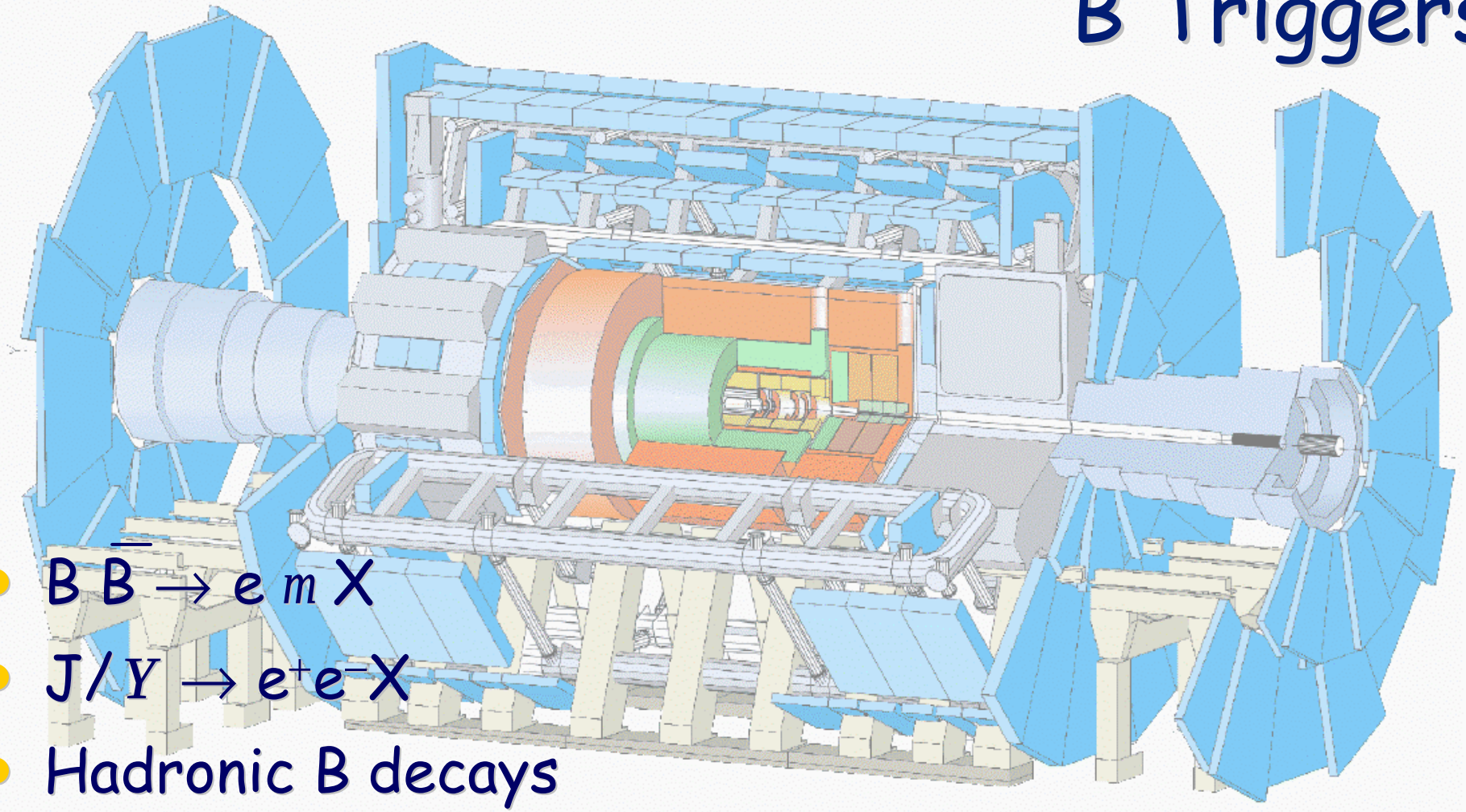
Can Calorimeter RoIs Guide B Triggers?



- $B\bar{B} \rightarrow e\,m\,X$
- $J/Y \rightarrow e^{+}e^{-}X$
- Hadronic B decays

The Problem

Strategy so far

- Trigger on muon(s)
- Full scan at Level-2 to select interesting channels

Is there a viable alternative?

- Use Level-1 RoIs to restrict scan?

