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Non-linear evolution of vortical disturbances in two-fluid boundary layers LUCA BURINI, TAMER A. ZAKI, Imperial College London — The stability characteristics of boundary layers are altered by the presence of a wall-film of different density or viscosity. The effects of stratification on modal stability of this flow has previously been studied using linear theory. The transient amplification of disturbances is also altered. We demonstrate that an optimal choice of viscosity and density ratios can result in a reduction of transient energy growth up to 30%. The predictions of linear, locally-parallel analyses do not, however, take into account the spreading of the mean flow. The contribution of non-parallelism is quantified in the case of spatially developing boundary layers. Furthermore, beyond the early linear stage, the amplitude of the instability waves becomes appreciable and non-linear effects can no longer be neglected. As a result, an accurate description of the evolution of disturbances in two-fluid boundary layers must account for non-linear interactions and mean flow modification. We apply the framework of the non-linear Parabolized Stability Equations (PSE) in order to study the evolution of the most amplifying disturbances in the two-fluid flow. Our methodology takes into account non-linear modal interactions, the mean flow correction and finite deformation of the interface.

Luca Burini
Imperial College London

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