Study of B-field strength

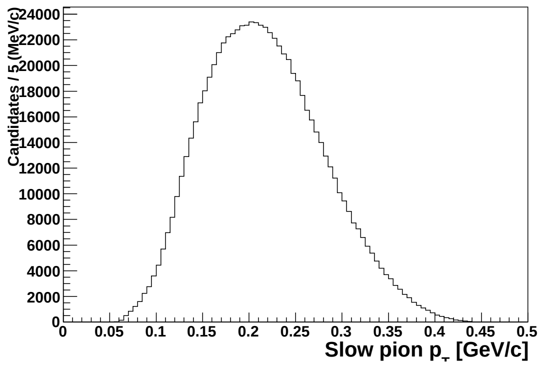
- **Run charm analyses in different SuperB configurations:**
  - **Default SuperB.**
  - **Varying B-field strength.**
  - **INMAPS SVT setup, in 'Lamp' and 'Long' variants.**
  - **BaBar configuration (for baseline comparison).**
- **Figures of merit:**
  - **Reconstruction efficiency.**
  - **Resolution of $D^{(*)}$ mass, ΔM, ΔE, m_{ES}.**
- **Analyses used:**
  - $c\overline{c} \rightarrow D^{*+} \rightarrow D^0\pi_s^+, D^0 \rightarrow K_S^0\pi^+\pi^-$.
  - $B^0\overline{B^0}$ **events tagged by** $D^{*+} \rightarrow D^0\pi^+$, $D^0 \rightarrow K\pi, K\pi\pi^0, K3\pi$, **or** $K_S^0\pi\pi$.

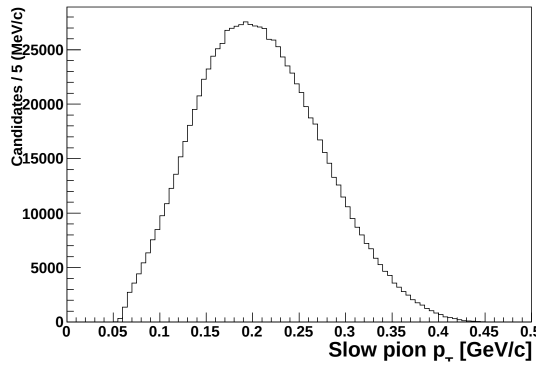
$D^0 \rightarrow K^0_S\pi^+\pi^-$ selection (for BaBar)

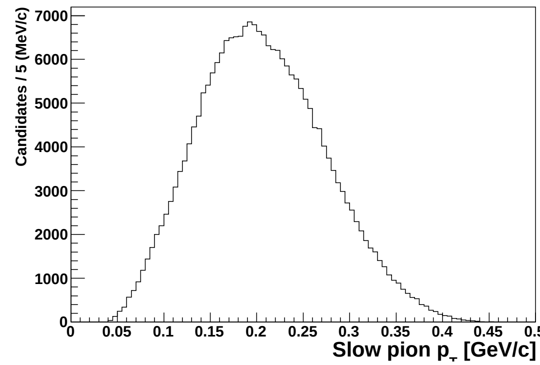
- Require D^0 CM momentum greater than 2.5 GeV.
- K^0_S candidate mass within 9 MeV of nominal value.
- Fit probability at least 0.01%.
- Slow pion must have at least one DCH hit.
- Pions from D^0 must have at least two SVT hits.
- K^0_S decay vertex separated from D^0 vertex by 10 flight-length errors.
- K^0_S momentum and flight angle parallel, $\cos\theta > 0.99$.
- All tracks must have at least 0.1 GeV of (lab) transverse momentum. This ensures that they make it to the tracking volume.
- For B-fields not equal to 1.5T, transverse-momentum cut is reduced proportionally; thus 0.1 GeV at $B = 1.5T$, 0.066 GeV at $B = 1.0T$. This is the source of the increased efficiency.

