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Reynolds and swirl number effects on turbulent pipe flow in a 90 degree pipe bend ATHANASIA KALPAKLI, RAMIS OERLUE, P. HENRIK ALFREDSSON, CCGEx, KTH Mechanics, Royal Institute of Technology, Stockholm, Sweden — Flows in pipe bends have been studied extensively over the last decades due to their occurrence both in the human respiratory and blood systems as well as in many technical applications. The centrifugal effect of the bend may give rise to Dean vortices and the behaviour of these has been of particular interest. While their motion has nicely been illustrated in laminar flows, the picture of their motion in turbulent flows remains rather blurred. Within the framework of the present work, fully developed turbulent pipe flow from a 100 diameter (D) long pipe is fed to a 90° bend and the flow field at $0.5D$ downstream the bend has been studied by means of Time-Resolved Stereoscopic Particle Image Velocimetry, covering a Reynolds number range from 7000 to 34000 based on bulk velocity (U_b) and D. Additionally, a well defined swirl profile could be introduced by rotating the $100D$ long straight pipe along its axis, yielding a variation in swirl number (S), defined as the ratio between the azimuthal velocity of the pipe wall and U_b, from 0 (the non-rotating case) to 1.2. The three-dimensional time-averaged and instantaneous flow field illustrating the symmetrical Dean vortices for $S = 0$ and the influence by the swirling motion for $S \neq 0$, the so-called "swirl-switching phenomenon," as well as the large-scale structures will be presented and discussed.

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