VACUUM SYSTEM OF TARN-II

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Abstract

The vacuum chambers of the dipole magnet section for TARN-II which is the synchrotron and cooler ring for heavy ions were constructed. Pumpdown test with the baking temperature at 300°C was performed and the result showed a good vacuum presuure of 3 x 10^{-11} Torr.

Introduction

Vacuum pressure of the order of 10^{-11} Torr is required to obtain long life time of heavy ions such as C, N, Ne, which is supposed to be sufficient for storage and beam cooling experiment at TARN-II .[1)2)] On the basis of the experience of TARN, all vacuum chambers are made of metal or inorganic material and metal gaskets for the capability of outgassing by high temperature baking. Chambers of dipole magnet sections are constructed and pumpdown test is carried out.

Vacuum System

Schematic layout of the pumping system of the ring is shown in Fig. 1. The ring is 78 m in cercumference and has 24 stages of dipole magnets, 18 stages of quadrupole magnets and 6 long straight sections, which are used for beam injection , RF cavity, beam extraction , stochastic cooling , electron cooling and internal target. Almost the same pumping system as in TARN is used, which is composed of the ion pumps, the Ti getter pumps and the turbo-molecular pumps. In addition, non evaporation getter (NEG) pump is used in the chamber of electron cooling system. The mechanical booster pumps are applied at the roughing pump line. Pumping stations are placed in the space between two dipole magnets.

Chamber

The vacuum chamber in the dipole magnet section is made of SUS 316L stainless steel plate in 4 mm thickness , because the repetition rate of magnetic field is rather slow.[2)] Each vacuum chamber is 3 m in length which corresponds to two stages of dipole magnets and has the cross sectional area of 240 mm (horizontal) x 53 mm (vertical). In the middle of the chamber, vacuum pump station is connected. The vacuum chamber is insulated from the magnet by ceramic for the purpose of direct heating caused by electric current through the chamber. Layouts of the chamber are shown in Figs. 2 and 3.

Pumping characteristics

Pumpdown test was carried out for the two dipole magnet chambers combined together, with the pump system in which the ion pump (800 l/s), the Ti getter pump (1000 l/s) and the turbo-molecular pump (450 l/s)are assembled. The chamber was thermally insulated by glass wool of 20 mm in thickness and was baked by electric current of 1000 A through the chamber, of which the electric resistance is about 1 mΩ . Surface temperature of the chamber reached 300°C. By the pumpdown with the baking time of 90 hours, the final vacuum pressure of 3 x 10^{-11} Torr was obtained and the leak of welding parts was not observed after the baking process. Measuring of vacuum pressure was performed by using nude type B-A ionization gauge with modulation electrode. From the vacuum pressure and the pump speed, we estimate that outgassing rate of the chamber wall is about 1x10^{-12}Torr·l/s·cm². Pumpdown curve and mass spectra are shown in Figs. 4 and 5. The constructed chambers are shown in Fig. 6.

