Update: SL recoil analyses vs Bwd-EMC

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SEZIONE DI PISA

SuperB

Outline

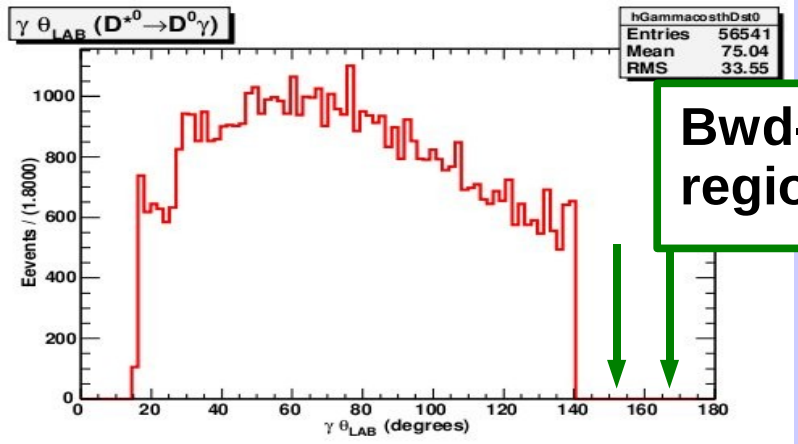
- Samples used
- Bwd-EMC studies strategy
- Results on Bwd-EMC Studies
- Summary and outlook

Summer 2010 Production

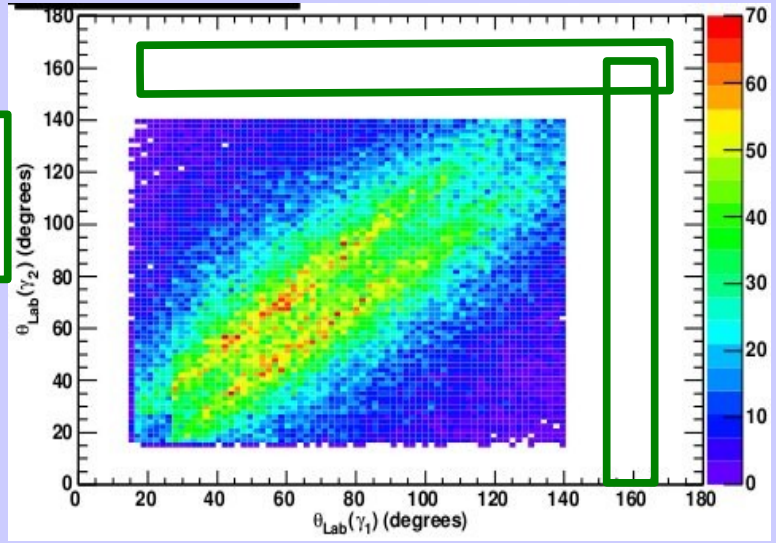
- **Signal samples:**
  - $B^+ \to K^+ \nu\nu$ (DG_BaBar/DG_4/DG_4a): 3.00/4.02/3.03 M
  - $B^0 \to K^0 \nu\nu$ (DG_BaBar/DG_4/DG_4a): 3.00/3.00/3.00 M
  - $B^0 \to K^{*0} \nu\nu$ (DG_BaBar/DG_4/DG_4a): 3.00/3.00/2.94 M
  - $B^+ \to K^{*+} \nu\nu$ (DG_BaBar/DG_4/DG_4a): 3.00/2.97/3.00 M
  - $B^+ \to \tau^+ \nu$ (DG_BaBar/DG_4/DG_4a): 3.00/3.00/3.00 M
- **Background Samples:**
  - B^+B^- SL-cocktail (DG_BaBar/DG_4/DG_4a): 89.30/340.72/344.32 M
  - B^0B^0 SL-cocktail (DG_BaBar/DG_4/DG_4a): 71.90/284.00/284.56 M
- **All samples generated with bkg mixing NoPairs (V0.2.5 Rev 307)**
- **Checked that DG_4 and DG_4a are equivalent samples (variables distributions and efficiencies)**
- **DG_4 and DG_4a are merged together to perform the DGWG studies**

Bwd-EMC Studies Strategy: Veto device

- B_{tag} and B_{sig} candidates reconstructed without neutrals from Bwd-EMC



Bwd-EMC region



- Two types of E_{extra} variables:
  - → E_{extra}(Barrel-Fwd) = Σ(extra neutrals on Barrel-Fwd EMC)
  - → E_{extra}(Bwd) = Σ(extra neutrals on Bwd EMC)
- Can used E_{extra}(Bwd) to cut on and E_{extra}(Barrel-Fwd) to perform a fit
- Test different $E(\gamma)_{min}$ cut for Bwd-EMC photons (none, 30, 50, 70 MeV)
- Try to define an optimum cut that maximizes a figure of merits
  ⇒ $S/\sqrt{(S+B)}$

Bwd-EMC Studies: Smearing Strategy

- Winter production: EMC (Fwd, Barrel and Bwd) resolution effect were Off
  ⇒ No energy smearing
- Impact of the Bwd-EMC may be too optimistic

- Use off-line smearing patch (Elisa Manoni) only on extra-photons
  ⇒ evaluate relative change on significance due to Bwd-EMC

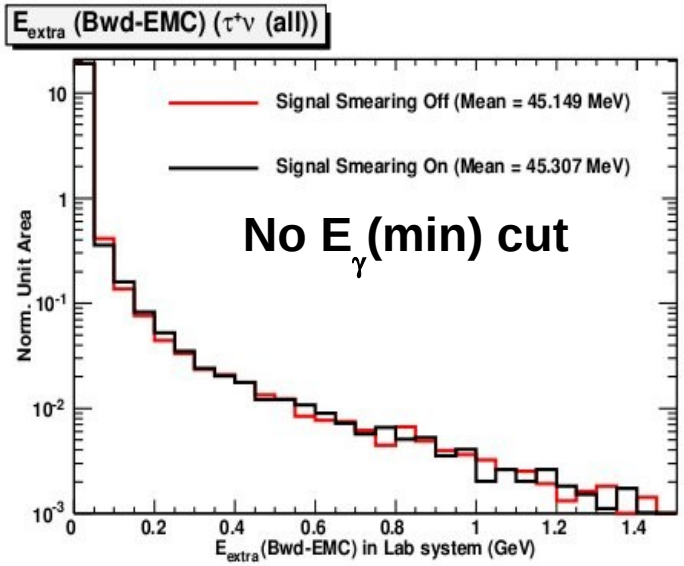
$$\delta(S/\sqrt{(S+B)}) = \frac{S/\sqrt{(S+B)}|_{bwd} - S/\sqrt{(S+B)}|_{nobwd}}{S/\sqrt{(S+B)}|_{nobwd}}$$

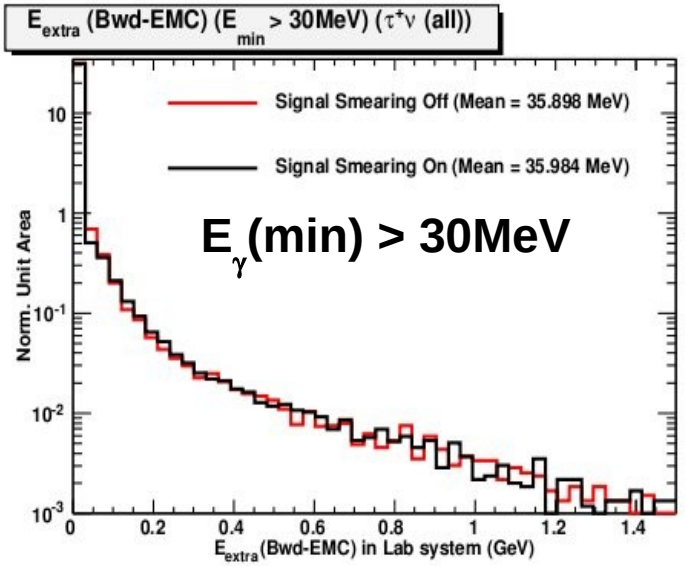
$\delta(S/\sqrt{(S+B)}) = (\varepsilon_S/\sqrt{\varepsilon_B} - 1)$ (case of background dominated mode (B >> S))

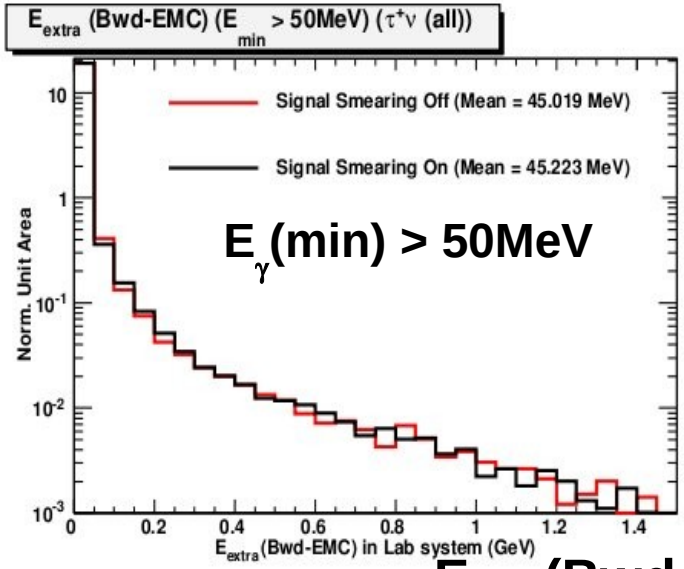
- ε_S (ε_B) is the signal (background) relative efficiency after E_{extra}(Bwd) veto

