$$
- \frac{a_{\rho x}^2 \pi^2 k \rho_x \left[2\cos\left(\frac{a_{\rho x}\pi x}{L}\right)^2 \rho_x + \sin\left(\frac{a_{\rho x}\pi x}{L}\right)\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]\right]\left[p_0 + p_x \cos\left(\frac{a_{px}\pi x}{L}\right) + p_y \sin\left(\frac{a_{py}\pi y}{L}\right) + p_z \cos\left(\frac{a_{pz}\pi z}{L}\right)\right]}{RL^2\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]^3} +
$$

$$
- \frac{a_{\rho y}^2 \pi^2 k \rho_y \left[2\sin\left(\frac{a_{\rho y}\pi y}{L}\right)^2 \rho_y + \cos\left(\frac{a_{\rho y}\pi y}{L}\right)\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]\right]\left[p_0 + p_x \cos\left(\frac{a_{px}\pi x}{L}\right) + p_y \sin\left(\frac{a_{py}\pi y}{L}\right) + p_z \cos\left(\frac{a_{pz}\pi z}{L}\right)\right]}{RL^2\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]^3} +
$$

$$
- \frac{a_{\rho z}^2 \pi^2 k \rho_z \left[2\cos\left(\frac{a_{\rho z}\pi z}{L}\right)^2 \rho_z + \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]\right]\left[p_0 + p_x \cos\left(\frac{a_{px}\pi x}{L}\right) + p_y \sin\left(\frac{a_{py}\pi y}{L}\right) + p_z \cos\left(\frac{a_{pz}\pi z}{L}\right)\right]}{RL^2\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]^3} +
$$

$$
- \frac{4}{3}\frac{a_{ux}^2 \pi^2 \mu u_x}{L^2}\left[\cos\left(\frac{a_{ux}\pi x}{L}\right)^2 u_x - \sin\left(\frac{a_{ux}\pi x}{L}\right)\left[u_0 + u_x \sin\left(\frac{a_{ux}\pi x}{L}\right) + u_y \cos\left(\frac{a_{uy}\pi y}{L}\right) + u_z \cos\left(\frac{a_{uz}\pi z}{L}\right)\right]\right] +
$$

$$
- \frac{a_{uy}^2 \pi^2 \mu u_y}{L^2}\left[\sin\left(\frac{a_{uy}\pi y}{L}\right)^2 u_y - \cos\left(\frac{a_{uy}\pi y}{L}\right)\left[u_0 + u_x \sin\left(\frac{a_{ux}\pi x}{L}\right) + u_y \cos\left(\frac{a_{uy}\pi y}{L}\right) + u_z \cos\left(\frac{a_{uz}\pi z}{L}\right)\right]\right] +
$$

$$
- \frac{a_{uz}^2 \pi^2 \mu u_z}{L^2}\left[\sin\left(\frac{a_{uz}\pi z}{L}\right)^2 u_z - \cos\left(\frac{a_{uz}\pi z}{L}\right)\left[u_0 + u_x \sin\left(\frac{a_{ux}\pi x}{L}\right) + u_y \cos\left(\frac{a_{uy}\pi y}{L}\right) + u_z \cos\left(\frac{a_{uz}\pi z}{L}\right)\right]\right] +
$$

$$
- \frac{a_{vx}^2 \pi^2 \mu v_x}{L^2}\left[\sin\left(\frac{a_{vx}\pi x}{L}\right)^2 v_x - \cos\left(\frac{a_{vx}\pi x}{L}\right)\left[v_0 + v_x \cos\left(\frac{a_{vx}\pi x}{L}\right) + v_y \sin\left(\frac{a_{vy}\pi y}{L}\right) + v_z \sin\left(\frac{a_{vz}\pi z}{L}\right)\right]\right] +
$$

$$
- \frac{4}{3}\frac{a_{vy}^2 \pi^2 \mu v_y}{L^2}\left[\cos\left(\frac{a_{vy}\pi y}{L}\right)^2 v_y - \sin\left(\frac{a_{vy}\pi y}{L}\right)\left[v_0 + v_x \cos\left(\frac{a_{vx}\pi x}{L}\right) + v_y \sin\left(\frac{a_{vy}\pi y}{L}\right) + v_z \sin\left(\frac{a_{vz}\pi z}{L}\right)\right]\right] +
$$

$$
- \frac{a_{vz}^2 \pi^2 \mu v_z}{L^2}\left[\cos\left(\frac{a_{vz}\pi z}{L}\right)^2 v_z - \sin\left(\frac{a_{vz}\pi z}{L}\right)\left[v_0 + v_x \cos\left(\frac{a_{vx}\pi x}{L}\right) + v_y \sin\left(\frac{a_{vy}\pi y}{L}\right) + v_z \sin\left(\frac{a_{vz}\pi z}{L}\right)\right]\right] +
$$

