Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Triad Resonance Mechanism for Turbulent Transition Over a Rotating Disk THOMAS CORKE, ERIC MATLIS, HESHAM OTHMAN, Univ. of Notre Dame — This work is part of an experimental study of mechanisms for transition to turbulence in the boundary layer on a rotating disk. The focus here is on a triad resonance between Type I traveling and a stationary cross-flow modes. This made use of a method for introducing controlled initial disturbances consisting of a distributed array of ink dots placed on the disk surface to enhance a narrow band of wave numbers. Hot-wire sensors primarily sensitive to the azimuthal velocity component, were positioned at different spatial (r, θ) locations on the disk to document the growth of disturbances. Spatial correlation measurements were used with two simultaneous sensors to obtain wavenumber vectors. Measured velocity time series were decomposed into those traveling with the disk rotation speed (stationary modes) and those traveling with respect to the disk frame of reference. Cross-bicoherence was used to identify three-frequency phase locking between pairs of traveling modes and a stationary mode. Determination of the wave-numbers associated with these frequencies confirmed that these involved a triad resonance. This was found to occur for a large range of wave numbers, high and low, but the most energetic involved low azimuthal mode number ($n = 3$ to 5) stationary modes. At transition to turbulence, these modes had the largest amplitude and dominated the integral development of the boundary layer. Evidence of this mechanism can be found in past flow visualization by others.

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Date submitted: 05 Aug 2006 Electronic form version 1.4