

$j = \overline{0, m}$, $i + j < n + m$, — заданные измеримые на G функции, удовлетворяющие условиям: $a_{ij}(t, x) \in L_p(G)$, $i = \overline{0, n-1}$, $j = \overline{0, m-1}$, и существуют функции $a_{nj}^0(x) \in L_p(x_0, x_1)$ и $a_{im}^0(t) \in L_p(t_0, t_1)$ такие, что выполняются условия

$$|a_{nj}(t, x)| \leq a_{nj}^0(x), \quad j = \overline{0, m-1} \quad \text{и} \quad |a_{im}(t, x)| \leq a_{im}^0(t), \quad i = \overline{0, n-1}$$

почти всюду на G , $\varphi_{i0}(x) \in W_p^{(m)}(x_0, x_1)$, $\varphi_{ni}(t) \in L_p(t_0, t_1)$ — заданные функции, где $W_p^{(m)}(x_0, x_1)$ — пространство функций $\varphi(x)$, имеющих обобщенные производные $D^i\varphi(x) \in L_p(x_0, x_1)$, $i = \overline{0, m}$. Решение задачи (1)–(3) будем искать в пространстве С.Л. Соболева

$$W_p^{(n,m)}(G) = \{u \in L_p(G) / D_t^i D_x^j u \in L_p(G), \quad i = \overline{0, n}, \quad j = \overline{0, m}\}$$

с доминирующей смешанной производной $D_t^i D_x^j u$. Норму в $W_p^{(n,m)}(G)$ определим равенством

$$\|u\|_{W_p^{(n,m)}(G)} = \sum_{i=0}^n \sum_{j=0}^m \|D_t^i D_x^j u\|_{L_p(G)}.$$

Поставленная задача сводится к интегральному уравнению, строится соответствующее сопряженное интегральное уравнение, вводится понятие фундаментального решения и с его помощью получается представление решения рассматриваемой задачи.

A ONE-DIMENSIONAL DISCRETE VELOCITY MODEL OF THE CAUCHY PROBLEM FOR THE BBGKY HIERARCHY OF EQUATIONS FOR MANY-KIND PARTICLE SYSTEMS

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There are two different methods of the construction of the Cauchy problem for the BBGKY hierarchy solutions as the iteration or the functional series.

A solution of the Cauchy problem for the BBGKY hierarchy of equations can be represented in the form of an expansion over particle groups whose evolution is governed by the cumulants (semi-invariants) of the evolution operator of the corresponding particle group [1–3].

Consider a one-dimensional discrete velocity model of mixture of gases, i. e. many-kind system of particles interacting as hard rods of lengths $2\sigma_i > 0$ and masses $m_i > 0$.

In the Banach space L^1 of infinite sequences of summable functions we examine a one-dimensional discrete velocity model of the Cauchy problem for the BBGKY hierarchy of equations with initial data possessing the factorization property (the chaos property).

In the space $L_1(V^s \times \mathbb{R}^s)$ of summable functions we prove that there exists a unique solution of the Cauchy problem for the BBGKY hierarchy of equations represented as the expansion over particle groups whose evolution is governed by the cumulants of the evolution operator of the corresponding particle group:

$$F_{|Y|}(t, Y) = S_s(-t, Y)\chi_s(Q^s) \prod_{i=-s_2}^{s_1} F_1(0, x_i) + \sum_{n=1}^{\infty} \sum_{n_1+n_2=n} \frac{1}{v^n} \times$$

$$\times \sum_{v_{-(s_2+n_2)}, \dots, v_{-(s_2+1)}, v_{s_1+1}, \dots, v_{s_1+n_1} \in V^n_{\mathbb{R}^n}} \int d(Q^{s+n} \setminus Q^s) \sum_{\substack{Z \subset X \setminus Y \\ Z \neq \emptyset}} (-1)^{|X \setminus (Y \cup Z)|} \times \\ \times \mathfrak{A}_2(t, Y, Z) \chi_{s+n}(Q^{s+n}) \prod_{i=-(n_2+s_2)}^{n_1+s_1} F_1(0, x_i), \quad |X \setminus Y| \geq 1,$$

where $1/v$ is the density,

$$Q^s = (q_{-s_2}, \dots, q_{s_1}), \quad Q^{s+n} = (q_{-(n_2+s_2)}, \dots, q_{s_1+n_1}),$$

$$Y = (x_{-s_2}, \dots, x_{s_1}), \quad X \setminus Y = (x_{-(n_2+s_2)}, \dots, x_{-(s_2+1)}, x_{s_1+1}, \dots, x_{s_1+n_1}).$$

Here $\sum_{\substack{Z \subset X \setminus Y \\ Z \neq \emptyset}}$ is the sum over all nonempty ordered subsets Z of the partially ordered set $X \setminus Y$, $Z \subset X \setminus Y$, and the group of $|Z|$ particles evolves as one element, $\mathfrak{A}_2(t, Y, Z)$ is the cumulant of the 2-nd kind, $\chi_s(Q^s)$ is the characteristic function of the set $\mathbb{R}^s \setminus \{W_s \cup \partial W_s^\varepsilon\}$, the set ∂W_s^ε , given $\varepsilon > 0$, is an ε -neighbourhood of the forbidden configurations set W_s .

References

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