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A prototype experiment on Cryocooler based Cryopump

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Content :

To characterize the ion and neutral Beam produced from the 100 keV, 60 A Beam Source for application in the Diagnostics Neutral Beam (DNB) for ITER, an installed pumping of 1.2 x 106 l/s is required to ensure low loss of ions due to stripping and low re-ionisation loss.

Such large pumping speeds are provided using in-situ pumping. In the present case, 12 cryo pumps based on Cryo-sorption mode of operation are dispersed symmetrically along the 9 m length of the test vessel. Each pump has a speed of ~ 1 x 105 l/s and the pressure profile obtained from the positioning is obtained using a Monte Carlo Gas Flow (MCGF) code.

The engineering configuration of the pumps is Chevron baffles having overall dimension of 3 m in height, 0.6 m in width and 0.3 m in depth. The Chevron baffles operate at ~ 85 K. The pumping surface is a charcoal coated (2.8 m height x 0.3 m width) Helium panel, where pumping from both sides are affected on the 15 K panel. Manufacturing of the pump is based on vacuum brazing, for which, the process qualification has been concluded. The heat loads on the Helium section of the pump is ~ 20 W, taking into account the loads due to radiation, gas loads and gas conduction. The cooling of the 85 K section is carried out using (Liquid Nitrogen) LN2 from a central supply.

The Helium section cooling shall be cryocooler based. An experimental validation of the temperature distribution on the Helium surface has been carried out on a prototype using a 20 W @ 15 K cryocooler (Sumitomo make). The experiment establishes temperature uniformity within 0.5 K at the extremities of the Helium panel for heat loads that is a factor of 2 higher than the estimates, and closely corroborates the simulation data, thereby ensuring a reliable pumping performance. The results of the prototype experiment leads to a technical decision of incorporating 12 cryocooler based cooling for the Helium section, thereby obviating the need for a dedicated 15 K Gaseous Helium Supply System. The paper shall present a brief configuration of the cryopump, the details of the prototype, the experimental results and the conclusions arrived at.

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