Impact of mis-alignments on propertime resolution

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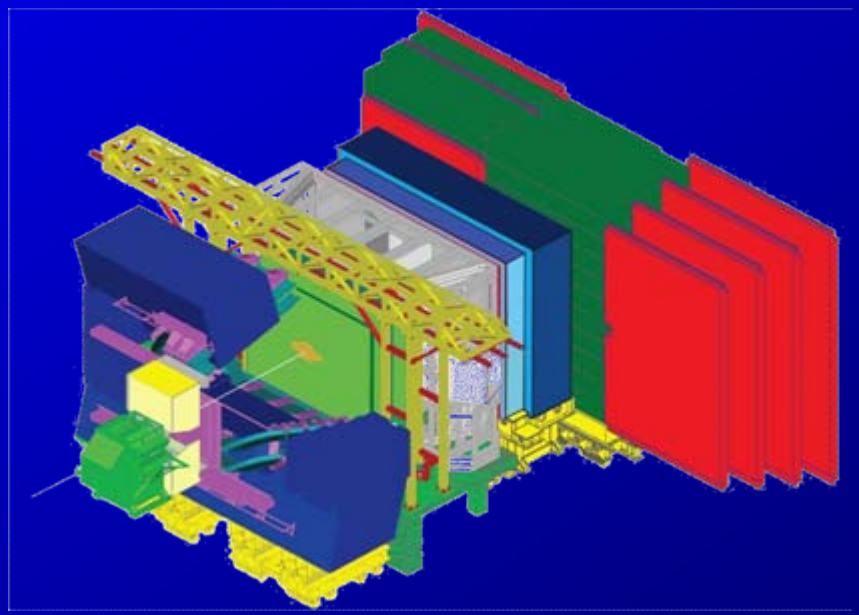


Contents

Goal

Study the effect of misalignments on the propertime (resolution)

- Run various misalignment scenarios
  - most relevant: difficult to constrain degrees of freedom
  - "random" (small) displacements/rotations
- Determine the effect on the propertime resolution
  - which degrees of freedom affect most the propertime?
  - feedback to those doing alignment:
    what degrees of freedom do we really have to get right?
  - can our resolution models (still) cope with the misalignments?

Methodology

B-selection in DaVinci :

- Start with reconstructed & selected B-mesons in DaVinci
  - ex.: $B_s \rightarrow J/\Psi(\mu\,\mu)\,\phi(K\,K)$
- Get the tracks which form the final state of the B
  - the μ's & the K's tracks

Make new B from refitted tracks with misalignments :

- Refit the "final state" tracks with a mis-aligned geometry
  - lie to the reconstruction about the geometry of the detector, using a geometry with misalignments, not corresponding to the one in simulation/initial recons.
- Re-build the B from the refitted tracks
  - tracks $\rightarrow$ proto-particles $\rightarrow$ particles (μ's, K's) $\rightarrow$ particles (J/Ψ, ϕ) $\rightarrow$ B-meson

Propertime study :

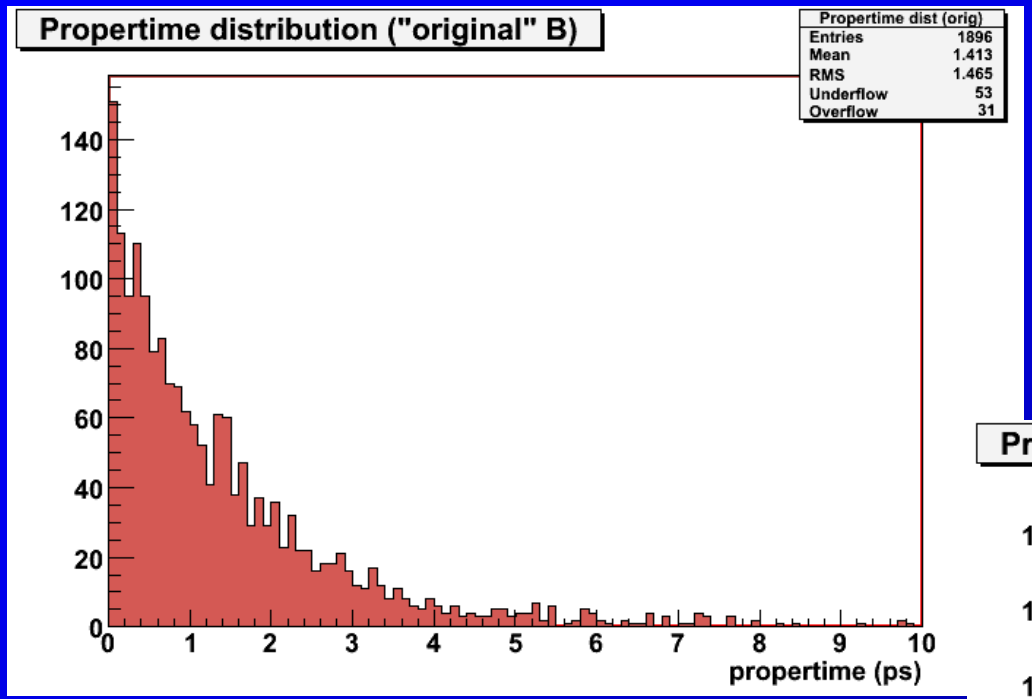
- Compute propertime of "original" and "refitted" B
  - compare propertime difference wrt typical propertime error
  - quick: only refitting a few tracks per event
  - statistically powerful: fully correlated samples

