① Polazeći od

$$\hat{P} = \sum_\alpha \rho_\alpha \langle (\vec{v}-\vec{u}) \otimes (\vec{v}-\vec{u}) \rangle_\alpha$$

ukupni tenzor napona

pokazati da vrijedi:

$$\hat{P} = \sum_\alpha \hat{p}_\alpha + \sum_\alpha \rho_\alpha \vec{u}_{diff,\alpha} \otimes \vec{u}_{diff,\alpha}$$

$$\hat{P} = \sum_\alpha \rho_\alpha \langle \vec{v}\otimes\vec{v} - \vec{v}\otimes\vec{u} - \vec{u}\otimes\vec{v} + \vec{u}\otimes\vec{u} \rangle_\alpha =$$

$$\rho\vec{u} = \sum_\alpha \rho_\alpha \vec{u}_\alpha \quad \to \quad \vec{u} = \frac{1}{\rho}\sum_\alpha m_\alpha n_\alpha \vec{u}_\alpha$$

$$\vec{u}_\alpha = \frac{1}{n_\alpha}\int_{V_{\vec{v}}} \vec{v} f_\alpha d^3\vec{v} \qquad / \langle \vec{v} \rangle_\alpha = \vec{u}_\alpha$$

$$\langle \vec{u}_\alpha \rangle_\alpha = \vec{u}_\alpha \qquad \langle \vec{u} \rangle_\alpha = \vec{u}$$

$$\vec{w}_\alpha = \vec{v} - \vec{u}_\alpha$$

$$= \sum_\alpha \rho_\alpha \langle \vec{v}\otimes\vec{v} \rangle_\alpha - \sum_\alpha \rho_\alpha \langle \vec{v} \rangle_\alpha \otimes \vec{u} -$$

$$- \sum_\alpha \rho_\alpha \vec{u} \otimes \langle \vec{v} \rangle_\alpha + \sum_\alpha \rho_\alpha \vec{u} \otimes \vec{u} =$$

$$= \sum_\alpha \rho_\alpha \langle (\vec{w}_\alpha + \vec{u}_\alpha) \otimes (\vec{w}_\alpha + \vec{u}_\alpha) \rangle_\alpha - \sum_\alpha \rho_\alpha \vec{u}_\alpha \otimes \hat{\vec{u}}$$

$$- \sum_\alpha \rho_\alpha \hat{\vec{u}} \otimes \vec{u}_\alpha + \rho \hat{\vec{u}} \otimes \hat{\vec{u}} =$$

$\langle \vec{w}_\alpha \rangle_\alpha = 0$

$$= \sum_\alpha \underbrace{\rho_\alpha \langle \vec{w}_\alpha \otimes \vec{w}_\alpha \rangle_\alpha}_{\hat{p}_\alpha} + \sum_\alpha \rho_\alpha \langle \vec{w}_\alpha \otimes \vec{u}_\alpha \rangle_\alpha +$$

$$+ \sum_\alpha \rho_\alpha \langle \vec{u}_\alpha \otimes \vec{w}_\alpha \rangle_\alpha + \sum_\alpha \rho_\alpha \langle \vec{u}_\alpha \otimes \vec{u}_\alpha \rangle_\alpha -$$

$$- \sum_\alpha \rho_\alpha \vec{u}_\alpha \otimes \hat{\vec{u}} - \sum_\alpha \rho_\alpha \hat{\vec{u}} \otimes \vec{u}_\alpha + \rho \hat{\vec{u}} \otimes \hat{\vec{u}} =$$

$$= \sum_\alpha \hat{p}_\alpha + \sum_\alpha \rho_\alpha \vec{u}_\alpha \otimes \vec{u}_\alpha - \sum_\alpha \rho_\alpha \vec{u}_\alpha \otimes \hat{\vec{u}} -$$

$$- \sum_\alpha \rho_\alpha \hat{\vec{u}} \otimes \vec{u}_\alpha + \rho \hat{\vec{u}} \otimes \hat{\vec{u}} \quad =$$

$$\vec{u}_{diff\,\alpha} = \vec{u}_\alpha - \hat{\vec{u}} \quad \Rightarrow \vec{u}_\alpha = \vec{u}_{diff\,\alpha} + \hat{\vec{u}}$$

$$= \sum_\alpha \hat{p}_\alpha + \sum_\alpha \rho_\alpha \vec{u}_{diff,\alpha} \otimes \vec{u}_{diff,\alpha} +$$

