Experiments on very large structures in fully developed turbulent pipe flow

The present work aims at investigation of turbulent pipe flow at high Reynolds numbers and low Mach numbers. During the recent years there has been an increasing interest in observation and understanding of large scale turbulent coherent structures forming Large and Very Large Scale Motions (LSM and VLSM). Nevertheless, a solid definition of their nature and vivid understanding of their evolution is still missing. Therefore, this study will focus on clarifying the nature and origin of LSM and VLSM as well as describing and identifying them in a quantitative manner. To this end experiments (and numerical computations together with possible partners within the SPP) will be performed and matched as closely as possible.

Experiments at Cottbus Large Pipe Test Facility (CoLa-Pipe), which was built up for this purpose, will be conducted at bulk Reynolds numbers of $6\times10^4 \leq Re_b \leq 1\times10^6$ (based on diameter (D) and bulk velocity (U_b)) and Mach numbers Ma < 0.23, measuring turbulent flow properties using sophisticated Hot Wire Anemometry (HWA) and state of the art Particle Image Velocimetry (PIV) methods.

Structural properties resulted from the premultiplied spectra, spatial auto correlations and sliced POD obtained via experiments should show convincing agreement with spatio-temporal structures and Exact Coherent Structures provides by other partners inside the SPP. This collaborative study will provide solid evidence for existence of VLSM at higher Reynolds numbers. Furthermore, uncertainties concerning LSM and VLSM, their interactions, length scales and their energy content will be clarified.