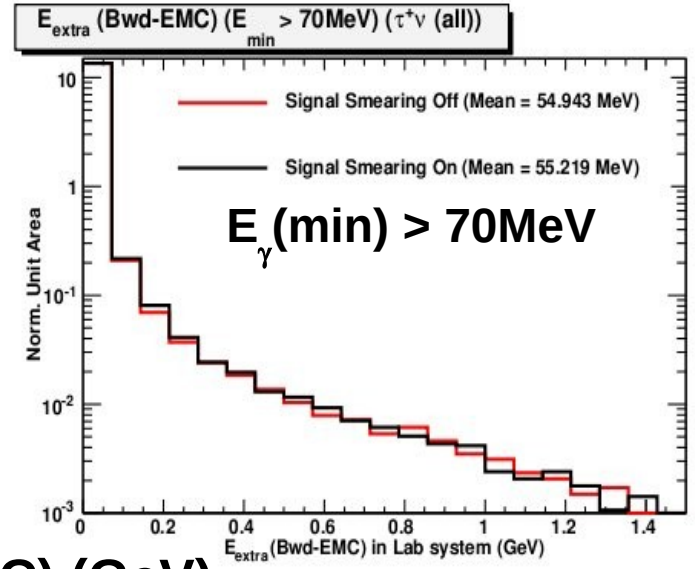
Physics Results on Bwd-EMC Studies

Smearing On/Off (Signal): $B^+ \to \tau^+ \nu$









Smearing On
Smearing Off

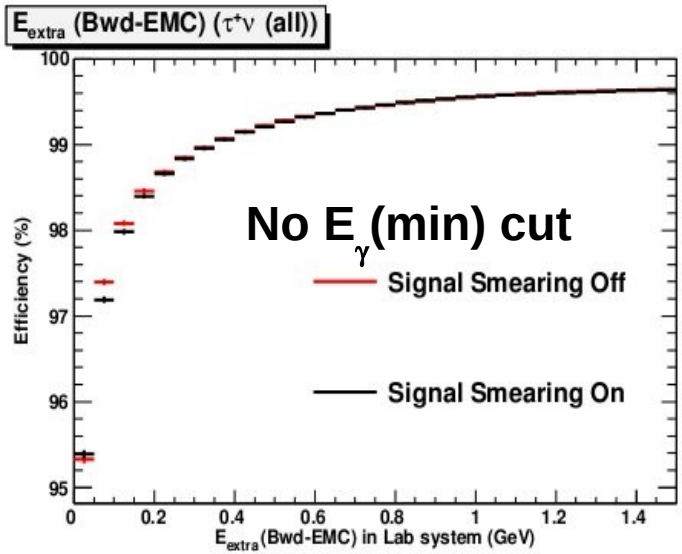
Warning:
log-scale in the vertical scale

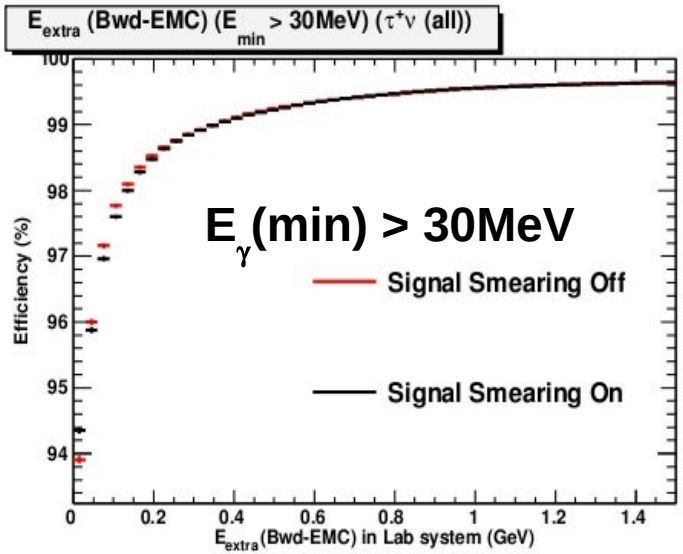
Smearing effect is small

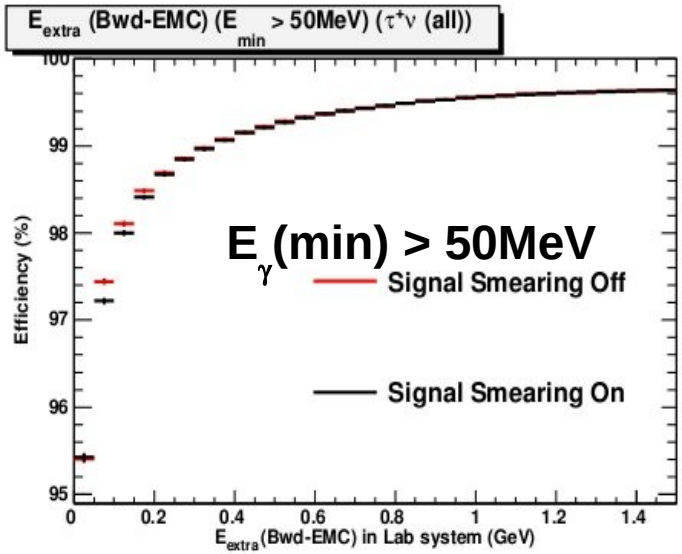
Smeared distribution shifted to higher values

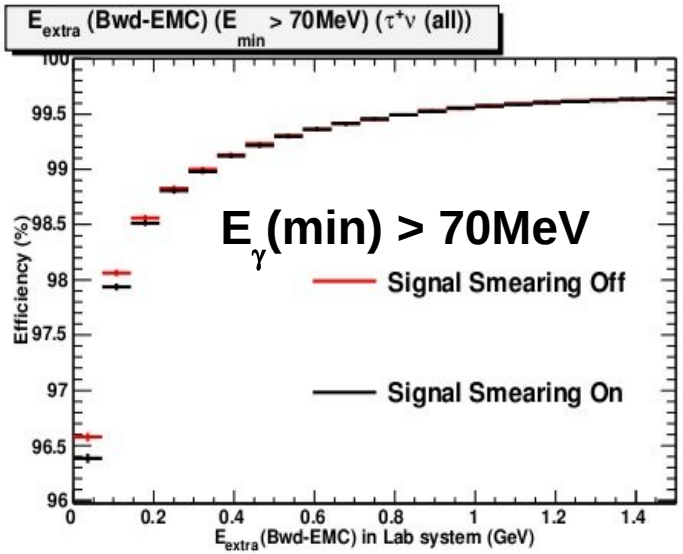
E_{extra}(Bwd-EMC) (GeV)

