VA 2: Vacuum technology: New developments and applications

Time: Monday 12:30–13:30 Location: HSZ 301

Invited Talk VA 2.1 Mon 12:30 HSZ 301

Vacuum Solutions for Dilution Refrigerators — •Stefan Lausberg — Atlas Copco - Scientific Vacuum Division, Bonner Str. 498, 50968 Köln

Dilution refrigerators are cryostats that can reach base temperatures as low as 2 mK. The refrigerant they use are mixtures of 3He and 4He that contain about 1/5 of the rare and very expensive 3He. Like in all cryogenic applications, vacuum products play an essential role for dilution refrigerators. In 2019, the world market for dilution refrigerators has increased to more than 200 systems per year driven by the emerging quantum computing market. In consequence, the dilution refrigerator is a growing application for vacuum pumps and accessories like gauges.

Here, we will discuss the requirements for vacuum products in this type of cryostat. Besides pump systems for insulation vacuum and pumps to supply the dilution refrigerator's 1-K-pot, the heart of the cryostat is the 3He pump system. This system circulates the mixture in a closed loop and requires a maximum leak rate of 1E-7 mbar*l/s to preserve the expensive 3He. In order to achieve an enhanced cooling capacity the necessary 3He gas flows require a pumping speed that can only be reached by using a two-stage pump system. We will see that the most appropriate 3He vacuum pump system would be an oil-free, dust-free pump system with an optimized pumping speed in the range of 0.01 to 1 mbar. Even though the pressure range is not within the focus applications of turbomolecular pumps we will see some advantages over roots pumps at the second stage.

VA 2.2 Mon 13:10 HSZ 301

Transient modelling of liquid ring vacuum pumps with mercury as working fluid — •Santiago Ochoa — KIT Karlsruhe, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen

For an application in fusion reactors, liquid ring pumps with mercury as working fluid are foreseen. This kind of pump is simple and robust in its design, but challenging in modelling: Reliable results - needed to design and optimize liquid ring pumps - can only be achieved if the geometry is modelled in full 3D, considering (turbulent) gas- and working fluid flows through the pump with simultaneous heat and mass transfer. This talk presents a modelling approach of liquid ring pumps with water and mercury as working fluid, using the software ANSYS CFX. In a first modelling step, 3D transient two-phase simulations have been performed using air as pumped gas and water as working fluid. Results will be presented for two different mesh resolutions and operating pressures. In a second step, mercury has been used as working fluid. In this case, it was much more difficult running the model and the computational needs were excessive. However, first results will be presented also here and lessons learned will be shown up.