HAMBA LAB.

[Physics and Modeling of Turbulence]

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Turbulence Modeling

Turbulence can be widely seen in air and water flows in nature and in engineering field. Turbulent flows can be simulated by solving the equation of fluid motion with computer. But it is difficult to simulate all eddies from the largest one to the smallest one. It is necessary to predict turbulent flows by simulating only large eddies of the mean velocity field. We then need to theoretically derive the equation for the mean velocity field. This is called the turbulence modeling.

The turbulent motion of small eddies is not solved; their effect on the large eddies is expressed as the viscosity enhanced by turbulence. It is important to evaluate the turbulent viscosity and to obtain a closed system of equations for the mean velocity field and the turbulence quantities. In our group, using statistical theory and numerical simulation we clarify the mechanism of turbulence and model the turbulent viscosity in order to develop universal model equations of turbulence.

◆Analysis of turbulent transport in channel flow

The mean shear near the wall is the important mechanism of the turbulence generation. The effect of mean shear on the turbulent transport is studied theoretically and numerically.

◆Analysis of turbulent diffusion in rotating system

Turbulent transport in a rotating system is enhanced by helical fluid motion. Turbulent diffusion from center plane toward top and bottom regions is simulated and the effects of rotation and helical motion are investigated.

◆Modeling the magnetohydrodynamic turbulence and magnetic reconnection

Solar flares are driven by the reconnection of magnetic flux tubes. The magnetic reconnection is simulated and analyzed from the viewpoint of magnetohydrodynamic turbulence modeling.

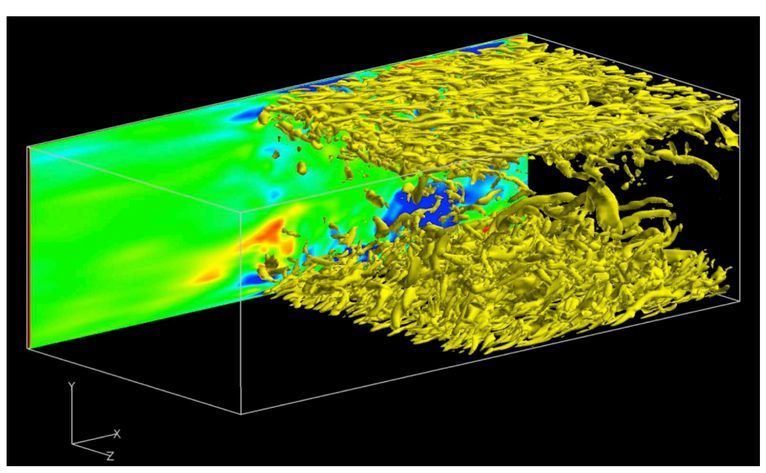

Fig.1 Vortices near the walls in turbulent channel flow

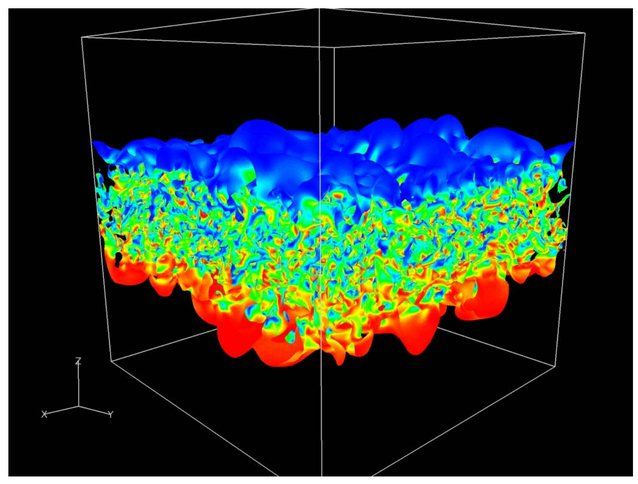

Fig.2 Kinetic energy of turbulent diffusion in rotating system

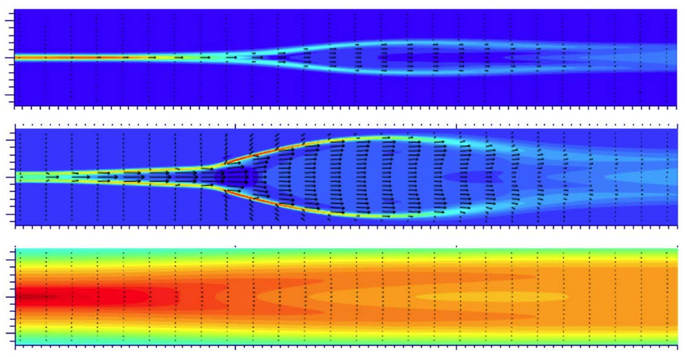

Fig.3 Current and jet of magnetic reconnection