KOLLOQUIUM ÜBER NEUERE ARBEITEN AUF DEM GEBIETE
DER MECHANIK UND STRÖMUNGSLEHRE
an der Technischen Universität Wien

EINLADUNG

zum Vortrag von Herrn

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über

Effects of radiative heat transfer on the structure of turbulent compressible channel flow

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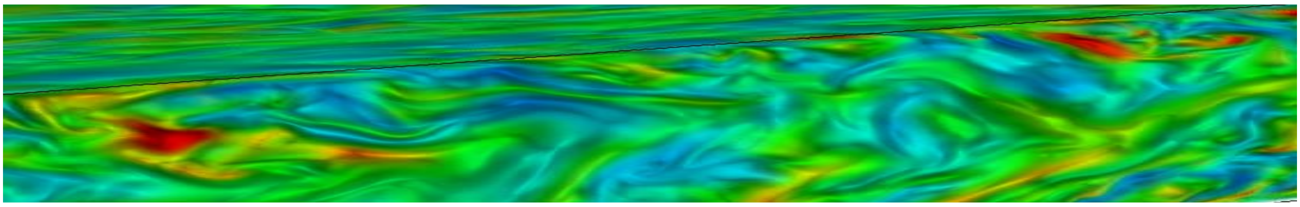

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Effects of radiative heat transfer on the structure of turbulent compressible channel flow

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The talk starts discussing Mach number effects in compressible channel flow without radiative heat transfer first, based on DNS (direct numerical simulation) data. Increasing the Mach number changes the turbulent stresses, their anisotropies and the pressure-strain correlations. A Green's function based analysis of the pressure field traces the changes in the pressure-strain correlations back to the variation (decrease) of the mean density.
Given the modification of the turbulence structure due to compressibility, it is interesting to realize that radiative heat transfer counteracts compressibility (Mach number) effects in the following sense: While compressibility dampens the turbulence activity, thermal radiation seems to enhance it. To demonstrate this at reasonable computational cost, we have performed large-eddy simulations (LES) of compressible turbulent flow in minimal channels (rather than DNS) and have coupled the LES with Discrete-Ordinates-Method (DOM) solutions of the radiative transfer equation (RTE) for an absorbing/emitting gas, namely pure water vapour. Two different models were used to account for the radiative properties of H_2O, the statistical narrow-band correlated-k (SNB-cK) model and a simple grey gas model. The latter allowed to artificially increase the absorption coefficient which proved necessary since the realistic SNB-cK model revealed very low optical thicknesses of the supersonic gas layer between the plates. We finally demonstrate the changes in the turbulence structure due to radiative heat transfer and the role of the radiative heat flux, compared to turbulent and mean molecular heat fluxes.