Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Nonlinear interaction of stationary and travelling crossflow modes with a common critical layer ALEX AMOS, XUESONG WU, Imperial College London — Laminar-turbulent transition of the three-dimensional boundary layer over a swept wing is caused by amplification of crossflow vortices. A puzzling and interesting experimental observation is that that the free-stream turbulence levels affect the development of stationary crossflow vortices. One possible explanation of this affect is that the travelling modes, which are excited by free-stream turbulence, interact nonlinearly with the stationary modes to affect their development. This interaction between modes is likely to be most effective when they share a critical level, where Rayleigh's equation becomes singular. We have shown that stationary and travelling modes having a common critical layer do exist. Their mutual nonlinear interactions are studied. The matched asymptotic expansion in conjunction with the multiple-scale method is used to derive the evolution equations for the amplitudes of the modes. The effects of the interactions on the growth of the amplitudes will be discussed, and possible self interactions and their consequence will be addressed.

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Date submitted: 31 Jul 2015 Electronic form version 1.4