

Detector Geometry WG

M. Rama and A. Stocchi for the DGWG
SuperB general meeting, Annecy 18 March 2010

Studies before this meeting

Summary of the main studies performed so far

| System | Recent studies |
|----------------|---|
| SVT | <ul style="list-style-type: none">▪ Time-dependent measurements as a function of the layer0▪ Tracking performance as a function of the SVT outer radius▪ Time-dep meas. with $B \rightarrow K_s K_s$ as a function of the SVT outer radius▪ Tracking performance as a function of the number of layers▪ Degradation of $\sin^2\beta$ error when the boost goes from 0.28 to 0.238 |
| DCH | <ul style="list-style-type: none">▪ Tracking performance as a function of the DCH inner radius▪ Tracking and dE/dx as a function of the DCH length |
| forward PID | <ul style="list-style-type: none">▪ $B \rightarrow K(*) \nu\nu$ SL tag with/without TOF▪ $B \rightarrow K(*) \nu\nu$ HAD tag with/without TOF (in progress) |
| EMC | <ul style="list-style-type: none">▪ $B \rightarrow \tau\nu$ with/without backward EMC▪ E resolution of fwd EMC as a function of material in front of it (prel) |
| IFR | <ul style="list-style-type: none">▪ Optimization of the muon selection |

See also the DGWG wiki page:

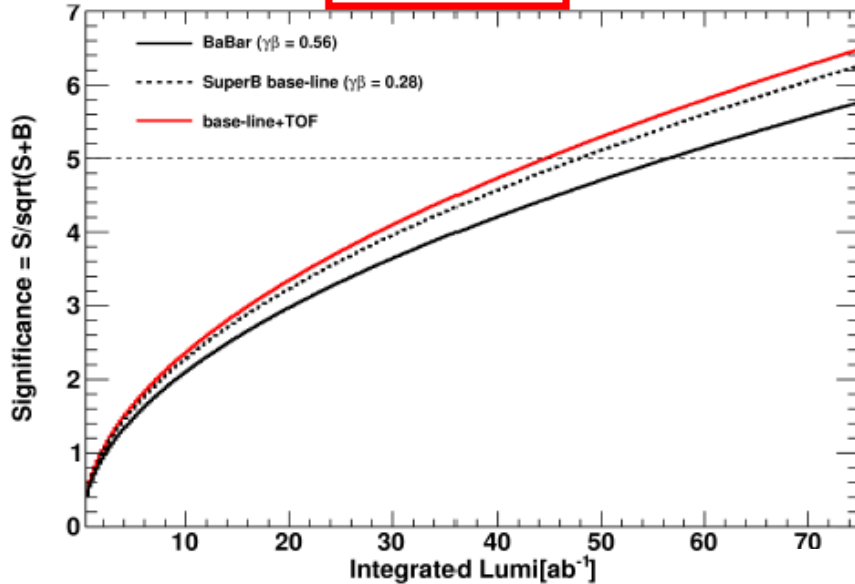
http://mailman.fe.infn.it/superbwiki/index.php/Detector_Geometry_Working_Group_portal ..

