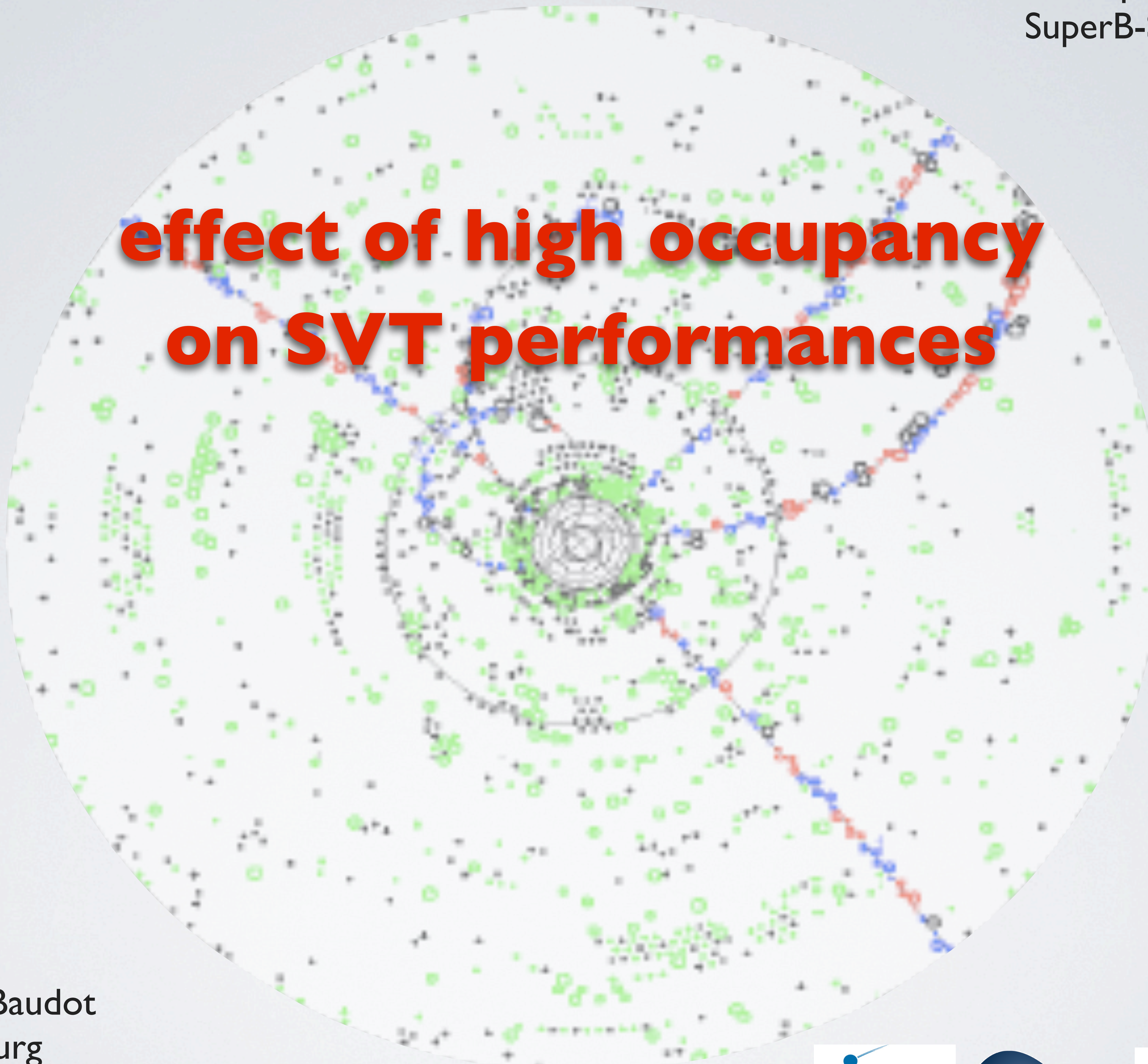
April 13th, 2012
SuperB-SVT meeting

effect of high occupancy on SVT performances



Isabelle Ripp-Baudot
IPHC Strasbourg
CNRS/IN2P3 and Université de Strasbourg

SVT tracking performances

- Issues discussed during previous SVT Frascati SuperB collab. meeting:
  - Are we able to perform track reconstruction in the SuperB dense environment?
  - Global tracking (DCH + SVT) / SVT stand-alone tracking?
- TDR: we should add a paragraph on this issue.
- To do list (Arantza, Fernando, Isabelle, Jérôme, Nicola currently involved):
  - Review of existing tracking methods w.r.t. experiments environment.
  - List the kind of studies we are able to do.
  - List the questions we have (technical, inputs). Correct inputs are needed from DCH (track extrapolation) and each SVT layer.
- Performances we are interested in:
  - Hit - track matching efficiency,
  - Spatial resolution at p.o.c.a.: σ_ϕ, σ_Z = f(intrinsic resol. $\oplus$ track extrapolation)
    ➛ decay vertex resolution,
  - Momentum resolution σ_P,
