Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Modeling height-dependent spatio-temporal spectra in wall-bounded turbulence[1] MICHAEL WILCZEK, Max Planck Institute for Dynamics and Self-Organization, RICHARD J.A.M. STEVENS, CHARLES MENEVEAU, Johns Hopkins University — Spatio-temporal spectra of wall-bounded turbulence show a non-trivial structure in the wavenumber-frequency domain. We here study spectra of streamwise velocity fluctuations by means of large-eddy simulations. Such spectra, for instance, indicate wavenumber-dependent frequency shifts induced by mean flow advection as well as frequency broadening related to large-scale velocity perturbations. In previous work, we introduced an advection model combining Taylor's frozen eddy hypothesis and the Kraichnan-Tennekes random sweeping hypothesis to capture these observations. For the logarithmic layer of the flow, we furthermore introduced analytical model parameterizations for the height-dependent wavenumber part of the spectrum as well as the frequency shift and broadening. After summarizing these results, we will present further comparisons of the model with simulation data. In particular, we will validate the model for a range of heights across the logarithmic layer by focusing on comparisons of wavenumber-frequency spectra in the streamwise wavenumber-frequency plane as well as in the spanwise wavenumber-frequency plane.

[1]Funding: DFG [WI 3544/2-1, WI 3544/3-1]; FOM Fellowships for Young Energy Scientists (YES!) and NSF (IIA 1243482, the WINDINSPIRE project)

Michael Wilczek
Max Planck Institute for Dynamics and Self-Organization

Date submitted: 24 Jul 2015 Electronic form version 1.4