Thoughts on Energy Chicane Design

Preliminary stuff by R. Arnold for the Energy Chicane Group

(no design yet, this is a discussion of issues)

Issues to consider

- Design for $10^{-4}$ energy error
- Number, length, location of magnets
- Desired dispersion
- System length needed, available in BDS
- BPM performance needed
- Design for low emittance growth
- Design for robust calibration and operation
- ....
Basic plan is:

- Chicane kink to modest dispersion in BDS
- Be invisible to the luminosity
- Measure beam offset with precision BPM’s
- Calibrate BPM’s often
- Measure and/or average over beam jitter
- Measure B.dL and magnet positions precisely
- Control and monitor drifts
- Measure energy averaged over some pulses
- Sample beam energy frequently enough
- Calibrate out drifts often
- Build a system that will last, low maintainance, immune to radiation, needs few pit stops
Primary requirement is to limit emittance growth from SR

$$\frac{d\varepsilon}{ds} \approx \frac{\gamma^5 \eta^2}{R^3 \beta}$$

Amount of Synch Rad  Damage to emittance

\(ds = \) path in bend field of radius \(R\)

\(\gamma = \frac{E}{m_e c^2}\)

\(\eta = \) local dispersion

\(\beta = \) local betatron function

Long magnets, low B fields where \(\eta\) is large
Preliminary ideas for chicane design and measurement strategy

Four magnets, move and measure $\Delta x$, avoids rotation of BPM’s.
Use $+B$ and $-B$ to reduce errors, BPM1 and BPM3 for beam jitter.
Cartoon of chicane layout (not a design)
Example of magnet configuration with small emittance growth

Much work yet to do on optimization
Example of measurement cycles

Establish BPM encoder calibrations by moving BPMS’s with beam stable

Measure energy, average over beam jitter and resolutions
Cycle magnet B field

+B

-One energy measurement

-B

Time ~ minutes

Monitor drifts
Much work to do yet to optimize design

- Length and strength of magnets
- Magnet type and design
- BDS optics, location of chicane
- Chicane length
- BPM design
- Encoders and position sensors
- Strategies for coping with drifts
- ....