fwd PID (TOF) with $B \rightarrow K^{(*)} \nu \nu$: reach

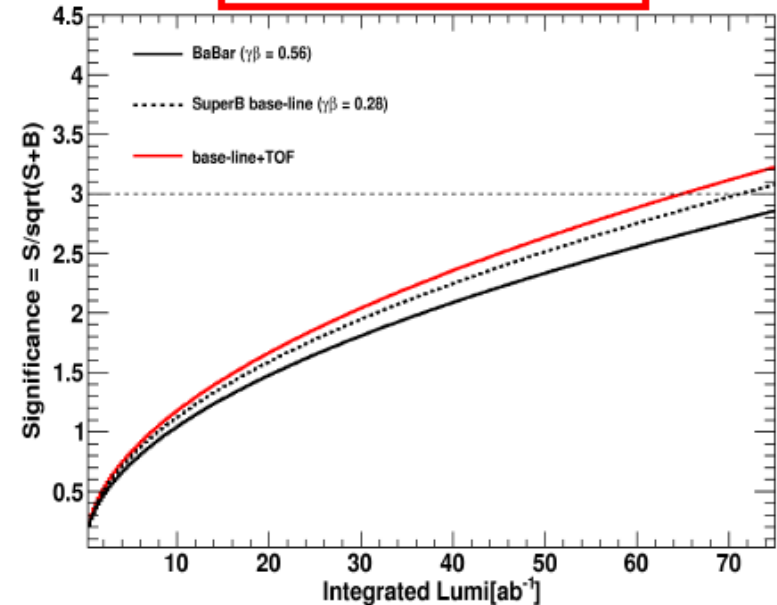
A. Perez

CONCLUSIONS:

$K^+ \nu \nu$



Combined $K^{*(0,+)} \nu \nu$



5 σ significance (stat-only):

- BaBar: $\sim 55 \text{ab}^{-1}$
- SuperB-base line: $\sim 48 \text{ab}^{-1}$
- +TOF: $\sim 44 \text{ab}^{-1}$

Gain on significance:

boost $\sim 7\text{-}8\%$
fwd PID $\sim 5\%$

3 σ significance (stat-only):

- BaBar: $> 75 \text{ab}^{-1}$
- SuperB-base line: $\sim 71 \text{ab}^{-1}$
- +TOF: $\sim 64 \text{ab}^{-1}$

backward EMC for $B \rightarrow \tau \nu$ study

A. Rakitin

CONCLUSIONS:

| $\tau \rightarrow \ell \nu \nu, \pi \nu$ | | | $\tau \rightarrow \rho(\pi \pi^0) \nu$ | | $\tau \rightarrow \pi 2\pi^0 \nu, a_1(3\pi) \nu, 3\pi \pi^0 \nu$ | |
|---|--------------------------|------------------------|--|--------------------------|--|---------|
| Mimicking decay | Rel. BF | | Mimicking decay | Rel. BF | Mimicking decay | Rel. BF |
| $B \rightarrow D^{(*)} \ell \nu$ | $\mathcal{O}(10^2-10^3)$ | direct ρ | $B \rightarrow D^{(*)} \rho$ | $\mathcal{O}(10^2-10^3)$ | Anything with final state $\pi 2\pi^0, 3\pi$ or $3\pi \pi^0$ | ??? |
| $B \rightarrow D^{(*)} \pi \ell \nu$ | $\mathcal{O}(10^2)$ | | $B \rightarrow J/\psi \rho$ | 1.39 | | |
| $B \rightarrow \text{non-charm } \ell \nu$ | $\mathcal{O}(1)$ | | $B \rightarrow \text{non-charm } \rho$ | $\mathcal{O}(1)$ | | |
| | | indirect ρ | $B \rightarrow \text{stuff},$ $\text{stuff} \rightarrow \rho + X_{\text{missed}}$ | ??? | | |
| | | $\pi^0 + \text{track}$ | Anything with final state $\pi^0 + \text{track} + X_{\text{missed}}$ | ??? | | |
| | | | Special case: $B \rightarrow \pi^0 \ell \nu$ (nothing is missed) | 0.55 | | |
| Done, $\sim 8\%$ improvement in $S/\sqrt{S+B}$ due to bwd EMC | | | Partially done, $\sim 10\%$ imp. for direct ρ , need generic MC for the rest | | Definitely need generic MC | |

