SVT detector configurations for Physics studies

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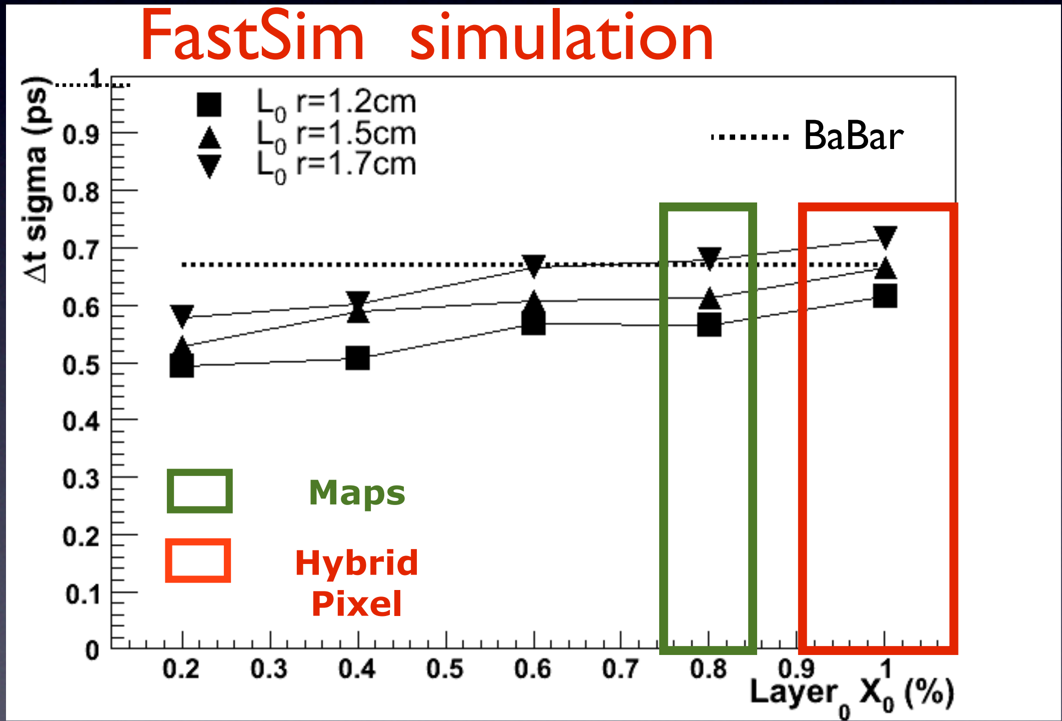
Identification of figure of merits for SVT geometry optimization

- Adequate proper time resolution for time-dependent measurements:
  - consider BaBar proper time resolution as reference;
  - impact of proper time resolution on TD analysis of benchmark channels as $K_S\pi^0(\gamma)$;
- Impact of improved vertex resolution on Physics:
  - B-D vertex separation (already proved at 3-4σ level for D^0):
    - evaluate bkg rejection performances and impact on benchmark channels;
    - dipole-based tagging algorithm (not figure of merit but a possibility to explore) ;
  - tau physics: vertexing information for bkg rejection (e.g. impact on $\tau\to\mu\gamma$)?
- Impact of increase of tracking volume down to 0.2 rad on efficiency and purity on benchmark channels: rare decays with neutrino, B recoil.
- Impact of layer position and multiplicity on Ks and soft-pion reconstruction.

Proper time resolution vs layer$_0$ X_0(%)

$B_0 \rightarrow \pi^+ \pi^-$ decay mode $\beta\gamma$=0.28 beampipe X_0 = 0.424%
hit resolution = 10 μm



- Main result is that proper time resolution is adequate for time dependent measurements.

Baseline configuration for layer$_0$

- According to available studies for proper time resolution and background rate, we know that:
  - ✓ radius for layer$_0$ has to be within 1.5 cm;
  - ✓ intrinsic hit resolution for layer$_0$ about10 μm;
  - ✓ layer$_0$ material budget less than 1.0% (X_0);
  - ✓ readout architecture up to 100 MHz/cm^2 to cope with bkg rate (with safety factor 5 x 4 cluster size);
  - ✓ radiation hardness several Mrad.

- Hybrid pixel has the best chance to meet all the above requirement in the TDR timescale (MAPS could improve performances but more R&D needed):
  - ✓ radius for layer$_0$ = 1.5 cm;
  - ✓ intrinsic hit resolution = 10 μm at normal incidence, to be studied resolution at large angles with 50 μm pitch and digital readout;
  - ✓ material budget around 1.0 % (X_0).

SVT configurations for SuperB

- SVT solutions that are under study:

baseline

(a) Layer$_0$ with hybrid pixels technology + BaBar SVT configuration for Layer$_1$ - Layer$_5$;

(b) Layer$_0$ and Layer$_1$ with hybrid pixels technology + BaBar SVT configuration for Layer$_2$ - Layer$_5$;

(c) solution (a) removing layer$_2$;

(d) solution (b) removing layer$_2$;

(e) hybrid pixels with 50x250 μm^2 (z, r-phi) as foreseen for Atlas Ibilayer upgrade. Well advanced project with similar specs and timescale.

Configurations for $layer_1$

- Double side strip detector, as in BaBar, is the baseline solution for $layer_1$:
  - dE/dX information with 3 bit ADC for pulse height (FSSR2 chip)
- Present studies are not resolutive for the background rate on $layer_1$, we need to be open to a $layer_1$ pixel solution:
  - larger amount of material 0.5% $X_0 \rightarrow \sim 1.0\% X_0$;
  - intrinsic resolution to be studied at large angles;
  - no dE/dX information (only digital information on pixel)

Configurations for layer$_2$ - layer$_n$

- Double side strip detector is the baseline solution:
  - dE/dX information with 3 bit ADC for pulse height (FSSR2 chip);
  - need to optimize the internal geometry:
    - number of layers;
    - radius of each layer;
    - arch-shape, barrel-shap or disks for external layers.

To do list

- Implement baseline configuration in FastSim ($Layer_0$ with hybrid pixels technology + BaBar SVT configuration for $Layer_1$ - $Layer_5$):
  - best guess of material budget for hybrid pixel;
  - intrinsic resolution vs large angle;
  - dE/dX with 3 bit ADC for strip detectors
- Implement different configurations (previously mentioned) in FastSim for SVT studies and test them on relevant benchmark channels.