Smearing On/Off (Signal): $B^+ \to \tau^+ \nu$









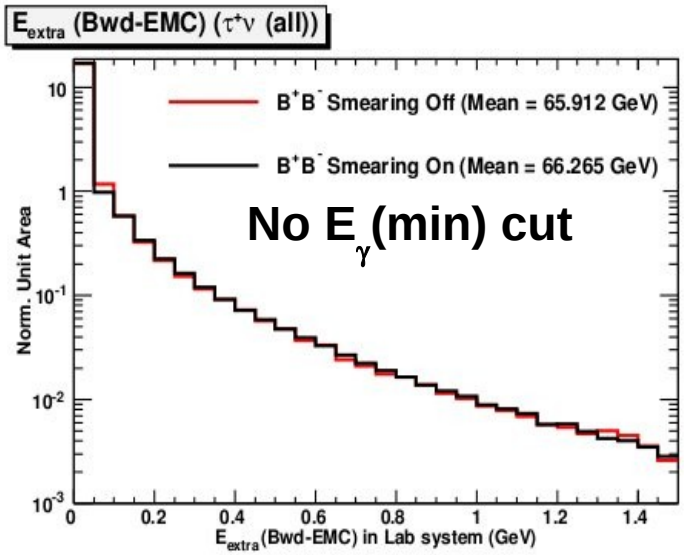
Smearing On
Smearing Off

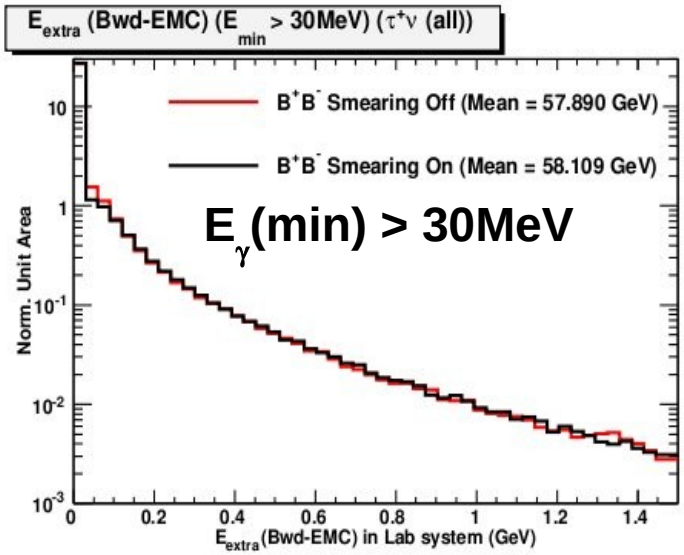
Warning: vertical scale not from zero

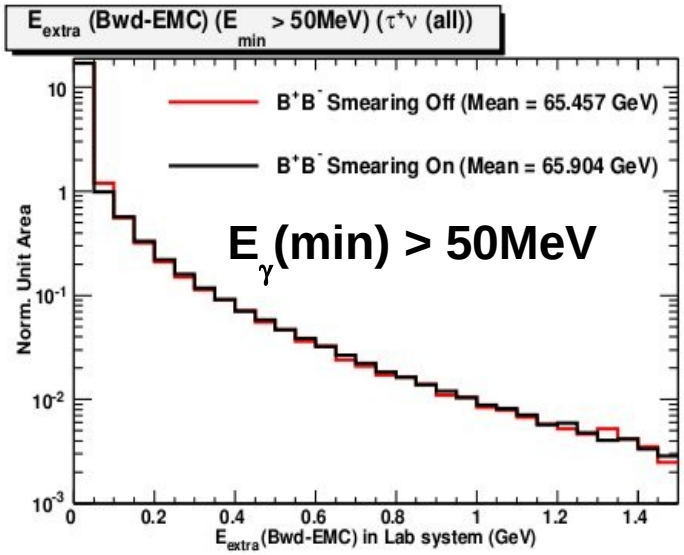
Smearing effect is small

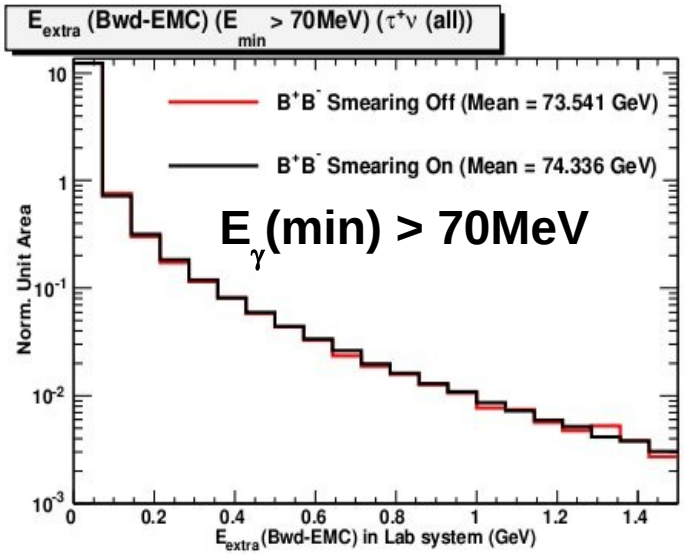
E_{extra}(Bwd-EMC) (GeV)

Smearing On/Off (B^+B^-): $B^+ \to \tau^+\nu$









Smearing On
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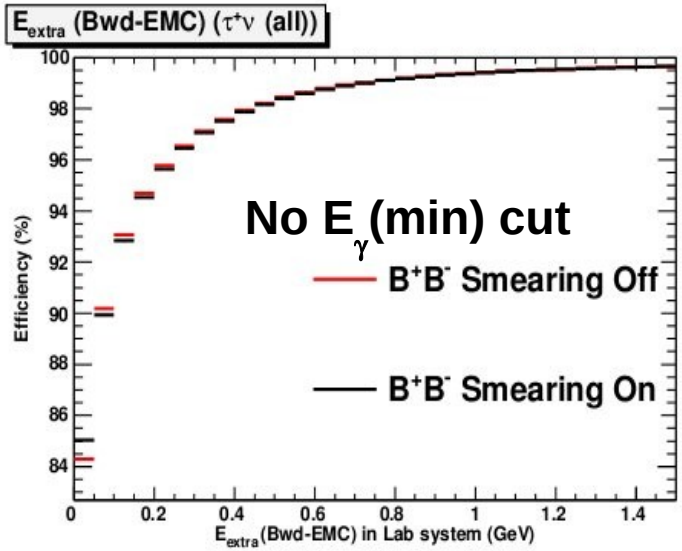
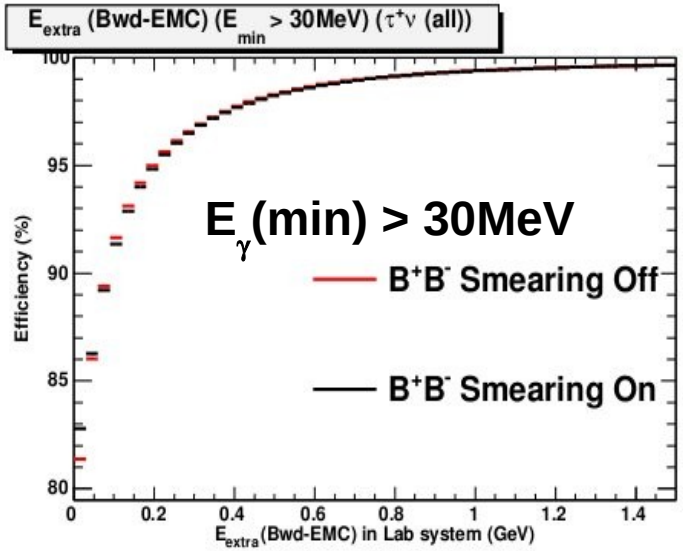
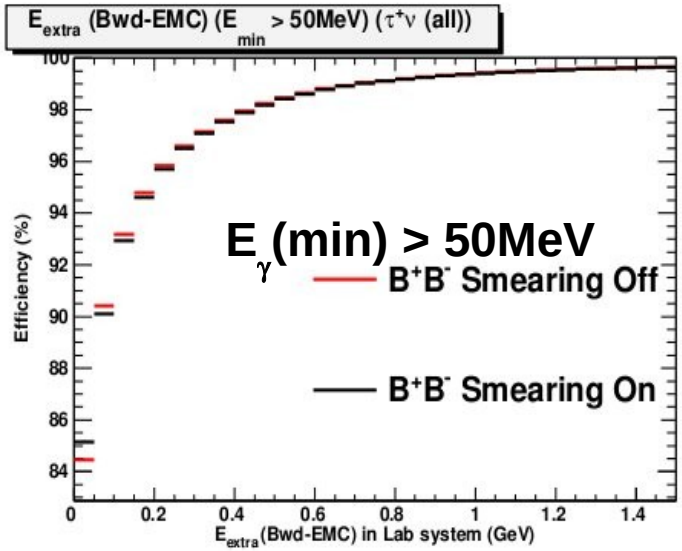
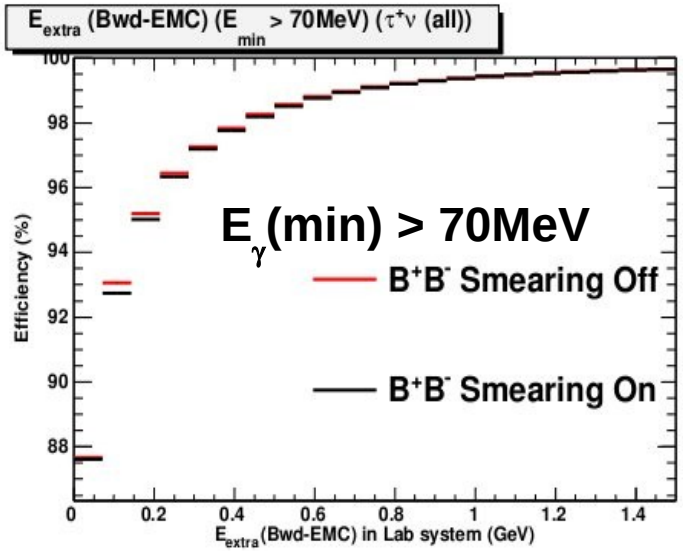
E_{extra}(Bwd-EMC) (GeV)

Smearing On/Off (B^+B^-): $B^+ \to \tau^+\nu$









Smearing On
Smearing Off

Warning: vertical scale not from zero

Smearing effect is small

E_{extra}(Bwd-EMC) (GeV)

Smearing On/Off (results): $B^+ \to \tau^+ \nu$

No E_γ(min) cut (E_{extra} cut at 50.00 MeV)

Smearing Off:

Effic(S) = (95.332 ± 0.047) %

Effic(B^+B^-) = (84.292 ± 0.037) %

Effic(B^0B^0) = (85.006 ± 0.071) %

ΔSignificance/Significance = (3.744 ± 0.068) %

Smearing On:

