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**Vanishing viscosity plane parallel channel flow and related singular perturbation problems.**

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Summary: We study a special class of solutions to the three-dimensional Navier-Stokes equations $\partial_t u^\nu + \nabla_{u^\nu} u^\nu + \nabla p^\nu = \nu \Delta_u^\nu$, with no-slip boundary condition, on a domain of the form $\Omega = (x, y, z) : 0 \leq z \leq 1$, dealing with velocity fields of the form $u^\nu(t, x, y, z) = (v^\nu(t, z), w^\nu(t, x, z), 0)$, describing plane-parallel channel flows. We establish results on convergence $u^\nu \to u^0$ as $\nu \to 0$, where $u^0$ solves the associated Euler equations. These results go well beyond previously established $L^2$-norm convergence, and provide a much more detailed picture of the nature of this convergence. Carrying out this analysis also leads naturally to consideration of related singular perturbation problems on bounded domains.

**MSC:**

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|---|---|
| 35B25 | Singular perturbations in context of PDEs |
| 35K20 | Initial-boundary value problems for second-order parabolic equations |
| 35Q30 | Navier-Stokes equations |



**Keywords:**

Navier-Stokes equations; viscosity; boundary layer; singular perturbation

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