Two studies

- e/γ RoI to select $B \rightarrow e\, \nu\, X$; $B \rightarrow J/\psi\, X \rightarrow e^+e^-X$
- Jet RoI to select $B \rightarrow pp$; $B_s \rightarrow D_s p \rightarrow \phi pp$
- In both cases, would still use muon to trigger event

Event & Trigger Simulation

Event Trigger

- muon, $p_T > 6$ GeV, $|h| < 2.5$
- MC truth information used – no simulation of m trigger
- BB events generated with $p_T > 7$ GeV

Calorimeter Trigger Simulation

- ATLFAST + parameterised calorimeter simulation
  - B-field, longitudinal & transverse shower profiles
  - pulse history, digitisation & BCID
  - complete Level-1 trigger algorithms

Caveats

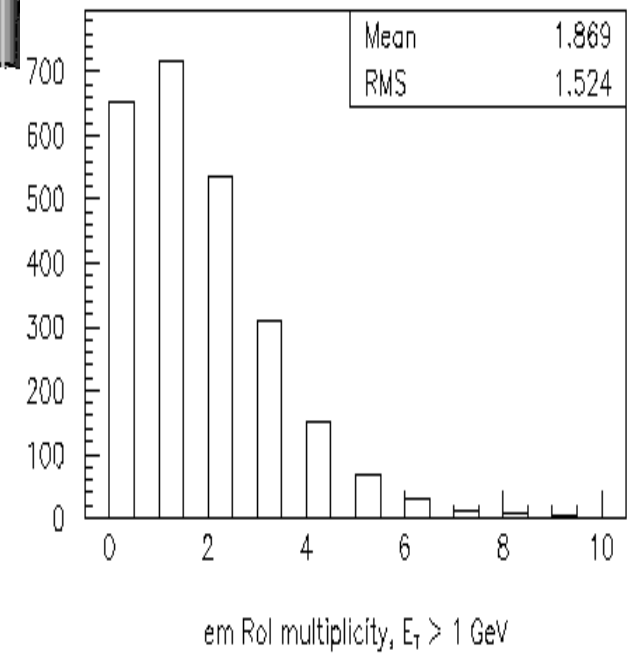
The Fast Level-1 Sim is pretty good:

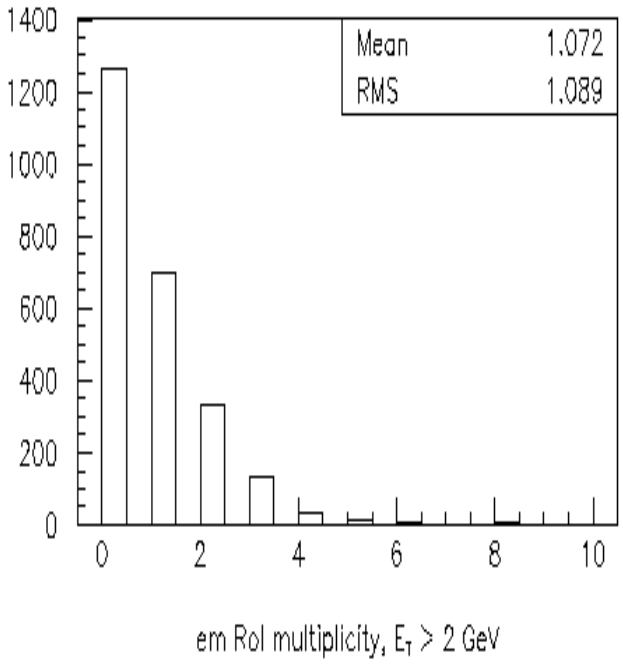
- Reproduces TDR e/γ trigger rates
- Low-E_T jets similar to the (limited) Level-1 studies done with full sim
- Pulse shape/history/BCID model much better than Atrig

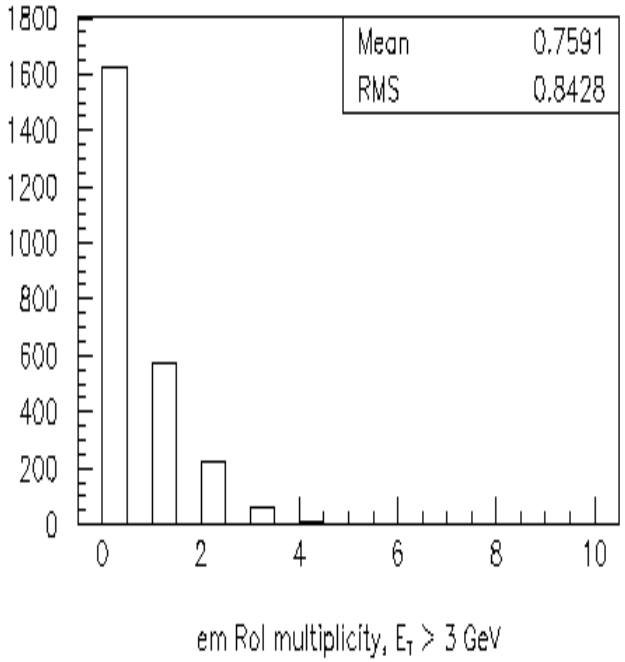
But it's not a full simulation:

