Abstract Submitted
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Strain dynamics for vortex ring mixing process[1] YANN BOUREMEL, MICHAEL YIANNESKIS, ANDREA DUCCI, Kings College London — Simultaneous PIV-PLIF measurements were carried out to investigate the mixing occurring in a laminar vortex ring flow during the formation stage (Re=357-1072). In the first part of the work a control volume analysis was used to determine the variation in time of the scalar concentration mean, variance, and probability density function. In the second part the advection-diffusion differential equations of the scalar, ξ, and of its energy, $0.5\ \xi^2$, were studied in depth to gain insight into the effect of the strain rate tensor, $\mathbf{S}$, on the local scalar concentration for increasing *Re*. The measurements were obtained with a high spatial resolution (12 μm for the PLIF) in order to resolve the scalar dissipative scales. Reliable estimates of the scalar dissipation rate ($\nabla\xi\cdot\nabla\xi$), and of the symmetric contraction term ($\nabla\xi\cdot\mathbf{S}\cdot\nabla\xi$), shown in equation 1, were obtained. $\nabla\xi\cdot\mathbf{S}\cdot\nabla\xi$ accounts for the reduction of scalar dissipation due to the straining component directed as the local scalar gradient (see Southerland et al.[2]) Equation 1: $\left(\frac{\partial}{\partial t}+\vec{u}.\nabla+\frac{1}{ReSc}\nabla^2\right)\frac{1}{2}\left(\nabla\xi.\nabla\xi\right)=-\left(\nabla\xi.S.\nabla\xi\right)-\frac{1}{ReSc}\nabla(\nabla\xi):\nabla(\nabla\xi)$

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[2]Southerland K B., Porter III J. R., Dahm, W. J. A., Buch K. A., An experimental study of the molecular mixing process in an axisymmetric laminar vortex ring, Phys. Fluids A 3 (5), May 1991

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