

A Preliminary Comparative Analysis of SuperB Backwards EMC

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Purpose

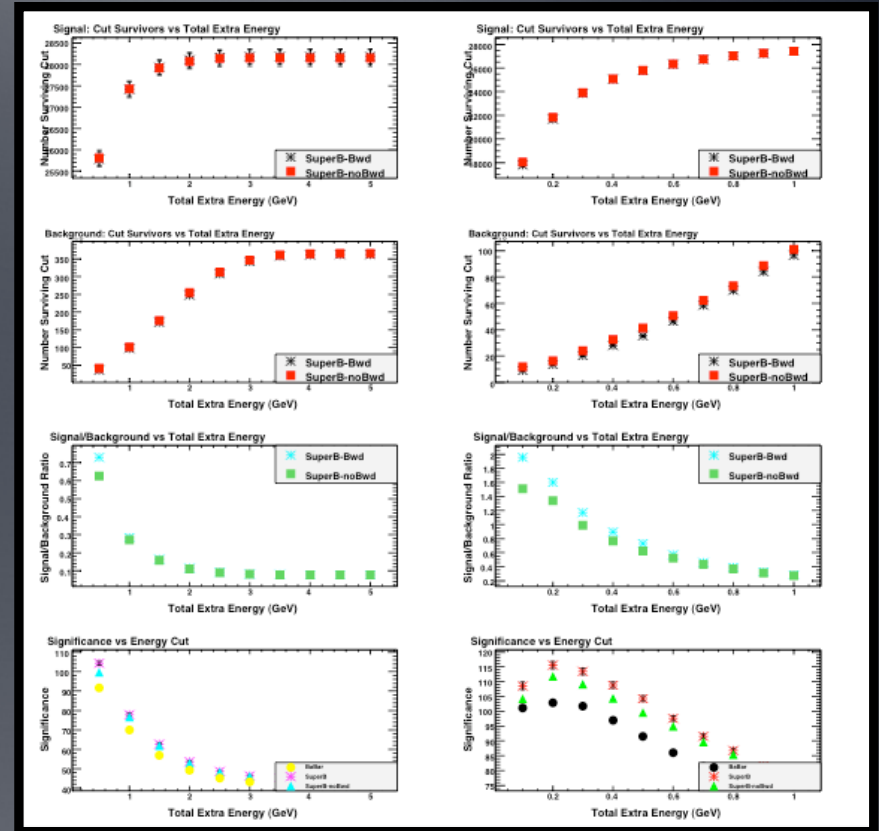
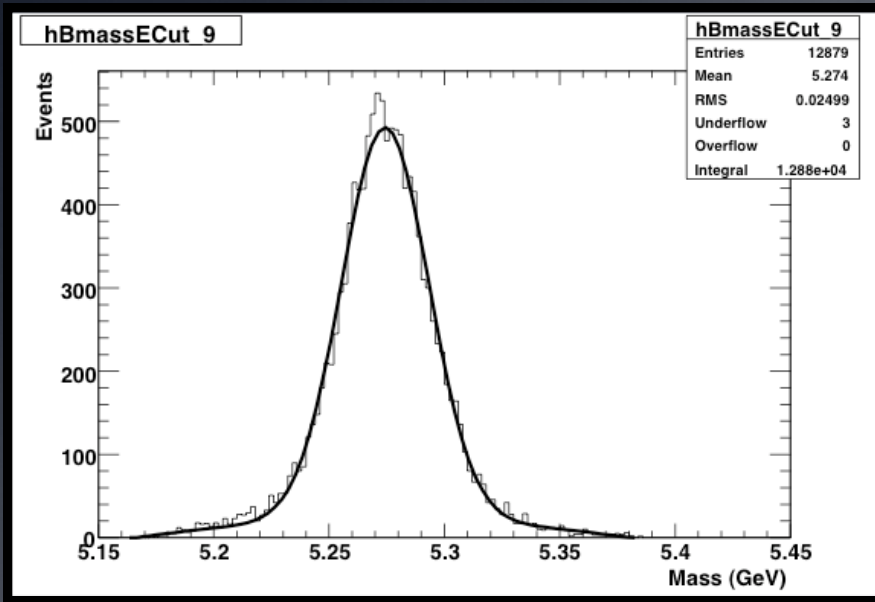
- To compare the performance of SuperB Factory with and without the Backwards EMC
 - 139 cm Backwards EMC Detector Configuration
 - Signal to Background Ratios
 - Precision/Significance - $S/\sqrt{S+B}$
 - With Backwards EMC vs. No Backwards EMC
 - In relation to BaBar
- To decide whether the performance bonus given by Backwards EMC justifies the increased cost

Methods

- Specify Tag B, Recoil B (Signal), and Background Decay
 - Tag- B+ -> anti-Do Pi, anti-Do -> K+ Pi-
 - Recoil- B- -> Tau- anti-tau neutrino
- Major Background Decays (Relative B.F. >1)
 - B- ->Do Lep Nu (160) B- ->D*o Lep Nu (406)
 - B- ->D- Pi Lep Nu (30) B- ->D*- Pi Lep Nu (44)
 - B- ->D**o Lep Nu (O(10^2)) *100 for purpose of analysis
- Minor Background Decays (Relative B.F. <1)
 - B- ->Pio Lep Nu (.55)
 - B- ->Eta Lep Nu (.43) B- ->Eta' Lep Nu (.12)
 - B- ->Omega Lep Nu (.93)
 - B- ->Rhoo Lep Nu (.91)

Methods (ctd.)

- Reconstruct Tag B from signal MC
- Apply same B reconstruction to background MC
- Compare Precisions and Signal to Background Ratios for B's when cut on Total Extra Energy
 - BaBar
 - SuperB with Backwards EMC
 - SuperB without Backwards EMC
 - Precisions meaningful only relative to each other based on arbitrary luminosity
- Each MC Run Contained 50k events
 - B.Fractions Normalized w.r.t B- \rightarrow Tau Nu running 1 MC Run

