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Very large-scale motions in a turbulent pipe flow[1] JAE HWA LEE, SEONG JAE JANG, HYUNG JIN SUNG, KAIST — Direct numerical simulation of a turbulent pipe flow with Re_D=35000 was performed to investigate the spatially coherent structures associated with very large-scale motions. The corresponding friction Reynolds number, based on pipe radius R, is R^+=934, and the computational domain length is $30R$. The computed mean flow statistics agree well with previous DNS data at Re_D=44000 and 24000. Inspection of the instantaneous fields and two-point correlation of the streamwise velocity fluctuations showed that the very long meandering motions exceeding 25R exist in logarithmic and wake regions, and the streamwise length scale is almost linearly increased up to y/R$\sim$0.3, while the structures in the turbulent boundary layer only reach up to the edge of the log-layer. Time-resolved instantaneous fields revealed that the hairpin packet-like structures grow with continuous stretching along the streamwise direction and create the very large-scale structures with meandering in the spanwise direction, consistent with the previous conceptual model of Kim & Adrian (1999).

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