The Di-muon Trigger and L0 Efficiency

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- Quick reminder of latest results:
  - ✓ Bandwidth division for the h/μ triggers
  - ✓ Effect of different pile-up veto scenarios on the L0 performance on signal events
- Effect of the di-muon trigger on the L0 efficiency

Procedure

- Main set-up and procedure:
  - h+μ triggers -> 800 kHz of min. bias events (single and mult. int.)
  - other triggers -> 200 kHz
  - vary the μ P_T threshold ... and adjust the hadron P_T threshold for h+μ = 800 kHz

✓ Various pile-up veto scenarios considered

✓ Physics channels studied:

B_s -> $J/\Psi(\mu\mu)$ ϕ (KK)

B_d -> π π

B_s -> $D_s(KK\pi)$ K

✓ Only true single interaction signal events

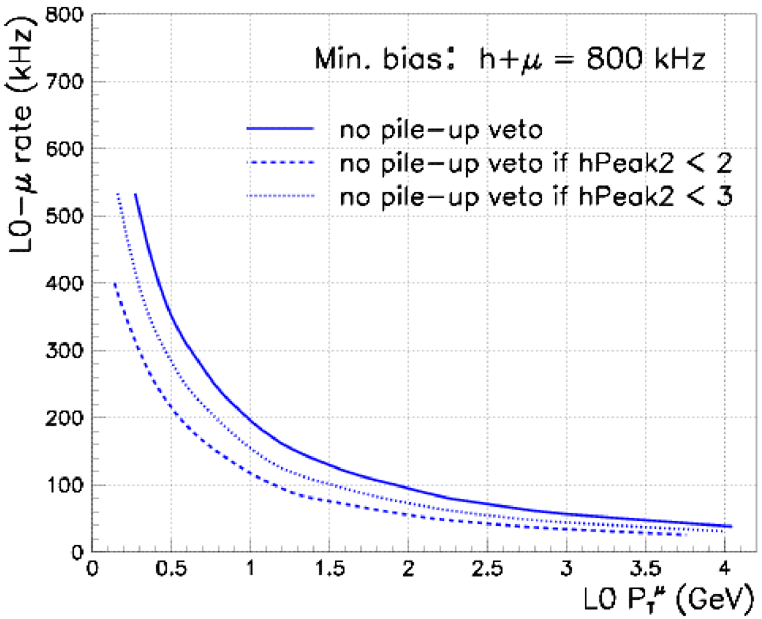
Pile-up Veto Scenarios

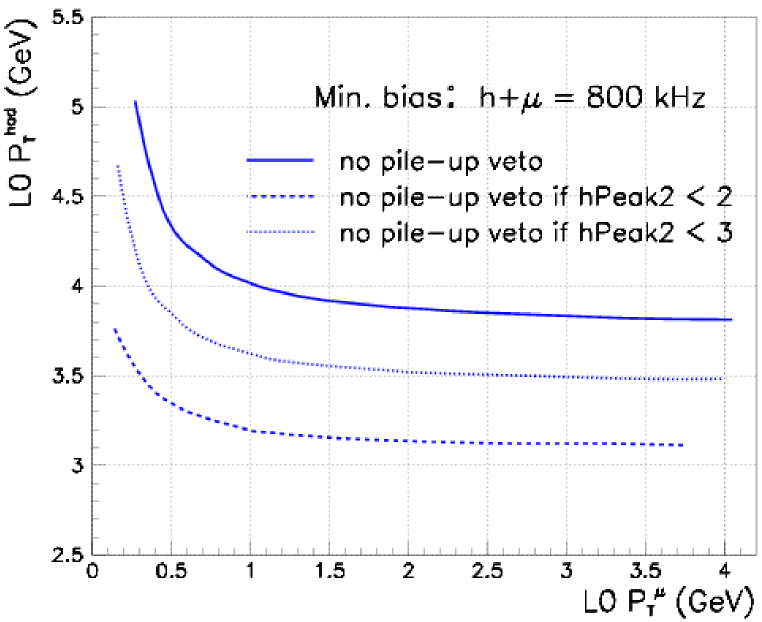
3 scenarios:

a) no pile-up veto
b) no veto if hPeak2 < 2
c) no veto if hPeak2 < 3

- μ-rates ~ 100-200 kHz in the P_T region "of interest"

