Experience with PravdaMC for SVT SuperB fast simulations

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Outline

- PravdaMC outlook:
  - Trackerr code for tracking
- Code status
- Pro and Cons
- Examples of Physics results
- Summary

MC fast simulation

- Pravda fast simulation code (A. Ryd, N.Kuznetsova) was redesigned and interfaced to Trackerr code (W. Innes) by F. Forti and G. Hamel de Monchenault in 2002.
- Code revived and migrated to analysis-26 (N. Neri), to analysis-42 (C. Cheng).
- Main features:
  - Use standard BaBar code to define a decay mode and reconstruct it.
  - Use trackerr configuration files to define detector geometry (cylindrical symmetry).
  - Trackerr is used to evaluate covariance matrix of the charged tracks (see later)
  - Calorimeter: a smearing is applied to the photon energy according to experimental resolution.
  - PID: PID tables are used as a function of momentum and polar angle.

W. Innes, BaBar note 121

Trackerr: tracking simulation

- EvtGen generates list of tracks for the specific decay mode
- Charged tracks are passed to trackerr in order to calculate the track fit error matrix for each generated track (no reconstruction efficiency simulated).
- Error matrix evaluated according to Billoir method.

  Pierre Billoir, NIM 225 (1984), 352
- Tracks are assumed to follow an helical trajectory using the initial momentum. Tracks with substantial energy loss will suffer this approximation (main limitation of the code).
- Track parameters and error matrix are returned into BetaCandidates, to be processed by standard BaBar analysis code.

PravdaMC: status and features

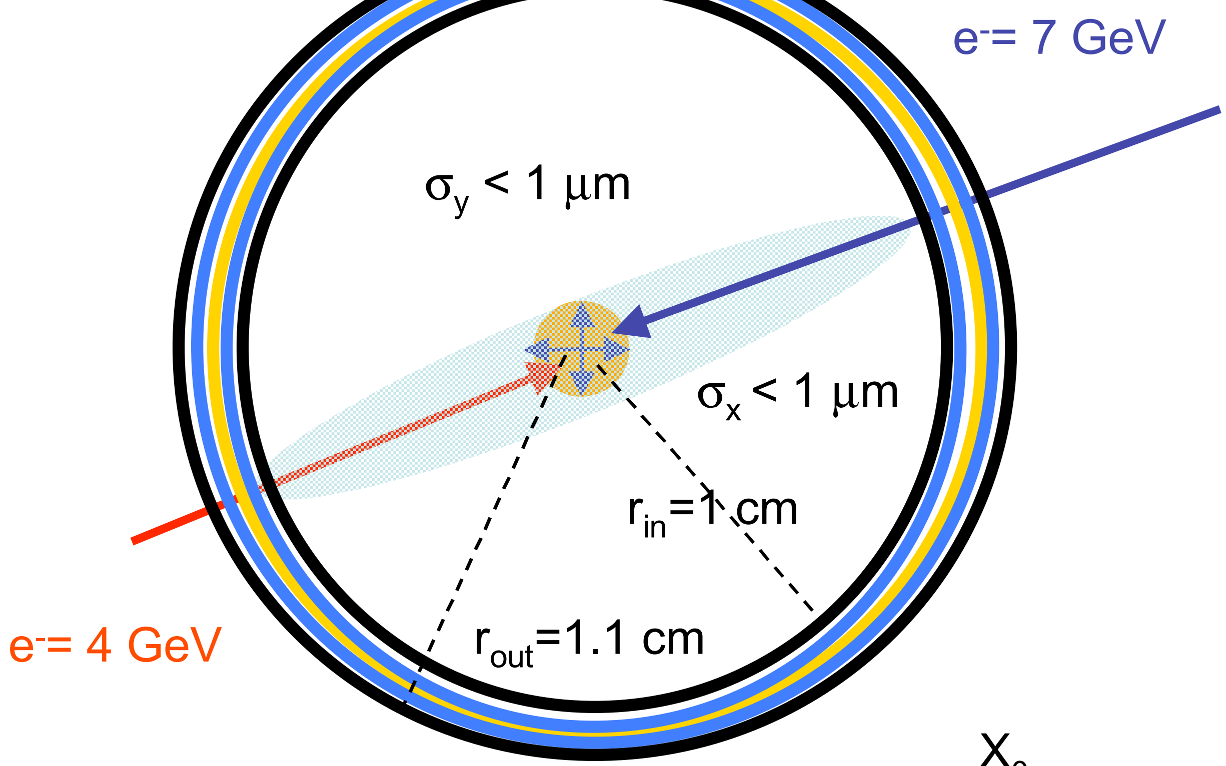
- Code migrated to analysis-42
- Available on CVS
- BaBar code is interfaced to setup jobs and produce output root files.
- Use standard BaBar vertexing algorithms.
- Possibility to define different detector configurations (trackerr input files), different CM energies, different boost scenarios.