Effic(S) = (95.391 ± 0.047) %

Effic(B^+B^-) = (85.046 ± 0.037) %

Effic(B^0B^0) = (85.675 ± 0.070) %

ΔSignificance/Significance = (3.356 ± 0.066) %

E_γ(min) cut 30.0 MeV (E_{extra} cut at 30.12 MeV)

Smearing Off:

Effic(S) = (93.909 ± 0.054) %

Effic(B^+B^-) = (81.371 ± 0.039) %

Effic(B^0B^0) = (82.335 ± 0.076) %

ΔSignificance/Significance = (3.977 ± 0.077) %

Smearing On:

Effic(S) = (94.350 ± 0.052) %

Effic(B^+B^-) = (82.803 ± 0.039) %

Effic(B^0B^0) = (83.625 ± 0.074) %

ΔSignificance/Significance = (3.574 ± 0.073) %

E_γ(min) cut 50.0 MeV (E_{extra} cut at 50.00 MeV)

Smearing Off:

Effic(S) = (95.405 ± 0.047) %

Effic(B^+B^-) = (84.466 ± 0.036) %

Effic(B^0B^0) = (85.165 ± 0.071) %

ΔSignificance/Significance = (3.718 ± 0.067) %

Smearing On:

Effic(S) = (95.423 ± 0.047) %

Effic(B^+B^-) = (85.156 ± 0.037) %

Effic(B^0B^0) = (85.768 ± 0.070) %

ΔSignificance/Significance = (3.326 ± 0.066) %

E_γ(min) cut 70.0 MeV (E_{extra} cut at 71.43 MeV)

Smearing Off:

Effic(S) = (96.577 ± 0.041) %

Effic(B^+B^-) = (87.661 ± 0.033) %

Effic(B^0B^0) = (87.966 ± 0.065) %

ΔSignificance/Significance = (3.113 ± 0.058) %

Smearing On:

Effic(S) = (96.383 ± 0.042) %

Effic(B^+B^-) = (87.607 ± 0.034) %

Effic(B^0B^0) = (88.000 ± 0.065) %

ΔSignificance/Significance = (2.926 ± 0.059) %

Smearing On/Off (results): $B^+ \to K^+ \nu\nu$

No E_γ(min) cut (E_{extra} cut at 50.00 MeV)

Smearing Off:

Effic(S) = (97.665 ± 0.064) %

Effic(B^+B^-) = (85.360 ± 0.757) %

Effic(B^0B^0) = (87.805 ± 1.475) %

ΔSignificance/Significance = (5.394 ± 0.908) %

Smearing On:

Effic(S) = (97.612 ± 0.065) %

Effic(B^+B^-) = (86.003 ± 0.743) %

Effic(B^0B^0) = (88.008 ± 1.465) %

ΔSignificance/Significance = (5.006 ± 0.893) %

E_γ(min) cut 30.0 MeV (E_{extra} cut at 30.12 MeV)

Smearing Off:

Effic(S) = (96.390 ± 0.079) %

Effic(B^+B^-) = (83.066 ± 0.803) %

Effic(B^0B^0) = (85.772 ± 1.575) %

ΔSignificance/Significance = (5.406 ± 0.996) %

Smearing On:

Effic(S) = (96.715 ± 0.076) %

Effic(B^+B^-) = (84.442 ± 0.776) %

Effic(B^0B^0) = (86.992 ± 1.517) %

ΔSignificance/Significance = (4.919 ± 0.940) %

E_γ(min) cut 50.0 MeV (E_{extra} cut at 50.00 MeV)

Smearing Off:

Effic(S) = (97.730 ± 0.063) %

Effic(B^+B^-) = (85.452 ± 0.755) %

Effic(B^0B^0) = (87.805 ± 1.475) %

ΔSignificance/Significance = (5.422 ± 0.907) %

Smearing On:

Effic(S) = (97.629 ± 0.065) %

Effic(B^+B^-) = (86.003 ± 0.743) %

Effic(B^0B^0) = (88.008 ± 1.465) %

ΔSignificance/Significance = (5.024 ± 0.893) %

E_γ(min) cut 70.0 MeV (E_{extra} cut at 71.43 MeV)

Smearing Off:

Effic(S) = (98.729 ± 0.048) %

Effic(B^+B^-) = (87.838 ± 0.700) %

Effic(B^0B^0) = (89.228 ± 1.398) %

ΔSignificance/Significance = (5.176 ± 0.836) %

Smearing On:

Effic(S) = (98.457 ± 0.052) %

Effic(B^+B^-) = (88.206 ± 0.691) %

Effic(B^0B^0) = (89.228 ± 1.398) %

ΔSignificance/Significance = (4.714 ± 0.830) %

Smearing On/Off (results): $B^0 \to K^0 \nu\nu$

No E_γ(min) cut (E_{extra} cut at 50.00 MeV)

Smearing Off:

Effic(S) = (98.254 ± 0.119) %

Effic(B^+B^-) = (87.129 ± 0.506) %

Effic(B^0B^0) = (91.388 ± 0.270) %

ΔSignificance/Significance = (3.313 ± 0.315) %

Smearing On:

Effic(S) = (98.377 ± 0.115) %

Effic(B^+B^-) = (87.673 ± 0.500) %

Effic(B^0B^0) = (91.851 ± 0.263) %

ΔSignificance/Significance = (3.159 ± 0.308) %

E_γ(min) cut 30.0 MeV (E_{extra} cut at 30.12 MeV)

Smearing Off:

Effic(S) = (97.521 ± 0.141) %

Effic(B^+B^-) = (84.231 ± 0.551) %

Effic(B^0B^0) = (89.649 ± 0.293) %

ΔSignificance/Significance = (3.690 ± 0.356) %

Smearing On:

Effic(S) = (97.759 ± 0.134) %

Effic(B^+B^-) = (85.315 ± 0.538) %

Effic(B^0B^0) = (90.565 ± 0.281) %

ΔSignificance/Significance = (3.370 ± 0.342) %

E_γ(min) cut 50.0 MeV (E_{extra} cut at 50.00 MeV)

Smearing Off:

Effic(S) = (98.311 ± 0.117) %

Effic(B^+B^-) = (87.243 ± 0.504) %

Effic(B^0B^0) = (91.499 ± 0.268) %

ΔSignificance/Significance = (3.308 ± 0.313) %

Smearing On:

Effic(S) = (98.402 ± 0.114) %

Effic(B^+B^-) = (87.720 ± 0.499) %

Effic(B^0B^0) = (91.879 ± 0.263) %

ΔSignificance/Significance = (3.167 ± 0.307) %

E_γ(min) cut 70.0 MeV (E_{extra} cut at 71.43 MeV)

Smearing Off:

Effic(S) = (99.003 ± 0.090) %

Effic(B^+B^-) = (90.256 ± 0.448) %

Effic(B^0B^0) = (93.442 ± 0.238) %

ΔSignificance/Significance = (2.805 ± 0.265) %

Smearing On:

Effic(S) = (98.871 ± 0.096) %

Effic(B^+B^-) = (90.333 ± 0.449) %

Effic(B^0B^0) = (93.590 ± 0.236) %

ΔSignificance/Significance = (2.587 ± 0.267) %

Smearing On/Off (results): $B^+ \to K^{*+}\nu\nu$

No E_γ(min) cut (E_{extra} cut at 50.00 MeV)

Smearing Off:

Effic(S) = (97.493 ± 0.081) %

Effic(B^+B^-) = (86.957 ± 0.106) %

Effic(B^0B^0) = (88.804 ± 0.151) %

ΔSignificance/Significance = (4.183 ± 0.124) %

Smearing On:

Effic(S) = (97.547 ± 0.080) %

Effic(B^+B^-) = (87.738 ± 0.096) %

Effic(B^0B^0) = (89.390 ± 0.133) %

ΔSignificance/Significance = (3.804 ± 0.116) %

E_γ(min) cut 30.0 MeV (E_{extra} cut at 30.12 MeV)

Smearing Off:

Effic(S) = (96.282 ± 0.098) %

Effic(B^+B^-) = (84.164 ± 0.115) %

Effic(B^0B^0) = (86.519 ± 0.163) %

ΔSignificance/Significance = (4.467 ± 0.146) %

Smearing On:

Effic(S) = (96.619 ± 0.093) %

Effic(B^+B^-) = (85.557 ± 0.103) %

Effic(B^0B^0) = (87.557 ± 0.143) %

ΔSignificance/Significance = (4.039 ± 0.132) %

E_γ(min) cut 50.0 MeV (E_{extra} cut at 50.00 MeV)

Smearing Off:

Effic(S) = (97.549 ± 0.080) %

Effic(B^+B^-) = (87.110 ± 0.106) %

Effic(B^0B^0) = (88.893 ± 0.150) %

ΔSignificance/Significance = (4.166 ± 0.123) %

Smearing On:

Effic(S) = (97.568 ± 0.080) %

Effic(B^+B^-) = (87.823 ± 0.096) %

Effic(B^0B^0) = (89.457 ± 0.133) %

ΔSignificance/Significance = (3.781 ± 0.115) %

E_γ(min) cut 70.0 MeV (E_{extra} cut at 71.43 MeV)