p_T distributions after other cuts

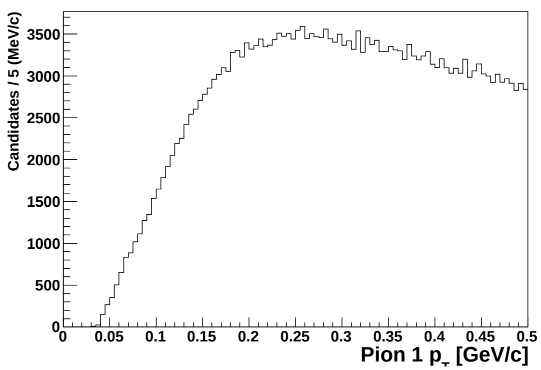
BaBar	SuperB	B=1.0T

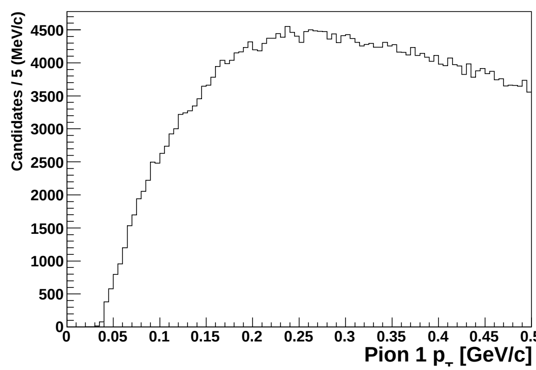


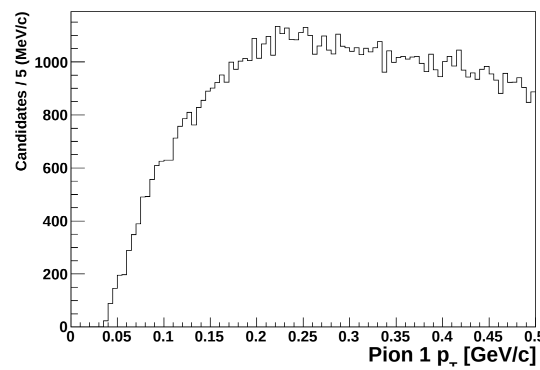




Slow pion	Slow pion	Slow pion



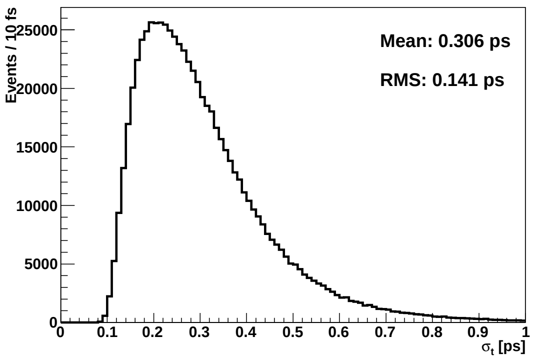