- Hadron thresholds vary significantly depending on the veto cut





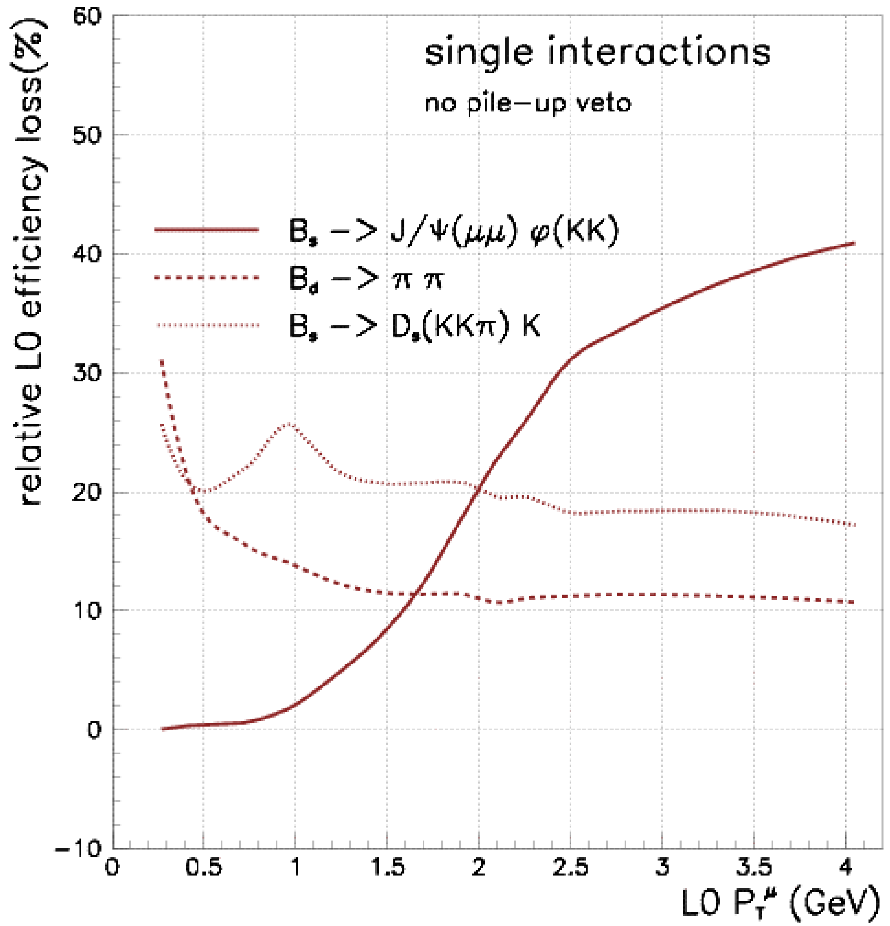
Pile-up Veto and h/μ Bandwidth Division

- B_s -> $J/\Psi(\mu\mu)$ ϕ (KK) channel prefers a pile-up veto cut at 3 (max. efficiency ~ 95%)
- B_d -> π π channel not very sensitive to pile-up veto cut at 2 or 3 (max. efficiency ~ 55-60%) and no-pile veto scenario is excluded
- B_s -> $D_s(KK\pi)$ K also gains from a pile-up veto (max. efficiency ~ 40%)

But the latest results on the L0 efficiency were presented for each of the 3 channels and separately for each pile-up veto scenario …

Bandwidth Division without Pile-up Veto

- Relative losses in L0 efficiencies wrt the maximum over the P_T range AND considering the various pile-up veto scenarios:



➢ B_s -> J/Ψ(μμ) φ (KK) favours low μ thresholds

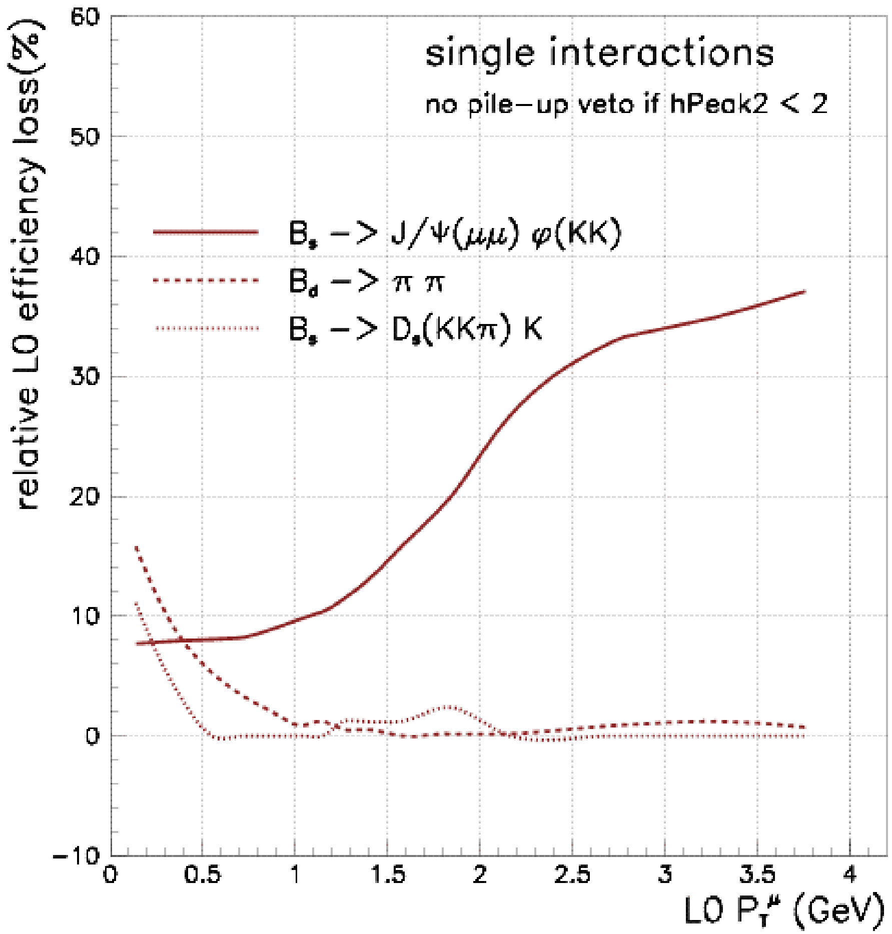
➢ Rather large losses for the hadronic channels!

