The TRITRON Development

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In April 1995 the final assemblage of the Tritron was completed. The main activities since then concerned the following topics.

- Commissioning of the beam transfer system.
- Continuous long–term operation of the refrigerator.
- Operation of the magnets above 1000 A.
- Conditioning of the rf–cavities.
- Commissioning of the rf–control system.
- Commissioning of the beam position probe system.
- Update and development of new control codes.
- Test runs with beams in the Tritron.

The rf–system of the post buncher in the beam line between the tandem and the Tritron was completed by adding a circulator. The phase and amplitude control was installed as part of the main rf–control system of the Tritron. A stable and reproducible operation of the post buncher was obtained by optimization of the electronic circuits and the control codes. Phase variations of the bunches are transformed into energy shifts by the post buncher. They are detected at slits between the 90^o–bending magnets in front of the Tritron and are corrected accordingly. In January 1996 a phase stabilized bunched beam was injected for the first time into the Tritron. The bunch length was about 150 psec, and the energy spread 10^{-2}.

The refrigerator caused some time–consuming problems, which mainly came up during long period operation: piston seizure of the compressors, leakage between the pure and impure helium circuits in the purifier, and failures of the electric circuits. Some experience had to be gained for stable operation of the refrigerator under conditions with rapidly varying reflux of cold helium gas due to the switch on or off of the rf–power of several cavities during simultaneous operation of the magnets.

The complete magnet system was tested for the first time with currents above 1000 A. During a quench a total voltage of up to 250 V to ground occured. This was sufficient to start a gas–discharge, damaging current leads. Therefore the maximum voltage was reduced to less than 80 V by centering the ground point and lowering the overall shunt resistors. The maximum current obtained so far in the complete magnet system is 1050 A. This is somewhat less than the values achieved in the single sectors tested separately. The source of the additional heat input causing the reduction still has to be identified.

The phase and amplitude control system of the cavities was supplied with a fast frequency fine tuning system consisting of piezo–actors and the related amplifiers and control–electronics. Presently it is working as planned. However an oscillation with 8 Hz and higher harmonics, the origin of which is not yet identified, is limiting the capability of the control system. The quality factors of the 2. and 3. cavity shown in Fig.1 were measured after extended conditioning. As an important result the superconducting PbSn–surfaces show no degradation even years after the electro-plating procedure. The surfaces are exposed to the laboratory air, whenever the Tritron–cryostat is opened.

The six arrays of beam position probes with up to 20 filament probes each were tested with beam. Some minor problems concerning the contacts of the filaments, the mechanical drive and the calibration had to be solved. A careful analysis of the probe signals reveals detailed informations about the beam position and width.

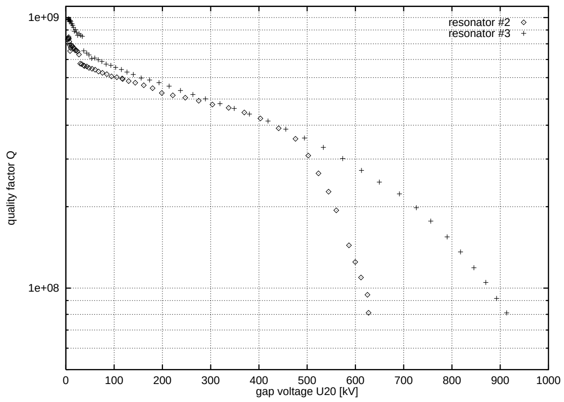

Fig. 1: Quality factors vice the voltage amplitude at the last beam hole for the 2. and 3. cavity, measured in February 1996 with the antennas strongly coupled to the field as under realistic beam conditions. The unloaded Q–values would be somewhat higher.

The software of the Tritron field processors has been adapted to the new ONF5.0 control system. New control hard– and software has been developed for the superconducting switches of the magnets. For the position probes a new self-scaling read–out interface has been developed and tested. The control desk software has been translated for use under Windows 3.1. In order to use the extended Windows facilities parts of the control code have been rewritten.

In June/July 1995 a $^{32}S^{14+}$–beam (40.4 MeV) was transported along the 2.6 innermost turns. The dispersion coefficients of the magnets were checked. In January 1996 for the first time a phase stabilized, bunched beam was accelerated by different cavities, operated at locked phases and fixed amplitudes. The beam displacement due to the energy shift caused by the rf–field was used to determine the phase with respect to the bunches and the amplitude of the cavity voltage. Thus at the beginning of 1996 in principle all tools were operating to handle the beam through the machine. The beam transport tests done so far have shown, that it would be very helpful in order to reduce the beam losses, if the beam positions could be measured in front of each channel magnet. The present probes are installed only in every second intermediate magnet sector. Therefore if possible additional scrapers shall be installed in front of each channel just outside of the geometrical aperture, which can be read out without delay.

References

[1] U. Trinks, CAS CERN Accelerator School, CERN 96–02
[2] O. Schoerrig, diploma thesis, 1996