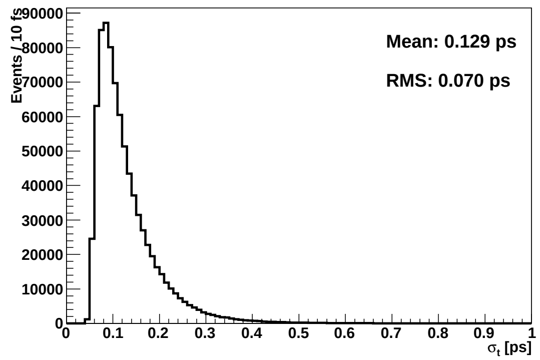
π^+ from D^0	π^+ from D^0	π^+ from D^0

σ_t distributions

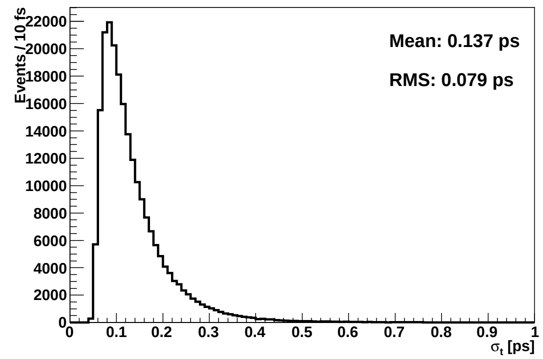
BaBar



SuperB

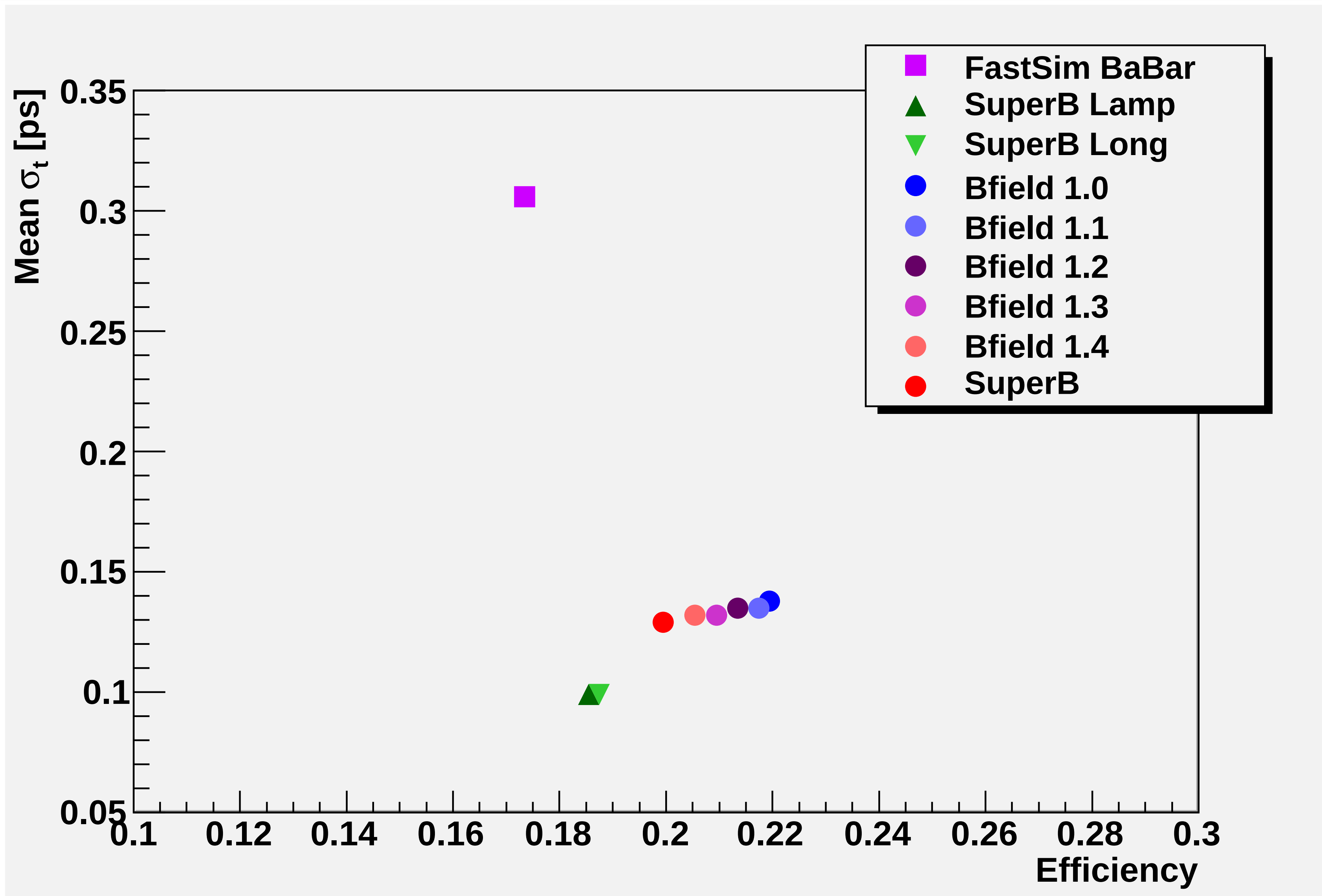


B=1.0T



Configuration	σ_t mean [fs]	σ_t RMS [fs]
BaBar	306	141
