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Diploma-/Bachelor-/Master Thesis

Simulation of low pressure mercury gas flows through the nozzle system of mercury diffusion vacuum pumps

At KIT, a linear mercury vapour diffusion pump is under development. This pump shall be used as large and tritium compatible vacuum pump for fusion reactors. The working principle of this pump is based on the interaction of a high speed (supersonic) low pressure mercury vapour jet, that interacts with process gas particles at very low pressure. The process gas is being pumped by momentum exchange between the gas and the mercury vapour jet inside the pump.

The linear design of the pump requires a linear nozzle for producing the vapour jet. This nozzle has to be supplied with gaseous mercury from both sides as shown in Figure 1. The nozzle consists of a pipe at a given diameter and a connected nozzle with given opening angle and width.

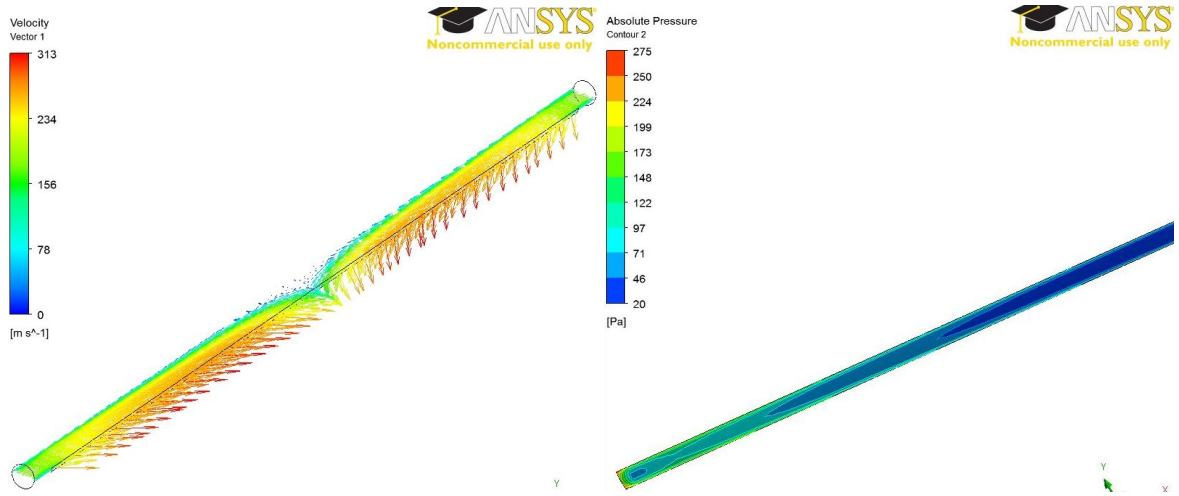

Figure1: Mercury flow simulation through the linear nozzle (preliminary results).

In this work, the flow through the nozzle shall be examined using a commercial simulation tool (ANSYS CFX). To start the work, the nozzle geometry and the gas properties of mercury vapour have to be implemented. The following questions shall now be addressed:

- What is the resulting Mach number and pressure upstream and downstream the nozzle?
- What nozzle pipe diameter is required to guarantee a uniform flow field at the outlet of the nozzle? What is the mass flow rate of mercury vapour? How large is the energy consumption for evaporation?
- How is the pipe diameter dependant on parameters like nozzle opening width and upstream/downstream pressure conditions?

This work will take place at KIT Campus North in Eggenstein-Leopoldshafen. A full working environment will be provided. The work should be written in English.

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