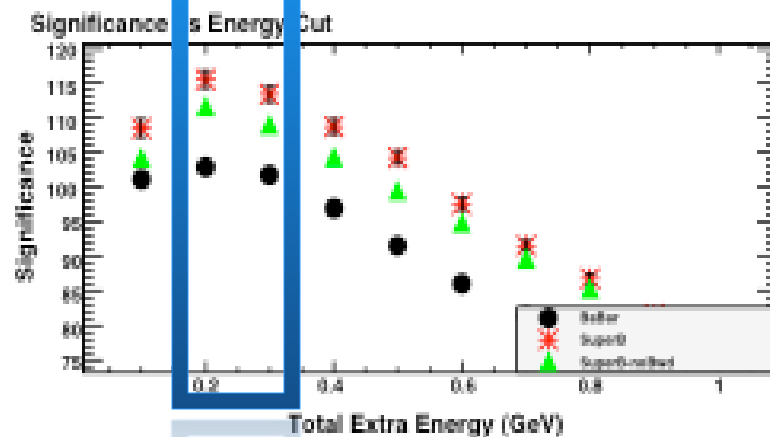
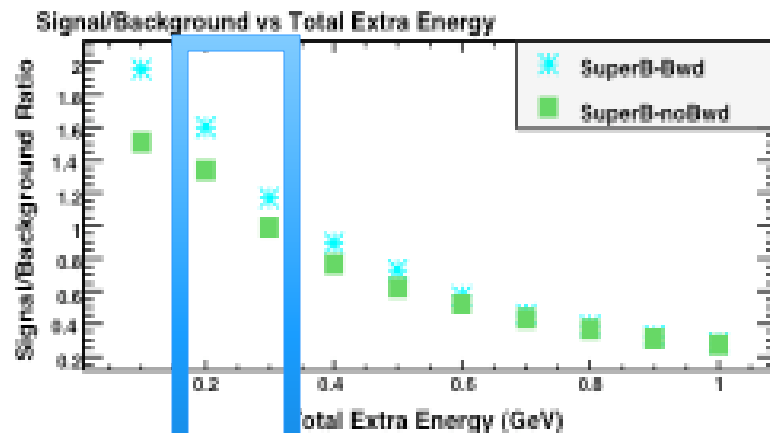
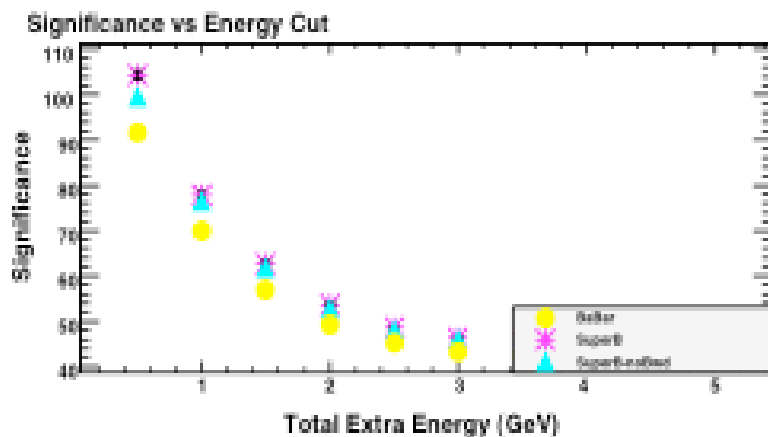
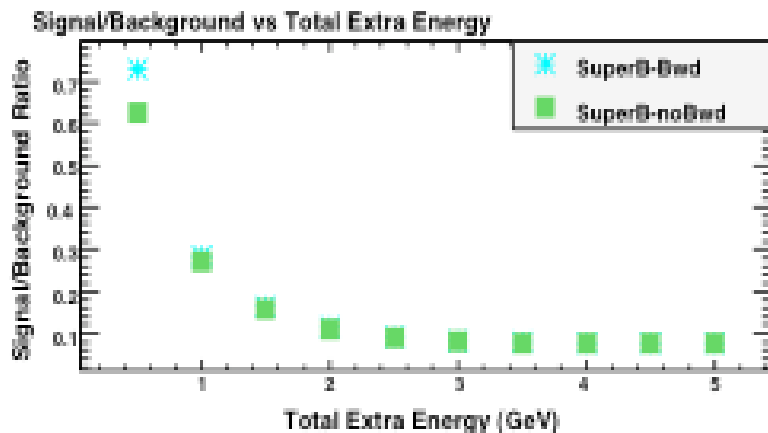


Total Extra Energy

We analyze B mass plots with cuts on the Total Extra Energy in the detector. We fit with a Gaussian+Bkg for each cut, record the integral, for both the Signal and Background decay (for both with and w/o bwd EMC), and plot the data to generate Signal and Background Decay plots. We then use those Signal and Background Plots to generate Signal/Background and Precision $S/\sqrt{S+B}$ plots.

Tag B Reconstruction

- In order to compensate for the huge branching fractions in the background, we cut on the mass of D_0 to be around PDG mass
 - Removes Combinatorial Background
- Also Place an additional cut to have 4 tracks
 - Makes Branching Fraction Comparable



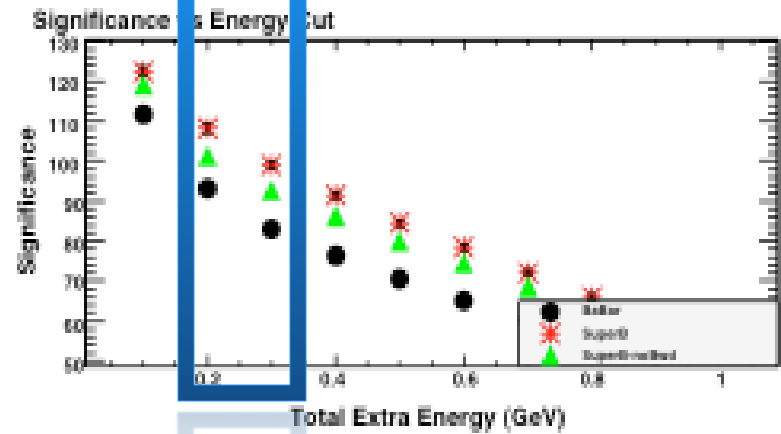
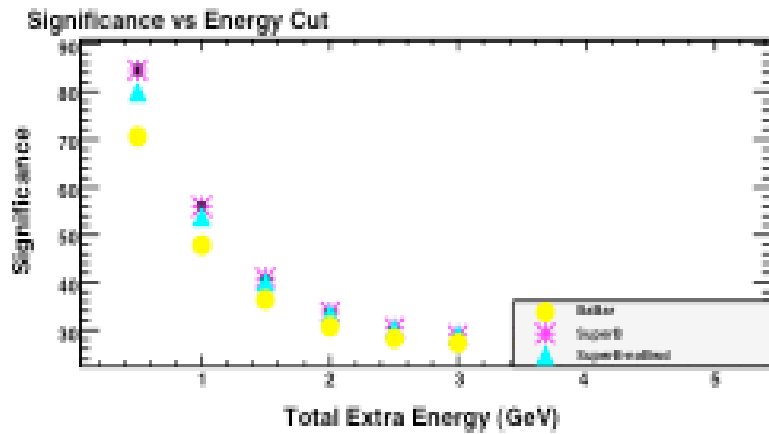
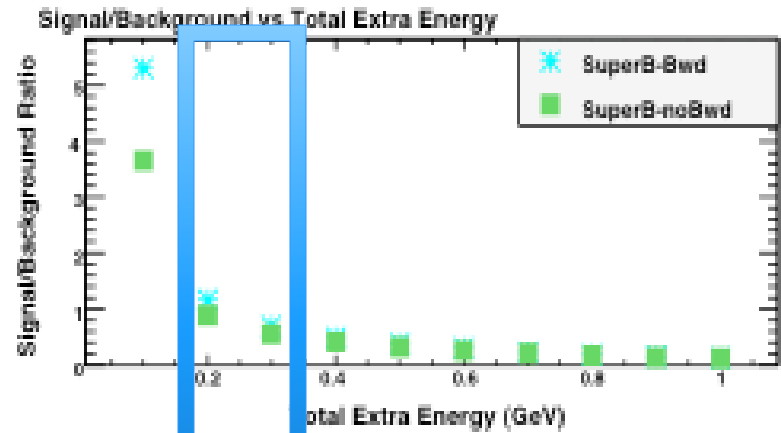
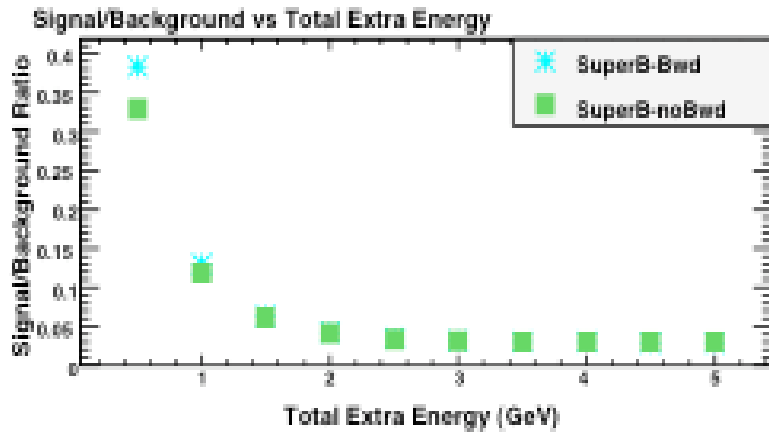
B→D₀ Lep Nu Background

