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Computational Fluid Dynamics (CFD) simulations of a Heisenberg Vortex Tube CARL BUNGE, Washington State University, HARISWARAN SITARAMAN, National Renewable Energy Laboratory, JAKE LEACHMAN, Washington State University — A 3D Computational Fluid Dynamics (CFD) simulation of a Heisenberg Vortex Tube (HVT) is performed to estimate cooling potential with cryogenic hydrogen. The main mechanism driving operation of the vortex tube is the use of fluid power for enthalpy streaming in a highly turbulent swirl in a dual-outlet tube. This enthalpy streaming creates a temperature separation between the outer and inner regions of the flow. Use of a catalyst on the peripheral wall of the centrifuge enables endothermic conversion of para-ortho hydrogen to aid primary cooling. A κ-ε turbulence model is used with a cryogenic, non-ideal equation of state, and para-orthohydrogen species evolution. The simulations are validated with experiments and strategies for parametric optimization of this device are presented.

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