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Corrigendum to Vorticity and enstrophy transport in head-on quenching of turbulent premixed ames, Eur. J. Mech. Fluids/B, DOI: 10.1016/j.euromech u.2016.10.013

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This corrigendum indicates the correct near-wall behaviour of the combined molecular diffusion and dissipation term of the Reynolds-averaged enstrophy (i.e. $\overline{\Omega} = \overline{\omega_i \omega_i}/2$ with ω_i being the i^{th} component of vorticity) transport equation in the case of head-on quenching of turbulent premixed flame. This was inadvertently incorrectly reported in Ref. [1] due to an error in post-processing the Direct Numerical Simulation data.

The Reynolds-averaged enstrophy transport equation is given by [1-3]:

$$\frac{\partial \overline{\Omega}}{\partial t} + \overline{u_k \frac{\partial \Omega}{\partial x_k}} = \underbrace{\overline{\omega_i \omega_k \frac{\partial u_i}{\partial x_k}}}_{T_I} \underbrace{\overline{-\epsilon_{ijk}\omega_i \frac{1}{\rho^2}\frac{\partial \rho}{\partial x_j}\frac{\partial \tau_{kl}}{\partial x_l}}}_{T_{II}} + \underbrace{\overline{\frac{\epsilon_{ijk}\omega_i}{\rho}\frac{\partial^2 \tau_{kl}}{\partial x_j \partial x_l}}}_{T_{III}} \underbrace{\overline{-2\frac{\partial u_k}{\partial x_k}\Omega}}_{T_{IV}} + \underbrace{\overline{\epsilon_{ijk}\frac{\omega_i}{\rho^2}\frac{\partial \rho}{\partial x_j}\frac{\partial p}{\partial x_k}}}_{T_V} \tag{1}$$

where $\bar{Q}$, $\tilde{Q} = \overline{\rho Q}/\bar{\rho}$ and $Q'' = Q - \tilde{Q}$ are the Reynolds-averaged, Favre-averaged and Favre fluctuation of a general quantity Q respectively. The term T_I indicates the vortex-stretching contribution, whereas T_{II} arises due to misalignment between gradients of density and viscous stresses. The T_{III} is responsible for molecular diffusion and dissipation of $\overline{\Omega}$, where T_{IV} and T_V represent the dilatation and baroclinic torque contributions respectively. Substituting $\tau_{kl} = \mu(\partial u_k/\partial x_l + \partial u_k/\partial x_l) - 2(\mu/3)\delta_{kl}(\partial u_m/\partial x_m)$ in $T_{III} = \overline{\epsilon_{ijk}\omega_i/\rho(\partial^2 \tau_{kl}/\partial x_j \partial x_l)}$ leads to [1]:

$$T_{III} = \overline{(\mu/\rho)\nabla^2 \Omega} + \overline{(\mu/3\rho)\vec{\omega} \cdot [\nabla \times \nabla(\nabla \cdot \vec{u})]} + f(\mu) - D_v \tag{2}$$

where $f(\mu)$ represents the contributions from viscosity gradients and $-D_v = -\overline{(\mu/\rho)(\partial \omega_i/\partial x_l)(\partial \omega_i/\partial x_l)}$ is the molecular dissipation of enstrophy. As dilatation rate $\nabla \cdot \vec{u}$ is a scalar the second term on right hand side of eq. 2 vanishes according to the mathematical identity $\nabla \times \nabla(\nabla \cdot \vec{u}) = 0$. There was an error in evaluating the diffusion term $\overline{(\mu/\rho)\nabla^2 \Omega}$ Figs. 9 and 10 in Ref. [1], which erroneously indicated non-zero values of $\overline{(\mu/3\rho)\vec{\omega} \cdot [\nabla \times \nabla(\nabla \cdot \vec{u})]}$ and implied that $\overline{(\mu/3\rho)\vec{\omega} \cdot [\nabla \times \nabla(\nabla \cdot \vec{u})]}$ plays a key role in the near-wall region. The variations of $\overline{(\mu/\rho)\nabla^2 \Omega}$, $\overline{(\mu/3\rho)\vec{\omega} \cdot [\nabla \times \nabla(\nabla \cdot \vec{u})]}$ and $(-D_v)$ with x_1/δ_Z are reported in Figs. 1 and 2 for cases A and E respectively (a monotonic qualitative trend is observed from case A to case E). The term $f(\mu)$ is identically zero for the cases considered here (i.e. μ =constant) and thus is not shown in Figs. 1 and 2. It can be seen from Figs. 1 and 2 that $\overline{(\mu/3\rho)\vec{\omega} \cdot [\nabla \times \nabla(\nabla \cdot \vec{u})]}$ remains zero. The term T_{III} assumes negative value away from the wall principally due to $(-D_v)$. On the contrary, the contribution of $\overline{(\mu/\rho)\nabla^2 \Omega}$ overwhelms the sink contribution of $(-D_v)$, and yields a positive value of T_{III} in the near-wall region.