$$+\cancel{\sum_\alpha \rho_\alpha \vec{u}_{diff,\alpha} \otimes \vec{u}} + \cancel{\sum_\alpha \rho_\alpha \vec{u} \otimes \vec{u}_{diff,\alpha}} +$$

$$+\cancel{\underbrace{\sum_\alpha \rho_\alpha}_{\rho} \vec{u} \otimes \vec{u}} - \cancel{\sum_\alpha \rho_\alpha \vec{u}_{diff,\alpha} \otimes \vec{u}} -$$

$$-\cancel{\sum_\alpha \rho_\alpha \vec{u} \otimes \vec{u}} - \cancel{\sum_\alpha \rho_\alpha \vec{u} \otimes \vec{u}_{diff,\alpha}} \cancel{- \sum_\alpha \rho_\alpha \vec{u} \otimes \vec{u}} +$$

$$+\cancel{\rho \vec{u} \otimes \vec{u}} =$$

$$= \sum_\alpha \hat{P}_\alpha + \sum_\alpha \rho_\alpha \vec{u}_{diff,\alpha} \otimes \vec{u}_{diff,\alpha}$$

∎

② Polazeći od:

ukupna gustina fluksa toplotnog provođenja

$$\vec{q} = \frac{1}{2} \sum_\alpha \rho_\alpha \langle (\vec{v} - u)^2 (\vec{v} - \vec{u}) \rangle_\alpha$$

pokazati da važi:

$$\vec{q} = \frac{1}{2} \sum_\alpha \rho_\alpha u^2_{diff,\alpha} \vec{u}_{diff,\alpha} + \sum_\alpha \vec{q}_\alpha + \sum_\alpha \frac{3}{2} p_\alpha \vec{u}_{diff,\alpha} +$$

$$+ \sum_\alpha \hat{P}_\alpha \cdot \vec{u}_{diff,\alpha}$$

$$\vec{q} = \frac{1}{2} \sum_\alpha \rho_\alpha \langle (v^2 - 2\vec{v} \cdot \vec{u} + u^2)(\vec{v} - \vec{u}) \rangle_\alpha =$$

$$= \frac{1}{2}\sum_\alpha{}' \rho_\alpha \langle v^2 \vec{v}\rangle_\alpha - \frac{1}{2}\sum_\alpha{}' \rho_\alpha \langle v^2 \vec{u}\rangle_\alpha - \frac{1}{2}\sum_\alpha{}' \rho_\alpha\, 2\langle(\vec{v}\cdot\vec{u})\vec{v}\rangle_\alpha$$

$$+ \frac{1}{2}\sum_\alpha{}' \rho_\alpha\, 2\langle(\vec{v}\cdot\vec{u})\vec{u}\rangle_\alpha + \frac{1}{2}\sum_\alpha{}' \rho_\alpha \langle u^2 \vec{v}\rangle_\alpha +$$

$$(\vec{u}\cdot\langle\vec{v}\otimes\vec{v}\rangle_\alpha)$$

$$- \frac{1}{2}\sum_\alpha{}' \rho_\alpha \langle u^2 \vec{u}\rangle_\alpha =$$

$$\vec{w}_\alpha = \vec{v} - \vec{u}_\alpha$$

$$\frac{1}{2}\rho_\alpha \langle v^2 \vec{v}\rangle_\alpha = \frac{1}{2}\rho_\alpha \langle(\vec{v}\cdot\vec{v})\vec{v}\rangle_\alpha =$$

$$= \frac{1}{2}\rho_\alpha \langle[(\vec{w}_\alpha + \vec{u}_\alpha)\cdot(\vec{w}_\alpha + \vec{u}_\alpha)](\vec{w}_\alpha + \vec{u}_\alpha)\rangle_\alpha =$$

$$= \frac{1}{2}\rho_\alpha \langle(w_\alpha^2 + 2\vec{w}_\alpha\cdot\vec{u}_\alpha + u_\alpha^2)(\vec{w}_\alpha + \vec{u}_\alpha)\rangle_\alpha =$$

$$= \frac{1}{2}\rho_\alpha \Big[\langle w_\alpha^2 \vec{w}_\alpha\rangle_\alpha + \langle w_\alpha^2 \vec{u}_\alpha\rangle + 2\langle(\vec{w}_\alpha\cdot\vec{u}_\alpha)\vec{w}_\alpha\rangle$$

