Tracking LOI Preparations

- LOI will describe SiD tracker design, R&D status, and simulated performance
- Many of the technical / hardware R&D efforts will be in incomplete on the time scale of the LOI
  - We should be able to show some preliminary results given state of detector and readout prototype efforts, other R&D in progress
  - Likely that there will be some significant holes
  - Vibration / Lorentz forces was an issue raised at the tracking review – need some good ideas on how to make progress on this topic given the largely unknown forces / torques that will be applied to the mechanical structure
- On the other hand, we should be able to put forward a detailed and fairly complete design with extensive simulation studies that demonstrate the SiD tracker is robust and capable of meeting the needs of the ILC physics program
  - Will focus on these issues today

Design and Simulation

- Ideally, the design optimization is an iterative process
  - Start from a baseline design and understand performance of baseline
  - Perform variations on the baseline to establish "performance derivatives"
  - Establish new baseline design with improved performance
  - Repeat until you achieve convergence
- This only works if:
  - Your performance metrics are relevant to the ILC physics program
    - Danger #1 – optimize for an irrelevant physics benchmark
    - Danger #2 – fail to optimize for the actual requirements needed at the ILC
  - Your simulation tools are sensitive to the design variations that will ultimately improve performance
    - Danger #3 – the simulation tools, not the detector design, limit the measured performance
    - Danger #4 – the level of simulation modeling is too coarse and misses important effects
  - Your backgrounds and hardware performance requirements are achieved
    - Danger #5 – backgrounds will be worse than expected
    - Danger #6 – hardware problems will not allow simulated performance to be achieved
- Important to retain / demonstrate "performance contingency"

Tracking Simulation Efforts I

Focus is currently on developing simulation tools

- MC simulation of tracker
  - Cylindrical barrel and disk geometry – complete
  - Planar detector geometry (McCormick / Nelson)
- Detailed simulation of tracker hits
  - Complete simulation of charge deposition in strips / pixels, readout, and clustering of strip hits to form "tracker hits" (Nelson)
  - Have also in hand a tracker hit cheater that simulates clustering and resolution effects (Nelson / Partridge)
  - Define extensions to existing org.lcsim framework needed for tracking (Kutschke + others)
- Track finding algorithms
  - Vertex seeded tracking (Stevens / Partridge)
  - Conformal mapping algorithm (Baker / Graf)
  - Stand alone outer tracking (Deaconu / Nelson)
  - Calorimeter seeded tracking (Onoprienko)

Tracking Simulation Efforts II

- Track fitting algorithms
  - Weight matrix (Sinev)
  - Kalman filter (Baker / Graf)
  - Fast helix finder for track finding (Stevens / Partridge)
- Tracking performance studies
  - Multi-algorithm track finding (Rice / Schumm)
  - Forward tracking studies (Francisco / Wenzel)
  - Tracking performance metrics (Meyer / Schumm)

Tracking Performance Metrics

- Traditional metrics
  - Efficiency, coverage, resolution, fake rate
  - Particularly useful for finding weaknesses in design (e.g. low efficiency for forward tracks)
- More difficult is developing metrics that measure physics performance
  - Physics will apply a non-uniform weighting to the traditional metrics
    - Inefficiency at high momentum more critical than at low momentum
  - Weighting may depend on physics
    - For example, leptonic ZH heavily weights momentum resolution
  - What is needed for good PFA performance?
    - Impact of long-lived secondaries
    - Impact of inefficiency and fakes
    - Impact of material
  - Probably should develop some physics weighted benchmarks
    - Weight efficiency, fake rates, by momentum?
    - How do we quantify forward tracking performance?