Beam Energy Measurement Uncertainties

Energy Measurement Type	DeltaE/E
Accelerator Bdl (non-dispersive, non-invasive)	1E-3
Arc Energy Bdl with BMP corrections (non-dispersive, non-invasive)	5E-4
Arc Energy Bdl with Harp Scans (dispersive, invasive, and possibility problematic at >6 GeV*)	2E-4
Single Hall Spin Dance with Compton (needs careful accelerator setup and coordination)	<1E-4

* The possible problem comes from the Synchrotron radiation as well as the energy spread at the high energies (!2E-4 @ 11 GeV).

Testing of ARC Mapper

The 8 dipoles in the Hall A arc are wired in series with a 9^{th} located in the mapper shed

Once the Hall is locked and the 9th dipolie is energize, we can start testing of the mapping system.

The goal will be to redo all the currents that were mapped by the accelerator magnet mapping team.

This should be done without beam!

Testing of the HARP System

With 5uA of CW beam, test the super Harp system.

This system is independent of the mapper as far as testing goes.

NOTE: I need to double check if we already have the survey data!!

Non-dispersive ARC Energy

Once ARC is working, a ARC scan can be done at any time.

Using the ARC Bdl information along with BPM information allows for the beam energy to be determined to ~5E-4.

This is non-invasive and can be done any time that we have >5uA CW beam in the hall.

Dispersive ARC Energy Measurement

Once ARC mapper is running and the super Harps are tested, we can do a full ARC energy measurement.

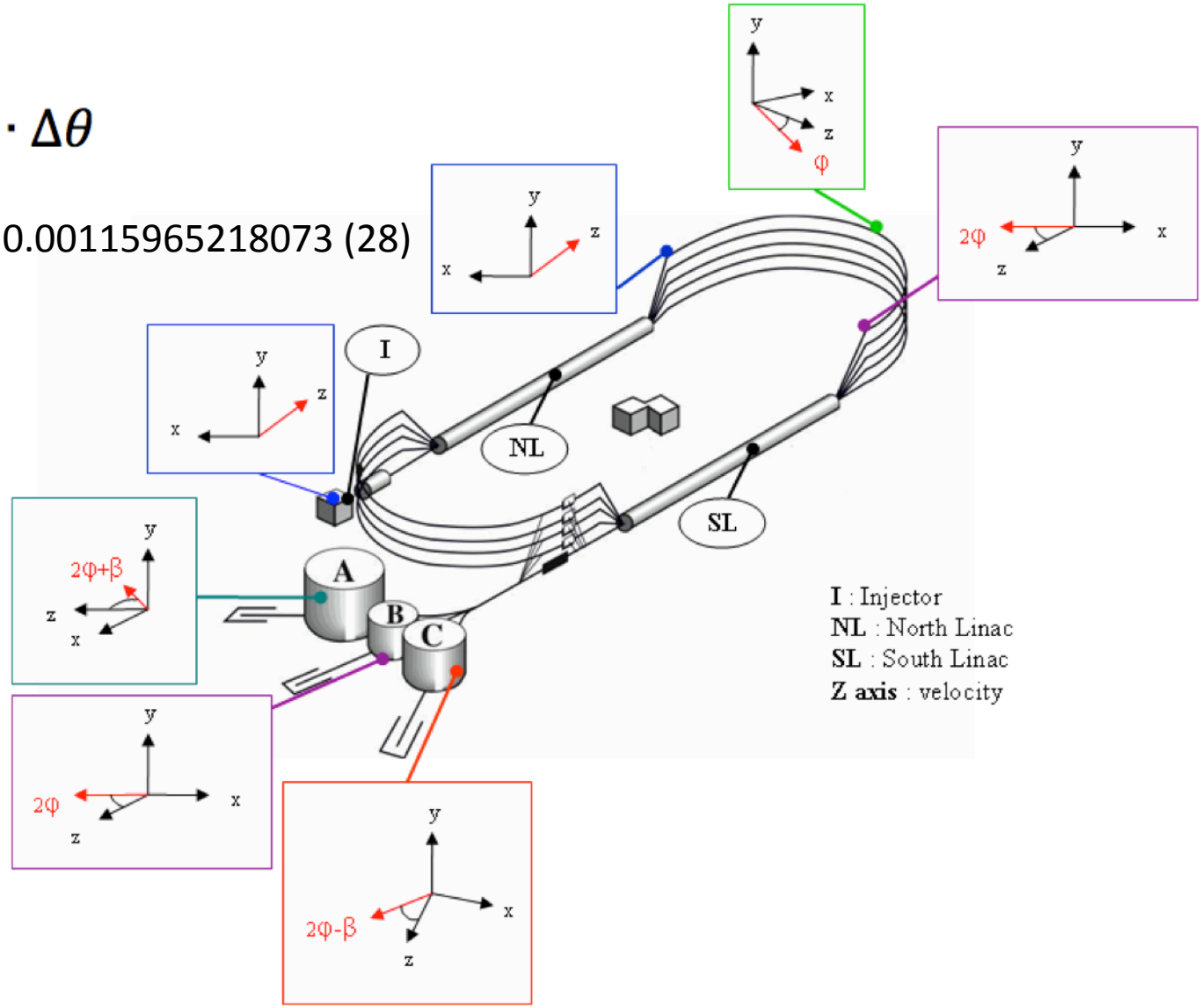
This requires dispersive optics which could be problematic at the highest beam energies especially if the energy spread is worse then predicted.

7 GeV should be ok and is great place to start!

Spin Precession At CEBAF

$$\Delta\varphi = \frac{g-2}{2} \cdot \frac{E}{m_e c^2} \cdot \Delta\theta$$

where electron (g-2)/2 = 0.00115965218073 (28)



Beam Energy From Total Precession

J. M. Grames et al., Phys. Rev. ST Accel. Beams 7 (2004) 042802.

Polarimeters	Ψ (deg)	E (MeV)
Mott-Compton	10 985.94 ± 1.37	5649.21 ± 0.89
Mott-Møller A	10 984.96 ± 0.71	5648.70 ± 0.65
Mott-Møller B	10 501.60 ± 0.64	5647.20 ± 0.66
Mott-Møller C	10 024.51 ± 0.69	5649.03 ± 0.71

NOTE: The Hall A and C polarimeters receive more attention to systematics then the Hall B polarimeter due to the requirements of the experiments (e.g. G0, HAPPEX, Qweak, etc.).

Even so, full spread these results is only 2 MeV (5648 +/- 1 MeV) so already 2E-4 level.

Using Spin At 11 GeV

- At 11 GeV, the beam processes >20k degrees before arriving in Hall A.
- 2 MeV of beam energy change (balanced) is a 5 degree change in the precession.
- Phase can be determined to the degree level with Compton (~8 hrs)
- That would be 9E-5 !! dE/E with just a single hall
- BUT accelerator systematics have to be under control
  - Injector Energy
  - Linac Balance (relative difference in energy)
  - Calibration of Wien angle