- and low-E_T trigger is the most difficult thing
- important to confirm with full sim as becomes available

e/γ RoI Multiplicity (B ® mX events)







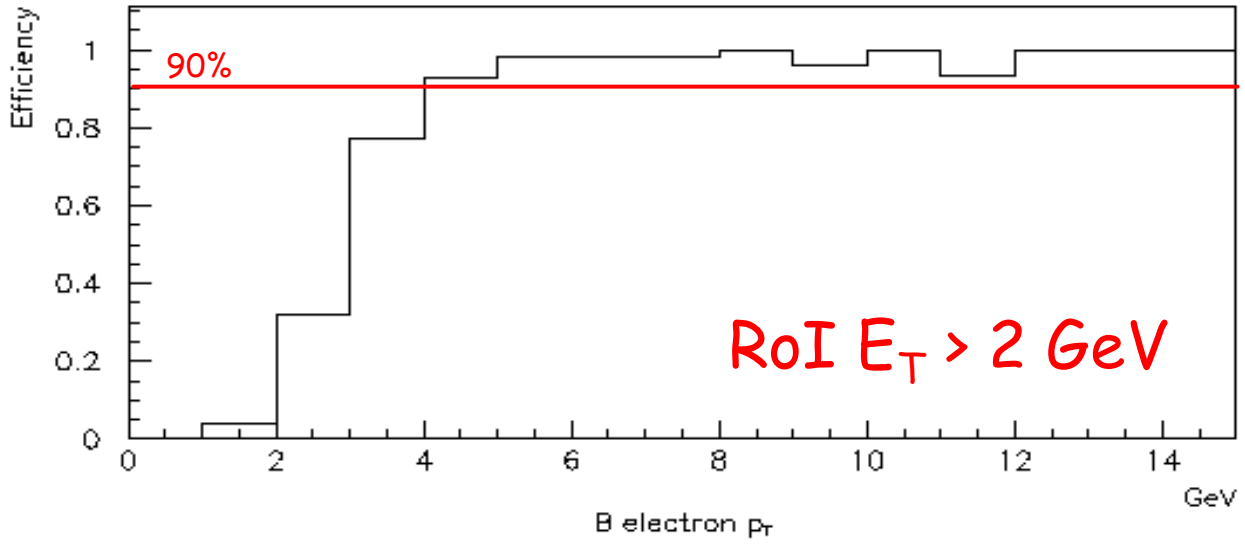
Mean RoI multiplicity vs threshold

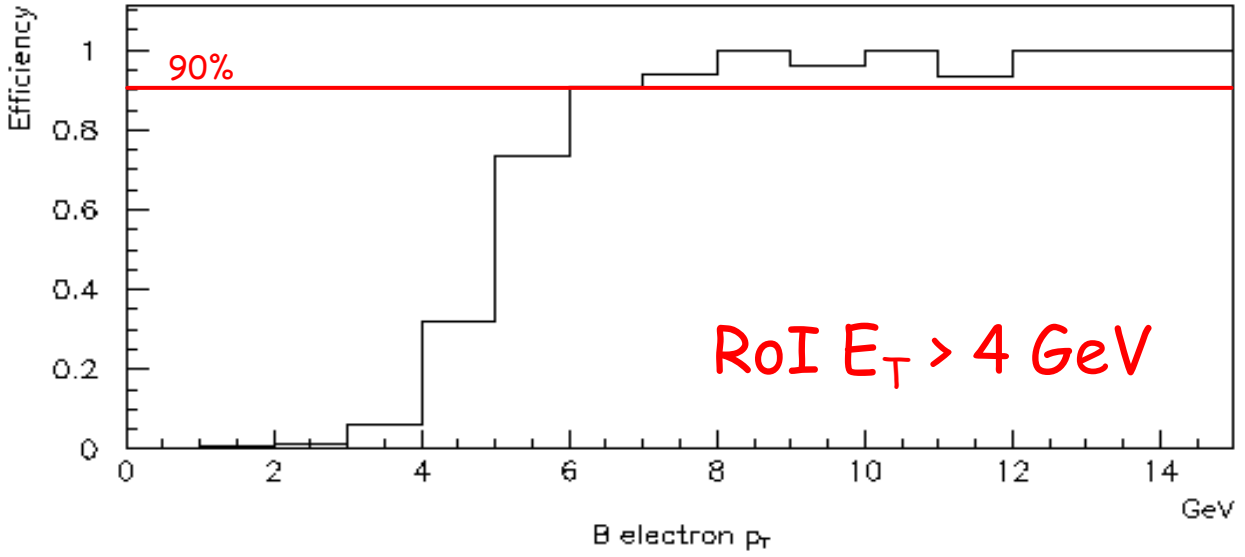
RoI E_T	> 1 GeV	> 2 GeV	> 3 GeV	> 4 GeV	> 5 GeV	> 6 GeV
$\langle N_{RoI} \rangle$	1.9	1.1	0.8	0.6	0.5	0.4

