Kineticka teoria

- Ukazeme si preco:

$$(\vec{r}, \vec{v}) \to (\vec{r}', \vec{v}') \tag{1}$$

$$|J| = 1 \tag{2}$$

- Priklad 5.1 z Bittencourta

5.1 Consider a system of particles uniformly distributed in space, with a constant particle number density n_0, and characterized by a velocity distribution function $f(v)$ such that

$$f(v) = K_0 \quad for \quad |v_i| \le v_0 \quad (i = x, y, z)$$

$$f(v) = 0 \quad otherwise,$$

$$J = \frac{\partial(\vec{r}', \vec{v}')}{\partial(\vec{r}, \vec{v})} \tag{3}$$

$$J = \begin{pmatrix} \partial x'/\partial x & \partial y'/\partial x & \cdots & \partial v_z'/\partial x \\ \partial x'/\partial y & \partial y'/\partial y & \cdots & \partial v_z'/\partial y \\ \cdots & \cdots & \cdots & \cdots \\ \partial x'/\partial v_z & \partial y'/\partial v_z & \cdots & \partial v_z'/\partial v_z \end{pmatrix}$$

4 bloky

$$\vec{v}' = \vec{v} + \vec{a}\mathrm{d}t \qquad \vec{r}' = \vec{r} + \vec{v}\mathrm{d}t \tag{4}$$

$$\frac{\partial x_i'}{\partial x_j} = \delta_{ij} \qquad \frac{\partial v_i'}{\partial x_j} = \frac{\partial a_i'}{\partial x_j}\mathrm{d}t \tag{5}$$

$$\frac{\partial x_i'}{\partial v_j} = \delta_{ij}\mathrm{d}dt \qquad \frac{\partial v_i'}{\partial v_j} = \delta_{ij} + \frac{q}{m}\frac{\partial(\vec{E} + \vec{v} \times \vec{B})_i}{\partial v_j}\mathrm{d}t \tag{6}$$

$$J = \begin{pmatrix} J_1 & J_2 \\ J_3 & J_4 \end{pmatrix} \tag{7}$$

4 bloky

$a = \frac{q}{m} \mathrm{d}t$

$$(J)_1 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$(J)_2 = \frac{dt}{m_\alpha} \begin{pmatrix} \partial F'_x/\partial x & \partial F'_y/\partial x & \partial F'_z/\partial x \\ \partial F'_x/\partial y & \partial F'_y/\partial y & \partial F'_z/\partial y \\ \partial F'_x/\partial z & \partial F'_y/\partial z & \partial F'_z/\partial z \end{pmatrix}$$

$$(J)_3 = \begin{pmatrix} dt & 0 & 0 \\ 0 & dt & 0 \\ 0 & 0 & dt \end{pmatrix}$$

$$(J)_4 = \begin{pmatrix} 1 & -aB_z & aB_y \\ aB_z & 1 & -aB_x \\ -aB_y & aB_x & 1 \end{pmatrix}$$

Determinant blokovej matice

Zdroj:

$$|J| = |J_1 J_4 - J_2 J_4^{-1} J_3 J_4| \tag{8}$$

Ale ak matice J_3 a J_4 komutuju, t.j:

$$J_3 J_4 = J_4 J_3 \tag{9}$$

tak:

$$|J| = |J_1 J_4 - J_2 J_4^{-1} J_3 J_4| = |J_1 J_4 - J_2 J_4^{-1} J_4 J_3| = |J_1 J_4 - J_2 J_3| \tag{10}$$

Vysledok

Vzhladom na to, ze:

$$\mathrm{d}t^2 = 0 \tag{11}$$

$$|J_2 J_3| \propto \mathrm{d}t^2 = 0 \tag{12}$$

$$|J_1 J_4| = |J_4| \tag{13}$$

$$|J_4| = 1 + \propto \mathrm{d}t^2 + \propto \mathrm{d}t^3 \tag{14}$$

5.1 z Bittencourta

5.1 Consider a system of particles uniformly distributed in space, with a constant particle number density n_0, and characterized by a velocity distribution function $f(v)$ such that

$$f(v) = K_0 \quad for \quad |v_i| \leq v_0 \quad (i = x, y, z)$$

$$f(v) = 0 \quad otherwise,$$

$$n(\vec{r}) = \int f(v)\ \mathrm{d}^3 v = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f(v)\ \mathrm{d}v_x \mathrm{d}v_y \mathrm{d}v_z = \tag{15}$$

$$\int_{-v_0}^{v_0} \int_{-v_0}^{v_0} \int_{-v_0}^{v_0} K_0\ \mathrm{d}v_x \mathrm{d}v_y \mathrm{d}v_z = K_0 (2v_0)^3, \tag{16}$$

$$n(\vec{r}) = n_0 = K_0 (2v_0)^3 \qquad \Rightarrow \qquad K_0 = \frac{n_0}{8v_0^3} \tag{17}$$