SuperB (B=1.5T)	129	70
SuperB (B=1.0T)	137	79

Efficiency versus decay-time resolution



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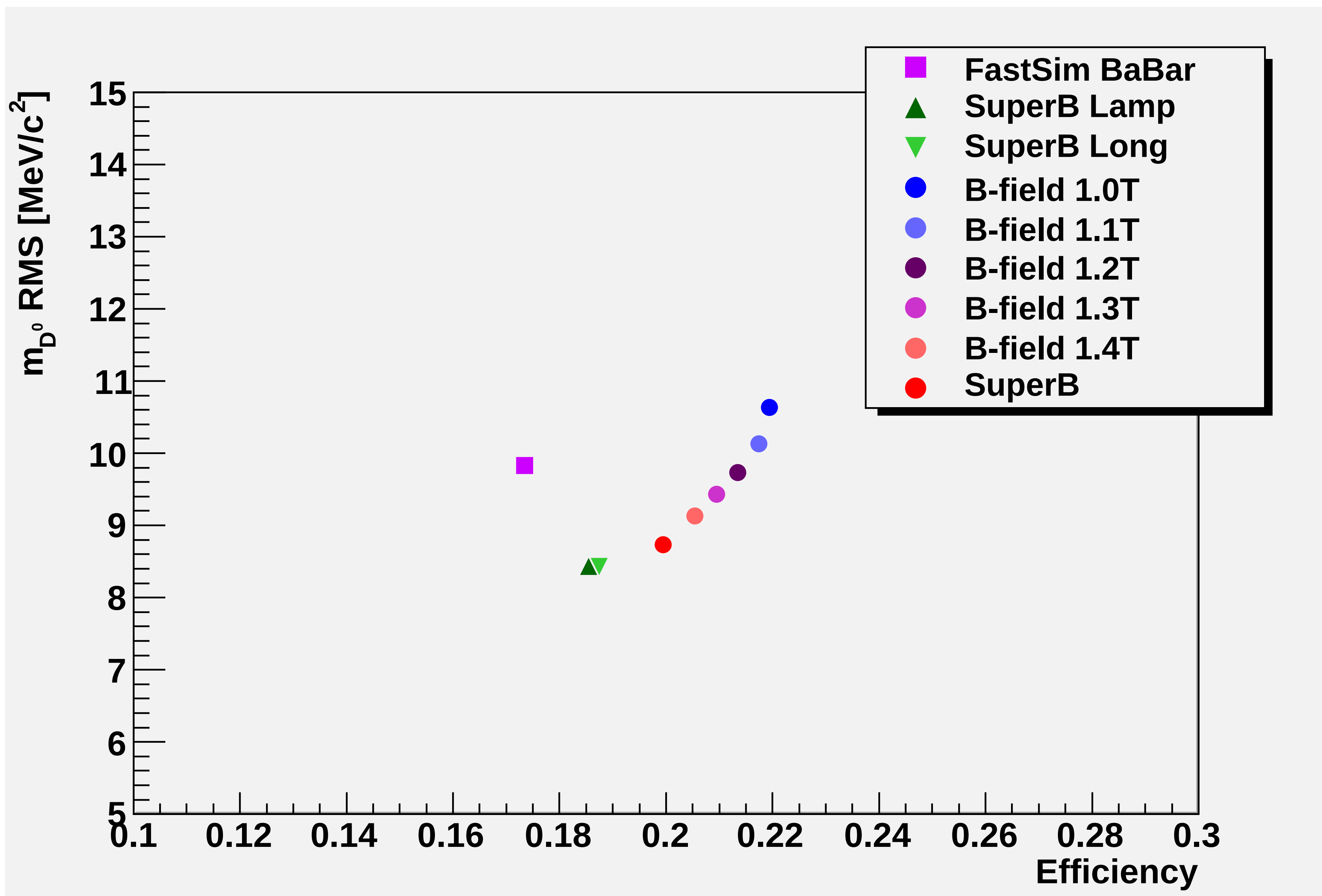
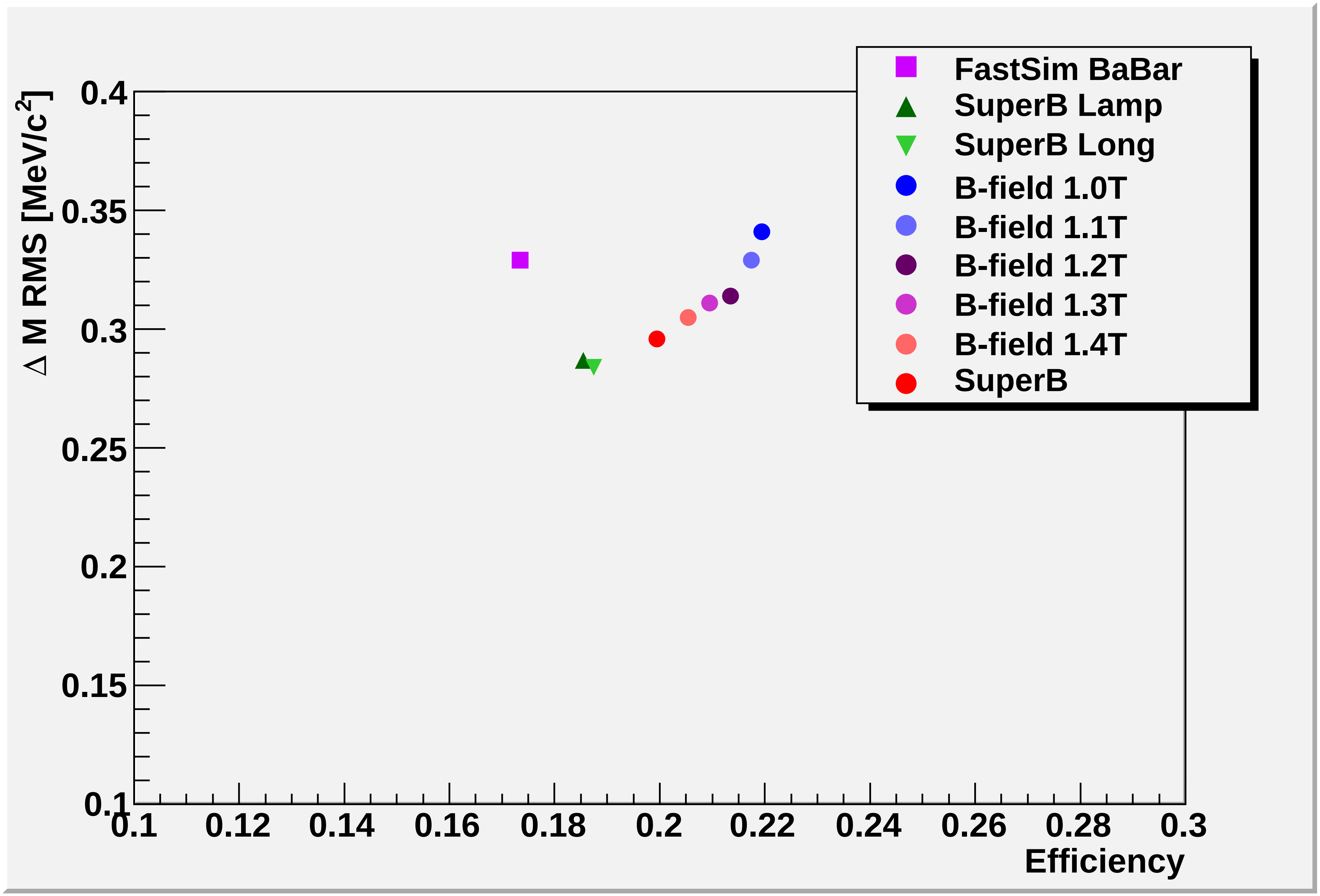
Efficiency versus D^0 mass resolution (no cut on ΔM)