e/γ RoI Efficiency

B → e efficiency

- Muon triggered events
- RoI matched to initial direction of B-decay electron
- $\Delta\eta, \Delta\phi < 0.25$
- No isolation requirement





B ® J/Y

Target: Low p_T $e^{\pm}$

- B-field bending significant: match to $\Delta\eta < 0.15$, $\Delta\phi < 0.3$
- Look at lowest RoI E_T thresholds possible

Tagging $J/\Psi \rightarrow e^+e^-$ with RoIs:

- 2421 events with μ trigger & 2 e, $|\eta| < 2.5$ (all e p_T)
- RoI > 1 GeV $\Rightarrow$ 96% $\geq$ 1 e tagged, 48% both e tagged

Varying e p_T range & RoI threshold

Min. e p_T	RoI Threshold	Both e tagged?
p_T > 2 GeV	E_T > 1 GeV	86%
p_T > 3 GeV	E_T > 2 GeV	80%
p_T > 4 GeV	E_T > 3 GeV	73%

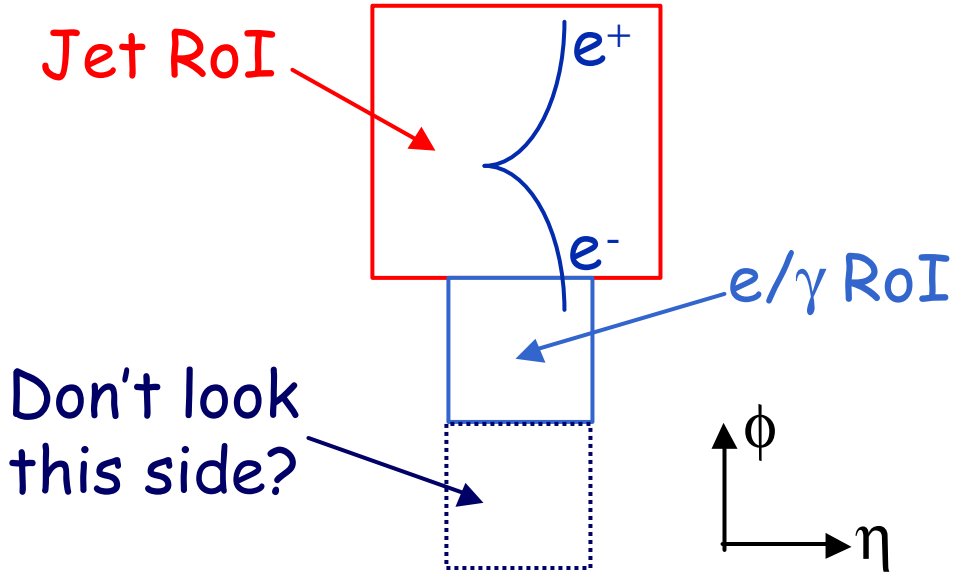
Random Thoughts

e/γ RoIs: Δf = 0.3?

- Only need wide Δφ for lowest p_T e
  - > 1 RoI threshold? Not unlikely, if we go this way.

e/g plus jet?

- If jet RoI near to e/γ, can we narrow electron search?
- Is 1 e/γ + 1 jet RoI enough to look for J/Y?

