

# Multi-Bunch Systems at DESY

Rolf-Dieter Kohaupt  
DESY Hamburg, 22607 Hamburg

## Abstract

A central problem for the electron machines PETRA, HERA and DORIS is the strong current limitation due to multi-bunch instabilities. The design currents of these machines are a factor of twenty above threshold currents. For the proton machines the beam quality is strongly affected by instabilities. In order to reach the design currents in routine operation of the electron machines very effective multi-bunch feedback systems have been developed. Starting with an intensive theoretical investigation of those systems the technical concept was elaborated.

## I. Introduction

The electron machines PETRA, HERA and DORIS have all been equipped with transverse and longitudinal feedback systems. They have worked successfully in routine operation for about two years.

For the proton machine DESY III the observed longitudinal instability has been cured by a longitudinal multi-bunch feedback system based on a completely new concept. The longitudinal bunch deviation is corrected by horizontal kicks at places with large dispersion. Also this system works successfully in routine operation.

For the HERA p ring a transverse multi-bunch feedback system with low noise level has been developed in order to cure the observed instability in this machine. This system will be brought into operation for the next luminosity run period.

## II. Review of the Theory

The multi-bunch feedback system was investigated within the theory of discrete systems (1) where the pick-up and the definition systems are explicitly localized. The result is a rigorous description of the multi-bunch theory including feedback systems.

## III. Realization of Feedback Systems

The feedback systems are built up according to the following scheme:

1. Pick up
2. Wide band detector
3. Analog digital converter
4. Phase processing (digital filter)
5. Digital analog converter
6. Chain of amplifiers
7. Deflecting devices

The systems have a bandwidth of 5 MHz according to a bunch-to-bunch separation of 96 nsec.

The systems have operated successfully in PETRA, HERA and DORIS. They work in all three directions. In the transverse direction the beam is influenced by ferrite loaded kickers. The

power is 1 kW for each kicker. In the longitudinal direction rf systems with 200 kW peak power feed broad band cavities.

For DESY III the longitudinal bunch deviation is corrected by four horizontal kickers at places with large horizontal dispersion. This system reduces the proton bunch oscillations of 30 degrees to about 1 degree at ejection energy. The damping time is 30 msec. (2)

For HERA P a transverse multi-bunch feedback system was developed with low-noise e-level detectors and two kickers in each direction. The damping was measured to be around 200 msec. The system will be operated for the next luminosity period.

## References

- [1] R. D. Kohaupt, DESY 91-071
- [2] R. D. Kohaupt et al. DESY Report (to be published)