Abstract Submitted
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An experimental study of the edge effect on transition of the rotating-disk boundary-layer flow SHINTARO IMAYAMA, R.J. LINGWOOD, P. HENRIK ALFREDSSON, Linne FLOW Centre, KTH Mechanics, Royal Institute of Technology, Stockholm, Sweden — Lingwood [J. Fluid Mech., 299, 17 (1995)] showed that the flow instability in the rotating-disk boundary layer is not only of convective nature but also that the flow becomes absolutely unstable. Furthermore, in the absence of bypass mechanisms, the absolute instability triggers nonlinearity and transition to turbulence at a fixed Reynolds number (Re). Healey [J. Fluid Mech., 663, 148 (2010)] suggested that the observed spread (albeit small) in transition Re in different experiments is an effect of the Re at the disk edge and provided a nonlinear model to take this effect into account. Here, we further investigate this problem experimentally with hot-wire measurements on a rotating polished glass disk with a diameter of 474mm and a total imbalance and surface roughness less than 10μm. To investigate the influence of the disk edge, we vary Re at the disk edge by changing the rotational speed and map the development of the disturbance velocity in the radial direction. Furthermore, the effect of a stationary annular plate around the edge of the rotating disk is also investigated. Our experiments show no effect of the disk edge Re on the stability and transition, however there was a shift of both the growth curve and the transition Re by about 10 units with and without the outer stationary plate, with the lower Re observed with the plate.

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