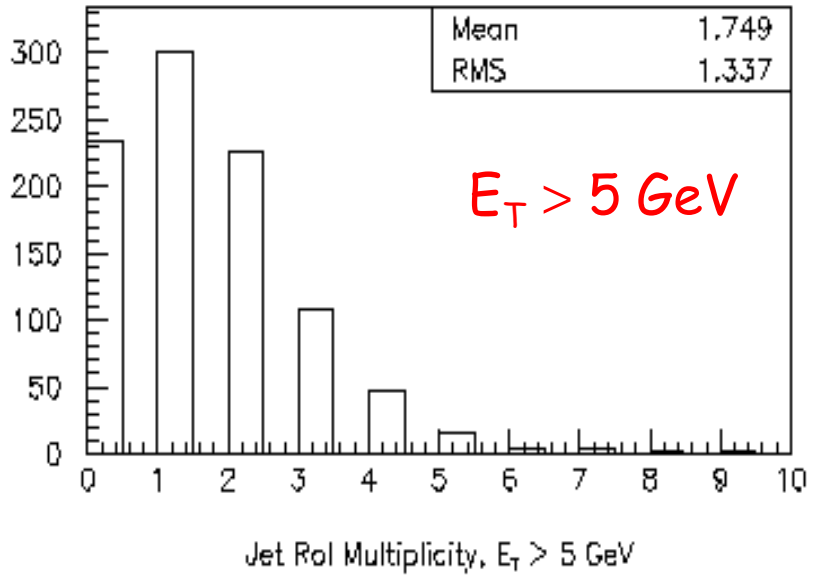


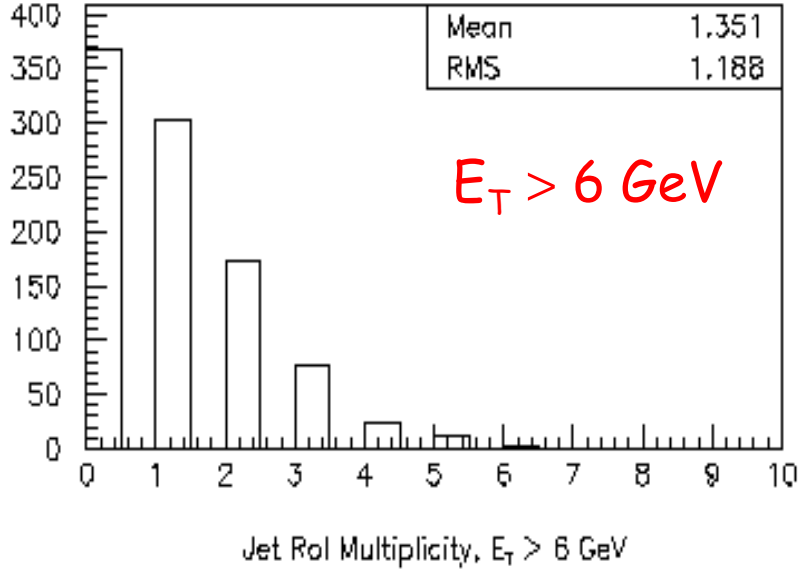
Hadronic B Decays

Idea:

- Use Jet RoI to guide track scan (0.8×0.8 jet cluster)
- As always, require m > 6 GeV to trigger event
- Consider "matched" if RoI within $\Delta\eta, \Delta\phi < 0.4$ of B hadron