Efficiency versus ΔM resolution (no cut on m_{D^0})



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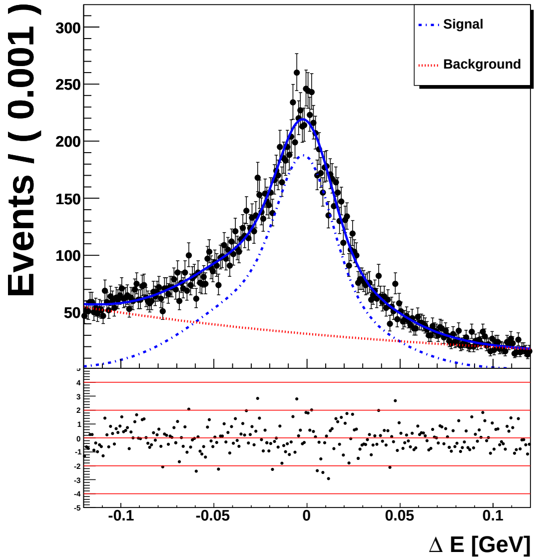
B tagging

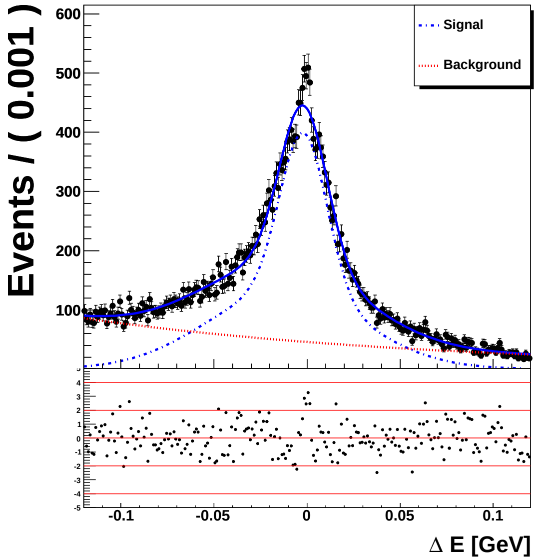
- Use B-tagging code provided by Elisa Manoni.
- Relax tag-side cuts on ΔM, ΔE and m_{D^0}.
- Select tags with charged D^* decay.
- Study effects of B-field strength on efficiency and resolution of (tag-side) ΔE, m_{ES}, ΔM and m_{D^*}.
- One additional configuration studied: 'Boosted BaBar', using the SuperB beam setup and BaBar detector.

