Studies of energy aperture in bypass and dump-line

John Carwardine

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Energy aperture study

- **Pre-requisites:**
  - Good 3nC bunches at end of linac
  - All RF systems set up for 800us flat top

- **Objectives**
  - Correct linear and non-linear dispersion
  - Measure energy aperture
  - Measure energy distribution, use to set up best energy match

- **Part of the machine setup studies**

Start with single 3nC bunches...

- Match energy to the bypass line ‘design’ energy (minimize rms orbit using ACC456 energy knob), correct the orbit
- Measure single-bunch energy spread in dogleg
- Correct the linear dispersion in bypass line
- Correct non-linear dispersion using S5BYP, S10BYP, compare with optics model
- Measure energy aperture and loss points in the bypass & dump line, compare with optics model
- Adjust sextupoles to maximize the energy aperture, compare with settings from dispersion correction

- *(Somewhere in here, we would start charaterizing the new dump-line diagnostics)*

Long-pulse mode (30 bunches at 40kHz)

- (Use bunch-train to ‘sample’ the LLRF vector sum)
- Optimize LLRF regulator gains (see separate sheet)
- Set up LLRF for flattest energy profile
- Measure bunch-by-bunch energy distribution over many pulses
- Adjust ACC456 energy to give best match between the bunch-train energy distribution and the energy aperture
- Perform energy scan for entire bunch train, use BLMs to confirm that energy distribution is well matched with the energy aperture
- Correct the orbit using the same approach as above, using bunch-by-bunch orbit statistics

A few parameters to monitor while the beam power is ramped up

- Monitor bunch-by-bunch energy and orbit statistics as beam power is ramped up. Use as tuning knob
- How do beam losses scale with beam power?
- Vector sum profile vs energy profile. Identify the source of any relative changes (eg beam phase, ACC1 phase,...)
- General comment: we should try to avoid tripping the BLMs when making step changes in the length of the bunch train.

Study to set LLRF regulator gains in order to minimize beam loss