The aforementioned correction does not affect any of major conclusions made in the original paper [1] apart from the fact that combined molecular diffusion and dissipation contribution becomes positive near the wall due to molecular diffusion of enstrophy (instead of the contribution arising from dilatation rate gradient).

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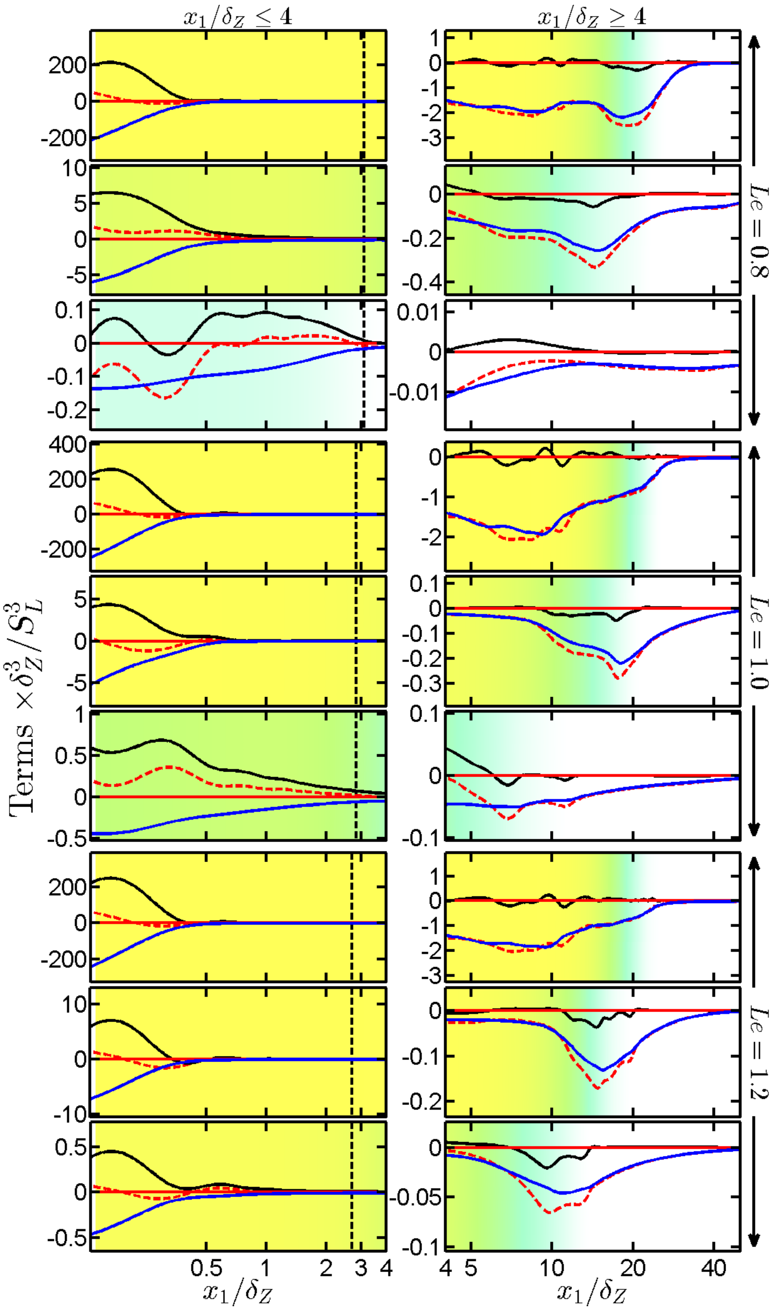

Figure 1: Variations of $T_{III} \times \delta_Z^3/S_L^3$ (red dashed line), $\overline{(\mu/\rho)\nabla^2\Omega} \times \delta_Z^3/S_L^3$ (black solid line), $\overline{(\mu/3\rho)\vec{\omega} \cdot [\nabla \times \nabla(\nabla \cdot \vec{u})]} \times \delta_Z^3/S_L^3$ (red solid line) and $(-D_\nu) \times \delta_L^3/S_L^3$ (blue solid line) with x_1/δ_Z (log scale) for case A at $t = 2\delta_Z/S_L, 6\delta_Z/S_L$ and $10\delta_Z/S_L$ (1^{st} - 3^{rd} row).

