Depolarization (hardware)

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With input from the BE RF colleagues
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The depolarization process itself was never studied in detail at LEP.

Some ‘magic’ depolarization settings were established and kept for the entire LEP life-cycle.

It is not unrealistic to assume that as a starting point one can consider similar depolarization settings for FCC-ee and LEP.

- Scale the time scales for the ~4 times longer revolution period.
- More issues with decoherence of the spin vectors during depolarization process at FCC-ee ?!
LEP kicker

- Magnetic kicker with max field of ~ 0.4x10^{-3} Tm.
- Kicker pulse: ~1 μs FWMH. One pulse per revolution.
- Standard field strength for depolarization ~ 0.2x10^{-3} Tm.
  - orbit kick of 1.2 μrad, spin rotation of 140 μrad.

Depolarization sweeps were typically 22 Hz wide to provide an energy within ±0.44 MeV.
  – More precise frequency determinations were possible, usually not used because the standard accuracy was adequate and more accurate scans could be time consuming.

In the first set of measurements $Q_s$ was modified to confirm that the depolarization did not happen on a $Q_s$ sideband, and the energy was varied using the RF frequency to determine if the depolarization scan corresponded to $\nu_s$ or $1-\nu_s$.
  – From them on it was usually possible to track the energy.
LHC transverse feedback system

- Four kickers per beam, per plane, located in RF zone (UX451) at point 4
  - Electrostatic kicker, length 1.5 m.
  - Providing a kick of \( \sim 2 \mu \text{rad} @ 450 \text{ GeV} \) (all 4 units combined).
  - Useful bandwidth \( \sim 1 \text{ kHz} – 20 \text{ MHz} \).

ADT kickers and power amplifiers at point 4
- Impulse response of “standard bandwidth” and “enhanced bandwidth” operation of the LHC TF.
- Almost bunch-by-bunch kicker for LHC 25 ns bunch spacing.
  - More or less what would be nice to have for FCC-ee depolarization.
The LHC TF system would provide a transverse kick of up to ~20 μrad at the Z peak with ~10 MHz bandwidth. This is 10x more than what we may need → OK!

For a LEP like kick of ~1 μrad there is a factor 4-5 margin wrt DA. AM arrangement of 2 kickers with adequate phase advance to enhance the deflection may be used to overcome DA issues.