Abstract Submitted
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The flow mechanism causing performance breakdown in cavitating axial turbomachines[1] DAVID TAN, RINALDO MIORINI, Johns Hopkins University, ELENA VAGNONI, Politecnico di Milano, IAN WILKES, JOSEPH KATZ, Johns Hopkins University — Cavitation degrades the performance of pumps, eventually leading to complete performance breakdown. Identifying the mechanisms causing breakdown has been a long-standing challenge. Using high-speed imaging (9.6 kHz) and pressure fluctuation measurements in the JHU optically refractive index matched facility, we elucidate the cavitation breakdown process in a waterjet pump. It involves interactions of a cavitating tip leakage vortex with the trailing edge of attached cavitation on the rotor blade, specifically, entrainment of the vortical cloud cavitation by the tip vortex. As the pressure is decreased, the blade suction side (SS) sheet cavitation extends further downstream. When the trailing edge extends to the region where the rotor blades overlap, the entrained sheet cavitation vorticity forms a vortex with axis aligned perpendicularly to the blade, and extending over the entire passage. Decreasing the pressure increases the size of this vortex and generates several parallel structures. The process causes a sharp drop in the pressure difference across the blade tip, i.e. the blade loading (performance) diminishes. Examination of previously published images of cavitation in rocket inducers suggests that this phenomenon occurs in other axial turbomachines as well.

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