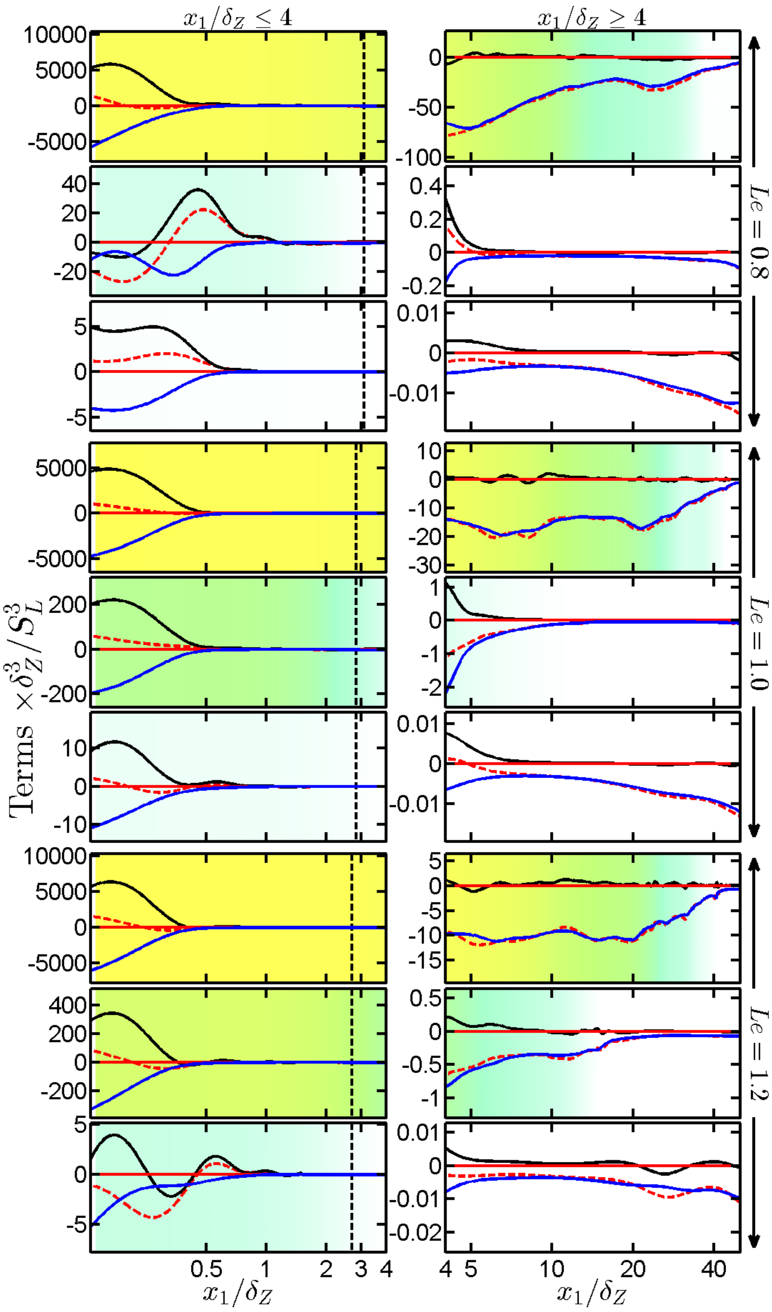

Figure 2: Variations of $T_{III} \times \delta_Z^3/S_L^3$ (red dashed line), $\overline{(\mu/\rho)\nabla^2\Omega} \times \delta_Z^3/S_L^3$ (black solid line), $\overline{(\mu/3\rho)\vec{\omega} \cdot [\nabla \times \nabla(\nabla \cdot \vec{u})]} \times \delta_Z^3/S_L^3$ (red solid line) and $(-D_\nu) \times \delta_L^3/S_L^3$ (blue solid line) with x_1/δ_Z (log scale) for case E at $t = 2\delta_Z/S_L, 6\delta_Z/S_L$ and $10\delta_Z/S_L$ (1st - 3rd row).