Bandwidth Division without Pile-up Veto if hPeak2 < 2

- "Inverse situation":

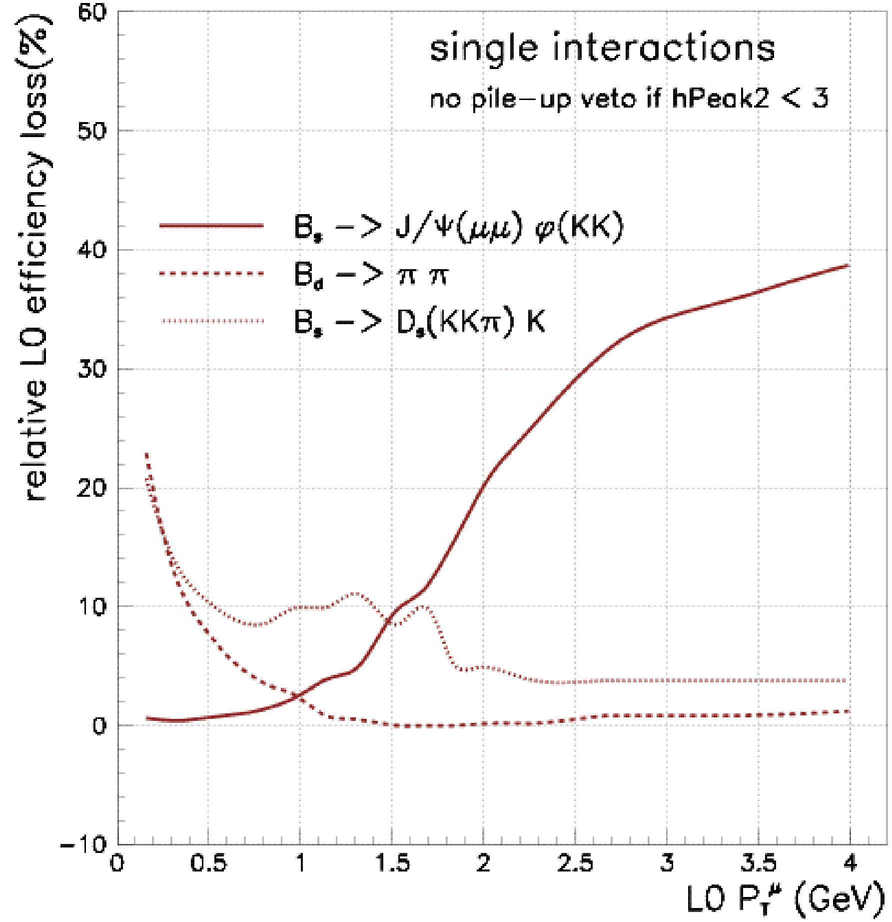
  - Loss in efficiency for B_s -> J/$\Psi(\mu\mu)$ ϕ (KK) is large

  - Very small losses for the hadronic channels for P_T > 0.5 GeV



Bandwidth Division without Pile-up Veto if hPeak2 < 3

- A softer pile-up veto seems to be preferred …
- … though the efficiency for B_s -> $D_s(KK\pi)$ K is large …
- ➔ Can one still keep the cut at 2 (preferred by the hadronic channels) and use the di-muon trigger to recuperate the efficiency on B_s -> $J/\Psi(\mu\mu)\ \phi$ (KK) ?



