Abstract Submitted
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Turbulent counterflow driven by swirl decay[1] ANATOLI BORISSOV, VLADIMIR SHTERN — Swirling counterflows occur in vortex combustors, hydrocyclones, and vortex tubes where the Reynolds number can exceed million. It is explained here why the elongated counterflows survive wild turbulent mixing in these devices. To this end, an analytical solution to the Reynolds averaged Navier-Stokes equations is obtained that describes the turbulent flow in a cylindrical container. The Reynolds stresses are modeled using the Prandtl mixing length approach modified here for swirling flows. A fluid enters the container through a tangential inlet and leaves through a central exhaust both located at the same end wall. Despite the inlet and exhaust are close, there is no short-cut flow. The fluid goes from the inlet near the sidewall to the dead end, turns around, and goes back near the axis to the exhaust. This global counterflow occurs due to swirl decay caused by friction at the sidewall. The combined effect of swirl and friction causes that pressure drops from the inlet to the dead end near the sidewall and from the dead end to the exhaust near the axis. Such a pressure distribution drives the counterflow and provides its survival against turbulent mixing. A simple experiment is performed confirming the counterflow geometry.

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