Sheared flow is known to decorrelate turbulence and reduce the radial energy flux in tokamaks. Under special conditions it can even lead to the formation of an Internal Transport Barrier (ITB), an abrupt transition to an enhanced confinement regime. We have studied the effect of sheared flow on the turbulent transport of energy and momentum employing the gyrokinetic flux tube code GS2. The results show two striking features, namely, (i) given the value of the heat flux, there is a maximum temperature gradient that is achieved for a finite velocity shear; and (ii) the ratio of turbulent momentum and energy diffusivities is constant for a wide range of flow shear values, giving a constant turbulent Prandtl number of order unity.

Based on this knowledge, we investigate the self-consistent transport equilibrium in a tokamak heated by neutral beams. We look for steady state solutions in which all the energy and momentum deposited by the beam is diffused out by turbulent or neoclassical mechanisms. Without neoclassical transport, bifurcations to enhanced confinement are not possible because for given energy and momentum depositions there is only one solution. If neoclassical transport is included, under specific circumstances that favour regions of low magnetic shear we find that for some energy and momentum depositions there are up to three simultaneous solutions (see the figure). It is possible to transit to enhanced confinement solutions, but to do so it is necessary to decrease the energy input, contradicting the phenomenology of ITBs. We propose a new mechanism that drives bifurcations to enhanced confinement solutions based on new terms in the momentum equation. These new terms are also the drive of intrinsic rotation.