  - Rate of fake tracks reconstructed.

➛ performances result from the tracking system in its entirety, but also from the algoritms used.

some material

- BaBar AD 707: Final Report of the SVT Long Term Task Force (2004).
  ➢ What do we learn from these studies for SuperB?
- BaBar note 499: An alternative algorithm for stand-alone SVT pattern recognition (1999).
  ➢ Does it work in SuperB?
- R. Frühwirth *et. al.*, Rev. of Mod. Physics 82, 1419 (2010):
  Track and vertex reconstruction: From classical to adaptive methods.

  Review on methods of track and vertex reconstruction and examples of alignment:
  Z factories (DELPHI, ALEPH, SLD), B factories (BaBar, Belle), ep (H1, ZEUS) and hadronic colliders (DØ, LHCb, ALICE, ATLAS, CMS).

  ➢ Discussion of performances vs. detector occupancy.
  Possible tools that might be used to improve Tracking algorithm with high background.

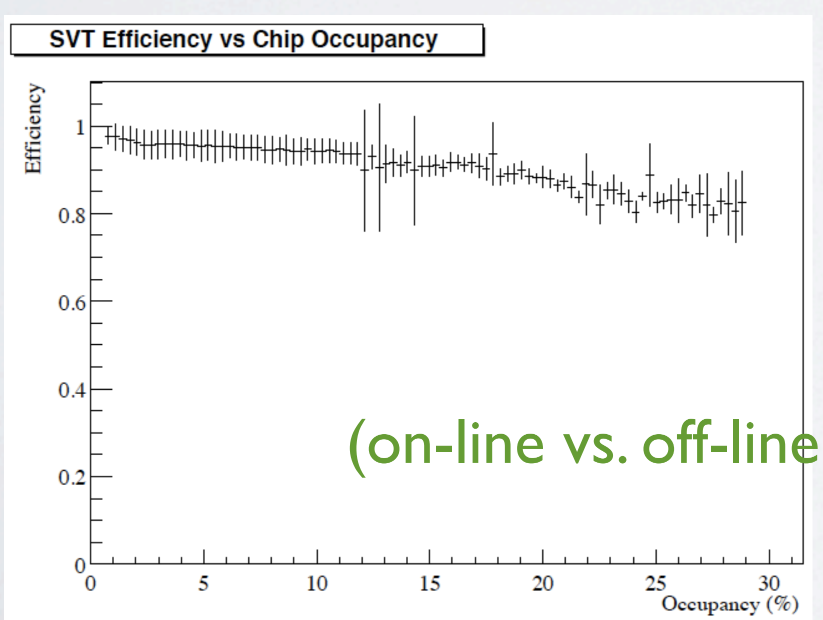
what had been done in BaBar

BaBar AD 707: Final Report of the SVT Long Term Task Force (2004).

