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# Stability of coaxial swirling jets

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In order to improve the mixing properties of injectors, we investigate the potential synergy between azimuthal and axial shear. For this purpose, we examine the linear modal stability of a simplified analytical model which consists of a temporally evolving swirling jet surrounded by an annular jet with a different axial velocity. We denote  $\Lambda = V_2/V_1$  the ratio between the axial velocity of the non-swirling annular jet  $V_2$  and the axial velocity of the central jet  $V_1$ ; and  $q = \Omega_c r_1/V_1$  the swirl number of the central jet where  $\Omega_c$  is the rotation rate on the jet axis and  $r_1$  the radius of the central jet. The present study extends the results of Gallaire & Chomaz (2003) where a single swirling jet was considered. For all values of the swirl number up to  $q = 2$ , adding the outer non-swirling jet increases substantially the growth rate of the most amplified mode, which can be more than doubled when  $\Lambda > 1$ . This is the result of the collaborative axial and azimuthal shear instabilities localised in between the two jets. The mode selection of larger azimuthal wavenumbers with increasing  $q$ , identified by Gallaire & Chomaz (2003), is no longer observed when the outer jet is at least as fast as the central jet  $\Lambda > 1$ , the axisymmetric  $m = 0$  mode being the most amplified.

## References

GALLAIRE, F. & CHOMAZ, J-M. 2003 Mode selection in swirling jet experiments : a linear stability analysis. *J. Fluid Mech.* **494**, 223–253.