OPERATION OF TARN

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The construction of TARN, Test Accumulation Ring for NUMATRON Project[1], was finished and the test operation was started since August, 1979. The ion beams, for example He^{2+} and H_2^+ of 7 MeV/u, from the INS SF Cyclotron are injected and accumulated into the TARN[2], as shown in Fig. 1 and 2. The important problems for the designing of NUMATRON as the multiturn injection, RF stacking[3], the beam monitoring and the ultra-high vacuum[4] had acquired footing.

The normal orbit of accumulated beam is in good agreement with the desgin value[5] and ν-value is set up 2.25. Two computer, HP 1000 and FACOM U-400, are used for the control of the beam and the RF system and the data logging. Also, the vacuum reached to 6×10^{-11} torr on beam condition which keeps the survival rate of the beam intensity of >90 %.

The typical results so far obtained are as follows: The injection into transverse phase space up to the effective intensity of 34 turns at the maximum is successfully achieved and the injection of about 20 turns into and optimum space considering the combination with RF stacking has been established as shown in Fig. 3. Upper and lower pictures in Fig. 4 show the beam profiles of He ions for the 20 turns injection and the 40 Hz RF stacking, respectively, observed by a sweeping scintillation monitor. This stacked beam corresponds to the intensity of about 200 turns and of about 10^9 particles. The mean lives of the accumulated ions are 35 ms and 250 s for 14 MeV H_2^+ molecular ions at the residual gas pressure of 6×10^{-10} torr and 28 MeV He ions at 1×10^{-10} torr, respectively.

Reference

1) Y. Hirao et al., NUMATRON. INS-NUMA-5, 1977
2) T. Katayama, A. Noda and Y. Hirao, NUMATRON and TARN, INS-NUMA-17, 1980
3) S. Yamada and T. Katayama, Injection and Accumulation Method in the TARN, INS-NUMA-12, 1079
4) A. Mizobuchi, Vacuum system for TARN, Vacuum 22 (1979) 213
5) A. Noda el al., Lattice structure and Magnet Design for the Test Ring, Proc. 2nd Symp. on accelerator Science and Technology, p 83, 1978

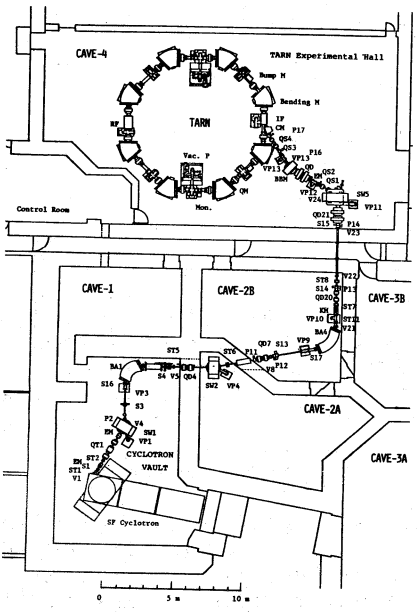

Fig.1 Layout of the Test Accumulation Ring for NUMATRON (TARN) and the Beam Transpot System from the SF-Cyclotron

Fig. 2 Picture of the TARN

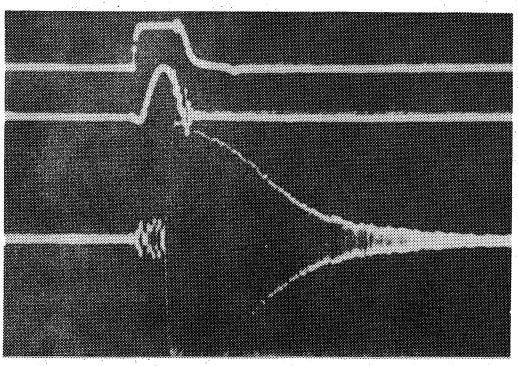

Fig. 3
Top: Indicate the beam duration transported from the SF-Cyclotron.
Middle: Current form of pulsed bump field.
Bottom: ∿20 turn injection of α beam, observed by electrostatic beam monitor

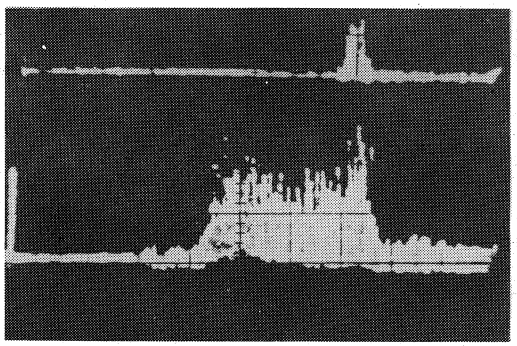

Fig. 4
Upper: 20 turn injection of α beam, observed by radially sweeping scintillation monitor.
Lower: 40 Hz RF stacking after 20 turn injection of α beam.