Computing for SuperB TDR: SVT

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Main Issues

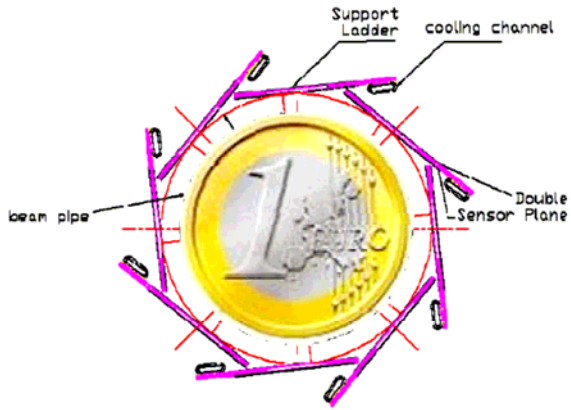
- Detector Optimization
  - perform simulations to try to optimize detector parameters, e.g. radius of Layer0
  - external constraints
- Characterization of performance
  - once we have optimized, estimate expected performance → input for physics studies
- Tools
  - detector simulations
  - algorithms

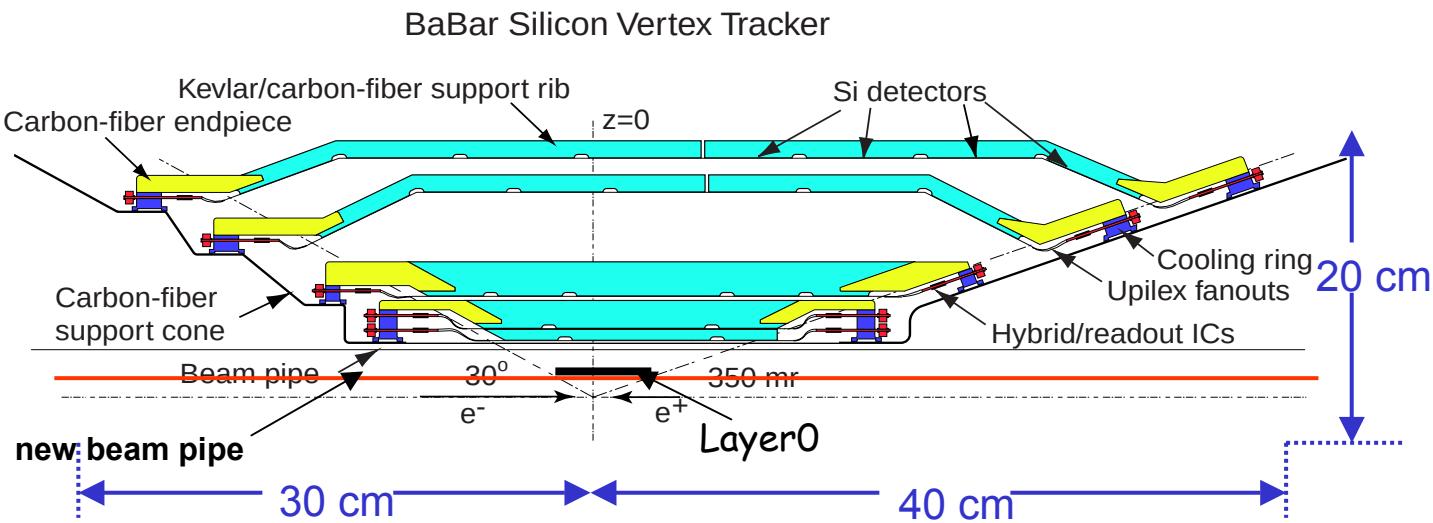
Time scale of TDR: completion in 2 years, need working tools well before that

Baseline Vertex Tracker for SuperB

- Start with Babar SVT as baseline
- Add Layer0 pixels at small radius
- Possible (small) changes in outer layers – smaller boost in SuperB

Layer0





Things we want to optimize

- Layer0
  - radius
  - intrinsic resolution
  - material budget

  } Impact on L0 technology
- Acceptance – angular coverage
  - heavily constrained by the machine
- Outer layers
  - radius
    - no support tube (as in Babar)
  - geometry
    - smaller boost ($\beta\gamma$=0.28 instead of 0.56)
    - bending in outer layers
  - dE/dx capability → decision on readout electronics