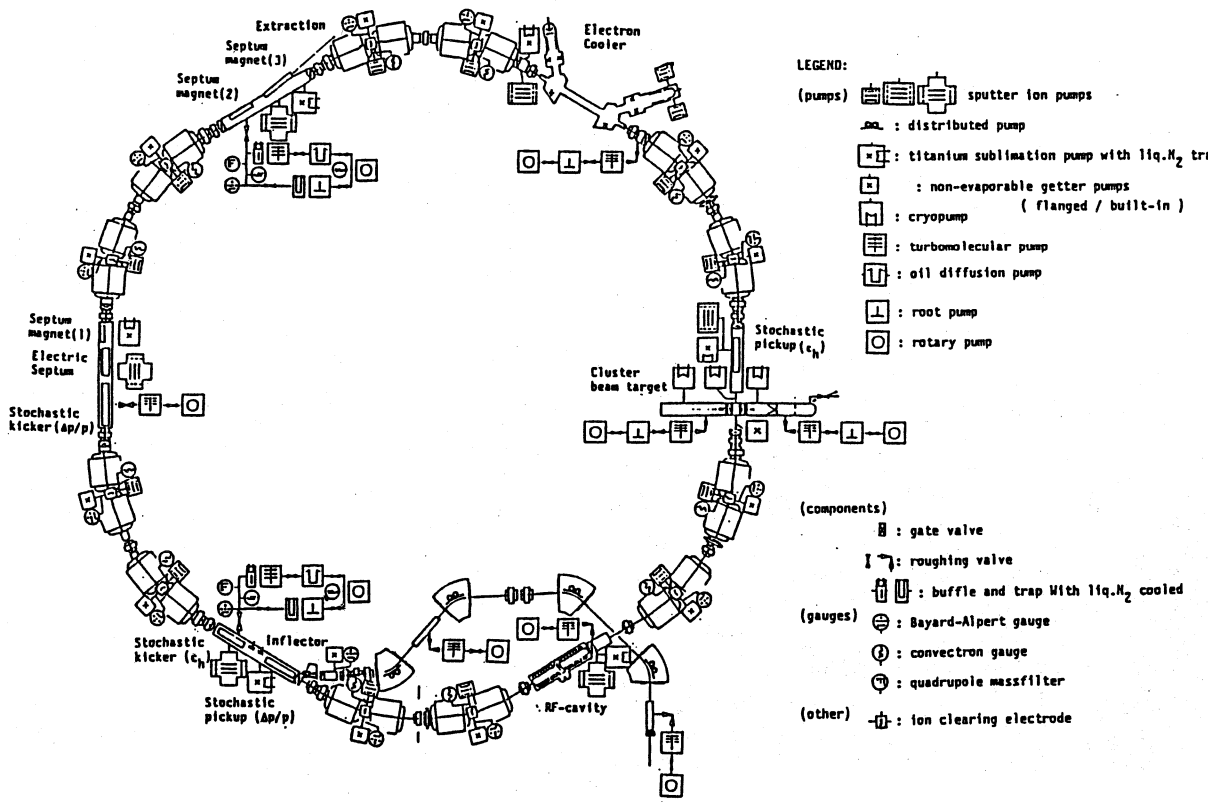

Fig. 1 Schematic layout of the TARN-II vacuum system

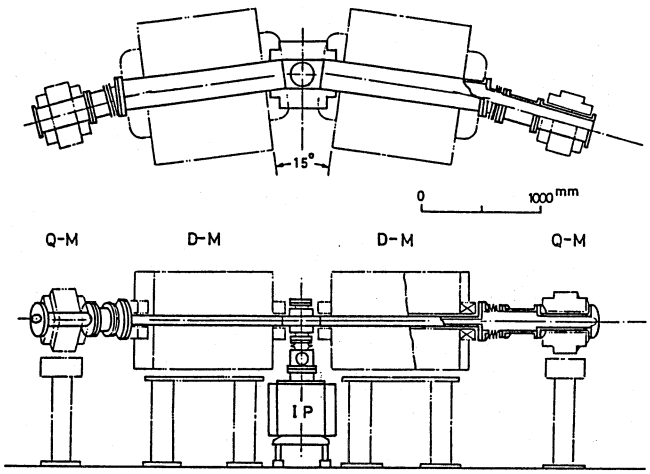

Fig. 2 The vacuum chamber of the TARN-II

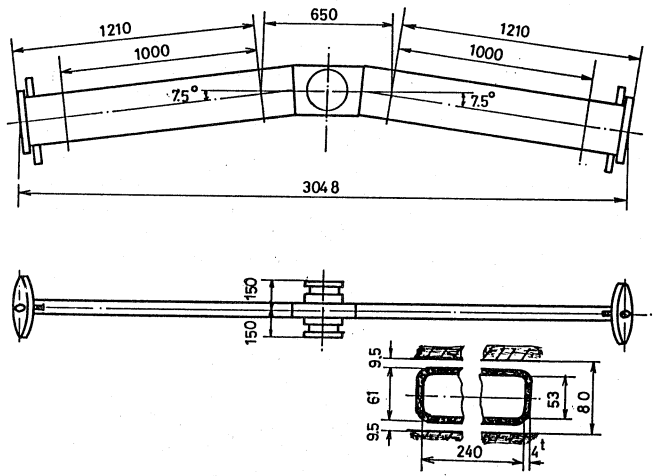

Fig. 3 The chamber of the dipole magnet section

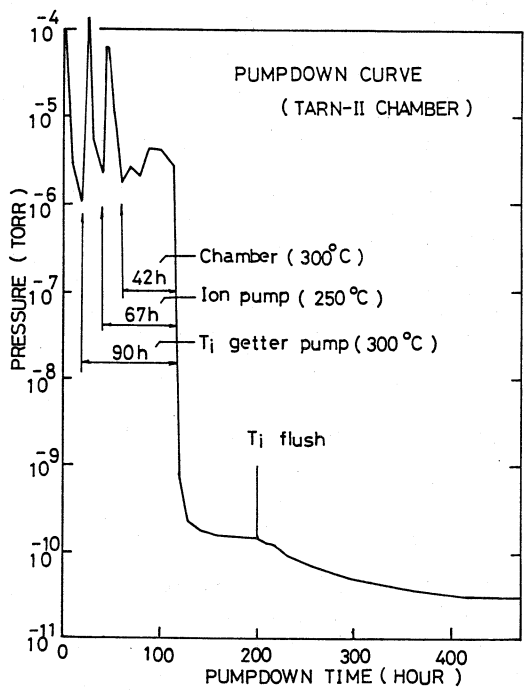

Fig. 4 Pumping characteristics of the chamber

