VACUUM SYSTEM OF TEST RING FOR THE NUMATRON

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Abstract

A test set for the ultrahigh vacuum was constructed and the fundamental data of the designing of the NUMATRON was obtained. The ultimate vacuum in test chamber is 2 x 10^{-11} Torr. Also, the vacuum system of the test ring for NUMATRON was designed.

§ 1. Introduction

The ultrahigh vacuum lower than 10^{-10} Torr must be realized for the acceleration and the storage of a heavy ion, because the charge exchange which cause a beam loss is reduced by the collision between the residual gas and the ion. Using the test ring, a preliminary test has been performed in order to obtain the fundamental data of the ultrahigh vacuum for the storage ring and the synchrotron.

§ 2. Estimation of Required Pressure

The required pressure for the test ring is determined by the taking the attenuation of the beam intensity into acount. The attenuation factor of the beam intensity, η, is represented as follows,

$$\eta = \frac{I}{I_0} = \exp(-\sigma l n_0 P), \quad l = vt,$$

where I_0 and I are the initial and the final beam intensity, σ is the charge exchange cross section, n_0 is the number of residual gas molecules per unit volume at 1 Torr, P is the pressure in Torr, l is the total flight length, v is the velocity of ion, and t is the flight time, respectivly.

The average attenuation factor, $\langle\eta\rangle$, was calculated as Fig. 1. In this calculation, the result of PRINCETON Group[1] was used for the cross section.

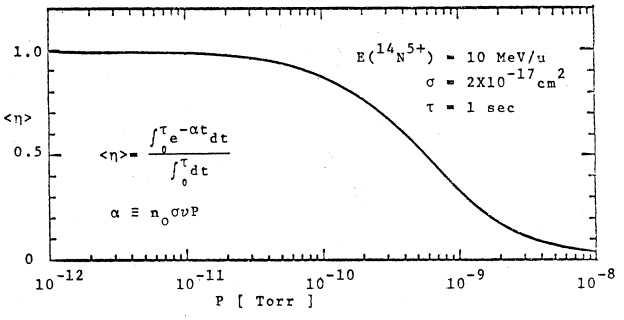


Fig.1. Beam attenuation factor for the test ring.

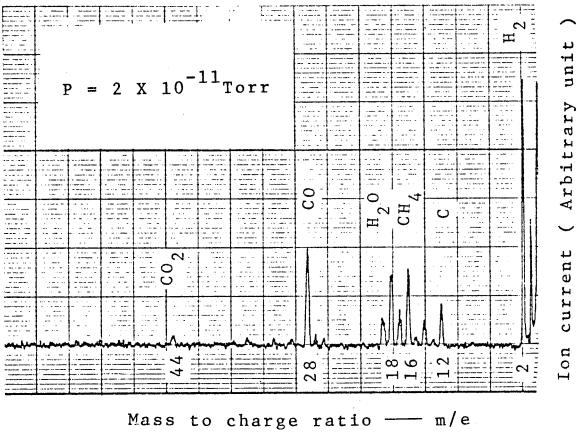
§ 3. Preliminary Tests for The Ultrahigh Vacuum

The test vacuum system which is composed of a turbo-molecular pump, a Ti getter pump with Liq. N_2 jacket and a stainless steel chamber with the volume of 200 liter, was constructed for the testing of ultrahigh vacuum. The vacuum pressure and the compo-

nents of residual gas were measured by the modulation B-A gauges and the quadrupole mass filter. The ultimate pressure was 2×10^{-11} Torr and the spectrum of the residual gas is shown in Fig. 2. The de-gassing rate of the chamber wall is measured at 6×10^{-12} Torr·l/sec·cm^2 by the build-up method.

§ 4. Design of The Vacuum System For The Test Ring

The layout of vacuum system is illustrated in Fig. 3. The chamber is made of the 316L stainless steel and the pumping system is used the turbo-molecular pumps, the ion pumps and Ti getter pumps. The mechanical booster pumps are applied at the roughing pump line.



Ref.[1] M.G.White, 8th Inter. conf. on High-Energy Accelerator. CERN (1971) P.568.

Fig.2. Residual gas spectrum of the test vacuum system.

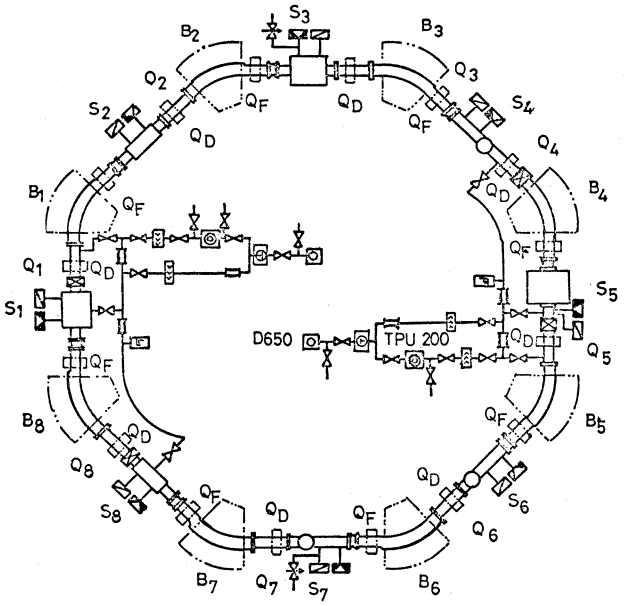


Fig.3. Layout of vacuum system for the test ring.

SIP	800	l/s
SIP	400	l/s
TGP	1500	l/s
TMP	190	l/s
RP	650	l/min
L-N TRAP		
GV		
LV		
RGA		
MBP	90	m^3/h