$$
- \frac{a_{wx}^2 \pi^2 \mu w_x}{L^2}\left[\cos\left(\frac{a_{wx}\pi x}{L}\right)^2 w_x - \sin\left(\frac{a_{wx}\pi x}{L}\right)\left[w_0 + w_x \sin\left(\frac{a_{wx}\pi x}{L}\right) + w_y \sin\left(\frac{a_{wy}\pi y}{L}\right) + w_z \cos\left(\frac{a_{wz}\pi z}{L}\right)\right]\right] +
$$

$$
- \frac{a_{wy}^2 \pi^2 \mu w_y}{L^2}\left[\cos\left(\frac{a_{wy}\pi y}{L}\right)^2 w_y - \sin\left(\frac{a_{wy}\pi y}{L}\right)\left[w_0 + w_x \sin\left(\frac{a_{wx}\pi x}{L}\right) + w_y \sin\left(\frac{a_{wy}\pi y}{L}\right) + w_z \cos\left(\frac{a_{wz}\pi z}{L}\right)\right]\right] +
$$

$$
- \frac{4}{3}\frac{a_{wz}^2 \pi^2 \mu w_z}{L^2}\left[\sin\left(\frac{a_{wz}\pi z}{L}\right)^2 w_z - \cos\left(\frac{a_{wz}\pi z}{L}\right)\left[w_0 + w_x \sin\left(\frac{a_{wx}\pi x}{L}\right) + w_y \sin\left(\frac{a_{wy}\pi y}{L}\right) + w_z \cos\left(\frac{a_{wz}\pi z}{L}\right)\right]\right] +
$$

$$
- \frac{a_{vx}\pi v_x}{L}\sin\left(\frac{a_{vx}\pi x}{L}\right)\left[u_0 + u_x \sin\left(\frac{a_{ux}\pi x}{L}\right) + u_y \cos\left(\frac{a_{uy}\pi y}{L}\right) + u_z \cos\left(\frac{a_{uz}\pi z}{L}\right)\right]\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]\cdot
$$

$$
\cdot\left[v_0 + v_x \cos\left(\frac{a_{vx}\pi x}{L}\right) + v_y \sin\left(\frac{a_{vy}\pi y}{L}\right) + v_z \sin\left(\frac{a_{vz}\pi z}{L}\right)\right] +
$$

$$
+ \frac{a_{vy}\pi v_y}{2L}\cos\left(\frac{a_{vy}\pi y}{L}\right)\left\{\left(\left[u_0 + u_x \sin\left(\frac{a_{ux}\pi x}{L}\right) + u_y \cos\left(\frac{a_{uy}\pi y}{L}\right) + u_z \cos\left(\frac{a_{uz}\pi z}{L}\right)\right]^2 + \left[w_0 + w_x \sin\left(\frac{a_{wx}\pi x}{L}\right) + w_y \sin\left(\frac{a_{wy}\pi y}{L}\right) + w_z \cos\left(\frac{a_{wz}\pi z}{L}\right)\right]^2 +
$$

$$
+3\left[v_0 + v_x \cos\left(\frac{a_{vx}\pi x}{L}\right) + v_y \sin\left(\frac{a_{vy}\pi y}{L}\right) + v_z \sin\left(\frac{a_{vz}\pi z}{L}\right)\right]^2\right)\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right] +
$$

$$
+ \left[p_0 + p_x \cos\left(\frac{a_{px}\pi x}{L}\right) + p_y \sin\left(\frac{a_{py}\pi y}{L}\right) + p_z \cos\left(\frac{a_{pz}\pi z}{L}\right)\right]\frac{2\gamma}{\gamma - 1}\Bigg\} +
$$

$$
+ \frac{a_{vz}\pi v_z}{L}\cos\left(\frac{a_{vz}\pi z}{L}\right)\left[w_0 + w_x \sin\left(\frac{a_{wx}\pi x}{L}\right) + w_y \sin\left(\frac{a_{wy}\pi y}{L}\right) + w_z \cos\left(\frac{a_{wz}\pi z}{L}\right)\right]\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]\cdot
$$

$$
\cdot\left[v_0 + v_x \cos\left(\frac{a_{vx}\pi x}{L}\right) + v_y \sin\left(\frac{a_{vy}\pi y}{L}\right) + v_z \sin\left(\frac{a_{vz}\pi z}{L}\right)\right] +
$$

$$
+ \frac{a_{wx}\pi w_x}{L}\cos\left(\frac{a_{wx}\pi x}{L}\right)\left[u_0 + u_x \sin\left(\frac{a_{ux}\pi x}{L}\right) + u_y \cos\left(\frac{a_{uy}\pi y}{L}\right) + u_z \cos\left(\frac{a_{uz}\pi z}{L}\right)\right]\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]\cdot
$$

$$
\cdot\left[w_0 + w_x \sin\left(\frac{a_{wx}\pi x}{L}\right) + w_y \sin\left(\frac{a_{wy}\pi y}{L}\right) + w_z \cos\left(\frac{a_{wz}\pi z}{L}\right)\right] +
$$

$$
+ \frac{a_{wy}\pi w_y}{L}\cos\left(\frac{a_{wy}\pi y}{L}\right)\left[v_0 + v_x \cos\left(\frac{a_{vx}\pi x}{L}\right) + v_y \sin\left(\frac{a_{vy}\pi y}{L}\right) + v_z \sin\left(\frac{a_{vz}\pi z}{L}\right)\right]\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]\cdot
$$