$$\langle\vec{w}_\alpha\rangle_\alpha = 0 \qquad + 2\langle(\vec{w}_\alpha\cdot\vec{u}_\alpha)\vec{u}_\alpha\rangle_\alpha + \langle u_\alpha^2 \vec{w}_\alpha\rangle_\alpha + \langle u_\alpha^2 \vec{u}_\alpha\rangle_\alpha =$$

$$= \underbrace{\frac{1}{2}\rho_\alpha \langle w_\alpha^2 \vec{w}_\alpha\rangle_\alpha}_{\vec{q}_\alpha} + \frac{1}{2}\underbrace{\rho_\alpha \langle w_\alpha^2\rangle_\alpha}_{3P_\alpha} \vec{u}_\alpha +$$

$$+ \rho_\alpha \vec{u}_\alpha \cdot \underbrace{\langle\vec{w}_\alpha \otimes \vec{w}_\alpha\rangle_\alpha}_{\hat{P}_\alpha} + \frac{1}{2}\rho_\alpha u_\alpha^2 \vec{u}_\alpha$$

! DEF: $\vec{q}_\alpha = \frac{1}{2}\rho_\alpha \langle w_\alpha^2 \vec{w}_\alpha\rangle_\alpha$

$$\frac{1}{2}\rho_\alpha \langle v^2 \vec{v}\rangle_\alpha = \vec{q}_\alpha + \frac{3}{2} p_\alpha \vec{u}_\alpha + \hat{P}_\alpha \cdot \vec{u}_\alpha + \frac{1}{2}\rho_\alpha u_\alpha^2 \vec{u}_\alpha$$

$$\frac{1}{2}\rho_\alpha \langle v^2\rangle_\alpha = \frac{1}{2}\rho_\alpha u_\alpha^2 + \frac{1}{2}\rho_\alpha \langle w_\alpha^2\rangle_\alpha =$$

$\vec{v} = \vec{w}_\alpha + \vec{u}_\alpha$ $\qquad \langle \vec{w}_\alpha \rangle_\alpha = 0$

$$= \frac{1}{2}\rho_\alpha u_\alpha^2 + \frac{3}{2} p_\alpha$$

$$\frac{1}{2}\rho_\alpha \langle \vec{v} \otimes \vec{v}\rangle_\alpha = \frac{1}{2}\rho_\alpha \vec{u}_\alpha \otimes \vec{u}_\alpha + \frac{1}{2}\rho_\alpha \langle \vec{w}_\alpha \otimes \vec{w}_\alpha\rangle_\alpha$$

$$= \frac{1}{2}\rho_\alpha \vec{u}_\alpha \otimes \vec{u}_\alpha + \frac{1}{2}\hat{P}_\alpha$$

$$= \sum_\alpha \vec{q}_\alpha + \sum_\alpha \frac{3}{2} p_\alpha \vec{u}_\alpha + \sum_\alpha \hat{P}_\alpha \cdot \vec{u}_\alpha + \frac{1}{2}\sum_\alpha \rho_\alpha u_\alpha^2 \vec{u}_\alpha$$

$$- \sum_\alpha \frac{1}{2}\rho_\alpha u_\alpha^2 \vec{u} - \sum_\alpha \frac{3}{2} p_\alpha \vec{u} - \sum_\alpha \rho_\alpha (\vec{u}_\alpha \otimes \vec{u}_\alpha)\cdot \vec{u}$$

$$- \sum_\alpha \hat{P}_\alpha \cdot \vec{u} + \sum_\alpha \rho_\alpha \vec{u}_\alpha \cdot (\vec{u} \otimes \vec{u}) +$$

$$+\frac{1}{2}\sum_\alpha \rho_\alpha u^2 \vec{u}_\alpha - \frac{1}{2}\sum_\alpha \rho_\alpha u^2 \vec{u} \quad (=)$$

$$\left(\vec{u}_{diff} + \vec{u} = \vec{u}_\alpha \right)$$

$$(=) \sum_\alpha \vec{q}_\alpha + \sum_\alpha \frac{3}{2} p_\alpha \vec{u}_{diff,\alpha} \cancel{+ \sum_\alpha \frac{3}{2} p_\alpha \vec{u}} + \sum_\alpha \hat{P}_\alpha \cdot \vec{u}_{diff,\alpha} +$$

