Contribution submission to the conference Regensburg 2016

Boundary layers in turbulent Rayleigh-Bénard convection —
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The heat transport throughout a fluid layer heated from below and cooled from above is mainly determined by two very thin flow regions adjacent to the hot bottom and the cold top wall. They are referred to as boundary layers. Following a hypothesis of Kraichnan [R. H. Kraichnan. Turbulent Thermal Convection at Arbitrary Prandtl Number. Phys. Fluids 5, 1374-1389 (1962)] it is widely believed nowadays that these boundary layers are of laminar type below a critical threshold in Rayleigh number and that they become turbulent above this limit. We show the results of highly resolved PIV measurements of the near-wall flow field in the large-scale convection facility Barrel of Ilmenau, an experiment which is seven meters in diameter and eight meters in height. Our measurements show that the dynamics of those boundary layers and the formation of coherent structures inside go far beyond a laminar shear layer of Prandtl-Blasius type although the Rayleigh number is considerably below the threshold predicted by Kraichnan.

Part:	**DY**
Type:	**Vortrag;Talk**
Topic:	**Fluiddynamik und Turbulenz; Fluid Dynamics and Turbulence (joint session DY/CPP)**
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