Analysis with the 120 cm configuration resulted in 50-60% improvement vs SuperB no Bwd EMC

Runs=8

Branching Fraction = 160

Improvement in S/B Ratios in .2 -.3 GeV Range: 17% - 20%

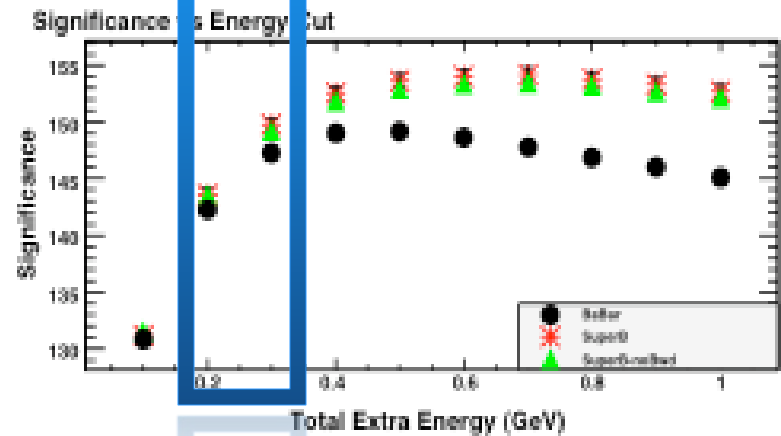
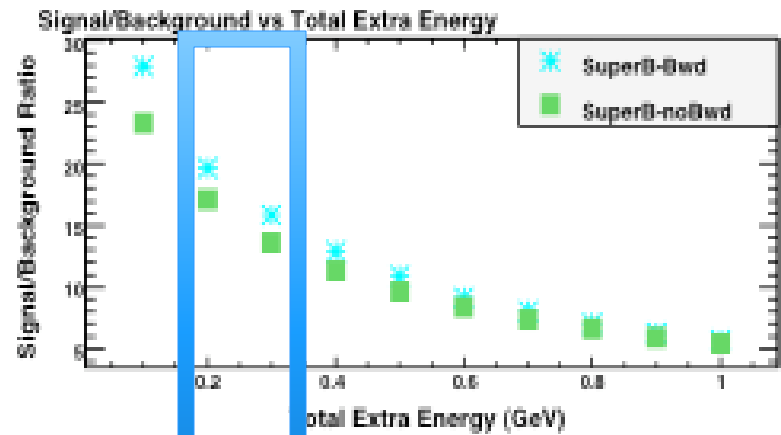
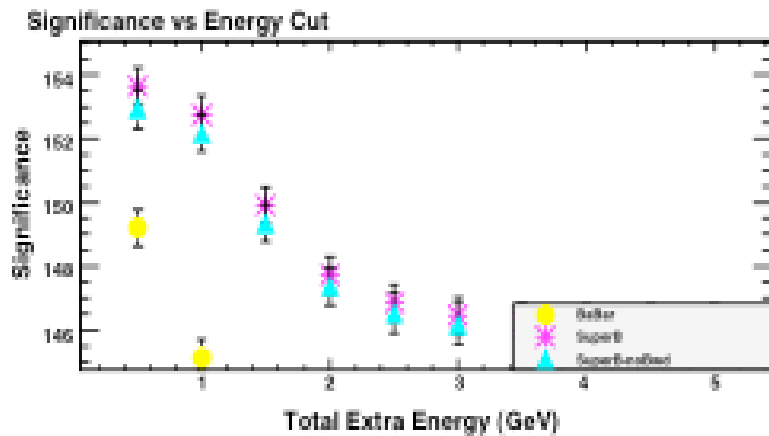
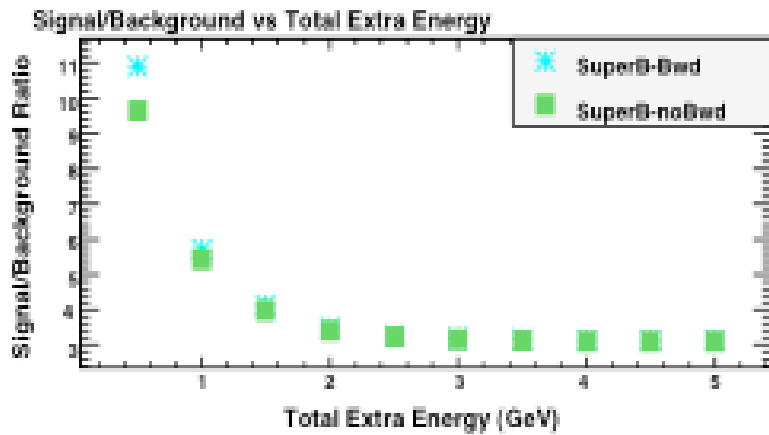


