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Global stability of the rotating disk boundary layer and the effects of suction and injection CHRISTOPHER DAVIES, CHRISTIAN THOMAS, Cardiff University — The von Karman boundary layer over a rotating disk is known to be absolutely unstable (Lingwood 1995). However, numerical simulations indicate that this absolute instability does not give rise to an unstable linear global mode, when account is taken of the radial dependence of the basic flow (Davies & Carpenter 2003). Analogous behaviour can be found in solutions of the linearized complex Ginzburg-Landau equation, similar to those derived by Hunt & Crighton (1991). These solutions show that detuning, arising from the radial variation of the local temporal frequency, may be enough to globally stabilize disturbances, even when local temporal growth rates increase with radius. Depending on the precise balance between the radial increase in growth rates and the corresponding shifts in frequency, it is possible for an absolutely unstable flow to remain globally stable. For the von Karman rotating disk boundary layer, the earlier numerical simulation results suggest that the balance in this case does in fact give rise to global stability. Similar behaviour has been identified in more recent numerical simulations that we have conducted, where mass injection was introduced at the disk surface. The modified flow still appears to be globally stable, despite the fact that injection is known to be locally destabilizing. More interestingly, it was also found that globally unstable behaviour was promoted when suction was applied.

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