

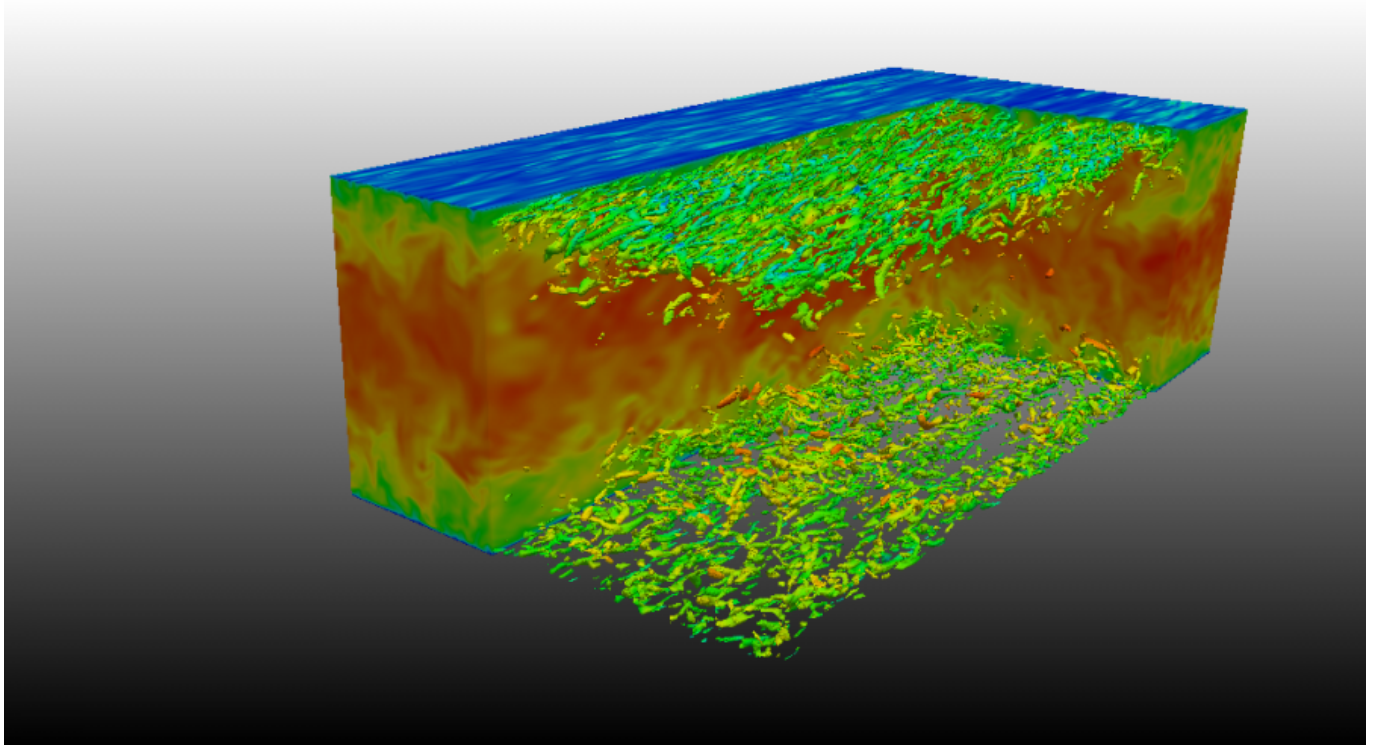
# 3D turbulent channel flow at $Re_{\tau} = 590$