Pros and Cons

- ***Pros:***
  - Fast.
  - Possibility to study different scenario: detector, boost, energy with relatively easy configuration.
  - Possibility to use BaBar analysis tools: combinatoric engines, event shape variables, vertexing, flavor tagging, etc.
  - Appropriate for optimization studies (tracking).
- ***Cons*:**
  - Tracking: not optimal for tracks which suffer substantial energy loss.
  - Calorimeter: just a smearing applied for a specific detector resolution. Not conceived for EMC detector optimization.
  - PID: PID tables used. Not conceived for PID detector optimization.

Examples of detector configuration

Not in scale



σ_z = 1 mm

- Be beam-pipe 600 μm thick
- Au foil 4 μm thick
- Water 300 μm thick
- Nickel coating 7 μm thick

X_0	
0.170%	(Be)
0.121%	(Au)
0.083%	(H_2O)
0.050%	(Ni)
0.424% X_0	ToT

Example of Boost Configuration

```
#  create the Pravda main sequence
sourceFoundFile PravdaMC/PravdaMC.tcl
module talk PepBuildEnv
  pepEnergiesFile  set  config/pepEnergies_7vs4.raw
  pepBoostCalFile  set  config/pepBoostCal_7vs4.raw
  pepBeamSpotCalFile  set  config/pepBeamSpotCal.raw
exit
```

Configure here SuperB parameters: CM energy, boost and beamspot:

