VA 2: Gas Flow Simulation

Time: Monday 11:00–12:00 Location: HSZ 101

VA 2.1 Mon 11:00 HSZ 101

Systematic vacuum study of the ITER model cryopump by Test Particle Monte Carlo simulation — •Xueli Luo, Horst Haas, and Christian Day — Institute for Technical Physics, Karlsruhe Institute of Technology, P.O. Box 3640, 76021 Karlsruhe, Germany

The primary pumping systems on the ITER torus are based on eight tailor-made cryogenic pumps because not any standard commercial vacuum pump can meet the ITER working criteria. This kind of cryopump can provide high pumping speed, especially for light gases, by the cryosorption on activated charcoal at 4.5K. In this paper we will present the systematic Monte Carlo simulation results of the model pump in a reduced scale by ProVac3D, a new Test Particle Monte Carlo simulation program developed by KIT. The simulation model has included the most important mechanical structures such as sixteen cryogenic panels working at 4.5K, the 80K radiation shield envelope with baffles, the pump housing, inlet valve and the TIMO (Test facility for the ITER Model Pump) test facility. Three typical gas species, i.e., deuterium, protium and helium are simulated. The pumping characteristics have been obtained. The result is in good agreement with the experiment data up to the gas throughput of 1000 sccm, which marks the limit for free molecular flow. This means that ProVac3D is a useful tool in the design of the prototype cryopump of ITER. Meanwhile, the capture factors at different critical positions are calculated. They can be used as the important input parameters for a follow-up Direct Simulation Monte Carlo (DSMC) simulation for higher gas throughput.

VA 2.2 Mon 11:20 HSZ 101

Follow-up vacuum study of the ITER model cryopump by the Direct Simulation Monte Carlo method — •Stylianos Varoutis[1], Felix Sharipov[2], Christian Day[1], Xueli Luo[1], and Horst Haas[1] — [1]Karlsruhe Institute of Technology (KIT), Institute for Technical Physics (ITeP), KIT Campus Nord, Hermann-von-Helmholtz-Platz 1, 76344, Eggenstein-Leopoldshafen, Germany — [2]Departamento de Física, Universidade Federal do Paraná, Caixa Postal 19044, Curitiba 81531-990, Brazil

The aim of the present work is a numerical modeling of the ITER model cryopump combining both DSMC and TPMC methods. The complicated flow configuration of cryopanels is modelled using the TPMC method since the intermolecular collisions can be neglected, while the remaining part of the cryopump is modelled with the DSMC method using as input the data obtained by the former approach. A detailed comparison with the corresponding experimental data is performed, which demonstrates the reliability of the computational tool. The numerical results provide detailed information about the gas flow field such as pressure distribution, number of particles and energy flux absorbed by each cryopanel, etc. These quantities can be used to optimize the pumping system in order to improve its performance.

VA 2.3 Mon 11:40 HSZ 101

3d-neutralgas simulation for vacuum facilities — •Robert Henrich, Michael Bachmann, Davar Feili, and Christian Heiliger — I. Physikalisches Institut, Justus Liebig University Giessen, D-35392, Germany

We present a three-dimensional simulation program for molecular gas flows at low pressures (high/ultrahigh vacuum). This program is designed to simulate the neutral gas distribution in any vacuum chamber with a size of a few centimeters up to a few meters. This can be used to optimize the pumping and/or gas distribution system for different applications. The main feature of the program is its ability of importing any arbitrary surface geometry that can be created in a CAD-program. Thereby the geometry will be converted to triangles. Once the geometry is imported each surface region can be assigned with special properties. At the moment gas inlets and pumps can be simulated and also appointing a specific surface temperature and specular/diffuse reflection coefficient is supported. With the actual version it is possible to simulate the distribution of the neutral gas and the influence of different pump arrangements on it. Furthermore the simulation is possible to calculate the neutral gas molecular flow transmission coefficients for arbitrary formed tubes.