Presentation 71

LEP-SPS Synchronisation

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The synchronization between the LEP and the SPS RF systems is established during lepton cycles with two signals which are transmitted from LEP to SPS:

71.1 A synchronization pulse

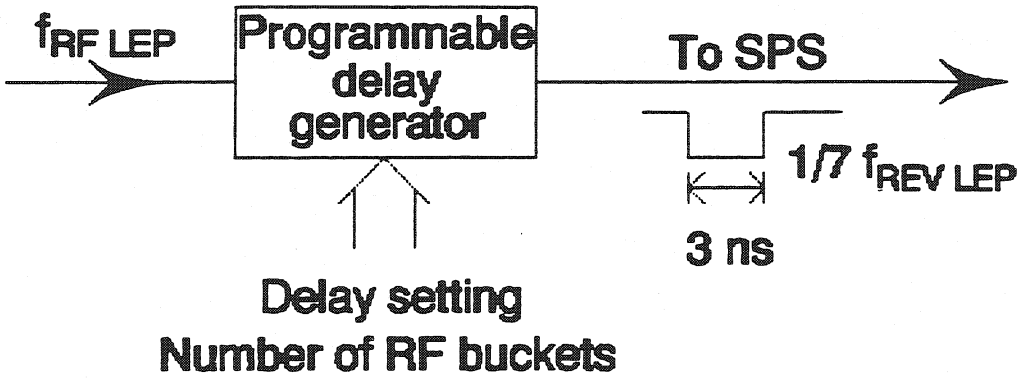

Figure 71.1: The synchronization pulse

With the programmable delay generator the output pulse at 1/7 of the LEP revolution frequency (the LEP-SPS fiducial frequency) can be delayed any number of RF periods from 1 to 31320, the LEP harmonic number [1]. The jitter of this pulse is less than 15 ps. Variation of insertion delay with programmed bunch number is also small - less than 5 ps. The performance of the generator is mainly limited by the delay variations with temperature. From 20 to 40 °C the change is about 120 ps.

In normal operation with four bunches in the injectors and LEP the delay is changed between positron and electron cycles. The difference in delay settings determines the collision points in LEP. The system is flexible. With delay changes between SPS supercycles any bucket and any number of buckets in LEP can be filled.

From this synchronization pulse the timing for the injection kickers is also derived.

71.2 The LEP RF frequency

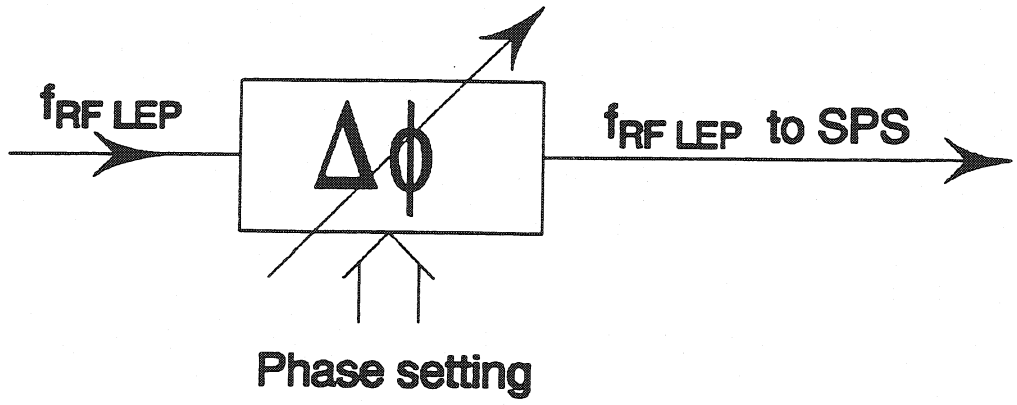

Figure 71.2: LEP RF frequency transmission to SPS

With the synchronization pulse and the LEP RF frequency the SPS is phase locked to LEP during lepton cycles. The programmable phase shifter is adjusted individually for electrons and positrons in such a way that the bunches are injected in the centre of the RF buckets. At present this adjustment is done empirically by optimizing the accumulation rate. With the mountain range display it should be possible to watch the bunches at injection and optimise the phase for minimum longitudinal oscillations.

The programmable delay and the phase shifter are controlled by an "RF equipment controller" The nominal settings are stored in EEPROMs. A slow timing module determines if the electron or positron settings are used.

References

[1] J. Sladen, Beam synchronized digital delay , LEP Note 519.