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Dipartimento di Fisica

Seminar

Friday, 7 November 2014 - h. 14:30

Sala Fisica della Materia (Dipartimento di Fisica)

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"Developments in Large Eddy Simulations for Compresible MHD Turbulence in Space Plasma"

Abstract

Large eddy simulation (LES) method is developed for study of decaying and forced compressible magnetohydrodynamic turbulence. The obtained results of numerical computations for large eddy simulation are compared with the results of direct numerical simulation of three-dimensional compressible magnetohydrodynamic turbulence under various similarity parameters, namely, magnetic Reynolds numbers, hydrodynamic Reynolds numbers and Mach numbers for polytropic case. The comparison of five subgrid-scale closures of large eddy simulation for magnetohydrodynamic case is made: the Smagorinsky model, the Kolmogorov model, the cross-helicity model, the scale-similarity model and mixed model. The comparison between large eddy simulation and direct numerical simulation is carried out regarding the time evolution of kinetic and magnetic energy, cross helicity, subgrid-scale and molecular dissipations for kinetic and magnetic energy, turbulent intensities and quantities that describe anisotropy of flow, that is, skewness and kurtosis of velocity and magnetic field. It is shown that some proposed subgrid-scale models provide sufficient dissipation of kinetic and magnetic energy, reduce computational efforts and produce adequate results of magnetohydrodynamic turbulent modeling for various values of similarity parameters of flows. We also consider a heat conducting compressible fluid with the use of an energy equation. Application of large eddy simulation approach to understand observed density fluctuations spectra in local interstellar media is reported. Novel developments in application of LES for forced compressible MHD turbulence are discussed.

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