$$\cancel{+\sum_\alpha \hat{P}_\alpha \cdot \vec{u}} + \frac{1}{2}\sum_\alpha \rho_\alpha \left(u_{diff,\alpha}^2 + 2\vec{u}_{diff}\cdot\vec{u} + u^2\right)\left(\vec{u}_{diff,\alpha} \cancel{+ \vec{u}}\right) +$$

$$\cancel{-\frac{1}{2}\sum_\alpha \rho_\alpha \left(u_{diff,\alpha}^2 + 2\vec{u}_{diff}\cdot\vec{u} + u^2\right)\vec{u}} \cancel{- \sum_\alpha \frac{3}{2} p_\alpha \vec{u}}$$

$$- \sum_\alpha \rho_\alpha \left(\vec{u}_{diff\alpha} \otimes \vec{u}_{diff\alpha} + \vec{u}_{diff,\alpha} \otimes \vec{u} +\right.$$

$$\left. + \vec{u} \otimes \vec{u}_{diff\alpha} + \vec{u} \otimes \vec{u}\right) \cdot \vec{u} \cancel{- \sum_\alpha \hat{P}_\alpha \cdot \vec{u}} +$$

$$+ \sum_\alpha \rho_\alpha \vec{u}_{diff} \cdot (\vec{u} \otimes \vec{u}) + \sum_\alpha \rho_\alpha \vec{u} \cdot (\vec{u} \otimes \vec{u}) +$$

$$+ \frac{1}{2}\sum_\alpha \rho_\alpha u^2 \vec{u}_{diff,\alpha} \cancel{+ \frac{1}{2}\sum_\alpha \rho_\alpha u^2 \vec{u}} -$$

$$\cancel{-\frac{1}{2}\sum_\alpha \rho_\alpha u^2 \vec{u}} =$$

$$= \sum_\alpha' \vec{q}_\alpha + \sum_\alpha' \frac{3}{2} p_\alpha \vec{u}_{diff\,\alpha} + \sum_\alpha' \hat{P}_\alpha \cdot \vec{u}_{diff,\alpha} +$$

$$+ \frac{1}{2}\sum_\alpha' \rho_\alpha u^2_{diff,\alpha} \vec{u}_{diff,\alpha} + \cancel{\frac{1}{2}\sum_\alpha' \rho_\alpha 2(\vec{u}_{diff} \cdot \vec{u})\vec{u}_{diff\,\alpha}} +$$

$$+ \cancel{\frac{1}{2}\sum_\alpha' \rho_\alpha u^2 \vec{u}_{diff,\alpha}} - \cancel{\sum_\alpha' \rho_\alpha (\vec{u}_{diff\,\alpha} \otimes \vec{u}_{diff\,\alpha})\vec{u}}$$

$$- \cancel{\sum_\alpha' \rho_\alpha (\vec{u}_{diff,\alpha} \otimes \vec{u}) \cdot \vec{u}} - \cancel{\sum_\alpha' \rho_\alpha (\vec{u} \otimes \vec{u}_{diff}) \cdot \vec{u}}$$

$$(\vec{u} \otimes \vec{u}) \cdot \vec{u}_{diff,\alpha}$$

$$- \cancel{\sum_\alpha' \rho_\alpha (\vec{u} \otimes \vec{u}) \cdot \vec{u}} + \cancel{\sum_\alpha' \rho_\alpha \vec{u}_{diff,\alpha} \cdot (\vec{u} \otimes \vec{u})} +$$

$$+ \cancel{\sum_\alpha' \rho_\alpha \vec{u} \cdot (\vec{u} \otimes \vec{u})} + \cancel{\frac{1}{2}\sum_\alpha' \rho_\alpha u^2 \vec{u}_{diff\,\alpha}} =$$

$$= \sum_\alpha' \vec{q}_\alpha + \sum_\alpha' \frac{3}{2} p_\alpha \vec{u}_{diff\,\alpha} + \sum_\alpha' \hat{P}_\alpha \cdot \vec{u}_{diff,\alpha} +$$

$$+ \frac{1}{2}\sum_\alpha' \rho_\alpha u^2_{diff} \vec{u}_{diff\,\alpha}$$

$\blacksquare$

③ Polazeći od osnovne kinetičke jdne u fizici plazme izvesti jdnu prenosa energije u hidrodinamici.