The Di-muon Trigger

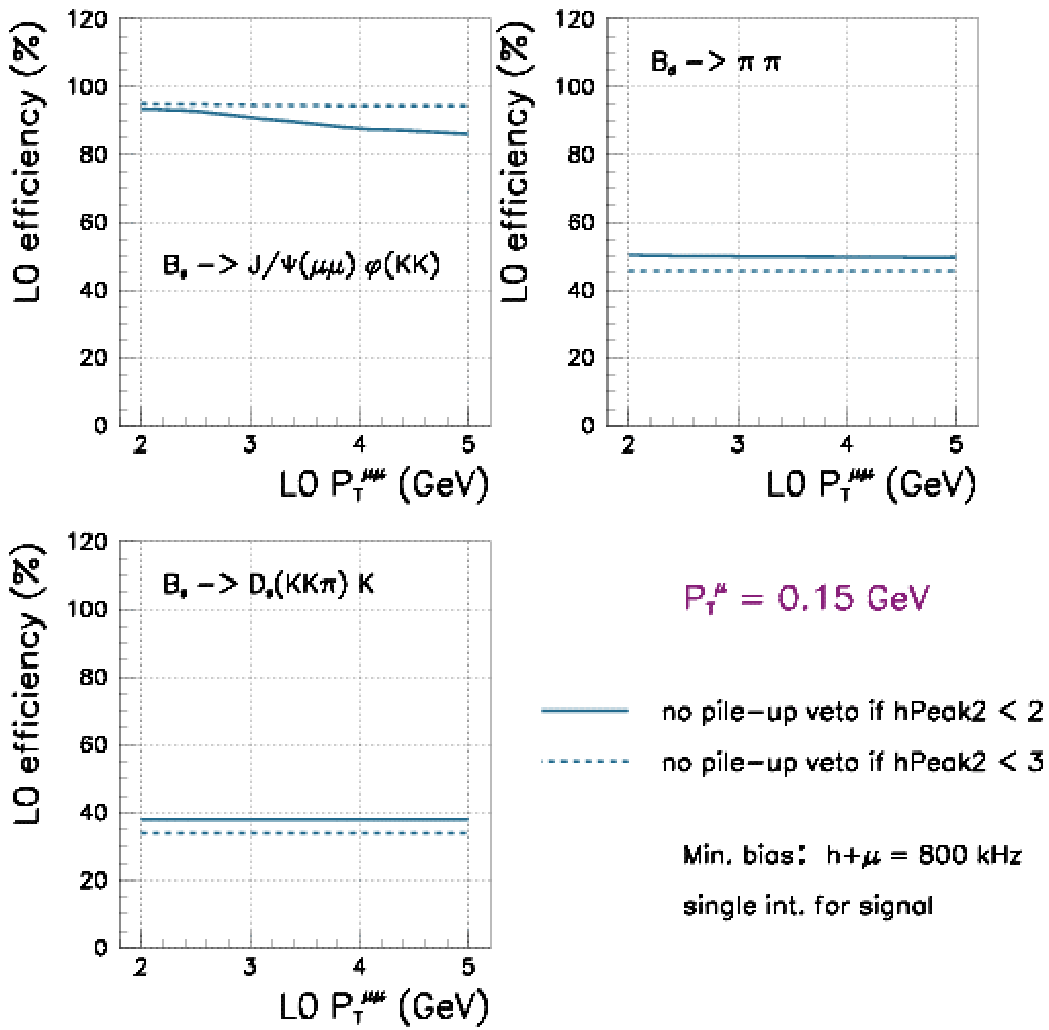
- Special trigger in the sense that it can override the pile-up veto decision
- Will mainly be important for di-muon channels such as B_s -> $J/\Psi(\mu\mu)\ \phi\ (KK)$
- The $P_T^{\mu\mu}$ cut was at 4.01 GeV in the previous plots (default bandwidth division)
- Bandwidth division for the di-muon trigger on minimum bias events is small, ~ 10-50 kHz
  (for a reasonable range of variation and the pile-up veto scenarios considered)

$P_T^{\mu\mu}$ thresholds at low P_T^{μ}

- In the plots
  L0 efficiency(P_T^{μ})
  3 points were chosen:
  $P_T^{\mu\mu} \cong$ 0.15, 1.0 and
  4.0 GeV

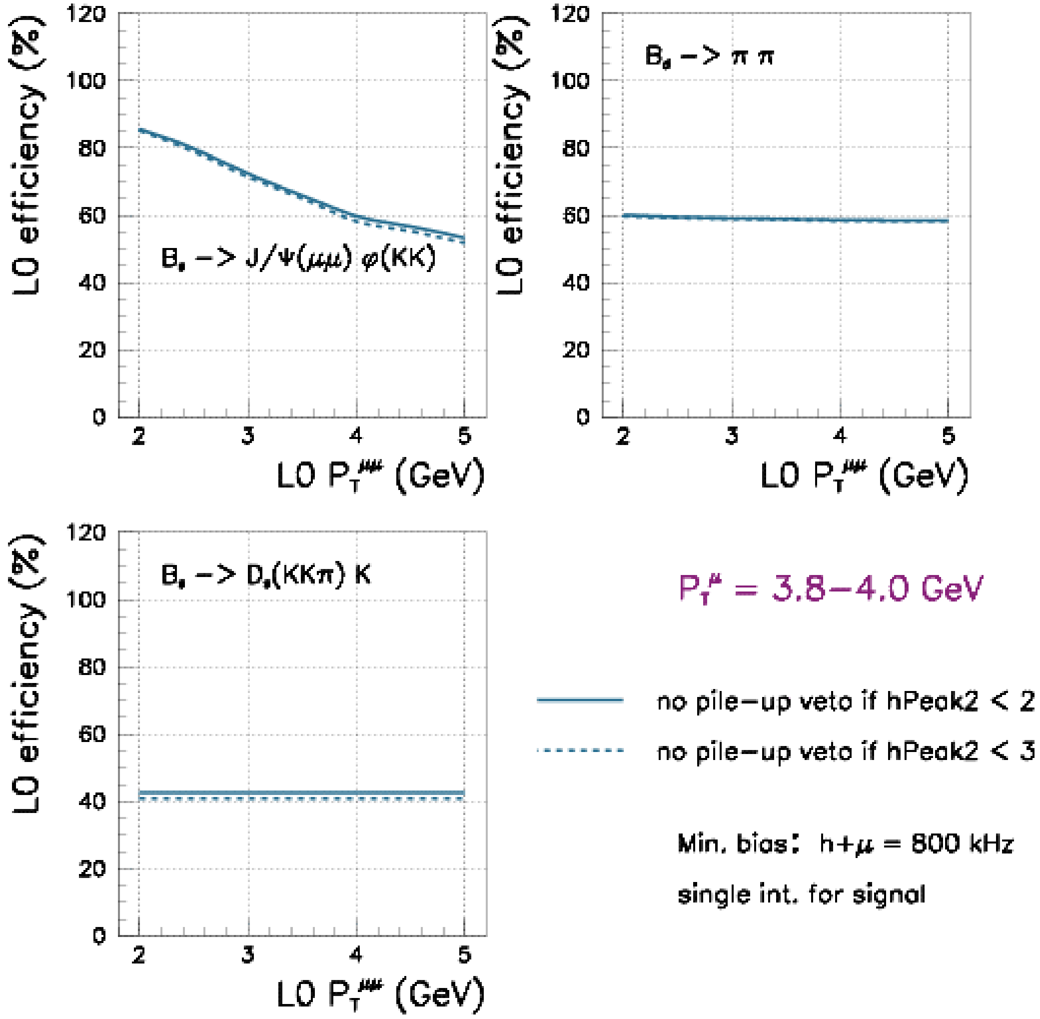
✓ With the "hard" pile-up veto the $\mu\mu$-trigger allows to recover eff. for B_s -> $J/\Psi(\mu\mu)$ ϕ (KK)

