Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Three-dimensional structure of a confined swirling jet at moderately large Reynolds numbers. ENRIQUE SANMIGUEL-ROJAS, M.A. BURGOS, Universidad Politec. Cartagena (Spain), CARLOS DEL PINO, RAMON FERNANDEZ-FERIA, University of Malaga (Spain) — We have performed a series of three-dimensional (3D) numerical simulations of the incompressible flow discharging from a rotating pipe into a co-axial cylindrical container through a sudden expansion. We have considered several values of the Reynolds number based on the pipe flow rate, Re_Q, between 100 and 400, and an expansion ratio of 8, and have analyzed the emerging 3D flow structures in the swirling jet exiting from the rotating pipe as the swirl Reynolds number Re_θ, based on the circumferential velocity of the discharging pipe, is increased. The results are compared with axisymmetric (2D) numerical simulations of the same problem. Three-dimensional, non-linear instabilities are found in the swirling jet above a critical value of Re_θ, which depends on Re_Q, that obviously do not appear in the axisymmetric simulations. These non-linear instabilities are triggered by the linear instabilities inside the rotating pipe. We characterize the azimuthal wave number, frequency and other properties of these instabilities as Re_θ is increased. There exists another critical value of Re_θ above which 3D (helical) vortex breakdown appears in the swirling jet. But this critical value and the structure of the vortex breakdown flow are both substantially different from the axisymmetric counterparts. *Supported by the Ministerio de Educacion y Ciencia of Spain (FIS04-00538).

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Date submitted: 26 Jul 2006 Electronic form version 1.4