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**Date** : August 2020

**Location** : DATABASE\_CHANNELFLOW\_RETAU590\_LES

**Simulation type** : LES, Mansour's model ([Sunfluidh code](#))



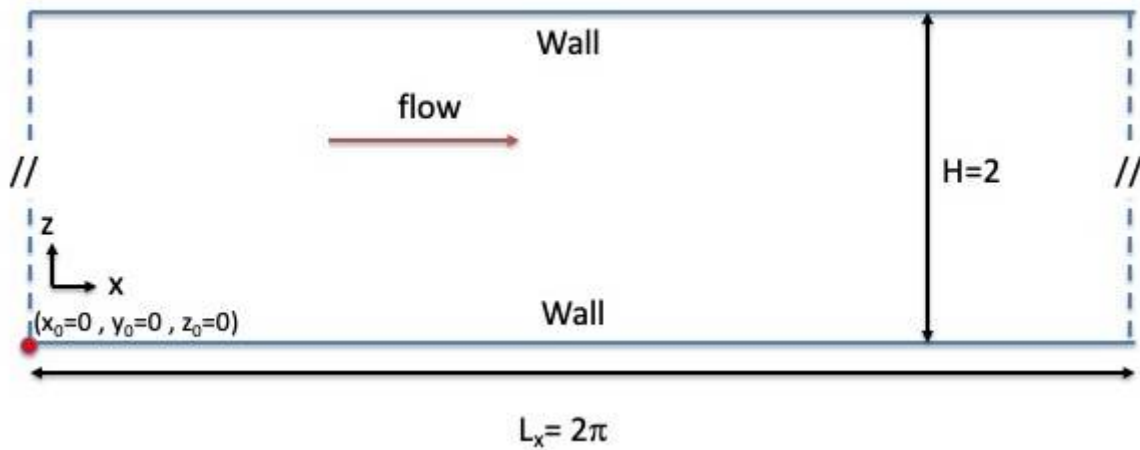
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## Simulation settings

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## 2D sketch



### Referential : cartesian geometry

1. axes :
  - $x(i)$  : downstream direction
  - $y(j)$  : spanwise direction
  - $z(k)$  : normal direction
2. origin :
  - $x_0 = 0$  : left down corner
  - $y_0 = 0$  : left down corner
  - $z_0 = 0$  : left down corner

### Reference scales

- Density : mass density of the fluid ( $\rho_0$ )
- Length : half height of the channel ( $h = \frac{H}{2} = 1$ )
- Velocity : wall friction velocity ( $u^*$ )
- Dynamic viscosity : dynamic viscosity of the fluid ( $\mu_0$ )
- Reynolds number :  $Re_H = \frac{\rho_0 \cdot u^* \cdot h}{\mu_0} = 590$

### Non-dimensionalised data

- velocity :  $U^* = \frac{U}{u^*}$
- density :  $\rho^* = \frac{\rho}{\rho_0} = 1$
- coordinates :  $x^* = \frac{x}{h}$ ,  $y^* = \frac{y}{h}$ ,  $z^* = \frac{z}{h}$

### Computational domain

1. **Domain scope**
  - Downstream direction ( $x$ ) :  $L_x^* = 2\pi$
  - Spanwise direction ( $y$ ) :  $l^* = \pi$
  - Normal direction ( $z$ ) :  $H^* = 2.0$
2. **Boundary conditions**
  - Wall conditions : Top and low walls of the domain

- Periodicity : lateral ends of the domain in  $x$  and  $y$  directions
- 3. **Domain decomposition** (128 MPI subdomains)
  - Along the downstream direction : 8
  - Along the normal direction : 4
  - Along the spanwise direction : 4
- 4. **Spatial resolution**
  - Grid :  $32 \times 64 \times 64$  per subdomain (16.777.216 cells over the domain)
  - About cell-size
    - $\Delta x_{\min} = \Delta x_{\max} = 2.45437 \cdot 10^{-2}$  (downstream direction)
    - $\Delta y_{\min} = \Delta y_{\max} = 1.22718 \cdot 10^{-2}$  (spanwise direction)
    - $\Delta z_{\min} = 6 \cdot 10^{-4} \simeq \Delta z_{\max} = 1.92765 \cdot 10^{-2}$  (normal direction)

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## Data Recording : information about data types

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- **Time series from probes**

