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Connections between density, wall-normal velocity, and coherent structure in a heated turbulent boundary layer[1] THERESA SAXTON-FOX, California Institute of Technology, STANISLAV GORDEYEV, ADAM SMITH, University of Notre Dame, BEVERLEY MCKEON, California Institute of Technology
— Strong density gradients associated with turbulent structure were measured in a mildly heated turbulent boundary layer using an optical sensor (Malley probe). The Malley probe measured index of refraction gradients integrated along the wall-normal direction, which, due to the proportionality of index of refraction and density in air, was equivalently an integral measure of density gradients. The integral output was observed to be dominated by strong, localized density gradients. Conditional averaging and Pearson correlations identified connections between the streamwise gradient of density and the streamwise gradient of wall-normal velocity. The trends were suggestive of a process of pick-up and transport of heat away from the wall. Additionally, by considering the density field as a passive marker of structure, the role of the wall-normal velocity in shaping turbulent structure in a sheared flow was examined. Connections were developed between sharp gradients in the density and flow fields and strong vertical velocity fluctuations.

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