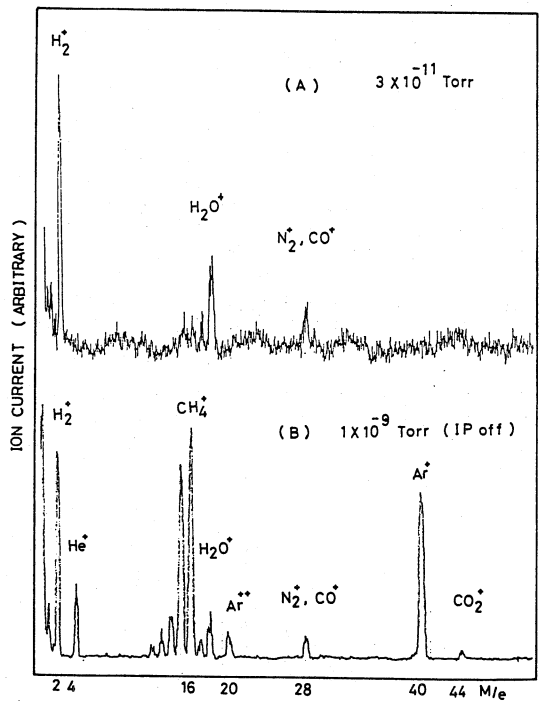

Fig. 5 Residual gas spectra of the TARN-II chamber
(A, Ion pump on ; B, Ion pump off)

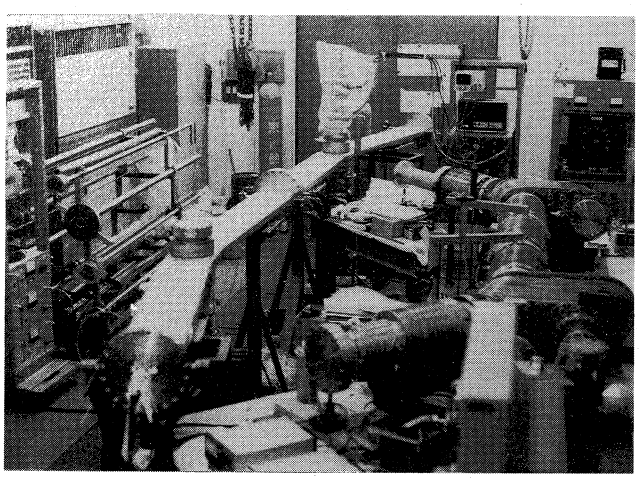

Fig. 6 View of the TARN-II chamber

References

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2) T. Katayama Proc. 11th Int. Conf. on Cyclotrons and Their Applications, Tokyo. (1987) p 128.