Beam Lock System for TARN

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Abstract

The preliminary experiment on RF system was reported.[1] Which is mainly described about hardware system and its operation experience with some results of experiment on capture, sweep and deposit of the beam.

Recently, reconstruction of hardware system have been carried out including the beam feed back system. The new system prepares the high slew rate ferrite of RF cavity and the composit beam lock mechanism so as to avoid a miss capturing of injected beam. The new ferrite is available for not only storage mode but also synchrotron acceleration mode.

A beam capture frequency of the RF system is set to bunching frequency of circulating beam in the TARN.

In the case of 7 Mev proton beam the bunching frequency is about 8 Mhz and longitudinal phase length is few nano-second at injection period. It is evident that RF bucket area must cover the area of injected beam, however, beam capture process is variable so that the many different type of beam is injected from SF cyclotron.

A new type of beam lock system have been developed to ensure the beam capture process which depend on not only longitudinal phase length but also the energy-spread of injected beam.

The new system have Two phase lock loop independently. The one refers the injection beam frequency which depend on the operation frequency of SF cyclotron (PL1), and the other refers the circulating beam phase in the TARN (PL2). Before the beam injection procedure the phase lock loop (PL1) is established which is locked to frequency of SF cyclotron, and RF voltage is not appeared on the RF cavity. After the beam injection the phase lock system is switched to the beam lock loop (PL2) at once. The switching operation is performed with electronic switch in the beam lock system. The schematic drawing is as shown in Fig. 1.

The PL1 is provided the lock range of 300 Khz which is 10 times of lock range of PL2. As the PL1 have a wide capture range frequency setting of RF system is carried out without a complex procedure. After the frequency setting a control voltage of frequency generator which determines the RF frequency is remained with level hold circuit because of prefer the lock-in action to the PL2. If beam bunch does not comes loose and applied RF bucket is suitable for

phase area of beam, the beam capture process grows up and then the beam bunch is narrowed smoothly with PL2. It is important that an accelerating energy per turn is supplied to circulating beam without frequency modulation due to electronic noise in the low level RF system. To avoide the electronic noise which is mainly including the phase detection components at the phase detector, new phase detection circuit is applied in the PL2.

The frequency weep voltage is added to the control input of frequency generator through the mixing circuit as well as control of phase lock procedure. The phase advance due to this control voltage is controlled to set the synchrotron phase angle of 60 degrees.

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FIG.1