➢ Hadronic channels are insensitive



$P_T^{\mu\mu}$ thresholds at high P_T^{μ}

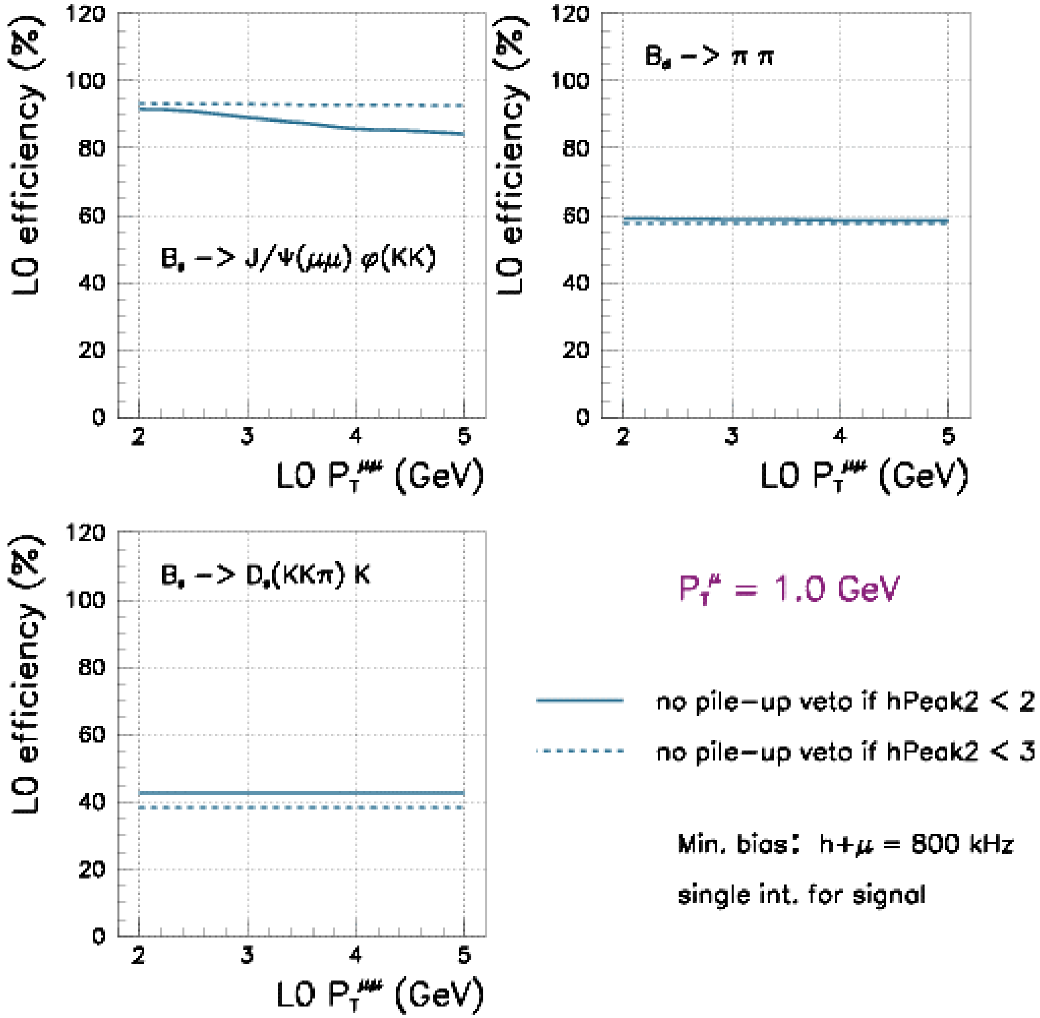
- At high $P_T^{\mu\mu}$ the $\mu\mu$-trigger has a large impact on the efficiency
- The pile-up veto scenario has little importance



