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Investigation of the temperature field in a turbulent boundary layer CLAYTON BYERS, MARCUS HULTMARK, Princeton University — The scaling and evolution of a developing turbulent thermal boundary layer is investigated. By allowing the temperature differences in the fluid to remain small enough to treat temperature as a passive scalar, the analysis can be extended to any turbulent convection/diffusion problem. Mean temperature scaling is developed and analyzed by utilizing the Asymptotic Invariance Principle developed by George and Castillo (1997). Possible effects of the Reynolds and Prandtl number are discussed. The derived power law solution for the inner and outer scaling is then used to develop a heat transfer law for the wall heat flux, q_w. Data collection is performed with a newly developed MEMS sensor, allowing improved performance and reduced spatial and temporal filtering of the signal. Integration with a PIV system will allow direct measurements of the turbulent heat flux $-\overline{\theta v}$ to investigate the extent of the overlap layer and validity of the proposed scaling laws. Temperature variance $\frac{1}{2}\overline{\theta^2}$ will also be investigated, with a possible scaling proposed.

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