$$\frac{\partial}{\partial t}\left(\frac{1}{2}\rho u^2 + \rho e\right) + \nabla\cdot\left(\left(\frac{1}{2}\rho u^2 + \rho e\right)\vec{u} + \hat{P}\cdot\vec{u} + \vec{q}\right) = \vec{E}\cdot\vec{j}$$

e – unutrašnja energija jedinične mase

$$\frac{\partial f_\alpha}{\partial t} + \vec{v}\cdot\nabla f_\alpha + \vec{a}\cdot\nabla_{\vec{v}} f_\alpha = I_\alpha \qquad \Big/ \frac{1}{2}m_\alpha \int_{V_{\vec{v}}} v^2\, d^3\vec{v}$$

„drugi moment"

$$\underbrace{\int_{V_{\vec{v}}} \frac{1}{2} m_\alpha v^2 \frac{\partial f_\alpha}{\partial t}\, d^3\vec{v}}_{I_{31}} + \underbrace{\int_{V_{\vec{v}}} \frac{1}{2} m_\alpha v^2\, \vec{v}\cdot\nabla f_\alpha\, d^3\vec{v}}_{I_{32}} +$$

$$+\underbrace{\int_{V_{\vec{v}}} \frac{1}{2} m_\alpha v^2 \, \vec{a} \cdot \nabla_{\vec{v}} f_\alpha \, d^3\vec{v}}_{I_{33}} = \underbrace{\int_{V_{\vec{v}}} \frac{1}{2} m_\alpha v^2 I_\alpha \, d^3\vec{v}}_{C_{3,\alpha}}$$

$$\boxed{I_{31}} = \int_{V_{\vec{v}}} \frac{1}{2} m_\alpha v^2 \frac{\partial f_\alpha}{\partial t} d^3\vec{v} = \frac{\partial}{\partial t} \int_{V_{\vec{v}}} \frac{1}{2} m_\alpha v^2 f_\alpha \, d^3\vec{v} =$$

$$= \frac{1}{2} m_\alpha \frac{\partial}{\partial t} \left(n_\alpha \langle v^2 \rangle_\alpha \right) = \boxed{\frac{1}{2} \frac{\partial}{\partial t} \left(\rho_\alpha \langle v^2 \rangle_\alpha \right)}$$

$$I_{32} = \int_{V_{\vec{v}}} \frac{1}{2} m_\alpha v^2 \, \vec{v} \cdot \nabla f_\alpha \, d^3\vec{v} \; \text{(=)}$$

$$\nabla \cdot \left(v^2 \vec{v} f_\alpha \right) = \underbrace{\vec{v} f_\alpha \cdot \nabla_{\vec{r}} (v^2)}_{0} + \underbrace{v^2 f_\alpha \nabla_{\vec{r}} \cdot \vec{v}}_{0} +$$

$$+ v^2 \vec{v} \cdot \nabla f_\alpha \qquad ! \; \nabla \equiv \nabla_{\vec{r}}$$

$$\text{(=)} \; \frac{1}{2} m_\alpha \int_{V_{\vec{v}}} \nabla \cdot \left(v^2 \vec{v} f_\alpha \right) d^3\vec{v} = \frac{1}{2} m_\alpha \nabla \cdot \int_{V_{\vec{v}}} v^2 \vec{v} f_\alpha \, d^3\vec{v}$$

$$= \frac{1}{2} m_\alpha \nabla \cdot \left(n_\alpha \langle v^2 \vec{v} \rangle_\alpha \right) = \frac{1}{2} \nabla \cdot \left(\rho_\alpha \langle v^2 \vec{v} \rangle_\alpha \right)$$

$$I_{33} = \int_{V_{\vec{v}}} \frac{1}{2} m_\alpha v^2 \vec{a} \cdot \nabla_{\vec{v}} f_\alpha \, d^3\vec{v} =$$

$$\vec{F} = m_\alpha \vec{a} =$$

$$= q_\alpha \vec{E} + q_\alpha \vec{v} \times \vec{B}$$

$$= \int_{V_{\vec{v}}} \frac{1}{2} v^2 \vec{F} \cdot \nabla_{\vec{v}} f_\alpha d^3 \vec{v} \quad \ominus$$

