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The highly excited confined mixing layer WEI ZHAO, GUIREN WANG, University of South Carolina, Columbia — In order to understand the mechanism of ultrafast mixing observed in confined mixing layer in a pipe, flow velocity and vorticity fields are quantitatively measured with PIV. Under strong forcing, the responses of the velocity and vorticity field are completely different, leading to a different mixing process. In free mixing layer, under strong forcing level, there will be saturation, and the initial mixing depends only on the convective scalar transport by velocity fluctuations of large scale spanwise vortex. However in confined mixing layer under strong forcing, it is found that not only the velocity fluctuations play important roles in mixing process, but also the mean velocity field. The local averaged vertical velocity V and spanwise velocity W are not negligible anymore and can be significantly affected by the forcing. These mean velocity constituents have two direct effects: One is to transport scalar outward from the axial line, which leads to a larger spreading rate. Another is to accelerate the breakdown of vortex structures by stretching. Hence, the mixing can be significantly enhanced. From the distributions of velocity, in cross-section, it can be found that both the corner vortex and strongly asymmetric influence of actuating coexist. When the forcing amplitude is increased to 11%, the instant vortex structures near the pipe axis indicate a high consistency with the mean vortex structures. Hence, at high forcing level, we tend to believe that the corner vortex is the primary source of V constituent.

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