B- \rightarrow D* ν Lep Nu
Background

Runs = 20

Branching Fraction= 406

Improvement in S/B Ratios in .2 -.3 GeV Range: 24 % - 33%

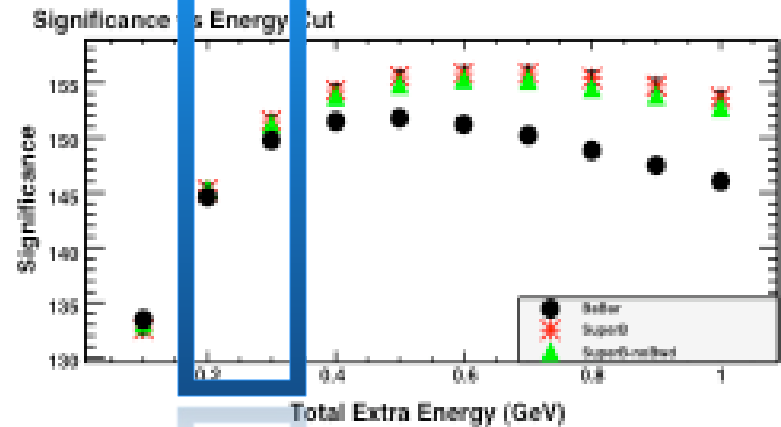
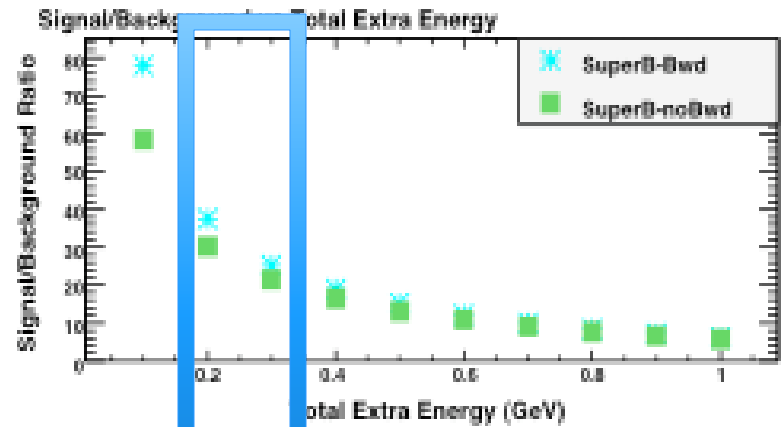
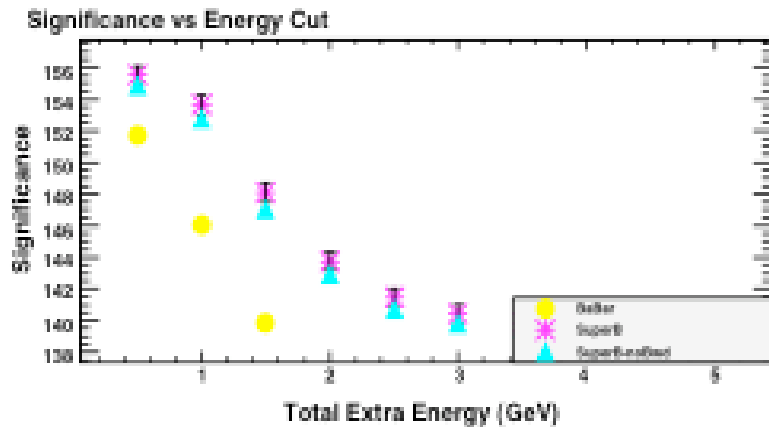
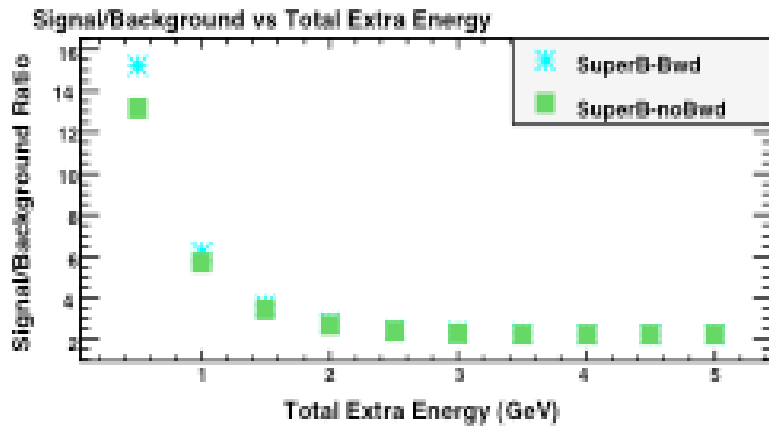