Smearing Off:

Effic(S) = (98.469 ± 0.063) %

Effic(B^+B^-) = (90.187 ± 0.094) %

Effic(B^0B^0) = (91.347 ± 0.134) %

ΔSignificance/Significance = (3.470 ± 0.102) %

Smearing On:

Effic(S) = (98.271 ± 0.067) %

Effic(B^+B^-) = (90.122 ± 0.088) %

Effic(B^0B^0) = (91.386 ± 0.121) %

ΔSignificance/Significance = (3.268 ± 0.099) %

Smearing On/Off (results): $B^0 \to K^{*0} \nu\nu$

No E_γ(min) cut (E_{extra} cut at 50.00 MeV)

Smearing Off:

Effic(S) = (98.870 ± 0.000) %

Effic(B^+B^-) = (86.957 ± 0.106) %

Effic(B^0B^0) = (88.804 ± 0.151) %

ΔSignificance/Significance = (5.654 ± 0.091) %

Smearing On:

Effic(S) = (98.933 ± 0.188) %

Effic(B^+B^-) = (87.738 ± 0.096) %

Effic(B^0B^0) = (89.390 ± 0.133) %

ΔSignificance/Significance = (5.280 ± 0.215) %

E_γ(min) cut 30.0 MeV (E_{extra} cut at 30.12 MeV)

Smearing Off:

Effic(S) = (98.072 ± 0.355) %

Effic(B^+B^-) = (84.164 ± 0.115) %

Effic(B^0B^0) = (86.519 ± 0.163) %

ΔSignificance/Significance = (6.408 ± 0.398) %

Smearing On:

Effic(S) = (98.467 ± 0.224) %

Effic(B^+B^-) = (85.557 ± 0.103) %

Effic(B^0B^0) = (87.557 ± 0.143) %

ΔSignificance/Significance = (6.028 ± 0.257) %

E_γ(min) cut 50.0 MeV (E_{extra} cut at 50.00 MeV)

Smearing Off:

Effic(S) = (98.936 ± 0.000) %

Effic(B^+B^-) = (87.110 ± 0.106) %

Effic(B^0B^0) = (88.893 ± 0.150) %

ΔSignificance/Significance = (5.647 ± 0.090) %

Smearing On:

Effic(S) = (98.933 ± 0.188) %

Effic(B^+B^-) = (87.823 ± 0.096) %

Effic(B^0B^0) = (89.457 ± 0.133) %

ΔSignificance/Significance = (5.233 ± 0.215) %

E_γ(min) cut 70.0 MeV (E_{extra} cut at 71.43 MeV)

Smearing Off:

Effic(S) = (99.269 ± 0.000) %

Effic(B^+B^-) = (90.187 ± 0.094) %

Effic(B^0B^0) = (91.347 ± 0.134) %

ΔSignificance/Significance = (4.310 ± 0.077) %

Smearing On:

Effic(S) = (99.133 ± 0.169) %

Effic(B^+B^-) = (90.122 ± 0.088) %

Effic(B^0B^0) = (91.386 ± 0.121) %

ΔSignificance/Significance = (4.175 ± 0.191) %

Summary and outlook

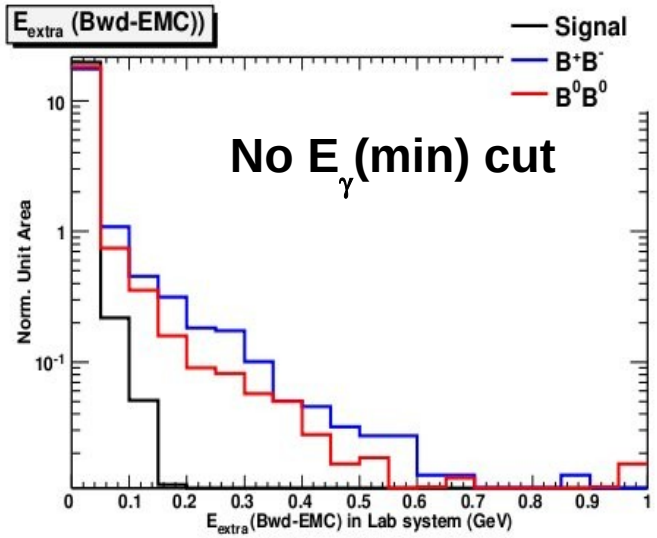
Bwd-EMC studies:

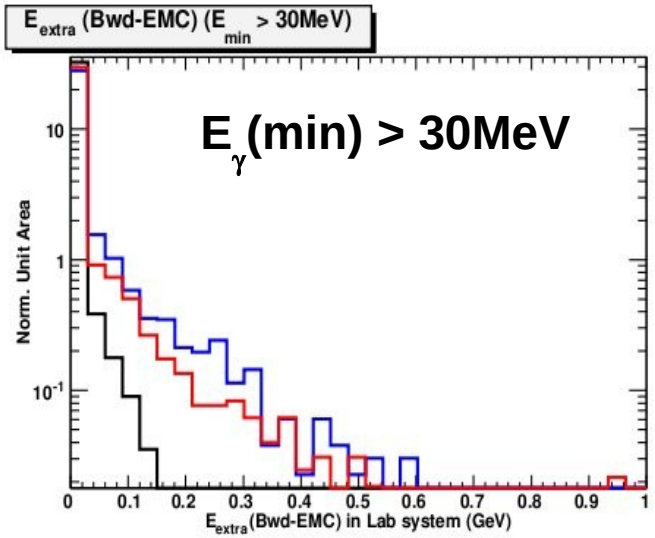
- EMC resolution effect turned Off for Winter production
- Implemented Off-line smearing patch (Elisa Manoni) on Extra-photons
- Marginal effect of smearing on the Bwd-EMC impact
- Best results on E_{extra}(Bwd) Veto obtained with extra-photon with $E\gamma(min) > 30MeV$
- All analysis give similar results:
  - Negligible reduction on signal efficiency ~(2-5)%
  - ~(10-15)% reduction on main backgrounds (B^+B^-, B^0B^0)

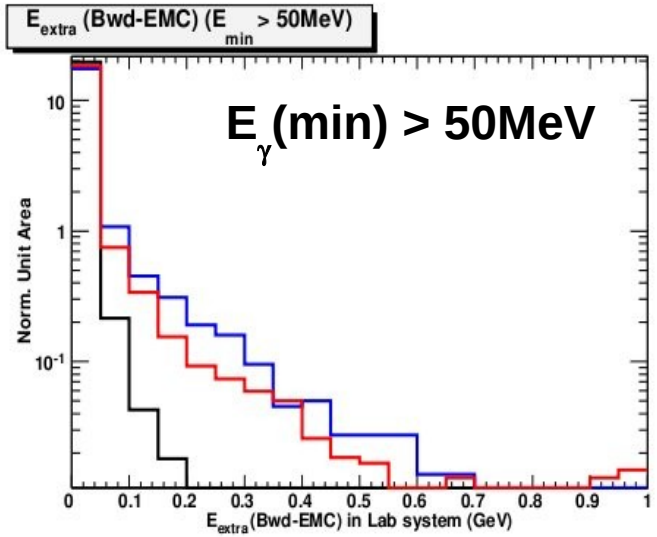
- Summary on $\delta(S/\sqrt{(S+B)})$ gain due to Bwd-EMC ($E\gamma(min) > 30MeV$):
  - $B^+ \to \tau^+\nu$: **(3.977 ± 0.077)% (Smear-Off) → (3.574 ± 0.073)% (Smear-On)**
  - $B^+ \to K^+\nu\nu$: **(5.506 ± 0.996)% (Smear-Off) → (4.919 ± 0.940)% (Smear-On)**
  - $B^0 \to K^0\nu\nu$: **(3.690 ± 0.356)% (Smear-Off) → (3.370 ± 0.342)% (Smear-On)**
  - $B^+ \to K^{*+}\nu\nu$: **(4.467 ± 0.146)% (Smear-Off) → (4.039 ± 0.132)% (Smear-On)**
  - $B^0 \to K^{*0}\nu\nu$: **(6.408 ± 0.398)% (Smear-Off) → (6.028 ± 0.257)% (Smear-On)**

