The seminar will first provide a short overview of the numerical framework, and then present briefly the main results concerning the Stokes eigenspace. Then follow the two main parts dealing with the DNS and LES of lid-driven cubical cavity flow.

- A number of different methods are available to enforce the incompressibility constraint. The Projection-Diffusion method allows to decouple the velocity and pressure computation in very efficient way. This method proceeds by two steps, a pressure evaluation based on a Poisson equation with an extrapolated in time Neumann condition, and a time implicit diffusion step for the final velocity. The pressure is expanded into polynomials of the same order as the velocity, while intermediate velocity results are truncated in a way that enforces continuity without any contamination by spurious pressure modes. The projection-diffusion method is chosen for its consistency with the continuous space-time problem and for its optimal cost.

- The knowledge of Stokes eigenmodes in a square/cube (or in any bounded domain) could provide some insight into the understanding or analysis of turbulent instantaneous flow field as simple as, for instance, those occurring in driven cavity. The scope of the present study is to provide the first deep insight into the Stokes eigenspace in simple confined geometries like the square or the cube. In the core of the eigenmodes, the dynamic equilibria exhibit a linear relationship between the vorticity and the potential vector. These features of the Stokes eigenmodes in the confined geometries are shared by the fully periodic Stokes eigenmodes. The knowledge and interpretation of the Stokes eigenmodes should thus bring an interesting point of view over the resulting dynamics of closed flows, complementary to what is well known regarding the inviscid regions. Analyzing the 3D Stokes eigenmodes in the cube will likely provide valuable understanding of the 3D corners eddies which is the generalisation of the analytical theory of Moffatt in the sixties.

- Direct numerical simulation of the flow in a lid-driven cubical cavity has been carried out at high Reynolds numbers (based on the maximum velocity on the lid), between $1.2 \times 10^4$ and $2.2 \times 10^4$. The resolution used up to 5.0 million Chebyshev collocation nodes, which enable the detailed representation of all dynamically significant scales of motion. The flow phenomena encountered within such systems are many and poorly understood. The dominant feature of the mean flow is studied: the large-scale recirculation which spans the cavity, the coexistence of fast- and slow-flowing regions near the moving lid, the presence of an inflectional mean velocity profile in the upstream part of the lid, of jets impingement on the bottom and upstream wall, and of spiralling vortices. The mean momentum budgets are presented and the leading terms in these balances are examined. The Reynolds stress budgets are computed and the statistics for the distribution of energy between the various components are discussed. The effects of Reynolds number on the driven cavity flow will be briefly discussed.

- The databases are used in the framework of the large eddy simulation (dynamic and mixed dynamic models) to validate filtering approaches and a priori / a posteriori simulation tests using a Legendre spectral element method. Selected results will be presented.