RoI Multiplicity vs Threshold

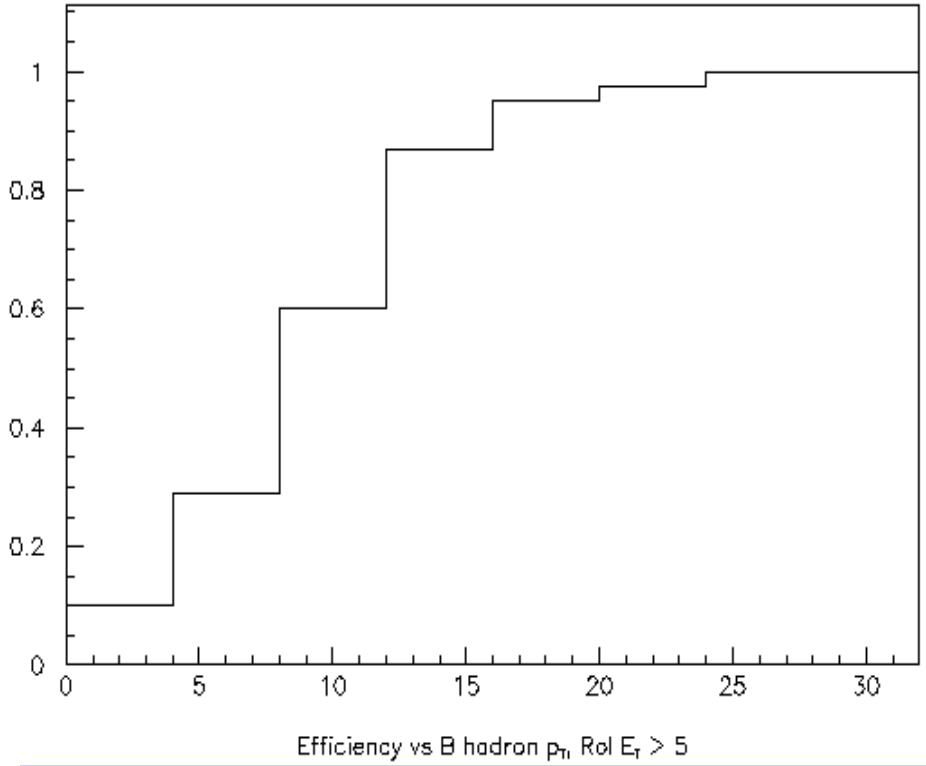




Specific B Modes

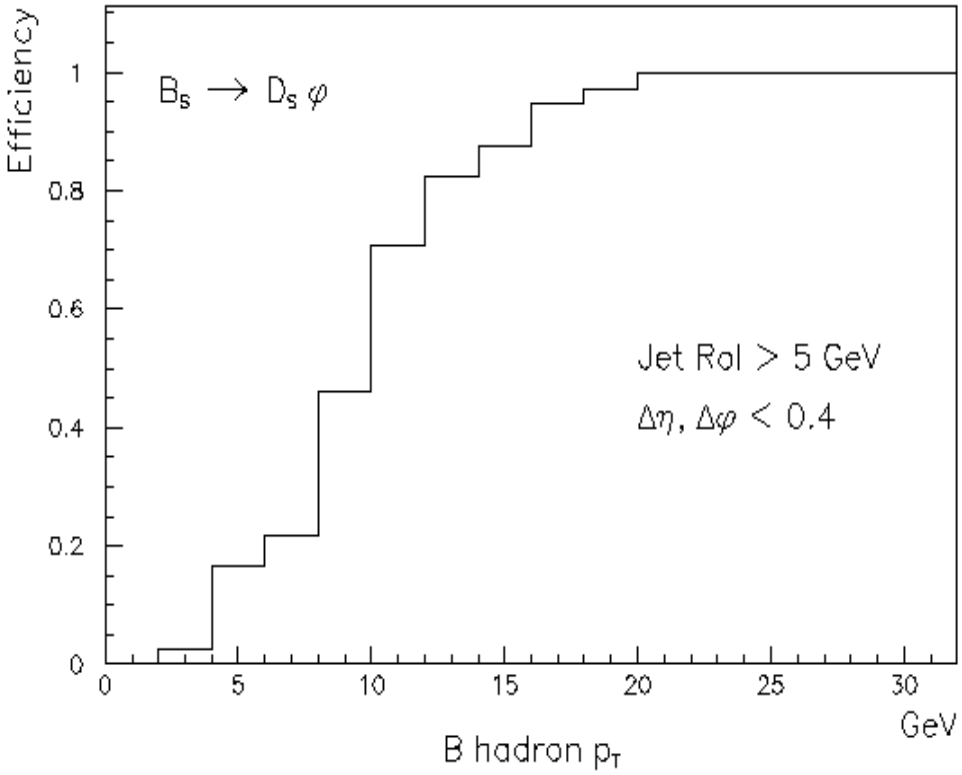
$B \rightarrow \pi\,\pi$

- $p_T\ \pi > 4$ GeV
- RoI $E_T > 5$ GeV



$B \rightarrow D_s\ f$

- p_T Ds, $f > 1$ GeV
- RoI $E_T > 5$ GeV



Summary

$B \rightarrow e$ flagging:

- Good efficiency seems possible for modest $e^{\pm}$ p_T & reasonable RoI multiplicity
- J/Ψ flagging seems possible
- Isolation doesn't help though (e not isolated)

Hadronic RoIs:

- Low E_T jets (~5 GeV) efficient for B p_T > 15-20 GeV
- No strong dependence on B decay mode

Things to do:

- Consider coincidence of e/γ & jet RoIs
- Verify using full simulation