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Turbulent spots and scalar flashes in pipe transition[1] RONALD ADRIAN, Arizona State University, XIAOHUA WU, Royal Military College of Canada, PARVIZ MOIN, Stanford University — Recent study (Wu et al, PNAS, 1509451112, 2015) demonstrated the feasibility and accuracy of direct computation of the Osborne Reynolds' pipe transition experiment without the unphysical axially periodic boundary condition. Here we use this approach to address three questions: (1) What are the dynamics of turbulent spot generation in pipe transition? (2) How is the succession of scalar flashes, as observed and sketched by Osborne Reynolds, created? (3) What happens to the succession of flashes further downstream? In this study, the inlet disturbance is of radial-mode type imposed through a narrow, three-degree numerical wedge; and the simulation Reynolds number is 6500. Numerical dye is introduced at the inlet plane locally very close to the pipe axis, similar to the needle injection by O. Reynolds. Inception of infant turbulent spots occurs when normal, forward inclined hairpin packets form near the walls from the debris of the inlet perturbations. However, the young and mature turbulent spots consist almost exclusively of reverse, backward leaning hairpin vortices. Scalar flashes appear successively downstream and persist well into the fully-developed turbulent region. Their creation mechanism is addressed.

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