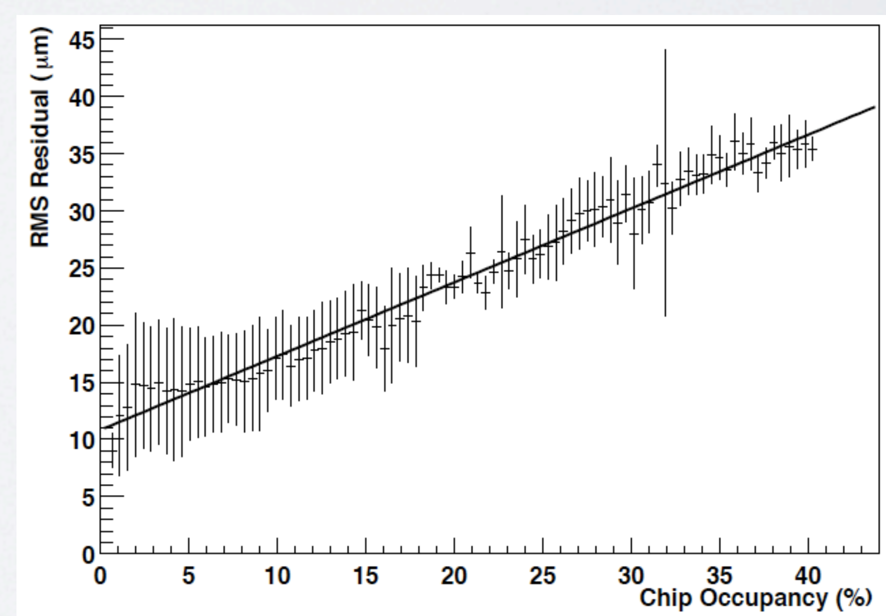
- Full simulation study: add multiple background events to $B^0 \to J/\psi\ K^0_s$ and $D^* \to D^0\ \pi_s$.
  1 background frame more ➛ CPU x2.
  With 5 more background events (⇔luminosity 25x higher):
  - Reconstructed mass: stable,
  - Mass resolution: stable,
  - Reconstruction efficiency: degrades (-12% for B^0, -19% for D^*),
  - Vertex resolutions: degrades (+7% on J/ψ and K^0_s vertices, +12 % on B^0 vertex).

(definition of one background event?)
(what about the DCH occupancy?)

- Real data study: samples of di-μ events and $D^* \to D^0\ \pi_s$ from Jan. to June 2003.
  Occupancy varied by more than x2.



(on-line vs. off-line occupancy?)



what may be done with FastSim in SuperB (I)

- Tracking in the FastSim:

 1) particles from the physics process are generated,
 ➢ hits are generated when the generated track crosses a sensitive material
 $= f(\sigma_\phi, \sigma_Z, \varepsilon, t)$.

 2) background tracks are generated and hits are simulated in the Fullsim, and then these hits are added to the Fastsim event.

 3) hit confusion: hits may be associated to the correct track or a neighbouring track, or may be merged or shadowed.

 4) track is fitted outside-in with hits ~ belonging to a same generated track.

➢ consequences: no ghost tracks are reconstructed.

what may be done with FastSim in SuperB (2)

- Will we actually reconstruct fake tracks in the SVT ??
  Is the current BaBar pattern recognition OK in the SuperB environment ??
  - If no fake tracks and BaBar patt-rec OK: we should be able to study SVT performances with the FastSim.
  - Else: what type of algorithm should we use?

- Global DCH+SVT Tracking algorithm (BaBar): (correct??)
  The tracklet reconstructed in the DCH is extrapolated towards the SVT-L5.
  Then, several hits may be associated to the track extrapolation, leading to several track candidates.
  These track candidates are extrapolated to the next layer (outside-in direction) and the one with the best χ^2 is kept.

- Hit - track matching efficiency $P_{match} = \dfrac{1}{1 + 2\pi\, \sigma_{\phi,\,eff}\ \sigma_{Z,\,eff}\ \rho}$

intrinsic resolution
$\oplus$ track extrapolation

hit density
~ integration
time