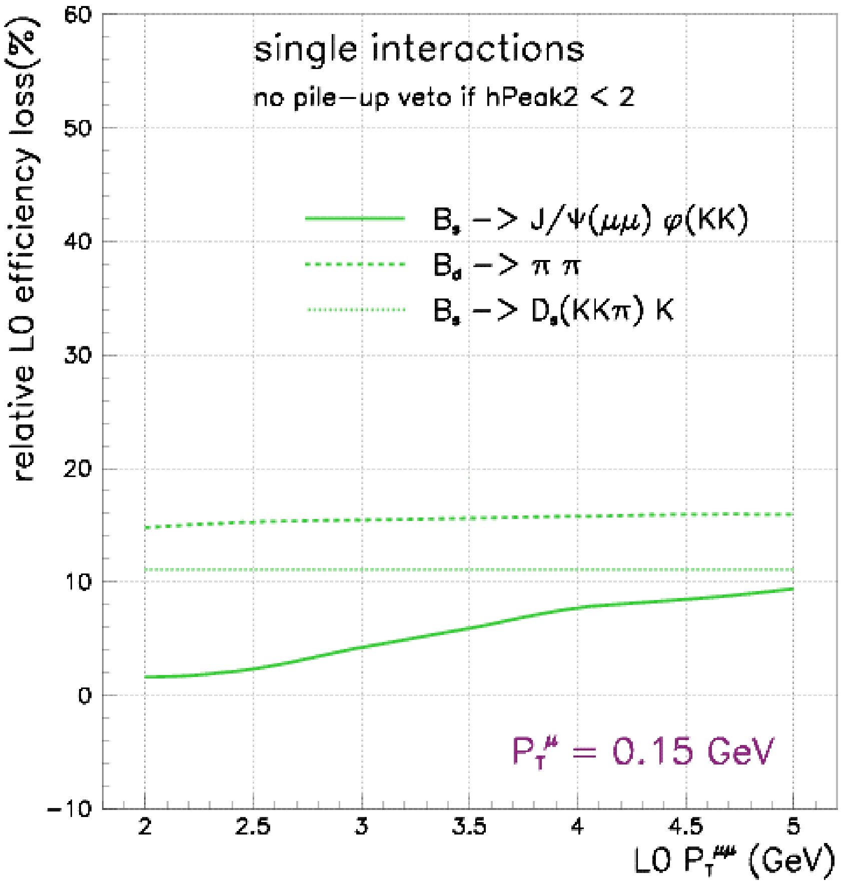
$P_T^{\mu\mu}$ thresholds at medium P_T^{μ}

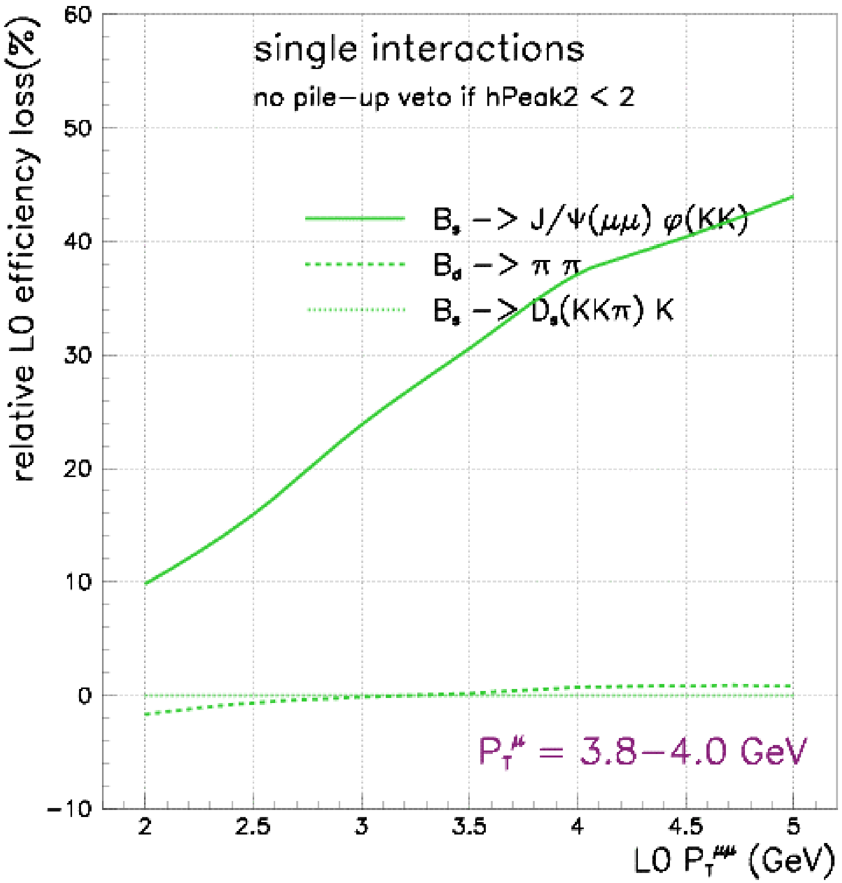
- Again the μμ-trigger allows to recover eff. for B_s -> J/Ψ(μμ) φ (KK)

- What about the plots of losses in efficiency?



