach and a numerical dissipative regularization are introduced for evolving MSF in the conducting fluids with a finite conductivity. From the construction and evolution of MSFs in three-dimensional MHD Taylor-Green (TG-MHD) flows, the topological changes of magnetic surfaces and the reconnection of magnetic lines are characterized. By comparing the structural evolutions in a TG-MHD flow and in a Taylor-Green hydrodynamic (TG-HD) flow, we elucidate the effects of the Lorenz force on the evolution of magnetic surfaces and vortex surfaces. Moreover, we find that the significant changes in energy spectra and dissipation rates in the transition are related to the appearance of some characteristic magnetic and vortex surfaces.

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