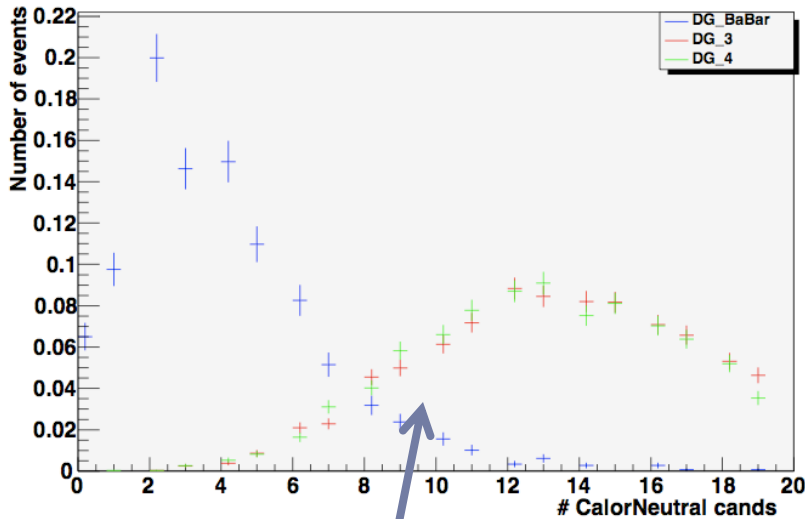
Next steps:

- Include other signal modes and bkg decays
- Include the main B tag modes (HAD+SL)

results with $B \rightarrow D^0 \pi$ tag

Effect of radBhabha+Bhabha on $B \rightarrow K^+ \nu \bar{\nu}$

number of Calor Neutral cands



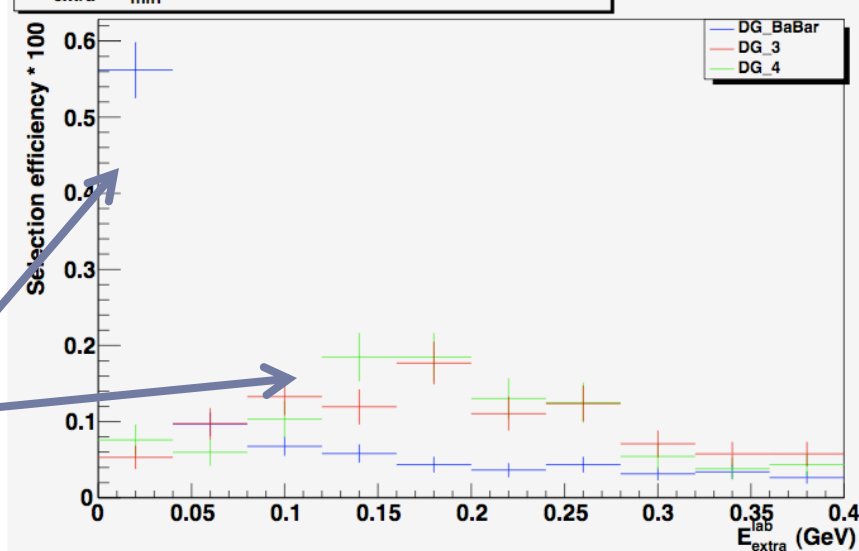
increased number of neutrals

signal E_{extra} no longer peaks at 0 when (rad)Bhabha is added

E. Manoni
 this meeting
 (see also **A. Perez**
 @**DGWWG** session)

Note: bkg overestimated by a factor ~ 4

$E_{\text{extra}}, E_{\text{min}}=30 \text{ MeV}$, after selection, $B^+ \rightarrow K^+ \nu \bar{\nu}$