config/pepEnergies_7vs4.raw

Config/pepBoostCal_7vs4.raw

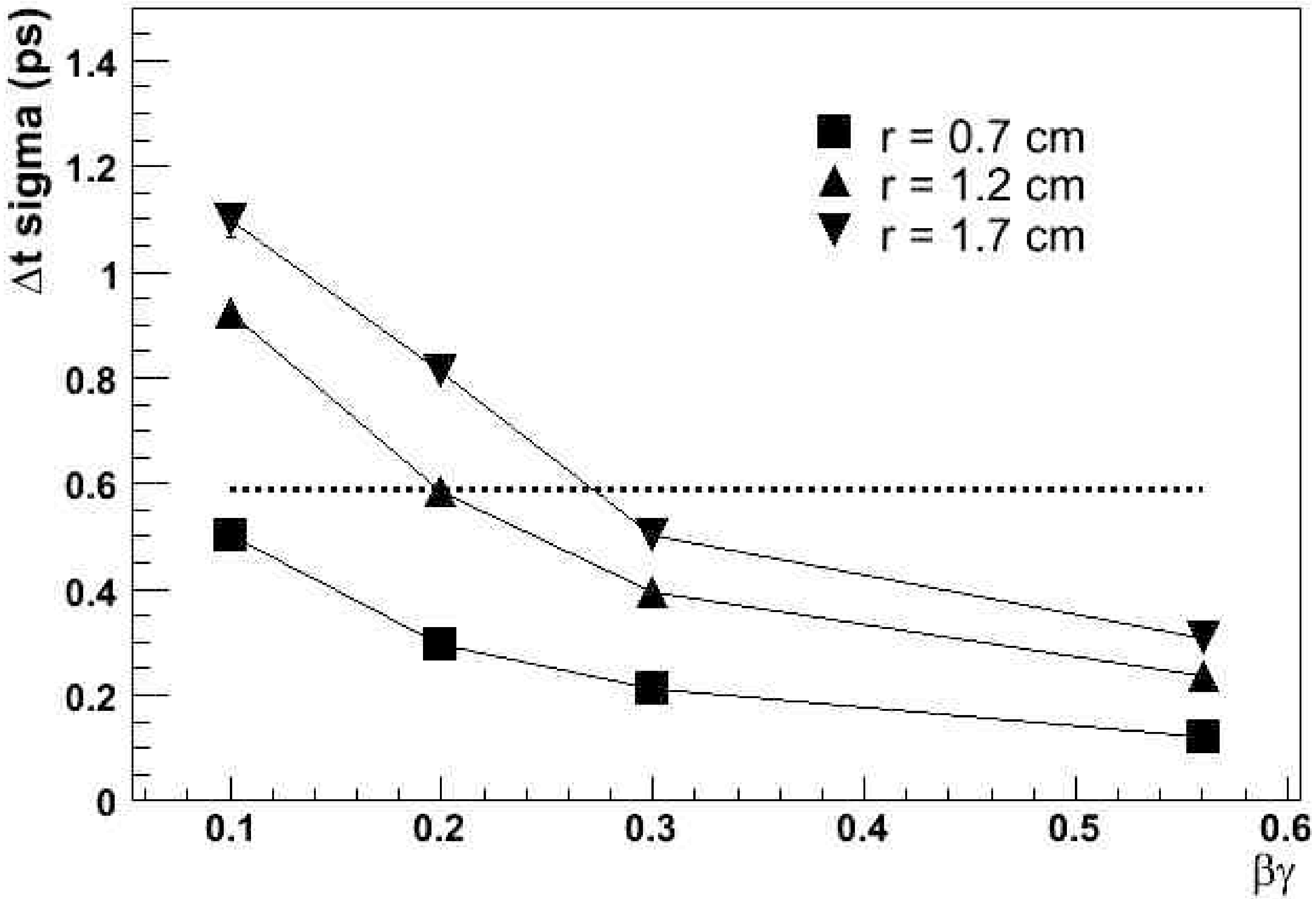
config/pepBeamSpotCal.raw

Beampipe & SVT configuration file

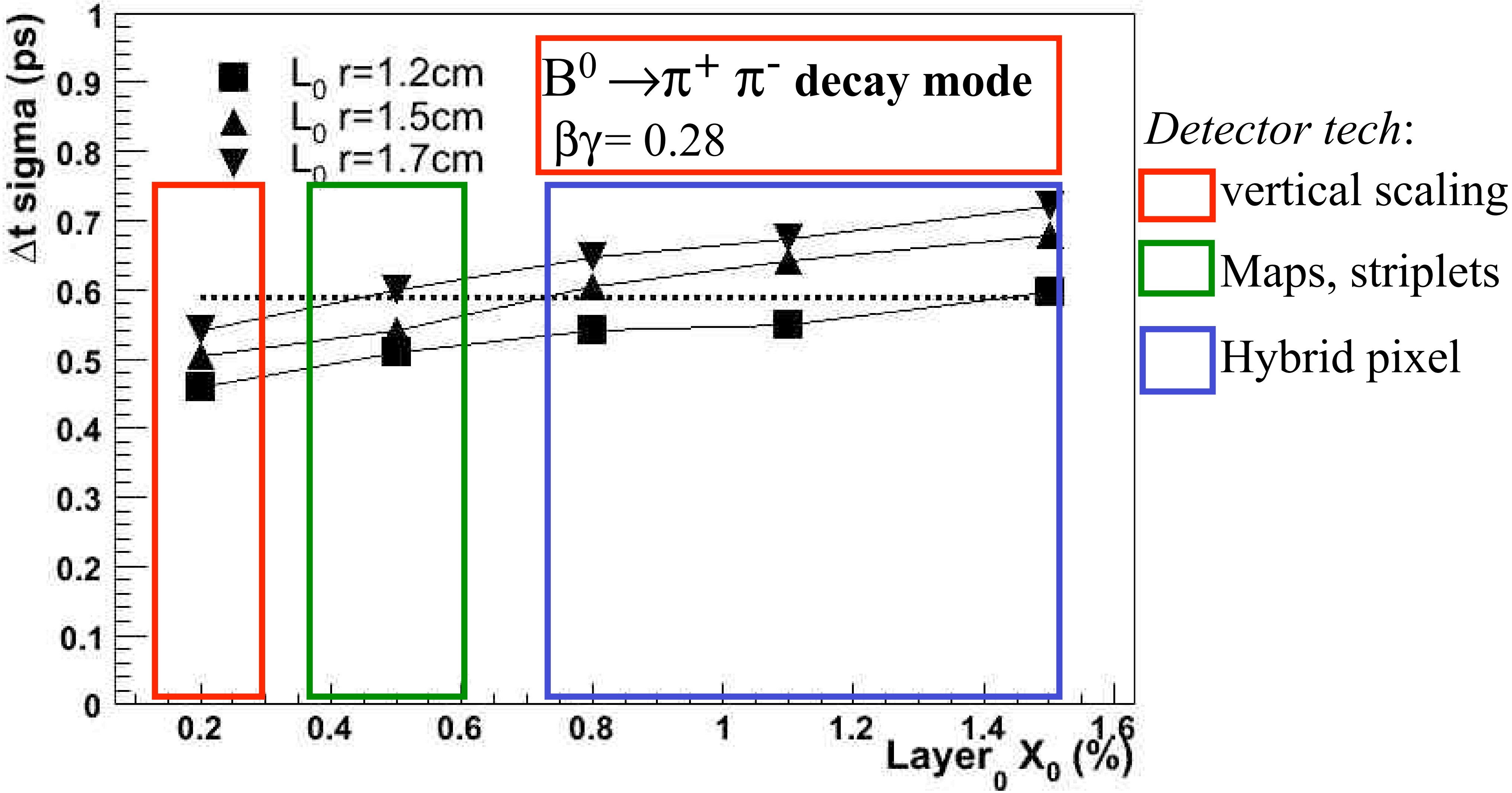
```
! Define a new beam pipe and a layer 0
! Materials
!              Z    A     rho      rl (gm/cm^2)=(density in gm/cc * rl in cm)
MATERIAL Au  79. 196.97  19.3    6.46    ! Gold mask
MATERIAL Wtr 10.  18.    1.0    36.08    ! Water
MATERIAL Ni  28.  13.208  8.478 12.08    ! Nickel lining
MATERIAL Cfbr 6.   12.0   1.6     43.    ! carbon fiber
! The layer at R=0 is necessary to extrapolate the parameters to the IP.
CYLINDER   VAC      .0000    .0000     .1000E+04    1.00   -1.00     .00   IP

CYLINDER   Au      1    0.00772   .1000E+04   14.40  -14.40     .00   bm pipe Au
CYLINDER   Be      1.0004    0.11088   .1000E+04   14.40  -14.40     .00   bm pipe Be
CYLINDER   Wtr     1.0604   0.03  .1000E+04   14.40  -14.40     .00   bm pipe Wtr
CYLINDER   Ni      1.0904    0.0059346   .1000E+04   14.40  -14.40     .00   bm pipe Ni
!
! Layer0 definition - Give same length as layer 1
!
DETECTOR  SIS   0.2   0.8
LAYER   Si     1.2   0.043571  0.0015  11.168 -5.815    0.     Si phi
DETECTOR  SIS   0.2   0.8
LAYER   Si     1.2187   0  0.0015  11.168 -5.815    1.5708 Si z
! support  and shielding
LAYER    Cfbr  1.2237  0.008    1e5   11.168 -5.815    0.
LAYER    Au    1.2237    0    1e5   11.168 -5.815    0.
! include existing vertex detector
FILE VTXpostTDR
```

Example of physics studies: Δt resolution in B→ππ decays *vs* βγ

15 μm intrinsic detector resolution



Example of physics studies: Δt resolution in $B \rightarrow \pi\pi$ decays *vs* L_0 $X_0(\%)$
10 μm intrinsic detector resolution



Summary

- PravdaMC is a useful tool for fast simulation studies:
  - Interface BaBar software with trackerr code.
- Appropriate for tracking detector optimization studies.
- Not conceived for EMC, PID, IFR optimization studies.