B→D Pi Lep Nu
Background

Runs = 50

Branching Fraction= 30

Improvement in S/B Ratios in .2 -.3 GeV Range: 15 % - 16%

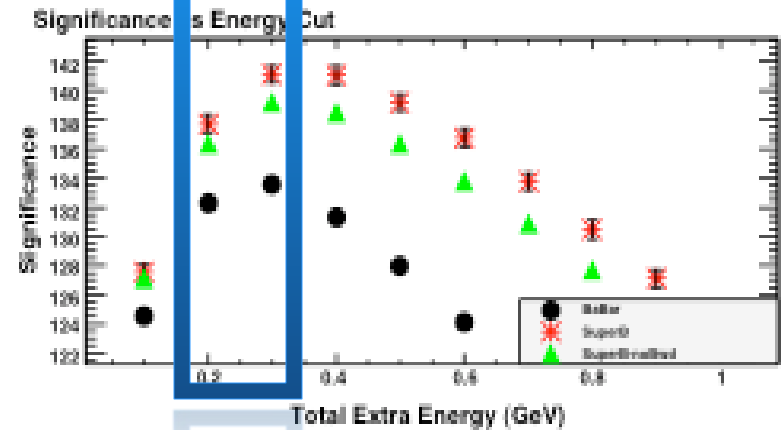
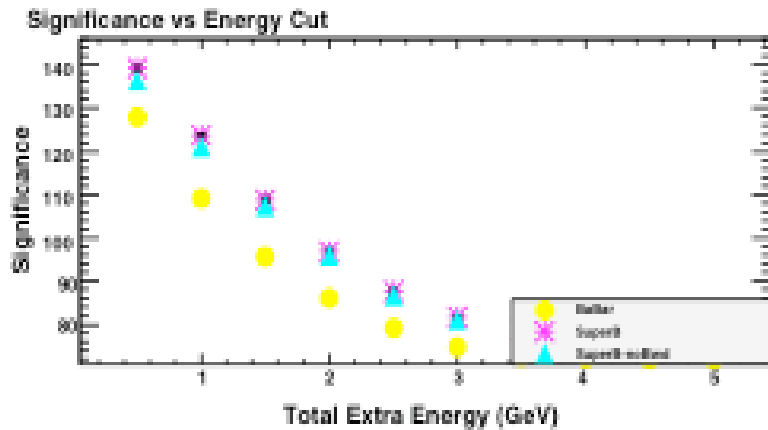
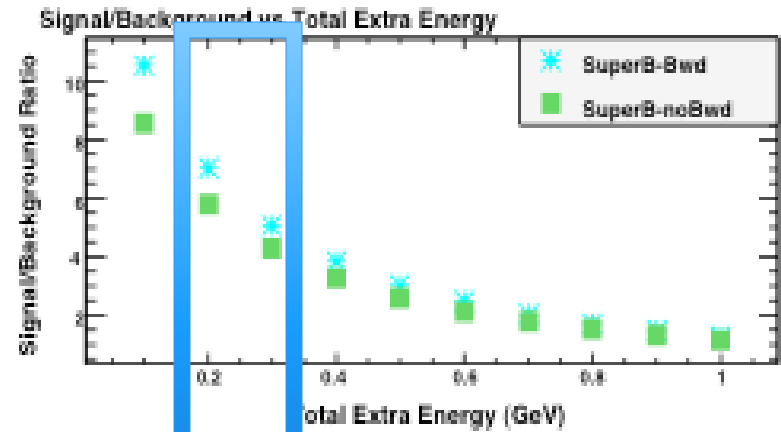
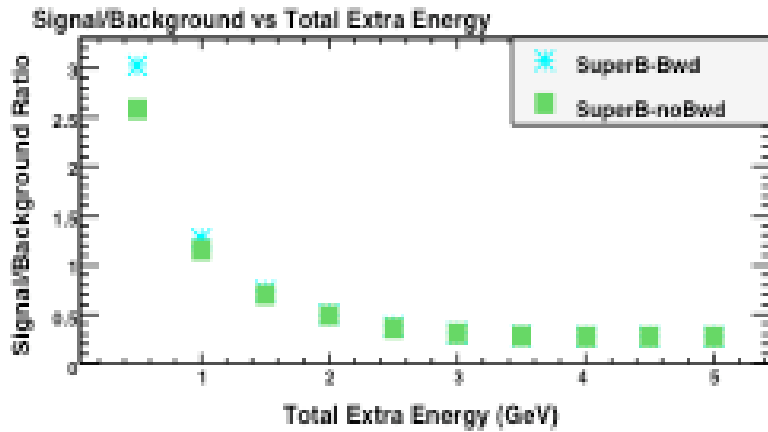


B→D*Pi Lep Nu
Background

Runs = 100

Branching Fraction= 44

Improvement in S/B Ratios in .2 -.3 GeV Range: 15 % - 17%

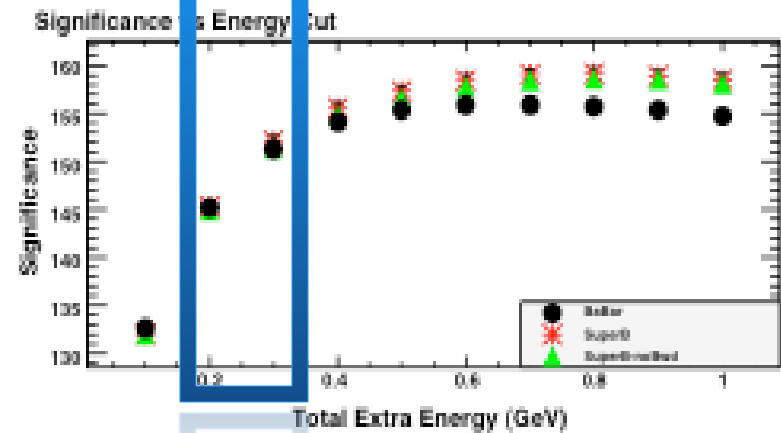
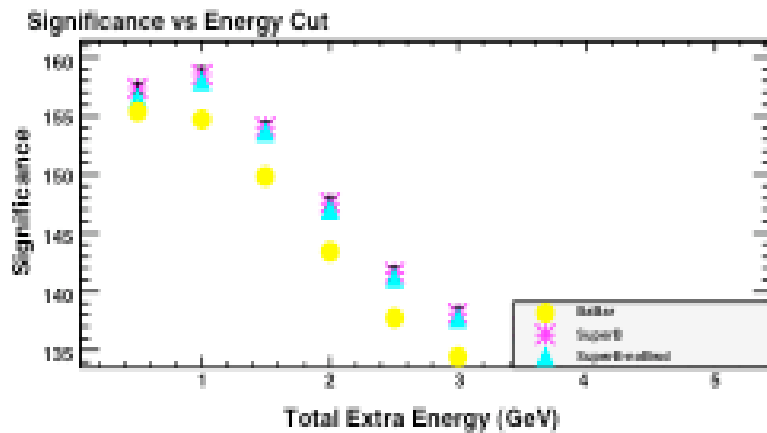
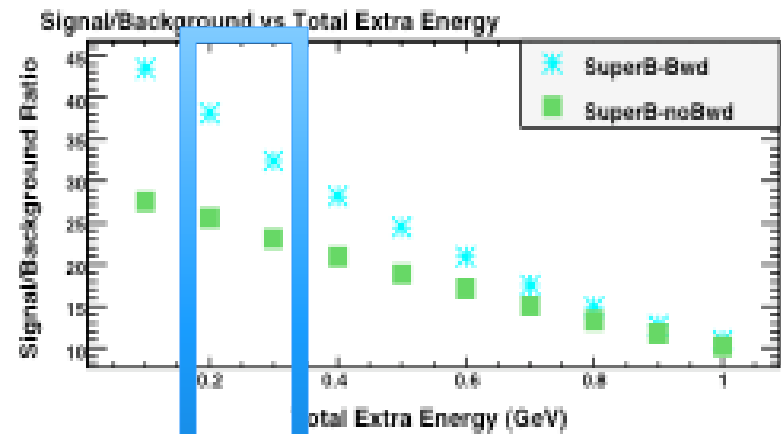
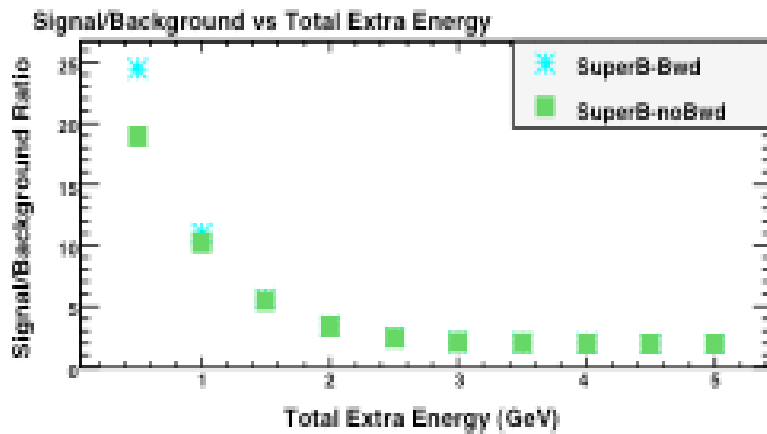