18 March 2010

Effect of radBhabha+Bhabha on $B \rightarrow \tau \nu$



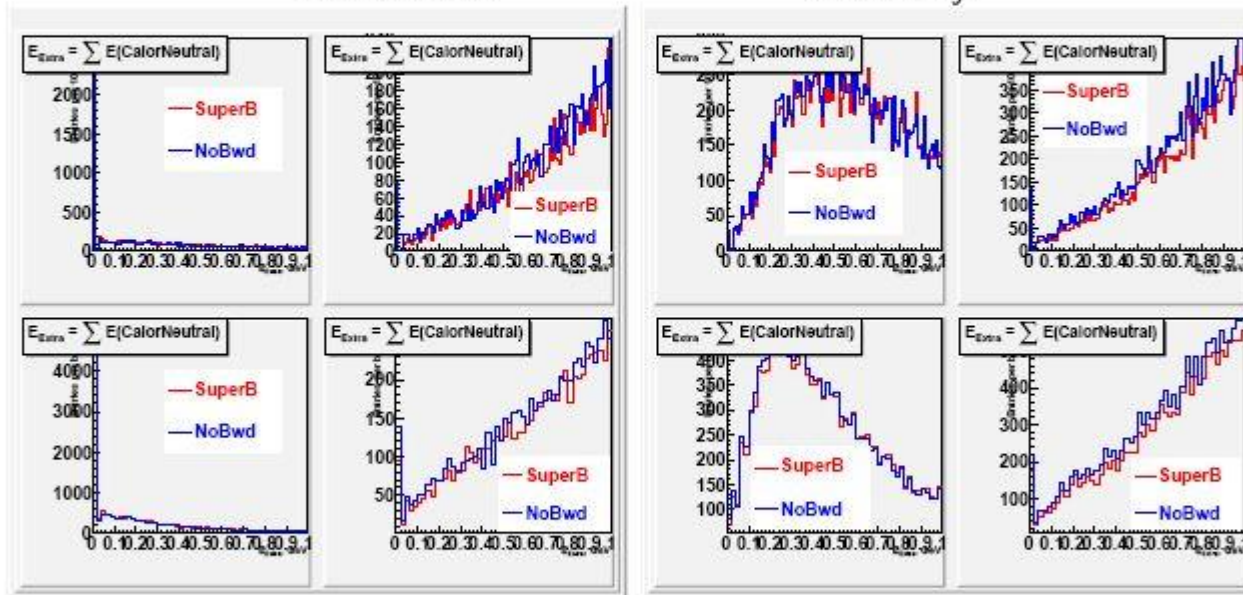
E_{extra}

A. Rakitin
this meeting



no bkg
November

with bkg
February



- Top: All B_{sig} , bottom: best B_{sig}
- Left: sig MC, right: generic MC

Note: bkg overestimated by a factor ~ 4

Need to evaluate how the machine bkg changes the conclusions we've reached so far (see sl. 2)

- ▶ Note: pairs background were not included in the FastSim Feb. production. We must include it in next productions.
- ▶ Studies concerning the position of the L0 are using the bkg rates as input (especially pairs).
- ▶ Results concerning tracking (SVT/DCH transition radius, #SVT layers, effect of boost on T.D. analyses) should still be valid at first order
 - ▶ At some point we wanted to evaluate the effect of bkg on reconstruction. It was already in the to-do list but not done yet.
- ▶ Can we trust the previous estimate of the fwd PID impact on $B \rightarrow K^{(*)} \nu \nu$? At first order our guess is yes
- ▶ The physics reach of $B \rightarrow \tau \nu$ vs bwd EMC must be re-evaluated