$$! \; \nabla \equiv \nabla_{\vec{v}} \; !$$

$$\nabla \cdot \left(v^2 \vec{F} f_\alpha \right) = \vec{F} f_\alpha \cdot \nabla (v^2) + v^2 f_\alpha \nabla \cdot \vec{F} + + v^2 \vec{F} \cdot \nabla f_\alpha$$

$$\Rightarrow 0$$

$$\nabla_{\vec{v}} (v^2) = ?$$

$$\nabla_{\vec{v}} \cdot (\vec{v} \cdot \vec{v}) = 2 \vec{v} \times (\nabla_{\vec{v}} \times \vec{v}) + 2 (\vec{v} \cdot \nabla_{\vec{v}}) \vec{v}$$

$$\nabla_{\vec{v}} \times \vec{v} = \begin{vmatrix} \vec{e}_x & \vec{e}_y & \vec{e}_z \\ \frac{\partial}{\partial v_x} & \frac{\partial}{\partial v_y} & \frac{\partial}{\partial v_z} \\ v_x & v_y & v_z \end{vmatrix} = \begin{bmatrix} \frac{\partial v_z}{\partial v_y} - \frac{\partial v_y}{\partial v_z} \\ \\ \\ \end{bmatrix} = \vec{0}$$

$$(\vec{v}\cdot\nabla_{\vec{v}})\vec{v} = \vec{v}\cdot(\nabla_{\vec{v}}\otimes\vec{v})$$

$$\nabla_{\vec{v}}\otimes\vec{v} = \begin{bmatrix}\partial_{v_x}\\ \partial_{v_y}\\ \partial_{v_z}\end{bmatrix}\begin{bmatrix}v_x & v_y & v_z\end{bmatrix} = \begin{array}{ccc} 1 & 0 & 0 \\ \begin{bmatrix}\frac{\partial v_x}{\partial v_x} & \frac{\partial v_y}{\partial v_x} & \frac{\partial v_z}{\partial v_x}\\ \dots & \dots & \dots\\ \dots & \dots & \dots\end{bmatrix} \end{array}$$

$$= \begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix} = \hat{I}$$

$$\vec{v}\cdot\hat{I} = \vec{v}$$

$$\nabla_{\vec{v}}(v^2) = 2\vec{v}$$

$$\Rightarrow \quad \nabla\cdot(v^2\vec{F}f_\alpha) = \vec{F}f_\alpha\cdot 2\vec{v} + v^2\vec{F}\cdot\nabla f_\alpha$$

$$\textcircled{=} \int_{V_{\vec{v}}} \frac{1}{2}\nabla_{\vec{v}}\cdot(v^2\vec{F}f_\alpha)\,d^3\vec{v} - \int_{V_{\vec{v}}} \vec{F}\cdot\vec{v}\,f_\alpha\,d^3\vec{v} =$$

$$= \frac{1}{2}\underbrace{\oint_{S_v=\partial V_{\vec{v}}} v^2 f_\alpha \vec{F}\cdot d\vec{S}_{\vec{v}}}_{0}^{\vec{v}\to\infty,\ f_\alpha\to 0} - \int_{V_{\vec{v}}}(q_\alpha\vec{E}+q_\alpha\vec{v}\times\vec{B})f_\alpha\vec{v}\,d^3\vec{v}$$

$$= -\int_{V_{\vec v}} q_\alpha \vec E \cdot f_\alpha \vec v \, d^3\vec v - \int_{V_{\vec v}} q_\alpha (\vec v \times \vec B) f_\alpha \cdot \vec v \, d^3\vec v =$$

$\longleftrightarrow (\vec v \times \vec v)\cdot \vec B = 0$

$$= -q_\alpha \vec E \cdot \int_{V_{\vec v}} \vec v f_\alpha \, d^3\vec v = -q_\alpha \vec E \cdot n_\alpha \vec u_\alpha =$$

$$= -\vec j_\alpha \cdot \vec E$$

$\circledast$ $I_{31} + I_{32} + I_{33}$

$$\Rightarrow \frac{1}{2}\frac{\partial}{\partial t}\left(\rho_\alpha \langle v^2 \rangle_\alpha\right) + \frac{1}{2}\nabla \cdot \left(\rho_\alpha \langle v^2 \vec v \rangle_\alpha\right) -$$

$$-\vec j_\alpha \cdot \vec E = C_{3,\alpha}$$

[nastavak sledeći čas .....]