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Simulation of supersonic jet injection into tokamak with Direct Monte Carlo Simulation method

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The injection of high-pressure supersonic jets into the tokamak plasma is considered a promising method of future thermonuclear reactor fuelling and as a tool for disruption mitigation. Injection of a supersonic gas jet is considered to be a new technique of material delivery into a tokamak. Expansion of jet outside of tokamak is simulated by solving of Boltzman equation with Direct Monte Carlo Simulation (DSMC) method. After that simulation is compared with results of an article and it showed good results. The ionization of the jet is simulated at the end and it can be added to the code for complete simulation of supersonic jet injection in the next steps.

Boltzman equation:

$$\frac{\partial}{\partial t}(nf) + c \cdot \frac{\partial}{\partial r}(nf) + F \cdot \frac{\partial}{\partial c}(nf) = \int_{-\infty}^{\infty} \int_{0}^{2\pi} n^2 (f^*f_1^* - ff_1) c_1 \sigma d\Omega dc_1$$

Results of jet boundary simulation and its comparison with experimental data from [1].

Errors were less than 7% and code is running for better accuracy. The table of errors will be added to the full paper.

Results of temporal ionization rate simulation (the positional ionization rate will be simulated after addition of magnetic field in the code) and comparing with experimental data:

$$\frac{dy_i}{dt} = n (y_{i+1}R_{i+1} - y_i (I_i + R_i) + y_{i-1}R_{i-1}) + n_e^{(inc)} (y_{i-1}I_{i-1}^{(inc)} - y_iI_i^{(inc)})$$

$i=0,1,2,3.$
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