B- \rightarrow D**o Lep Nu
Background

Runs = 200

Branching Fraction=100

Improvement in S/B Ratios in .2 -.3 GeV Range: 18 % - 19%



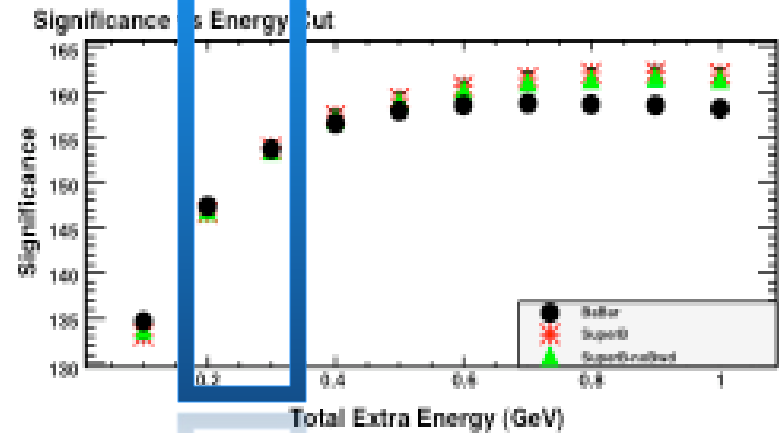
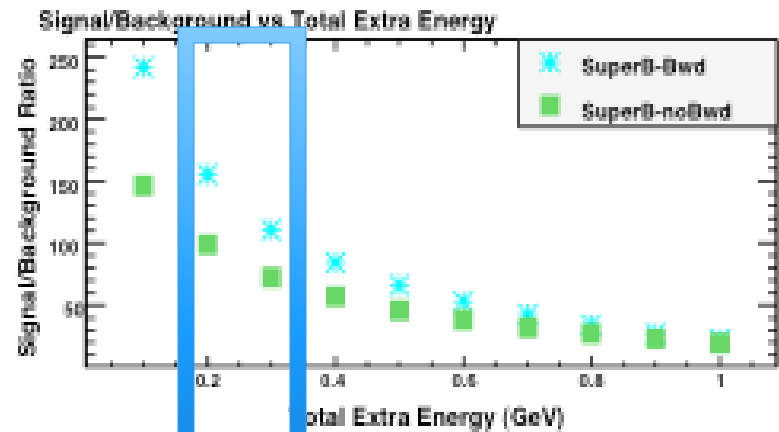
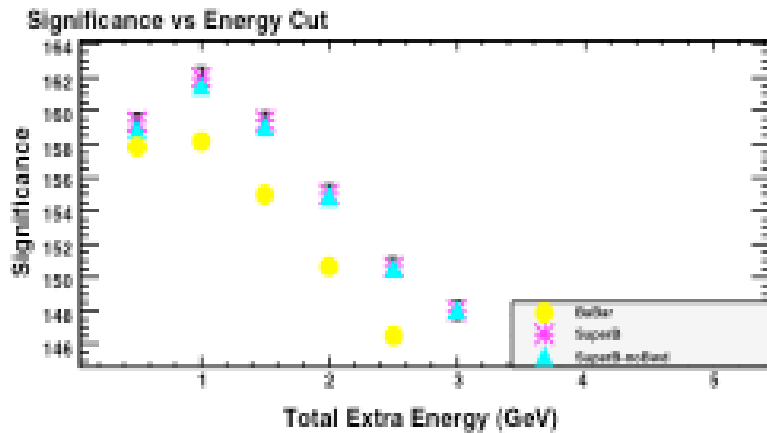
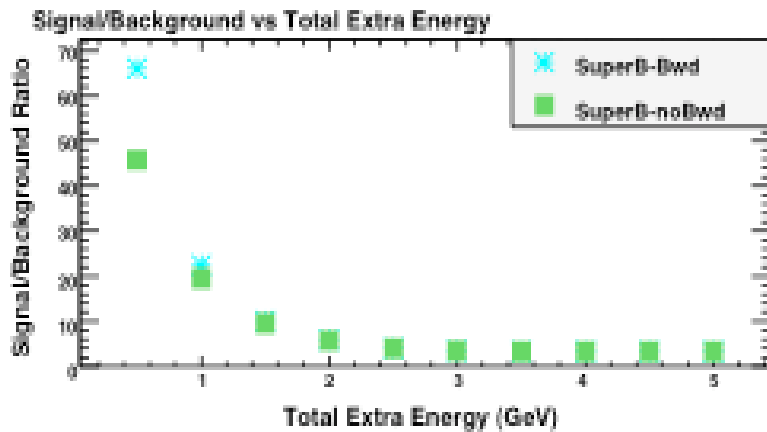
B->Pio Lep Nu Background

*This Analysis was also done on the 120 cm configuration and showed a 100% improvement over SuperB no Bwd EMC