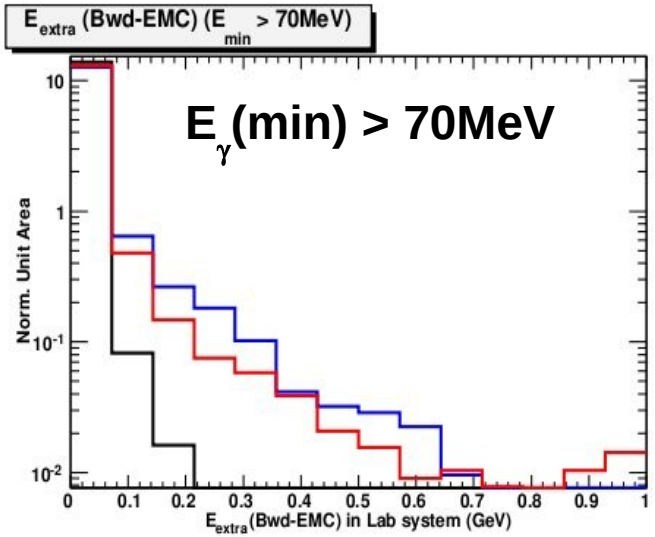
Backup

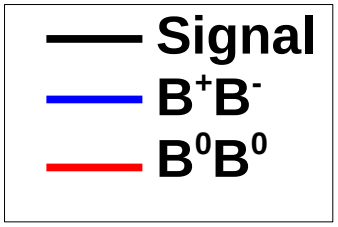
Bwd-EMC studies (smearing Off): B→Kνν









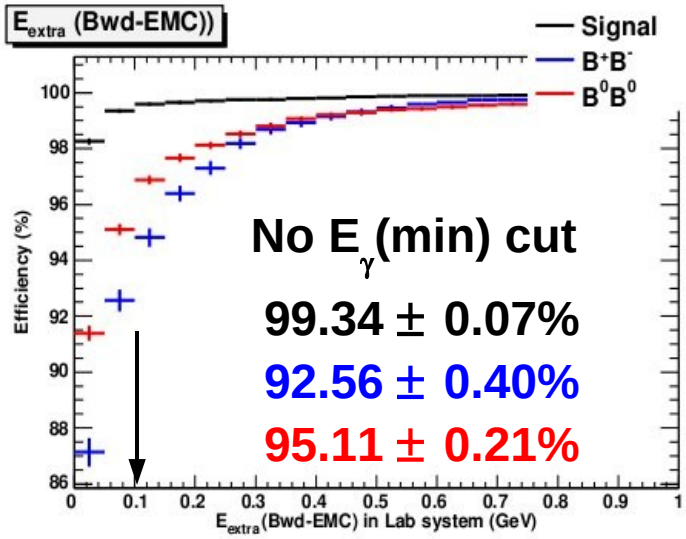


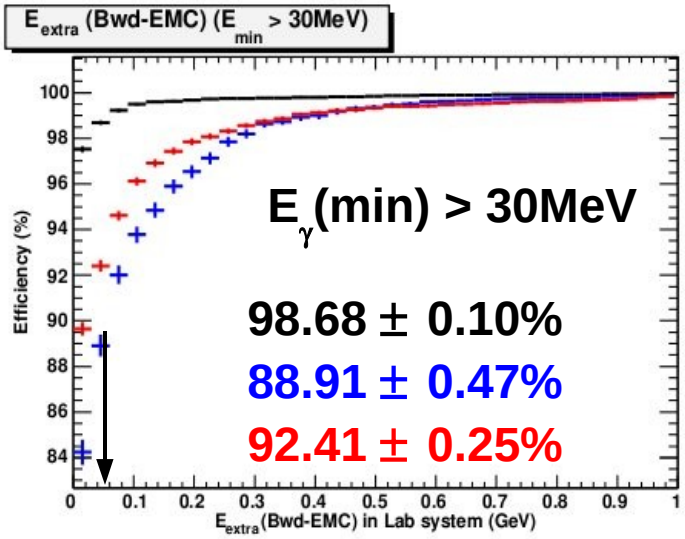
Warning:
log-scale in the vertical scale

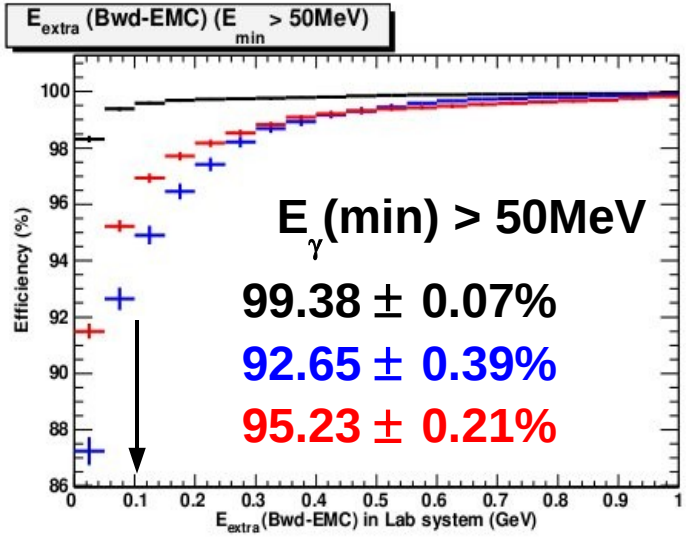
Backgrounds have longer tails to high values w.r.t signal

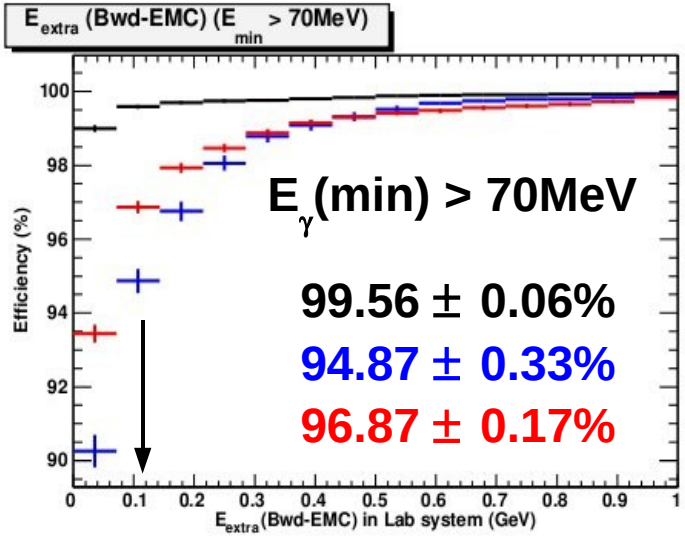
E_{extra}(Bwd-EMC) (GeV)

Bwd-EMC studies (smearing Off): B→Kνν









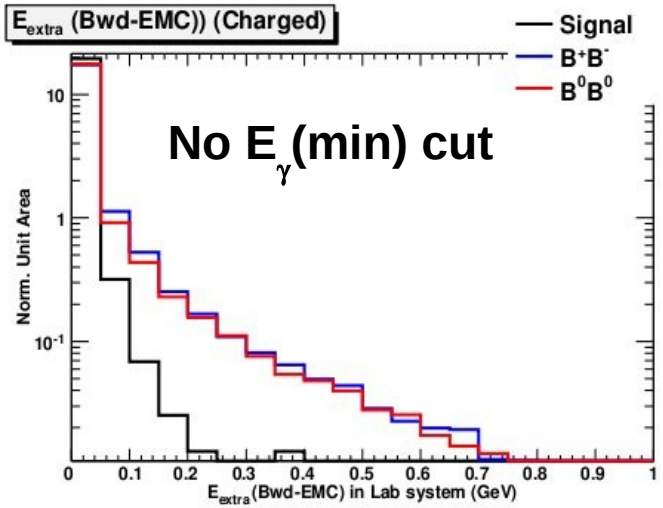
Signal
B^+B^-
B^0B^0

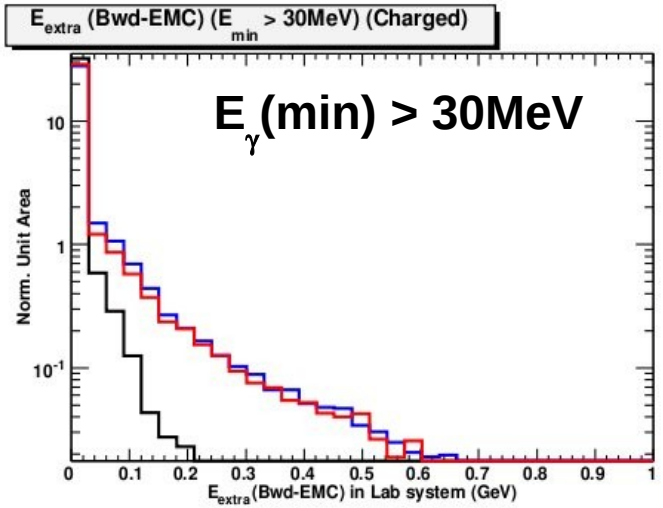
Seems that it is better to use E_γ(min) > 30MeV

