The operating range of modern high-bypass turbofan aircraft engines is limited by the axisymmetric breakdown of flow through the compressor known as stall. The initiation of stall has been attributed to the flow at the compressor tip. The flow physics associated with stall inception were investigated in a transonic axial compressor computationally and experimentally. It was found that an interface exists at the blade tip between incoming axial flow to the compressor and reverse leakage flow over the blade tip. The location of this interface was found to correspond with the axial location of a region of zero axial shear, denoted $x_{zs}$, at the compressor casing. The location of this region of zero axial shear was found to vary with changes in operating point. The movement of this region was proposed to be governed by a momentum balance between the axial flow and reverse flow. The compressor stalls once the location of this interface moves ahead of the blade leading edge plane. The generation of short length scale disturbances which lead to stall were linked to the location of the interface using a static tip gap offset. Stall was therefore interpreted to occur as a result of a critical momentum balance between the approach fluid and the tip-leakage flow.

Casing treatments have been shown to alter the stalling mass flow of axial compressors. The effects of circumferential groove casing treatments on both the performance and tip gap flow were investigated. In all cases tested the addition of circumferential grooves caused the compressor to stall at a lower mass flow than the typical smooth wall configuration. Computational results show that the addition of circumferential grooves alter the tip momentum balance by impeding the reverse leakage momentum. This altered the location of the interface causing the compressor to stall at a lower mass flow. The addition of casing treatments also caused a decrease in overall compressor efficiency. This is due to an increase in viscous shear losses which are a result of the exit flow from the groove.