Landmark of today's presentation

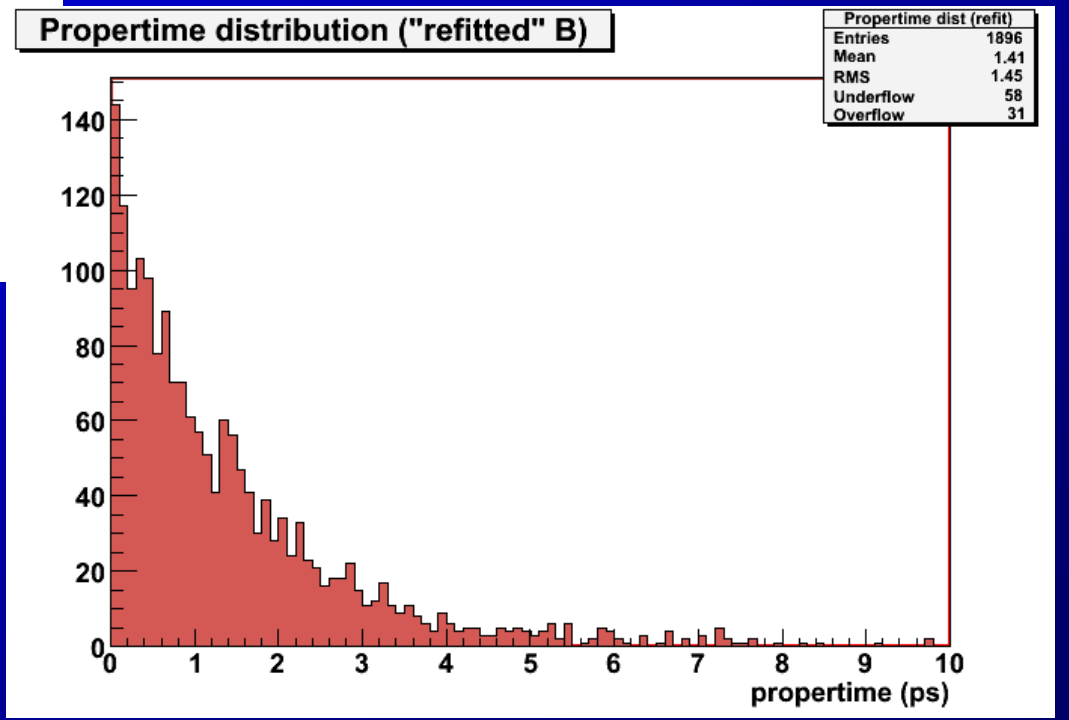
Proof of principle: follow method with no misalignment

- Set up all the machinery : not so trivial!
- Check there is no bug / I'm doing the right thing ;-)
- Check the sensitivity of the method itself