Runs = 1

Branching Fraction= .55

Improvement in S/B Ratios in .2 -.3 GeV Range: 40 % - 50%

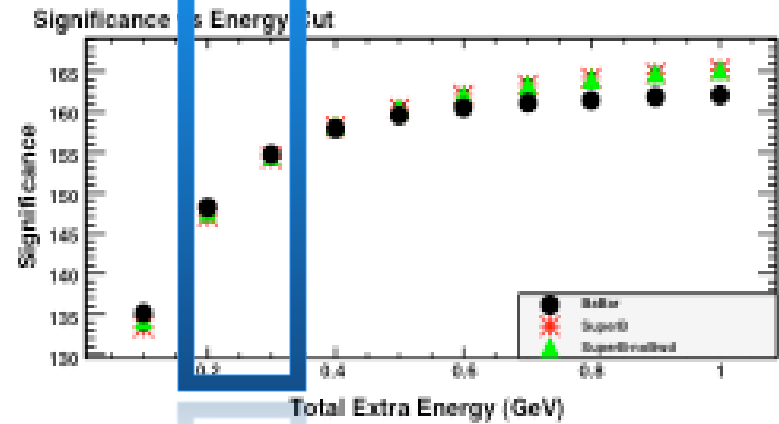
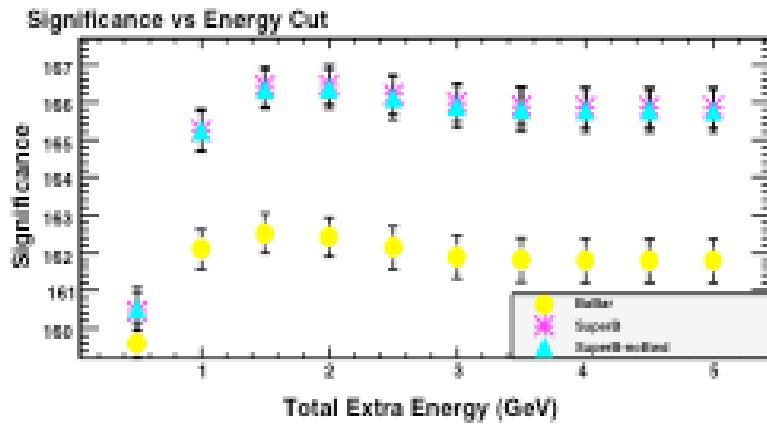
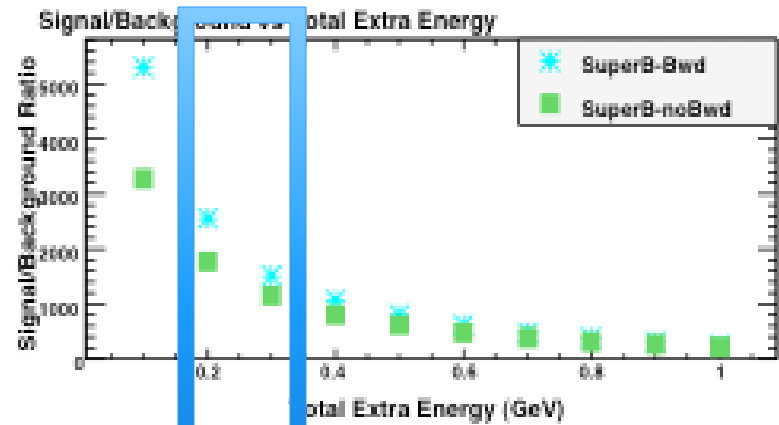
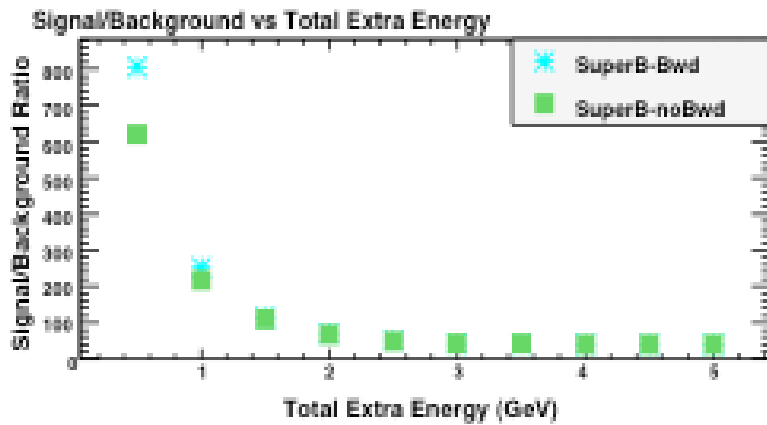


B→Eta Lep Nu
Background

Runs = 20

Branching Fraction=.43

Improvement in S/B Ratios in .2 -.3 GeV Range: 53 % - 58%

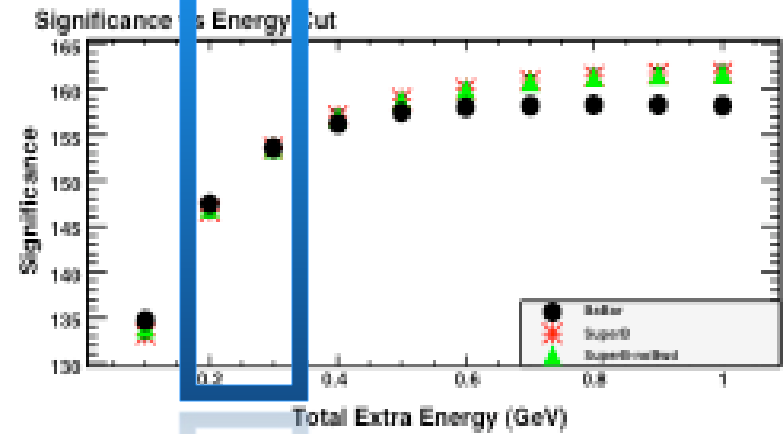
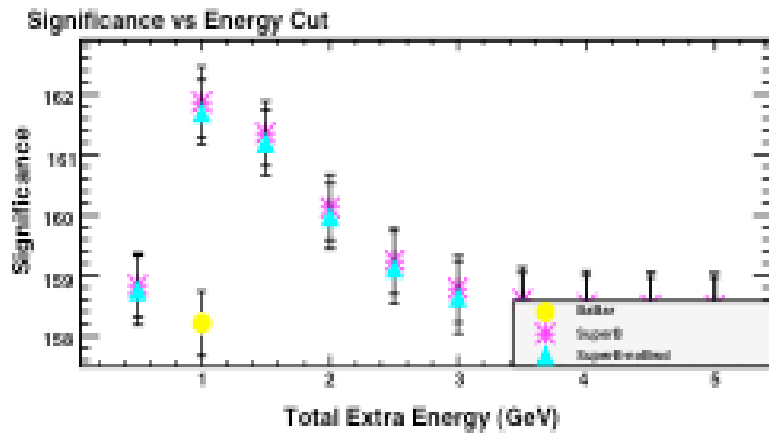
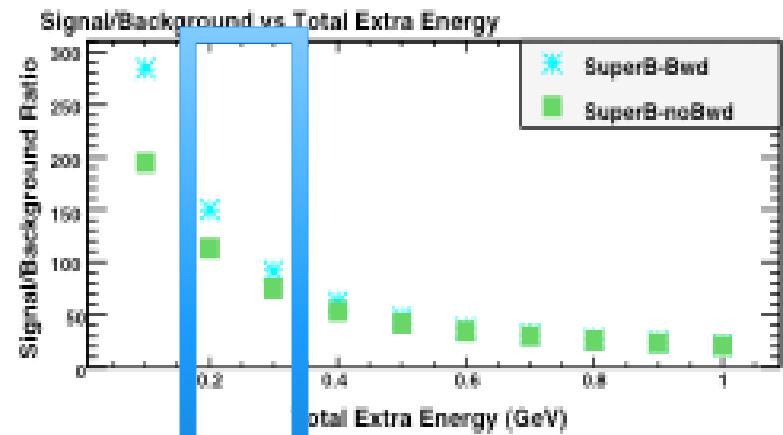
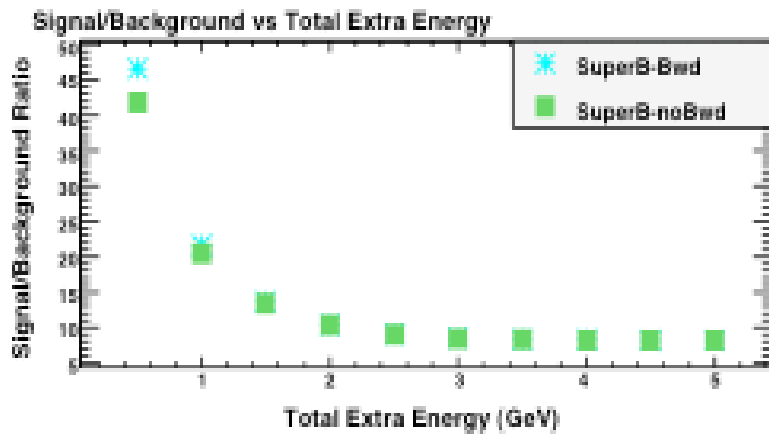