Fits to ΔE

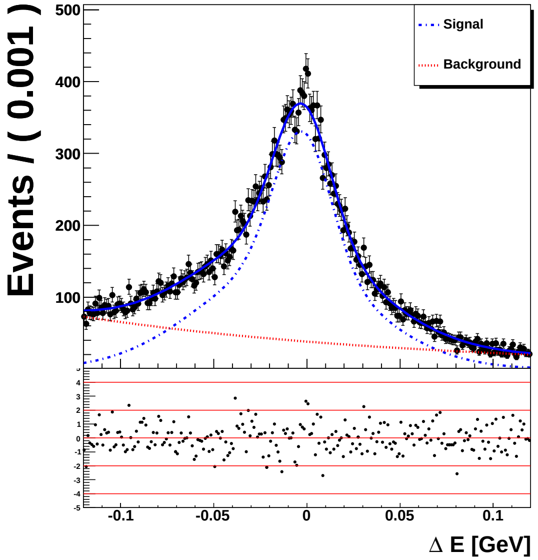
BaBar



SuperB

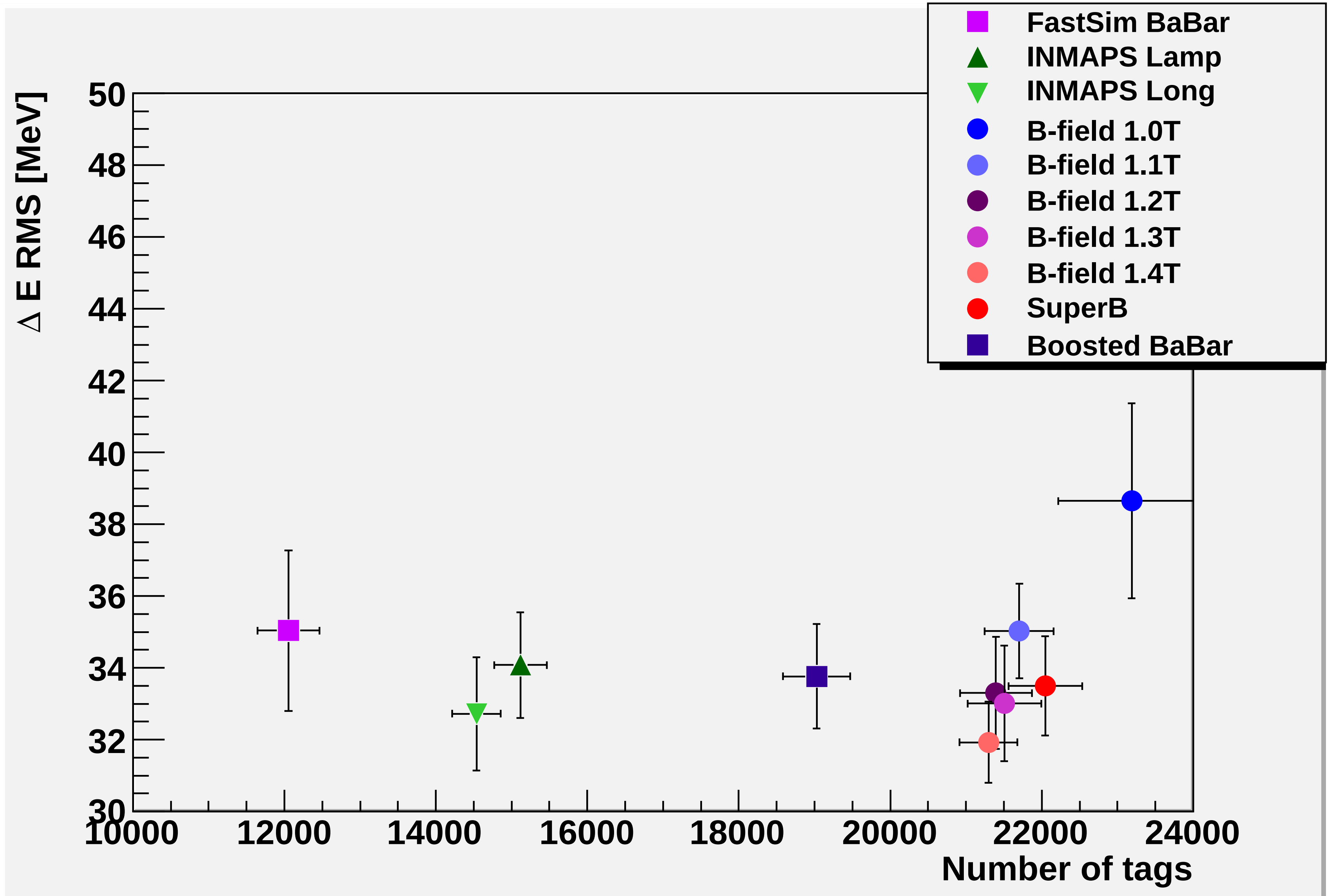


B=1.0T



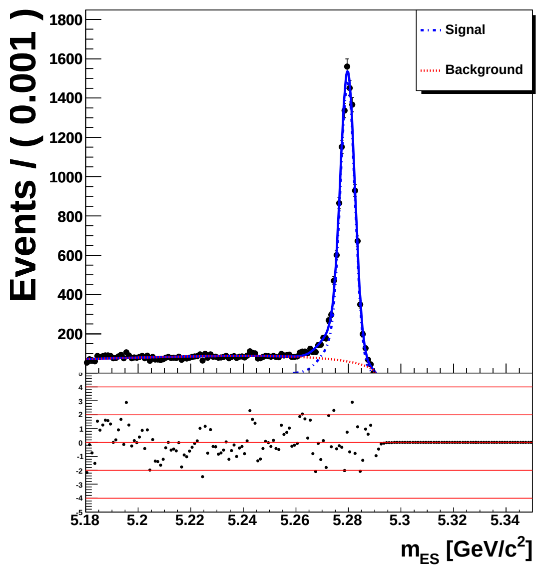
- **Fit to two Gaussians (uncommon mean and sigma) and exponential.**
- **Figures of merit are amount of signal and RMS of two-Gaussian PDF.**

