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<tr><td>volume</td><td>236</td></tr>
<tr><td>doi</td><td>10.1007/s00205-019-01464-8</td></tr>
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<tr><td>abstract</td><td>We consider the ideal magnetohydrodynamics (MHD) subjected to a strong magnetic field along x_1 direction in three-dimensional thin domains $\Omega_\delta=\mathbb{R}^2\times(-\delta,\delta)$ with slip boundary conditions. It is well-known that in this situation the system will generate Alfv\'en waves. Our results are summarized as follows: (i).\, We construct the global solutions (Alfv\'en waves) to MHD in the thin domain Ω_δ with $\delta>0$. In addition, the uniform energy estimates are obtained with respected to the parameter δ. (ii). We justify the asymptotics of the MHD equations from the thin domain Ω_δ to the plane $\mathbb{R}^2$. More precisely, we prove that the 3D Alfv\'en waves in Ω_δ will converge to the Alfv\'en waves in $\mathbb{R}^2$ in the limit that δ goes to zero. This shows that Alfv\'en waves propagating along the horizontal direction of the (3D) strip are stable and can be approximated by the (2D) Alfv\'en waves when δ is sufficiently small. Moreover, the control of the (2D) Alfv\'en waves can be obtained from the control of (3D) Alfv\'en waves in the thin domain Ω_δ with aid of the uniform bounds. The proofs of main results rely on the design of the proper energy functional and the null structures of the nonlinear terms. Here the null structures means two aspects: separation of the Alfv\'en waves (z_+ and z_-) and no bad quadratic terms $Q(\partial_3 z_-^h, \partial_3 z_+^h)$ where $z_\pm=(z_\pm^h, z^3_\pm)$ and $Q(\partial_3 z_-^h,\partial_3 z_+^h)$ is the linear combination of terms $\partial^\alpha \partial_3 z_-^h\partial^\beta \partial_3 z_+^h$ with $\alpha, \beta \in (\mathbb{Z}_{\geq0})^3$.</td></tr>
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