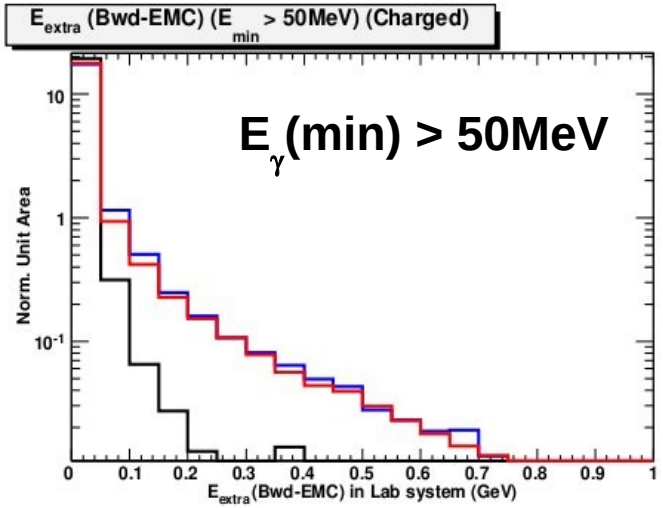
Could reduce backgrounds by around 10%

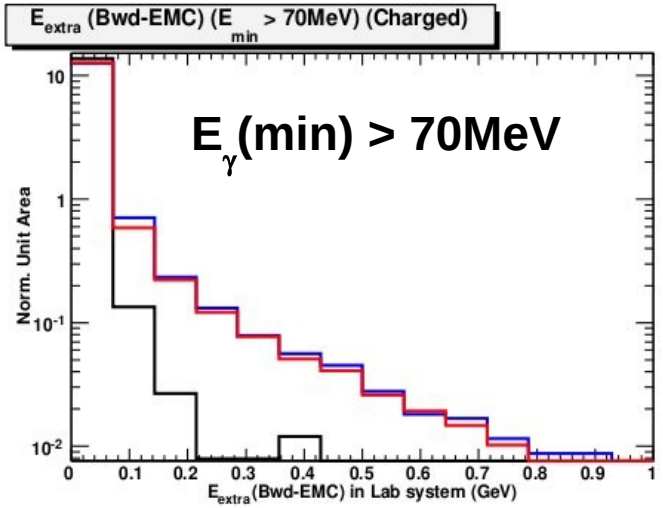
E_{extra}(Bwd-EMC) (GeV)

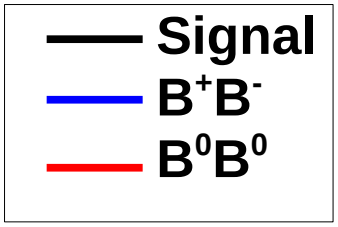
Bwd-EMC studies (smearing Off): $B \to K^* \nu\nu$









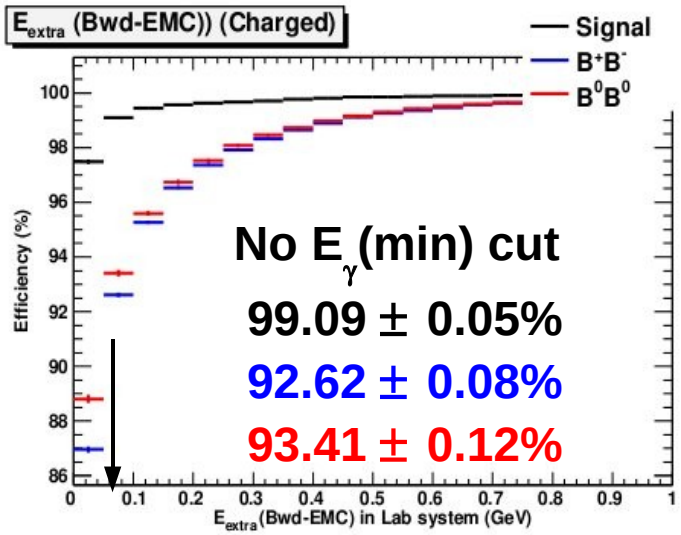


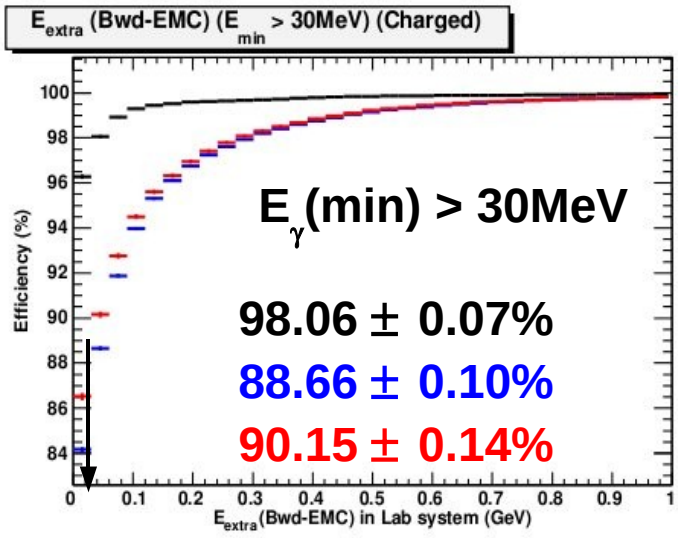
Warning:
log-scale in the vertical scale

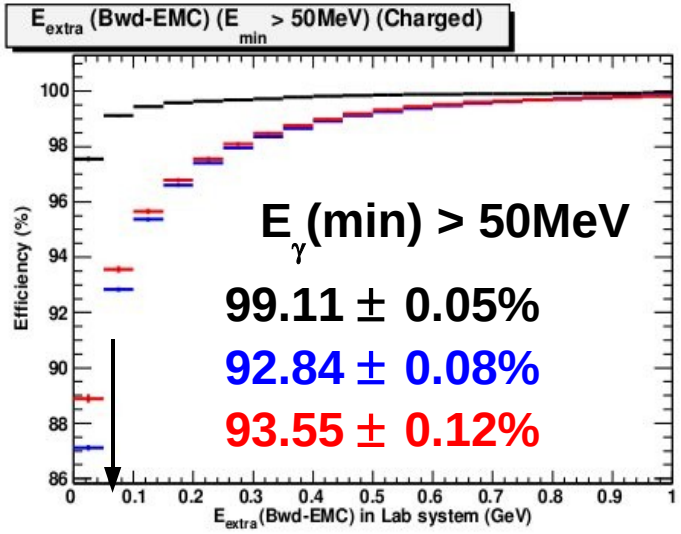
Backgrounds have longer tails to high values w.r.t signal

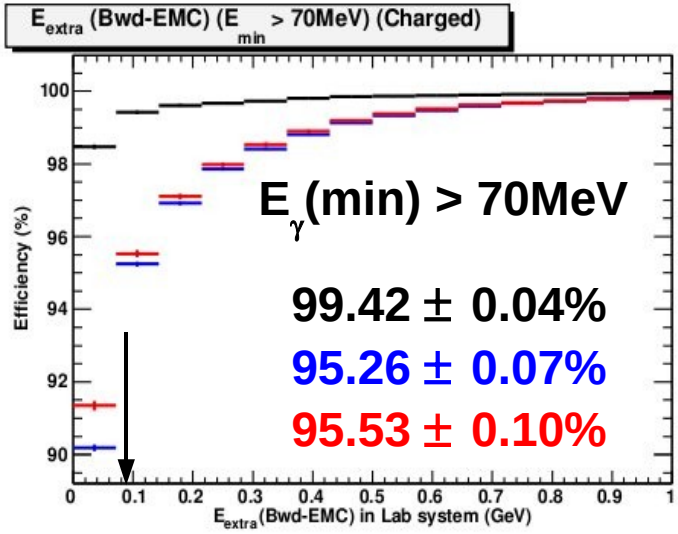
E_{extra}(Bwd-EMC) (GeV)

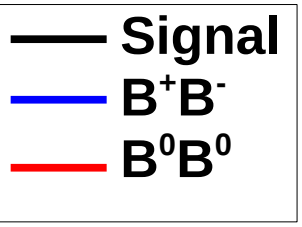
Bwd-EMC studies (smearing Off): $B \to K^{*} \nu\nu$









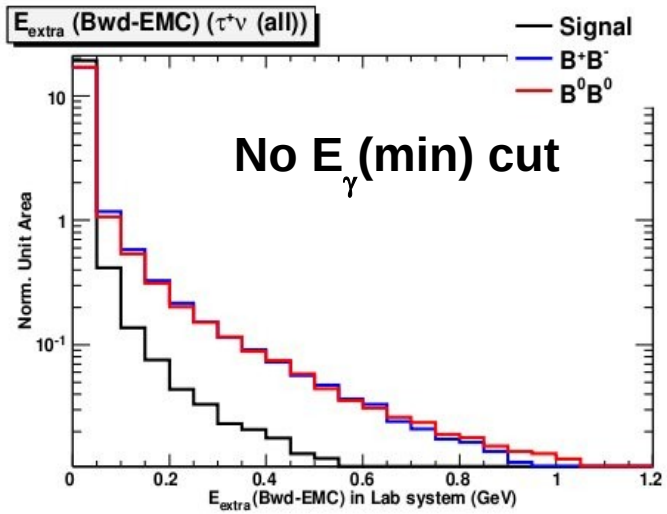


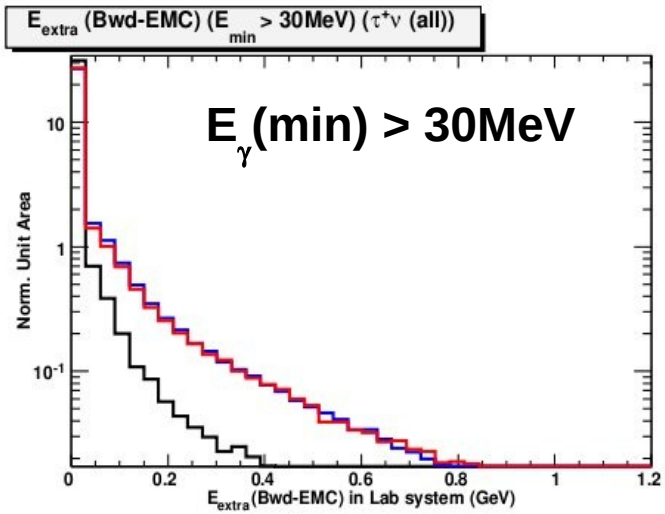
Seems that it is better to use E_γ(min) > 30MeV