$$
\cdot\left[w_0 + w_x \sin\left(\frac{a_{wx}\pi x}{L}\right) + w_y \sin\left(\frac{a_{wy}\pi y}{L}\right) + w_z \cos\left(\frac{a_{wz}\pi z}{L}\right)\right] +
$$

$$
- \frac{a_{wz}\pi w_z}{2L}\sin\left(\frac{a_{wz}\pi z}{L}\right)\left\{\left(3\left[w_0 + w_x \sin\left(\frac{a_{wx}\pi x}{L}\right) + w_y \sin\left(\frac{a_{wy}\pi y}{L}\right) + w_z \cos\left(\frac{a_{wz}\pi z}{L}\right)\right]^2 + \left[v_0 + v_x \cos\left(\frac{a_{vx}\pi x}{L}\right) + v_y \sin\left(\frac{a_{vy}\pi y}{L}\right) + v_z \sin\left(\frac{a_{vz}\pi z}{L}\right)\right]^2 +
$$

$$
+ \left[u_0 + u_x \sin\left(\frac{a_{ux}\pi x}{L}\right) + u_y \cos\left(\frac{a_{uy}\pi y}{L}\right) + u_z \cos\left(\frac{a_{uz}\pi z}{L}\right)\right]^2\right)\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right] +
$$

$$
+ \left[p_0 + p_x \cos\left(\frac{a_{px}\pi x}{L}\right) + p_y \sin\left(\frac{a_{py}\pi y}{L}\right) + p_z \cos\left(\frac{a_{pz}\pi z}{L}\right)\right]\frac{2\gamma}{(\gamma - 1)}\Bigg\} +
$$

$$
+ \frac{a_{px}^2 \pi^2 k p_x \cos\left(\frac{a_{px}\pi x}{L}\right)}{L^2 R\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]} +
$$

$$
+ \frac{a_{py}^2 \pi^2 k p_y \sin\left(\frac{a_{py}\pi y}{L}\right)}{L^2 R\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]} +
$$

$$
+ \frac{a_{pz}^2 \pi^2 k p_z \cos\left(\frac{a_{pz}\pi z}{L}\right)}{L^2 R\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]} +
$$

$$
- \frac{2a_{px}a_{\rho x}\pi^2 k p_x \rho_x \cos\left(\frac{a_{\rho x}\pi x}{L}\right)\sin\left(\frac{a_{px}\pi x}{L}\right)}{L^2 R\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]^2} +
$$

$$
- \frac{2a_{py}a_{\rho y}\pi^2 k p_y \rho_y \sin\left(\frac{a_{\rho y}\pi y}{L}\right)\cos\left(\frac{a_{py}\pi y}{L}\right)}{L^2 R\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]^2} +
$$

$$
- \frac{2a_{pz}a_{\rho z}\pi^2 k p_z \rho_z \cos\left(\frac{a_{\rho z}\pi z}{L}\right)\sin\left(\frac{a_{pz}\pi z}{L}\right)}{L^2 R\left[\rho_0 + \rho_x \sin\left(\frac{a_{\rho x}\pi x}{L}\right) + \rho_y \cos\left(\frac{a_{\rho y}\pi y}{L}\right) + \rho_z \sin\left(\frac{a_{\rho z}\pi z}{L}\right)\right]^2} +
$$

$$
+ \frac{4}{3}\frac{a_{ux}a_{vy}\pi^2 \mu u_x v_y}{L^2}\cos\left(\frac{a_{ux}\pi x}{L}\right)\cos\left(\frac{a_{vy}\pi y}{L}\right) +
$$

$$
- \frac{4}{3}\frac{a_{ux}a_{wz}\pi^2 \mu u_x w_z}{L^2}\cos\left(\frac{a_{ux}\pi x}{L}\right)\sin\left(\frac{a_{wz}\pi z}{L}\right) +
$$

$$
- \frac{2a_{uy}a_{vx}\pi^2 \mu u_y v_x}{L^2}\sin\left(\frac{a_{uy}\pi y}{L}\right)\sin\left(\frac{a_{vx}\pi x}{L}\right) +
$$

$$
+ \frac{2a_{uz}a_{wx}\pi^2 \mu u_z w_x}{L^2}\cos\left(\frac{a_{wx}\pi x}{L}\right)\sin\left(\frac{a_{uz}\pi z}{L}\right) +
$$

$$
- \frac{4}{3}\frac{a_{vy}a_{wz}\pi^2 \mu v_y w_z}{L^2}\cos\left(\frac{a_{vy}\pi y}{L}\right)\sin\left(\frac{a_{wz}\pi z}{L}\right) +
$$

$$
- \frac{2a_{vz}a_{wy}\pi^2 \mu v_z w_y}{L^2}\cos\left(\frac{a_{vz}\pi z}{L}\right)\cos\left(\frac{a_{wy}\pi y}{L}\right).
$$