Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

On new non-modal hydrodynamic stability modes and resulting non-exponential growth rates - a Lie symmetry approach MARTIN OBERLACK, Tech Univ Darmstadt, ANDREAS NOLD, Imperial College London, CEDRIC WILFRIED SANJON, YONGQI WANG, JAN HAU, Tech Univ Darmstadt — Classical hydrodynamic stability theory for laminar shear flows, no matter if considering long-term stability or transient growth, is based on the normal-mode ansatz, or, in other words, on an exponential function in space (stream-wise direction) and time. Recently, it became clear that the normal mode ansatz and the resulting Orr-Sommerfeld equation is based on essentially three fundamental symmetries of the linearized Euler and Navier-Stokes equations: translation in space and time and scaling of the dependent variable. Further, Kelvin-mode of linear shear flows seemed to be an exception in this context as it admits a fourth symmetry resulting in the classical Kelvin mode which is rather different from normal-mode. However, very recently it was discovered that most of the classical canonical shear flows such as linear shear, Couette, plane and round Poiseuille, Taylor-Couette, Lamb-Ossen vortex or asymptotic suction boundary layer admit more symmetries. This, in turn, led to new problem specific non-modal ansatz functions. In contrast to the exponential growth rate in time of the modal-ansatz, the new non-modal ansatz functions usually lead to an algebraic growth or decay rate, while for the asymptotic suction boundary layer a double-exponential growth or decay is observed.

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Date submitted: 28 Jul 2016 Electronic form version 1.4