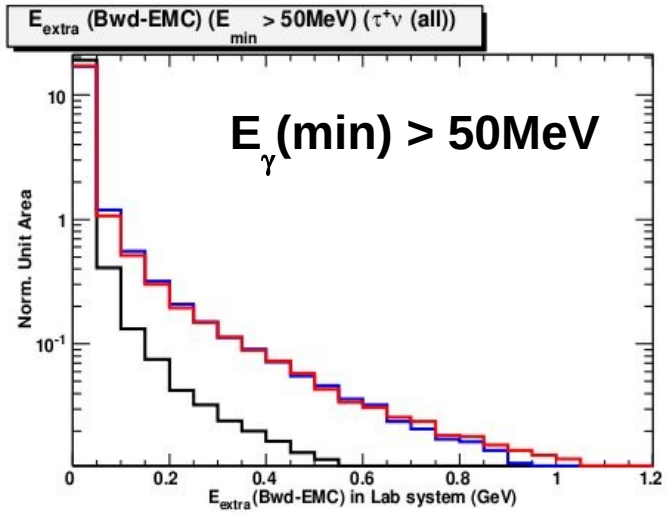
Could reduce backgrounds by around 10%

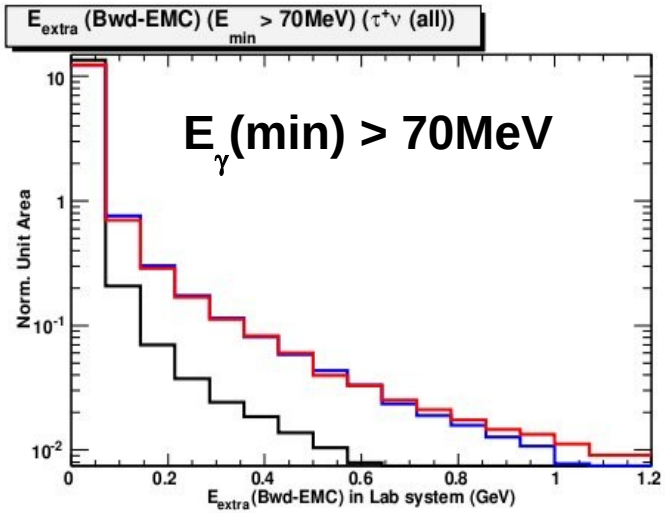
E_{extra}(Bwd-EMC) (GeV)

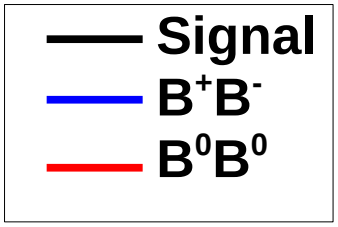
Bwd-EMC studies (smearing Off): $B^+ \to \tau^+ \nu$











Warning:
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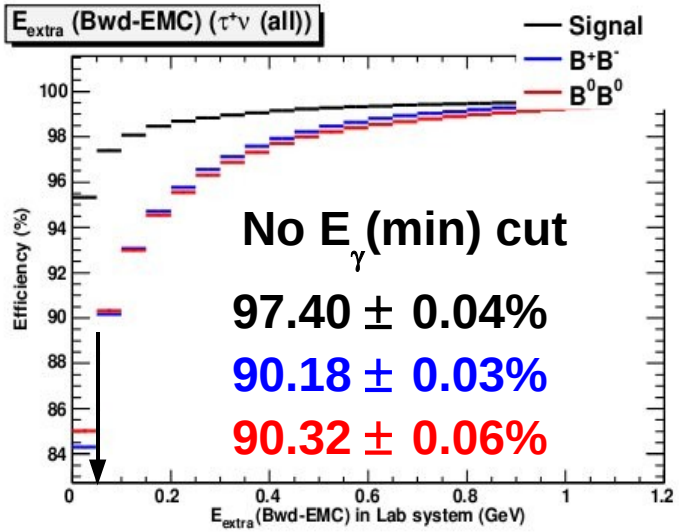
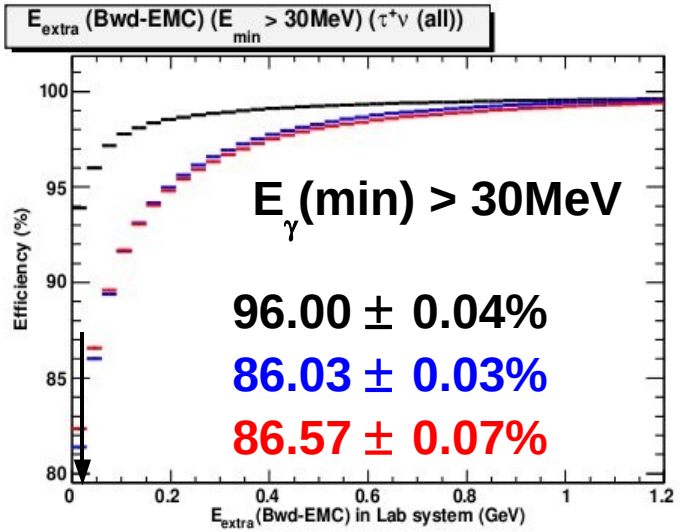
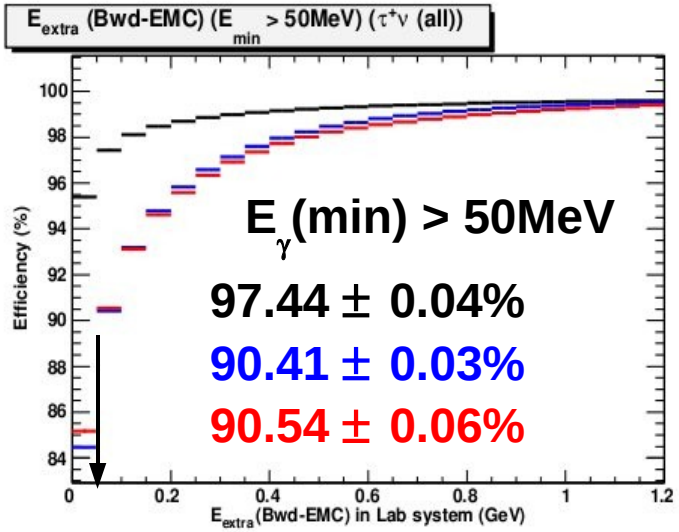
Backgrounds have longer tails to high values w.r.t signal

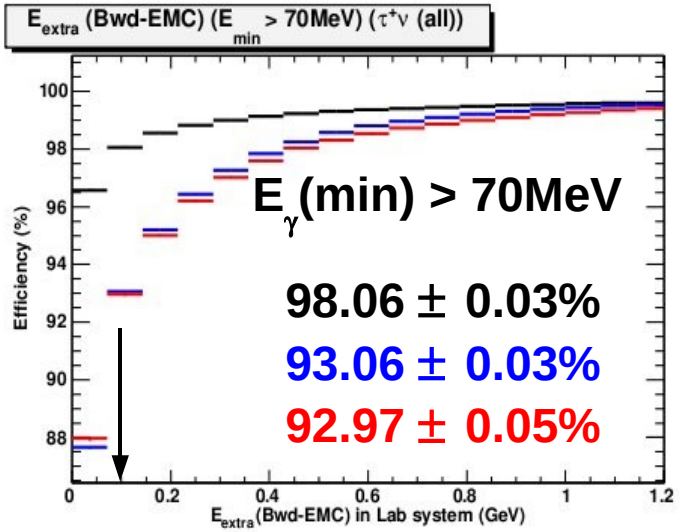
E_{extra}(Bwd-EMC) (GeV)

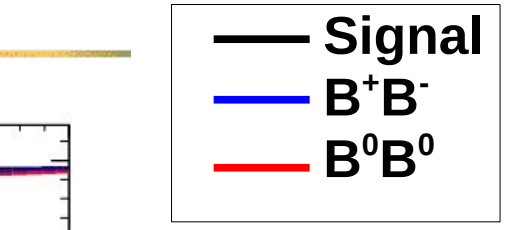
Bwd-EMC studies (smearing Off): $B^+ \to \tau^+ \nu$











Seems that it is better to use E_γ(min) > 30MeV

Could reduce backgrounds by around 10-14%

E_{extra}(Bwd-EMC) (GeV)