Di-muon Trigger and L0 Efficiency (no Pile-up Veto if hPeak2 < 2)





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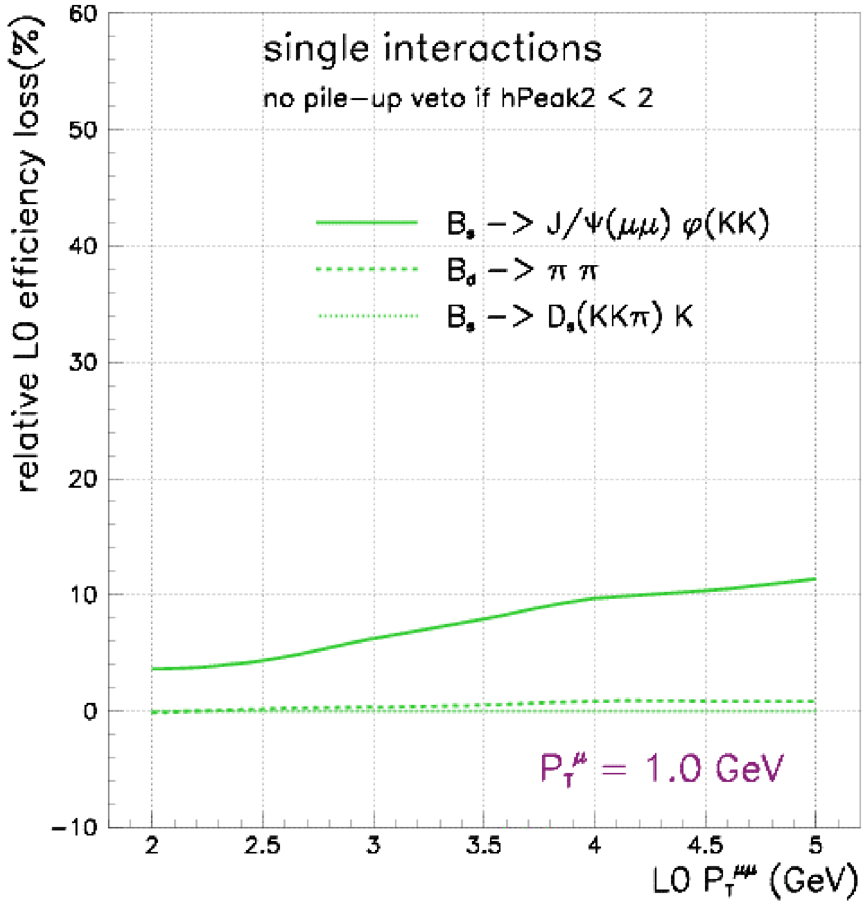
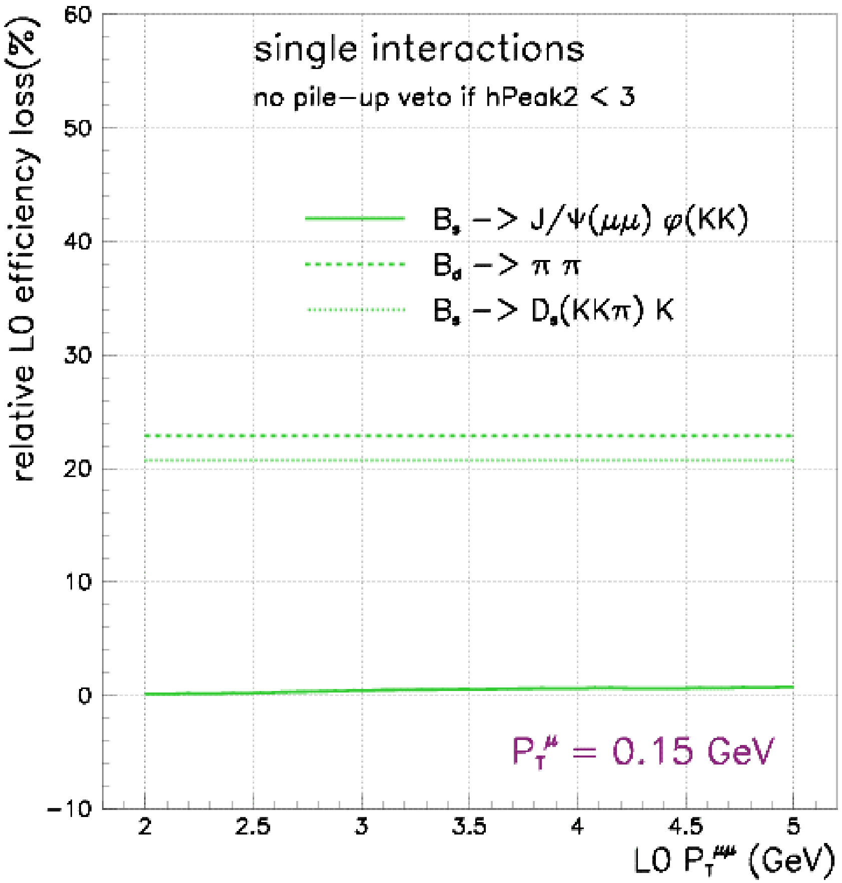
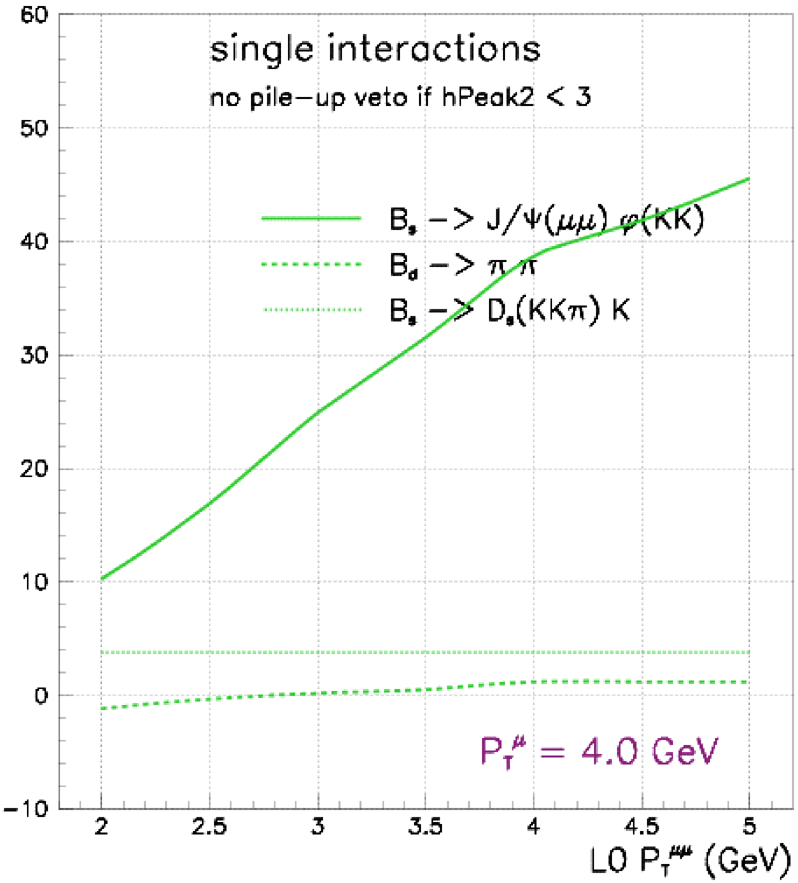
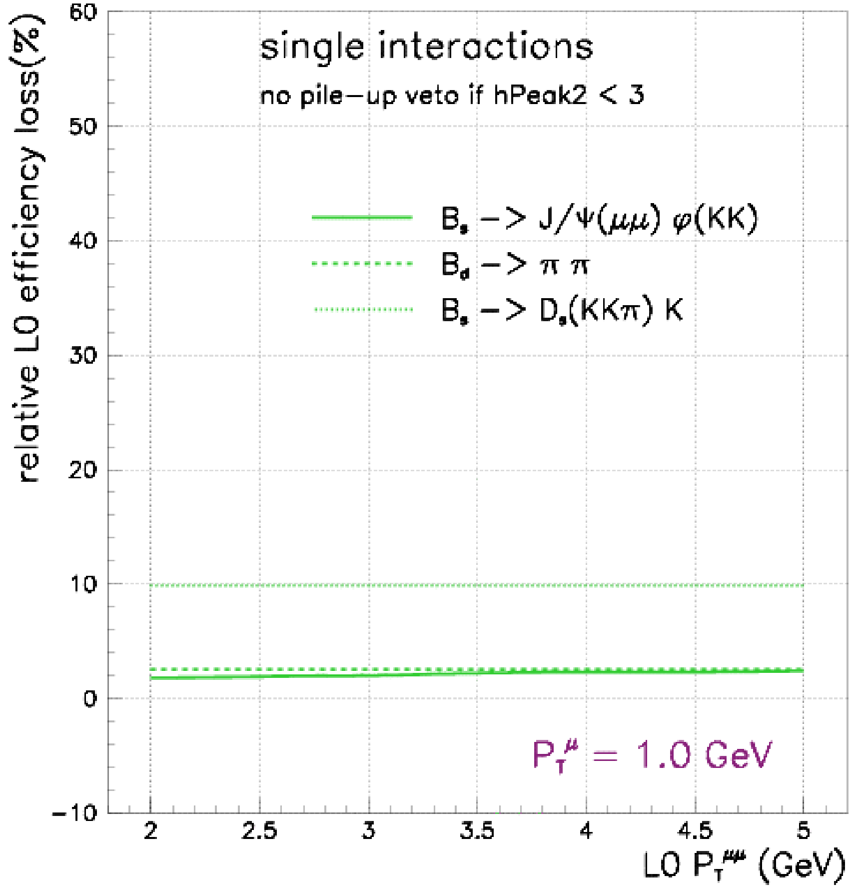


Di-muon Trigger and L0 Efficiency (no Pile-up Veto if hPeak2 < 3)





Di-muon Trigger and L0 Efficiency (no Pile-up Veto if hPeak2 < 3)



Outlook

- Pile-up veto cut: no veto if height 2nd peak < 2 is preferred (compared to a cut at 3) by the hadronic channels
- But B_s -> $J/\Psi(\mu\mu)\ \phi\ (KK)$ gains from a softer veto cut (cut at 3)
- Results suggest that the di-muon trigger is able to recover (most of) the loss in efficiency for the
  B_s -> $J/\Psi(\mu\mu)\ \phi\ (KK)$ channel
  <u>while not affecting</u> the hadronic channels …
  … then keeping a pile-up veto cut at 2