Development work needed. Some preliminary thoughts

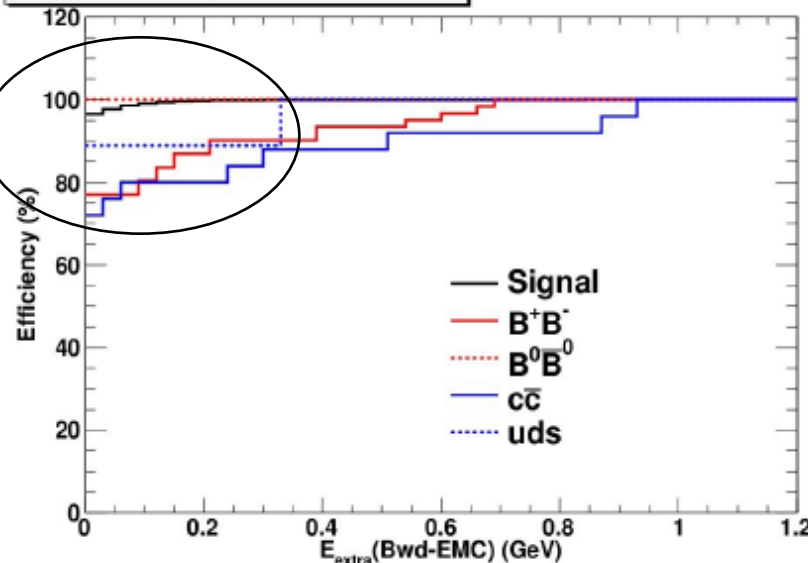
- ▶ **Consolidate the current analyses**
 - ▶ remove $n_clust < 15$ from B- \rightarrow Knunu SL tag, characterize the bkg properties
- ▶ **Optimize the analysis according to the SuperB environment, different from Babar**
- ▶ **Understand what margins there are at the detector level**
 - ▶ for example, how much the EMC time windows can be reduced, and what would be the impact on cluster reconstruction?
- ▶ **Organize ad hoc (mini?) productions before the Summer prod**
 - ▶ Can we speed up the current MC event rate, for example with ad hoc pre-selection cuts or by simulating subsamples of the events, still preserving the prediction power of the analyses? The statistics of the Feb production was not large enough to study the bkg properties of rare decays.

BEMC in veto mode for other analyses like K_{VV} .

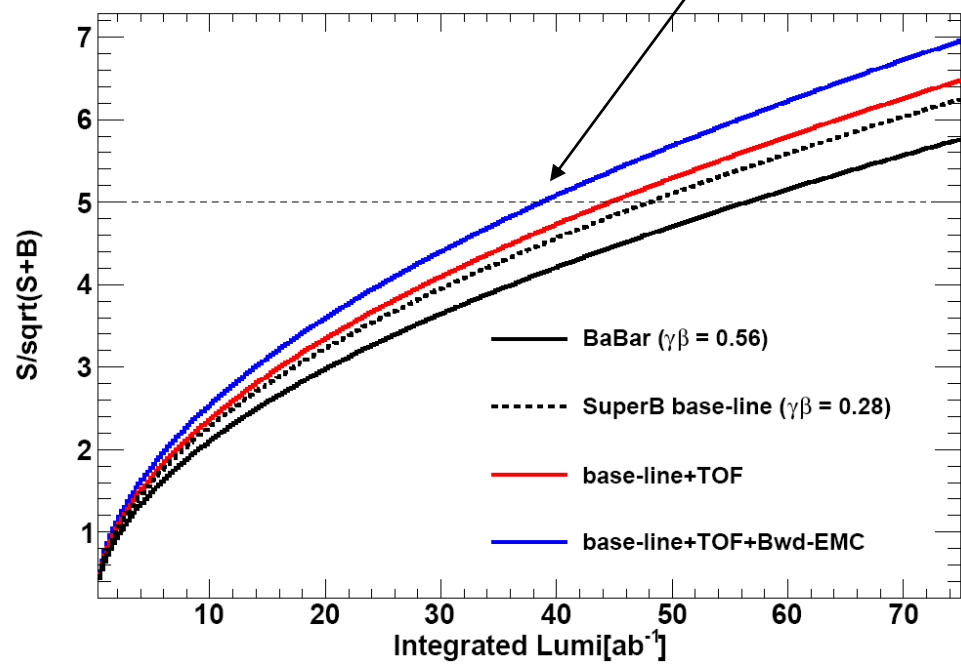
Preliminary results :
20% background reduction.
but is a $(20 \pm 10)\%$!

Reduction of 20% of the Background, have important impact

Efficiency vs E_{extra} (Bwd-EMC) cut



Gains for $B^+ \rightarrow K^+ \nu \bar{\nu}$



Alejandro, Achille

Important : We need a larger generic background production