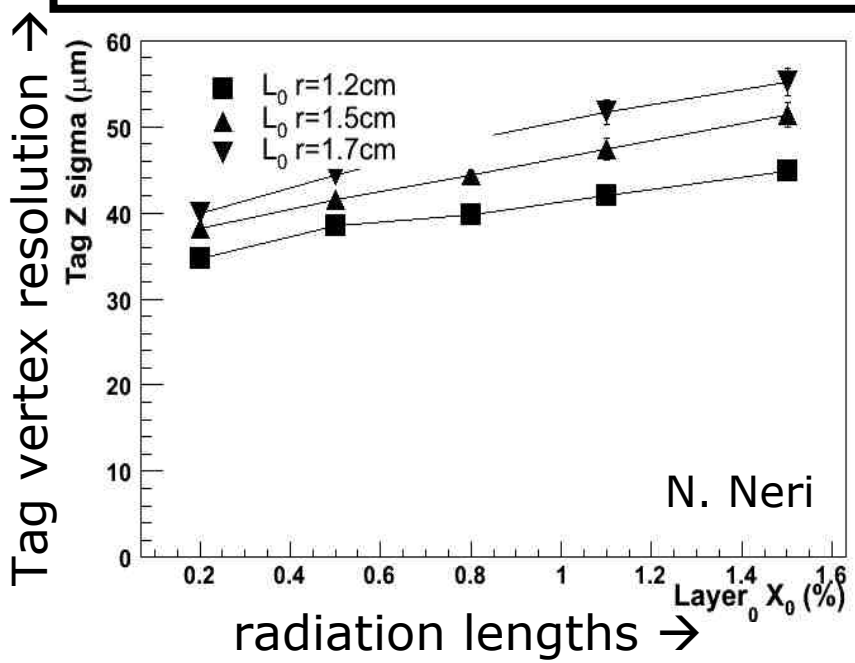
Figures of Merit, Decay Modes

- How do we decide what is optimal? Define Figures Of Merit (FOM).
  - vertex resolution: separation between two B decays: Δz or Δr (3-D separation)
  - efficiency (angular coverage)
  - PID for soft particles (dE/dx in SVT)
- Relevant decay modes:
  - vertex resolution: $\mathbf{B^0 \rightarrow \pi^+\pi^-}$ (cleaner), include higher-multiplicity modes, e.g. $\mathbf{B^0 \rightarrow \eta' K_s}$
  - acceptance: missing energy, high-multiplicity
    - LFV mode $\tau \rightarrow \mu\gamma$: not time-dependent, but vertexing could be important means of background suppression
  - dE/dx: soft pions from $D^{*+} \rightarrow D^0\pi^+$ decay

Preliminary Studies

- Nicola Neri has already performed a number of preliminary studies relating to Layer0.
  - material budget
  - resolution
  - radius
- Used Babar fast simulation (PravdaMC)
- See Nicola's talk later

Dependence of Vtx resolution on tag side on radius, material



A good start: need to amplify and systematize

Simulation Tools

- Babar fast simulation: Pravda
  - interfaced to Babar event generator and physics analysis modules
  - Is simulation accurate enough for our needs?
  - Nicola will say more
- If not Pravda, what?
  - GEANT-based simulation
    - adapt from Babar simulation
      - ✓ see Fabrizio's talk later
    - start from scratch
  - Keep Pravda idea, but improve on it
    - more realistic simulation
    - geometry definition
    - etc.

Would be quite challenging given time constraints

Infrastructure

- Detector studies generally have modest computing requirements:
  - any given point in optimization typically needs only a few thousand events
  - assuming fast simulation → no need to persist simulated events → limited disk space needs
  - ditto for CPU requirements
- Going to something more CPU-intensive like GEANT will change this picture
  - will need to evaluate when we have a clearer picture of CPU demands

Other issues

- Development of algorithms
  - exploit superior characteristics of SuperB vertex detector
    - tracking:optimization of Ks reconstruction alg's
    - vertexing: B/D vertex separation
    - BG rejection capability of SVT
- Bookkeeping
  - not necessarily for data sets, but, e.g., detector configurations
    - see talk by Igor Gaponenko later this morning

Summary

- Need simulation tool to optimize parameters of SuperB SVT on TDR time scale
  - parameters to optimize
  - figures of merit
- Initial studies
  - used Babar fast simulation (Pravda)
  - reasonable but perhaps we can do better
- Infrastructure requirements modest (assuming fast simulation)
- Algorithm development → exploit improved performance compared to Babar SVT