- Physical quantities : velocity components along  $x$ ,  $y$  and  $z$  directions ( $u,v,w$ ) and pressure ( $p$ )
- 9 probes
- Time step= 0.001 time unit
- Time range : 16.64 to 199.44 time units
- Locations (In vertical plan at  $y=1.0$ )
  - $X_i = 1.00, X_j = 1.00, X_k = 0.10$  - MPI Subdomain ID : 20
  - $X_i = 1.00, X_j = 1.00, X_k = 0.25$  - MPI Subdomain ID : 21
  - $X_i = 1.00, X_j = 1.00, X_k = 0.50$  - MPI Subdomain ID : 21
  - $X_i = 1.00, X_j = 1.00, X_k = 0.75$  - MPI Subdomain ID : 21
  - $X_i = 1.00, X_j = 1.00, X_k = 1.00$  - MPI Subdomain ID : 21
  - $X_i = 1.00, X_j = 1.00, X_k = 1.25$  - MPI Subdomain ID : 22
  - $X_i = 1.00, X_j = 1.00, X_k = 1.50$  - MPI Subdomain ID : 22
  - $X_i = 1.00, X_j = 1.00, X_k = 1.75$  - MPI Subdomain ID : 22
  - $X_i = 1.00, X_j = 1.00, X_k = 1.90$  - MPI Subdomain ID : 23

- File name (per physical quantity):  $x\_ins\_yyyy.d$  with  $x = u,v,w,p$  and 'yyyy' the MPI subdomain ID

- **3D snapshots**

- Instantaneous fields : velocity components in  $x$ ,  $y$  and  $z$  directions ( $U,V,W$ ) and pressure ( $P$ )
- Recording rate : 0.01 time units
- Time range from from 16.64 to 199.44
- File name :  $res\_xxxxx\_yyyyyy.d$  (xxxxx : MPI subdomain ID, yyyyyy : Time ID)
  - MPI subdomain ID: from 0 to 127
  - Time ID : from 9 to 18288

- **Statistics**

- fields : ( $i,j$  : indexes of direction  $x$ ,  $y$  or  $z$ )

- Mean fields of velocity components ( $\langle U_i \rangle$ ) and pressure ( $\langle P \rangle$ )
- Mean fields of square quantities ( $\langle P^2 \rangle$ ,  $\langle U_i U_j \rangle$ )
- Mean field of subgrid scale dynamic viscosity ( $\mu_{sg}$ )
- Mean field of square  $\mu_{sg}$  ( $\mu_{sg}^2$ )
- Time average computation
- Time startup = 20.0
- Time range per file = 5.0
- Total time range from 20.0 to 199.44
- file name : rst\_xxxxx\_yyyyyyy.d (xxxxx : MPI subdomain ID, yyyyyyy : Time ID)
  - MPI subdomain ID : from 0 to 127
  - Time ID : from 1 to 35

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## Database organisation

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**Data size** : ~ 5.1 To

**Main directory** :

/vol/DATABASE\_MECA/RESTRICTED\_ACCESS/DATABASE\_CHANNELFLOW\_RETAU590\_LES

For more details about files, see the [the wiki doc of Sunfluidh](#)

### Directories & files

```
/GRID : contains all ASCII files about grid setup
input data file          : data_meshgen.d
report on grid features : report_meshgen.d
grid files for sunfluidh: maillx.d, maily.d, maillz.d
check files (ASCII)     : check_mesh_I.d, check_mesh_J.d, check_mesh_K.d
                        (3 columns : indices, cell-face coordinates,
cell size)
/DATASETUP              : ASCII files
input data file for sunfluidh : input3d.dat
/TIMESERIES : contains time series recorded over the time range [16.64 ;
199.44]
                    ASCII files : x_ins_yyyyy.d with x= u,v,w,p
                    time series files are sliced in storage directories CAS-
MPI200-n (n from 5 to 50)
/SNAPSHOTS : snapshots binary files res_xxxxx_yyyyyyy.d
            files stored in archive files : res_yyyyyyy.tar for each
time ID
/STATISTICS : statistics binary files files rst_xxxxx_yyyyyyy.d
            files stored in archive files : res_z.tar , z is an ID
number (from 1 to 35)
/RESTART_AR : backup/restart archive save.tar at time 199.44
/FROM_COMPUTATION : regroups some directories and files related to the
simulation
                    directories : CAS-MPI128-n with n= 5 to 50 (from
```

simulation 5 to 50)

each directory contains files  
checkcalc\_00000.dat and checkdata\_00000.dat

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