B → η' Lep Nu
Background

Runs = 20

Branching Fraction = .12

Improvement in S/B Ratios in .2 - .3 GeV Range: 31% - 32%

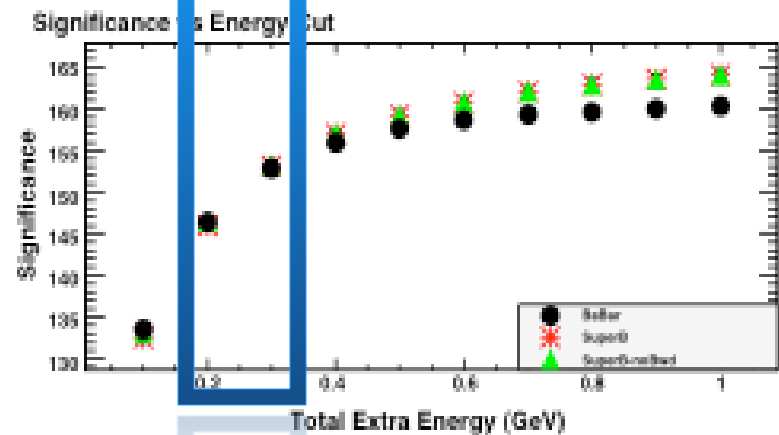
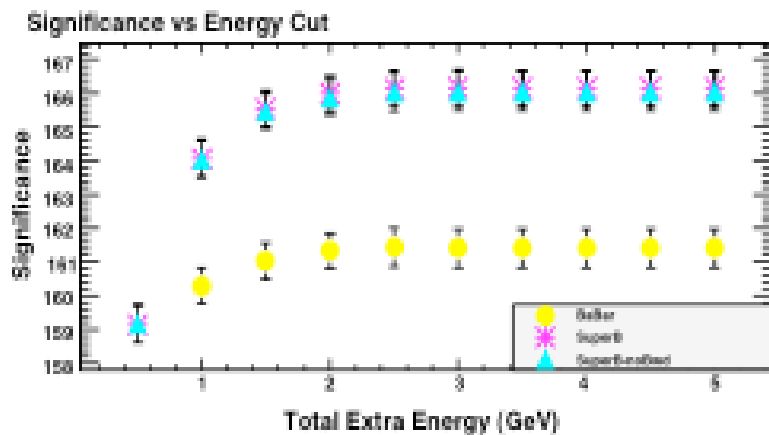
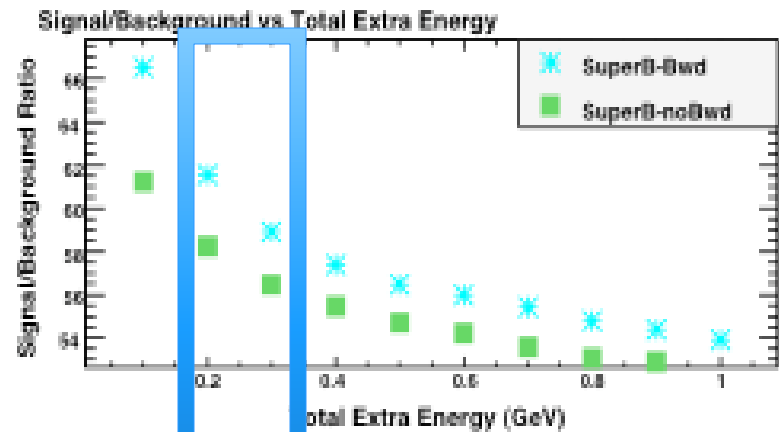
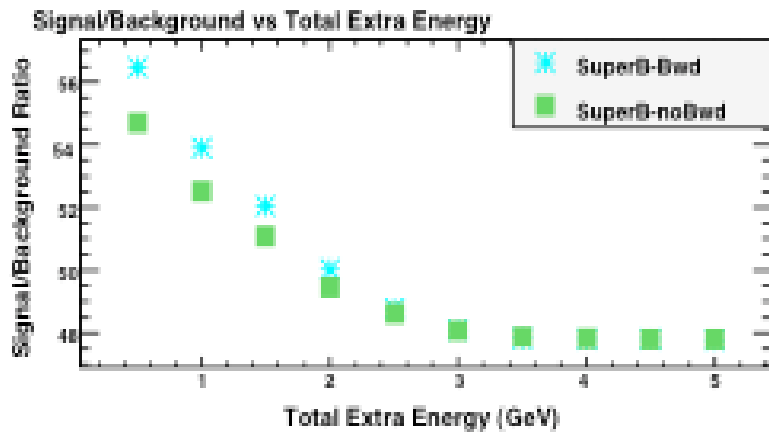


B->Omega Lep Nu
Background

Runs = 20

Branching Fraction=.93

Improvement in S/B Ratios in .2 -.3 GeV Range: 23 % - 33%



B → ρ^0 Lep Nu
Background

Runs = 20

Branching Fraction = .91

Improvement in S/B Ratios in .2 - .3 GeV Range: 4% - 6%

Trends

- Precision: .2 GeV to .3 GeV Range
 - SuperB with + w/o bwd EMC have distinct advantages over BaBar
 - SuperB with bwd EMC has advantage vs SuperB w/o
 - About 5% better with bwd EMC vs. SuperB w/o in Major Backgrounds
 - No difference with bwd EMC vs SuperB in Minor Backgrounds
 - Results may vary under analysis with different Tag and Recoil Signal Monte Carlos
- Signal vs Background: .2 GeV to .3 GeV Range
 - See distinct advantage with backwards EMC vs. without, but magnitude of the advantage varies from 15% to 60%
 - Larger Branching Fraction -> Appreciable Improvement
 - Smaller Branching Fraction -> Larger Improvement
 - B.F. Weighted Average of % Increase ~ 24%
 - Crude Estimate
- Early hint that 120 cm configuration provides significantly better results than 139 cm configuration

Follow Up Analyses

- Repeat Analysis for 120 cm detector configuration and compare results
- Repeat Analysis while varying Tag and Recoil Decays
- Combine Backgrounds together and repeat Precision and Signal/Background analysis from conglomerate Background