ΔE results

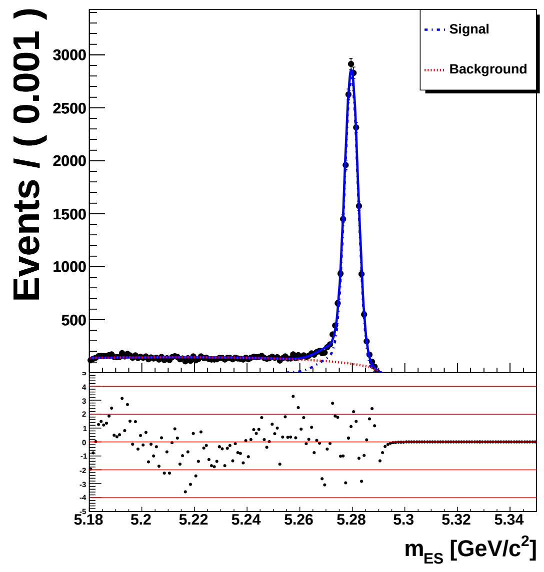


Fits to m_{ES}

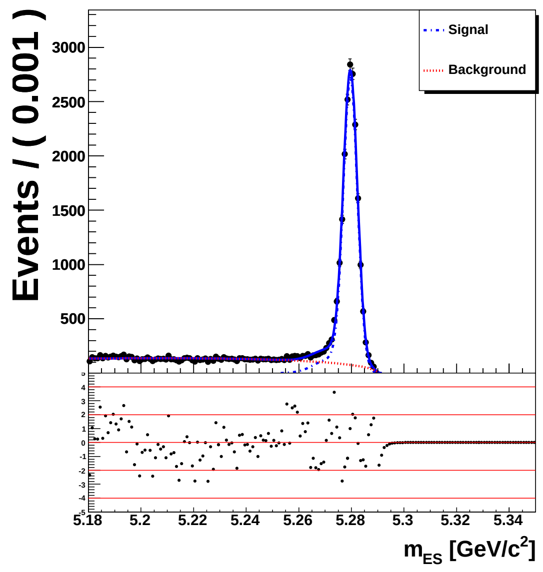
BaBar



SuperB

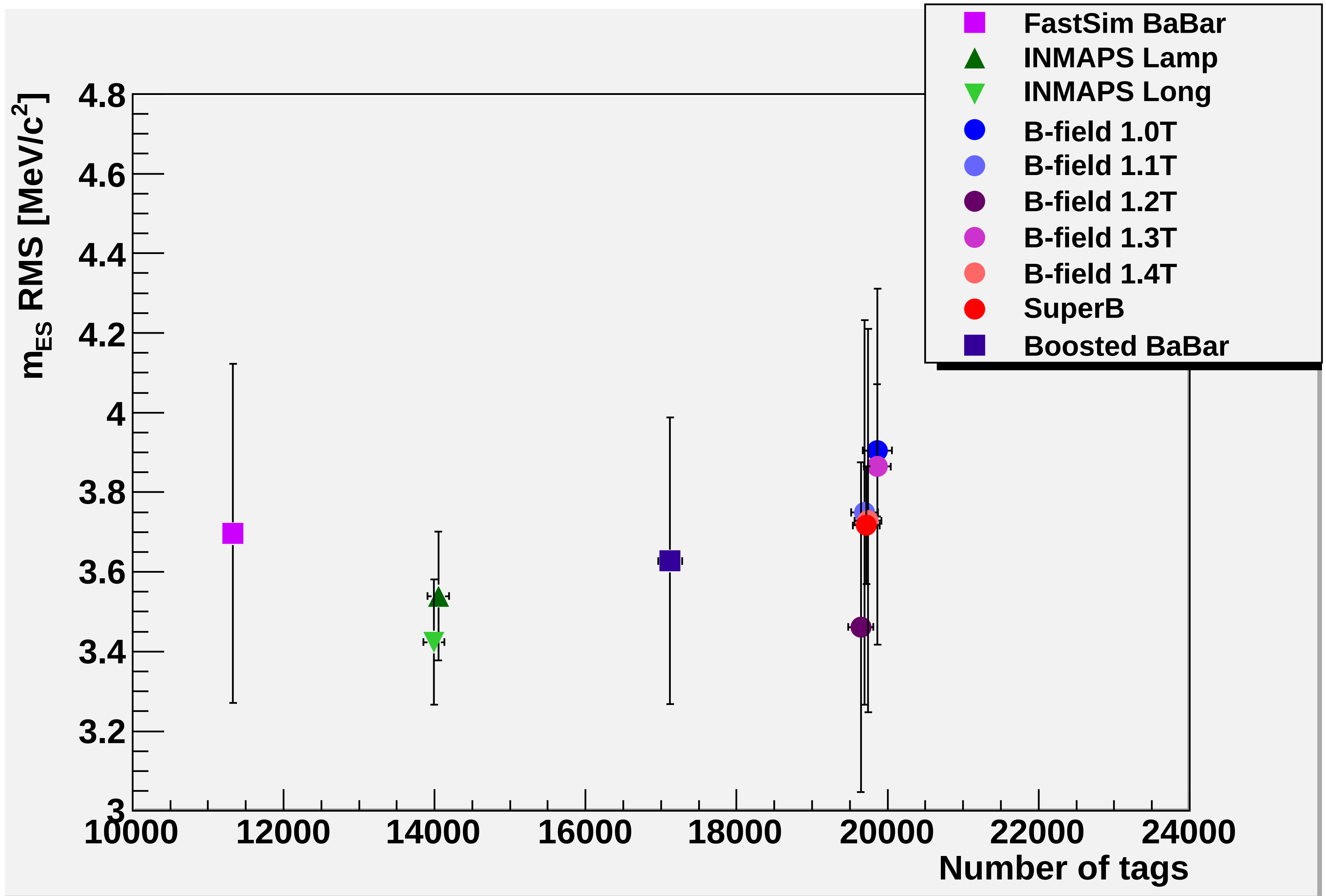


B=1.0T



- **Two Gaussians and threshold function.**

m_{ES} results



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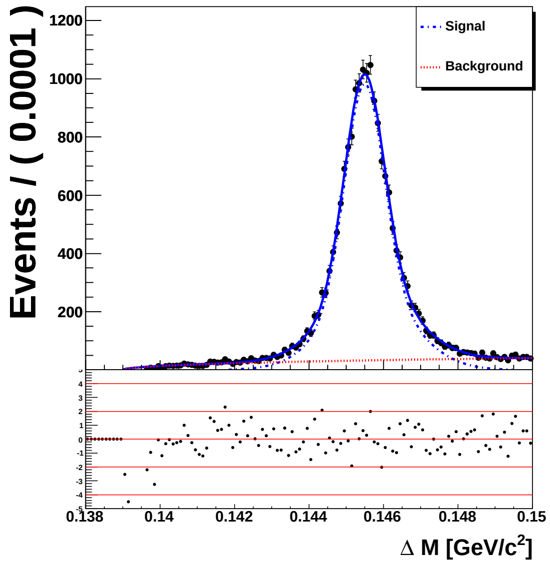
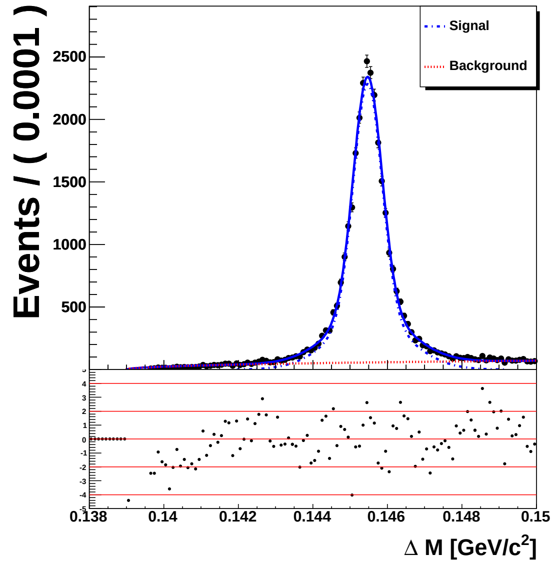
Fits to ΔM