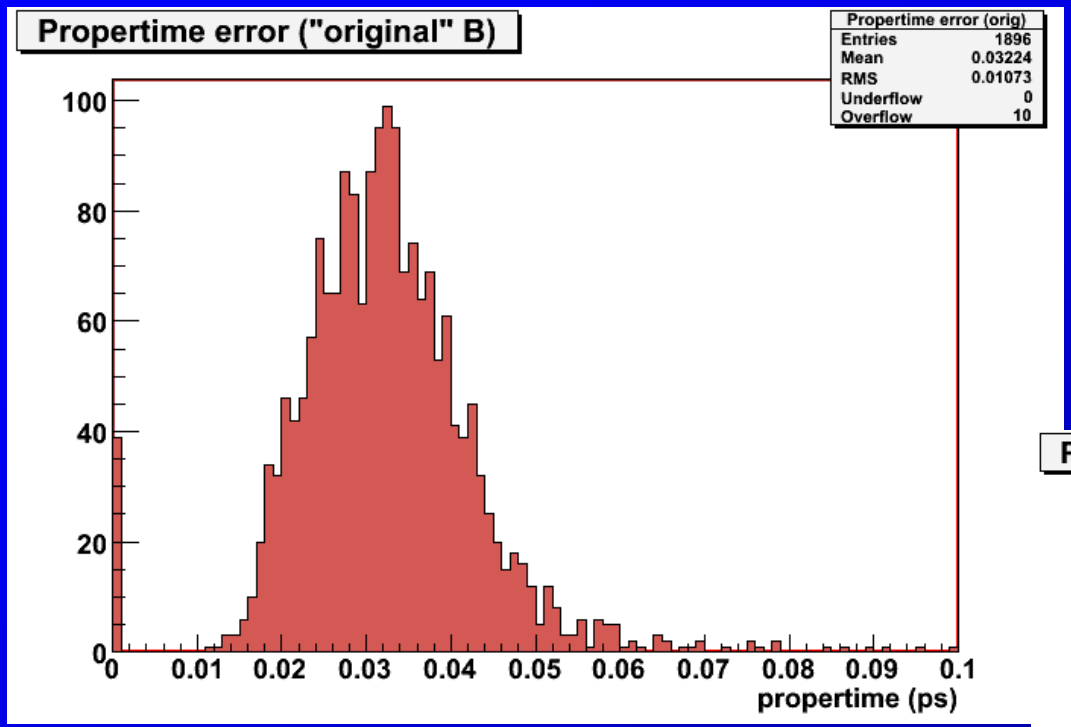
First results without mis-alignments (1/4)



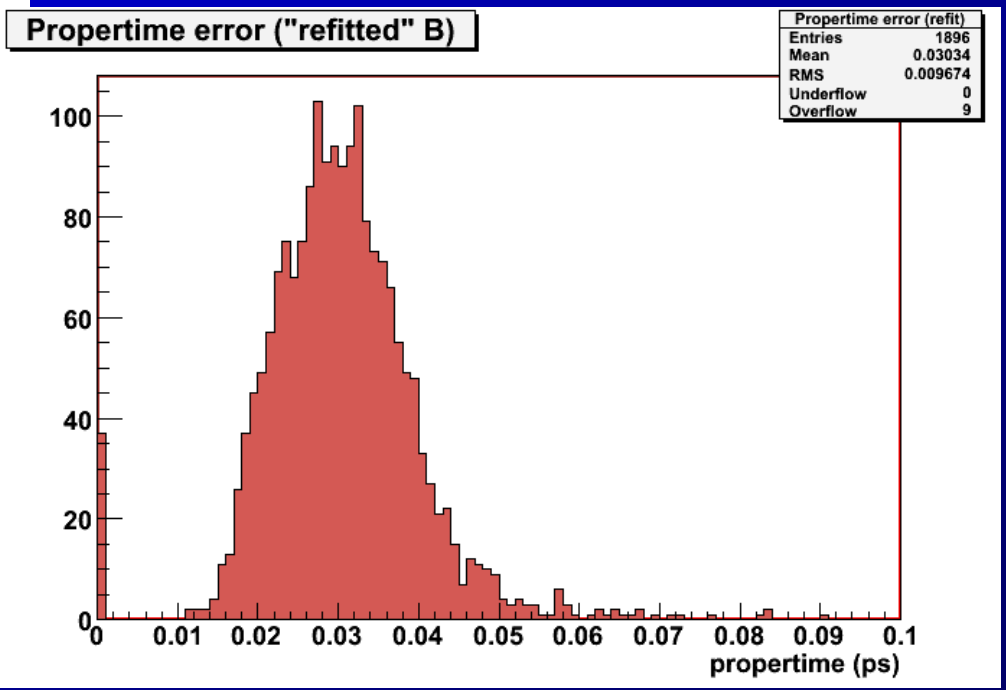
Typical <propertime>
1.4 ps



First results without mis-alignments (2/4)



