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Endwall Vortex Effects on Turbulent Dispersion of Film Coolant in a Turbine Vane Cascade[1] SAYURI D. YAPA, CHRISTOPHER J. ELKINS, JOHN K. EATON, Stanford University — Turbine flows include strong secondary flows due to flow turning. The dominant flow feature is the passage vortex, located in the corner between the endwall and the suction surface of the airfoil. This vortex may have a strong effect on scalar transport in the turbine wake. Experiments were conducted to examine the dispersion of coolant emitted along the trailing edge of the airfoil. 3D velocity and concentration measurements were made using magnetic resonance imaging to study turbulent mixing in a realistic film-cooled nozzle vane cascade. The passage vortex has large effects on the flow features in the vane wake and on coolant mixing. A shear layer is created on the vane's suction side and interacts with the passage vortex after shedding from the trailing edge. The resulting vortex pattern forces the coolant jet into a highly distorted shape. A key question is how this distortion affects the turbulent diffusion of coolant. The 3D MRI-based velocity and concentration measurements allows for estimation of turbulent diffusivity. Control volumes are defined using a streamtube that is defined beginning just downstream of the trailing edge. The turbulent diffusivity is determined by integrating the Reynolds-averaged advection-diffusion equation over these control volumes.

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