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On the Local Well-posedness of a 3D Model for Incompressible Navier-Stokes Equations with Partial Viscosity

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In this short note, we study the local well-posedness of a 3D model for incompressible Navier-Stokes equations with partial viscosity. This model was originally proposed by Hou-Lei in \cite{HouLei09a}. In a recent paper, we prove that this 3D model with partial viscosity will develop a finite time singularity for a class of initial condition using a mixed Dirichlet Robin boundary condition. The local well-posedness analysis of this initial boundary value problem is more subtle than the corresponding well-posedness analysis using a standard boundary condition because the Robin boundary condition we consider is non-dissipative. We establish the local well-posedness of this initial boundary value problem by designing a Picard iteration in a Banach space and proving the convergence of the Picard iteration by studying the well-posedness property of the heat equation with the same Dirichlet Robin boundary condition.

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