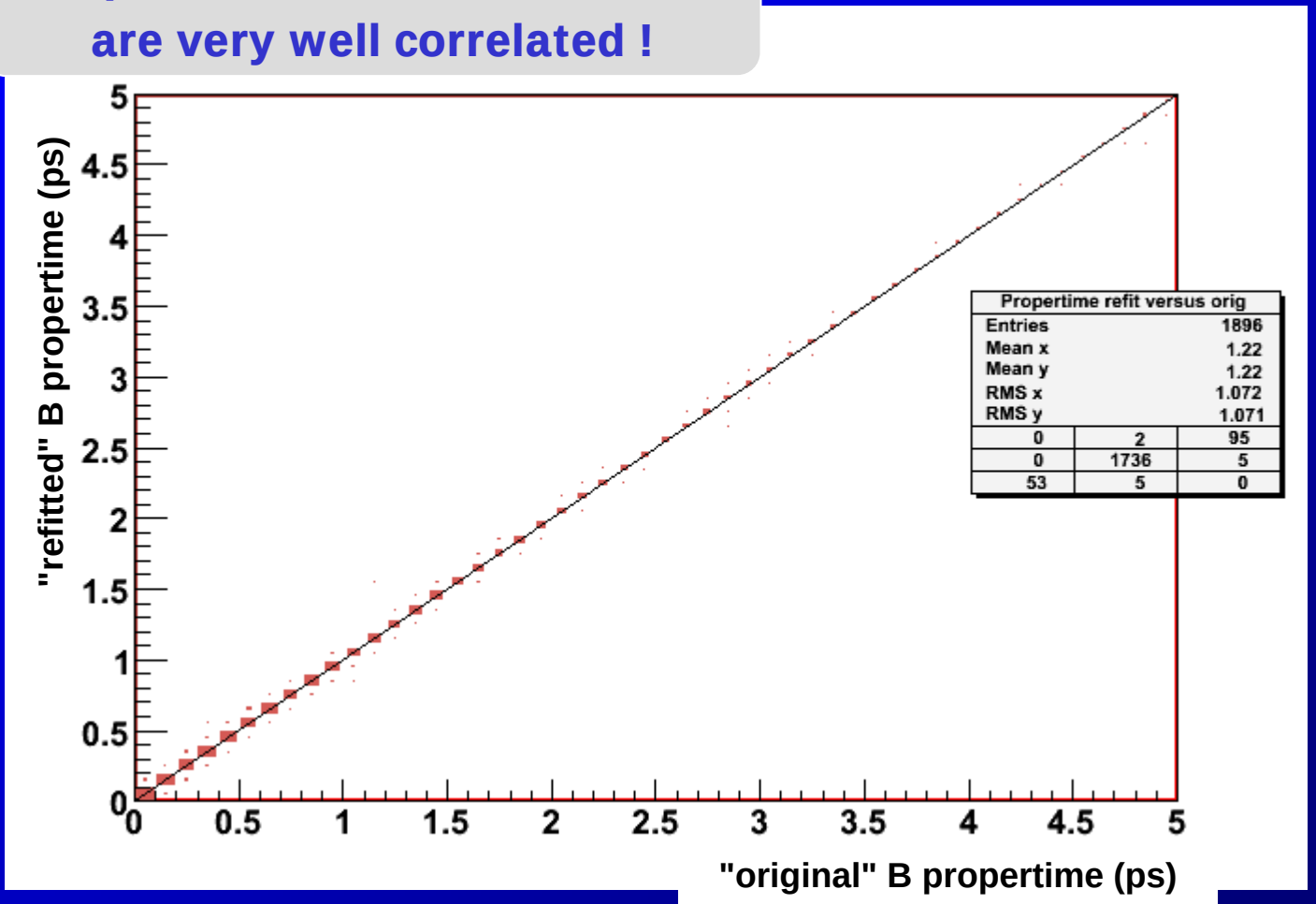
Typical <propertime error> ~ 30 fs



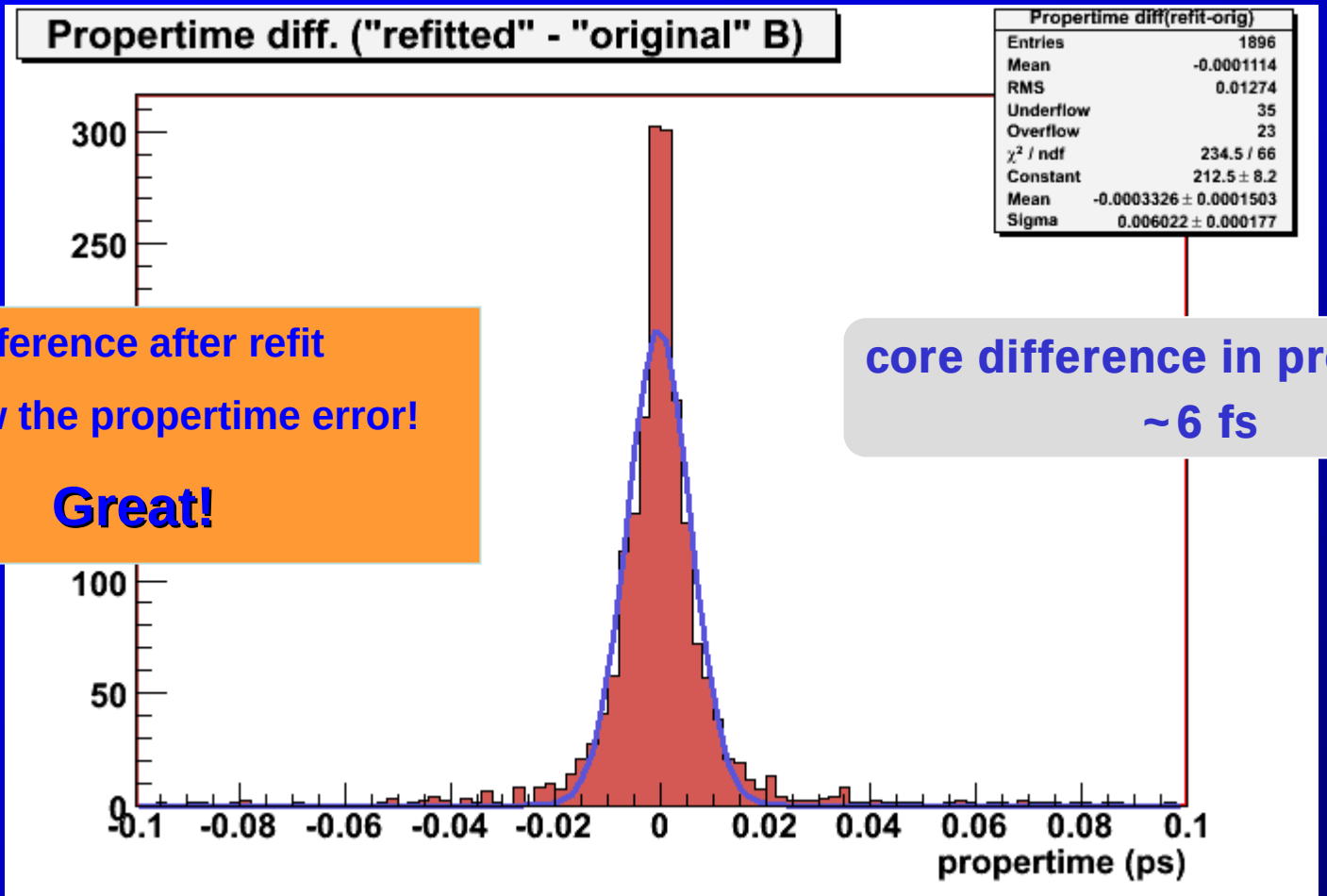
Strange bin @ 0 !
To be checked/investigated …

First results without mis-alignments (3/4)

Propertime before & after refit are very well correlated !



First results without mis-alignments (4/4)



Difference after refit

well below the propertime error!

Great!

core difference in propertime ~6 fs

Final remarks

Available software/tools :

- DaVinci & co., but not much is available to do all I need
- using PropertimeFitter, Particle2State tools, etc.
- playing with (private version of) the conditions database

Private software/tools :

- options to be able to refit tracks
- private Python algorithm to do the sequence
  "final state" tracks $\rightarrow$ proto-particles $\rightarrow$ particles (μ's, K's)
- simplified options files (ex. taken from PhysSel/Bs2JpsiPhi) for the sequence
  particles (μ's, K's) $\rightarrow$ particles (J/Ψ, ϕ) $\rightarrow$ B-meson
- will investigate what can be further used from DaVinci
- maybe existing tools can be adapted/"generalized"?
- running the job as a standalone (Gaudi)Python job

Future plans

Apply misalignments:

- collect set of useful misalignments to consider
- for now will use sub-detector tolerance numbers in the (draft) note on "Overview of LHCb misalignment challenge" from S. Blusk
- input from sub-detector experts welcome ;-)

Studies with misalignments :

- make a micro DST with the minimal DaVinci output info I need, using the nominal geometry
- use local copy of conditions database with tags for each misalignment
- Read back micro DST and perform the study with misaligned geom., i.e. refit the tracks, rebuild the B, etc. …