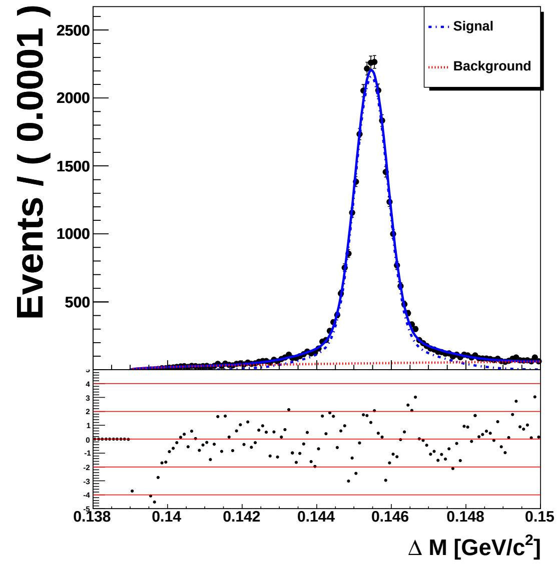
BaBar



SuperB

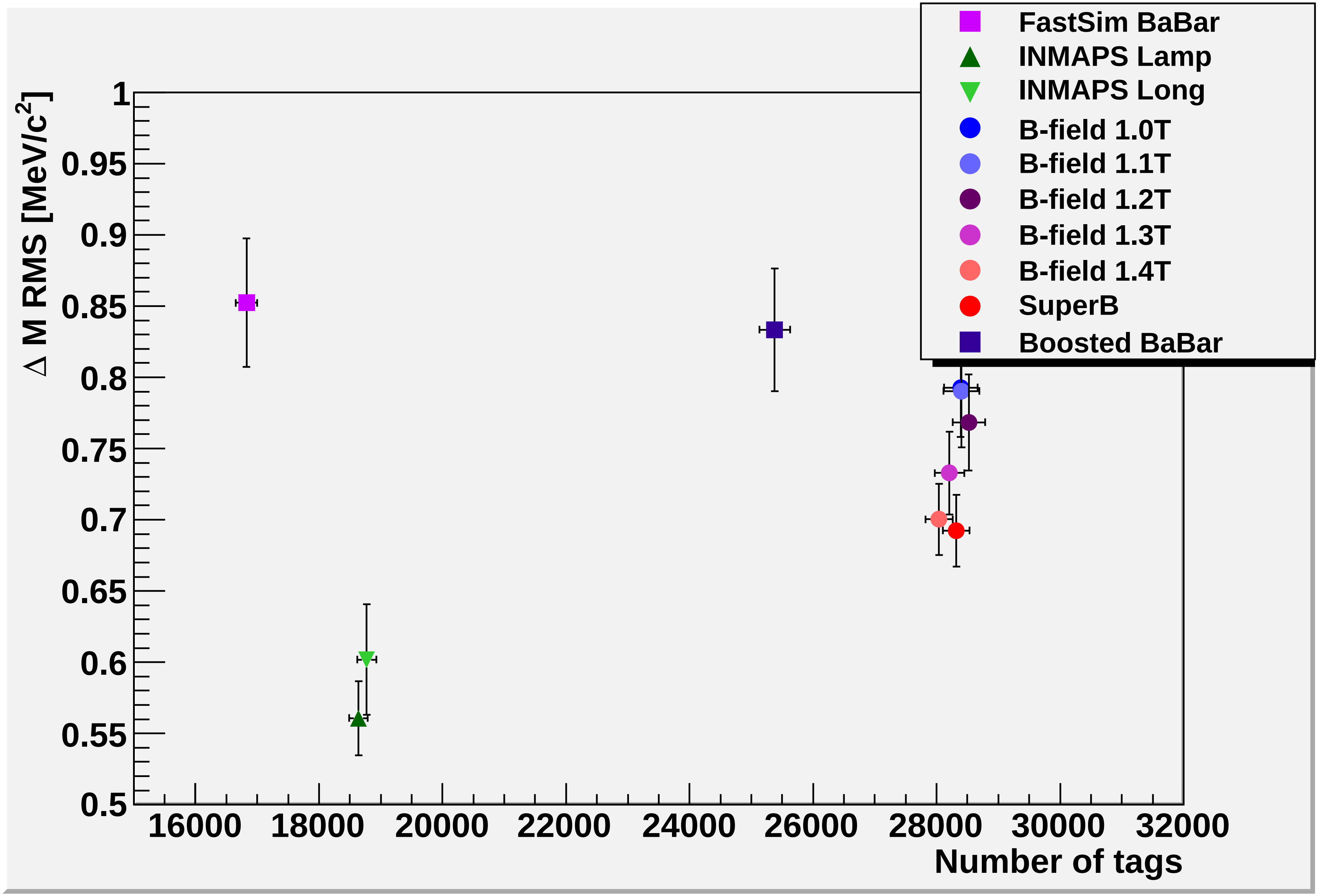


B=1.0T



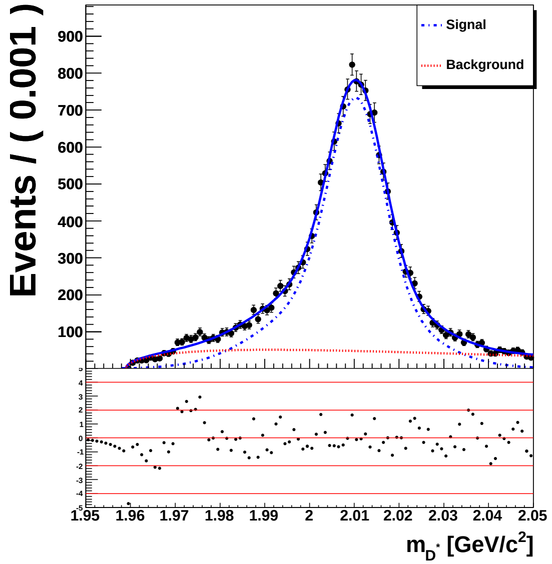
- **Two Gaussians and threshold function.**

ΔM results

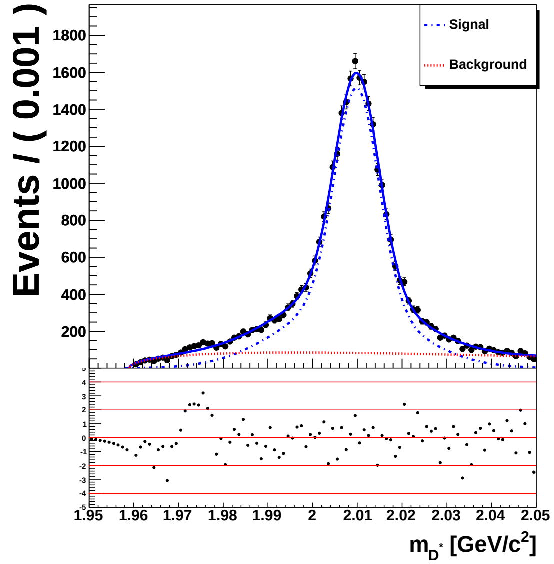


Fits to m_{D^*}

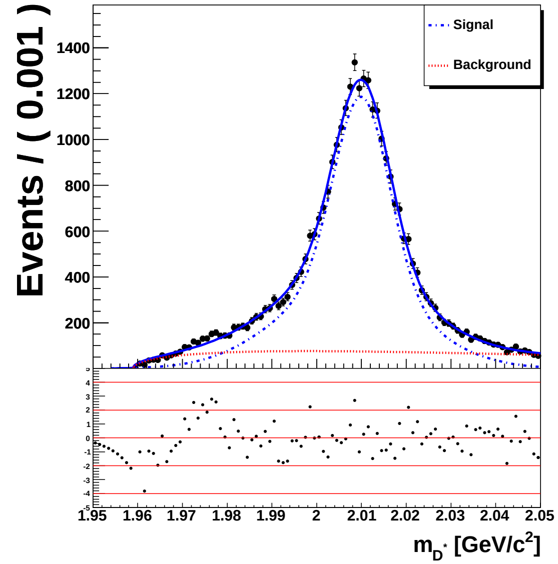
BaBar



SuperB

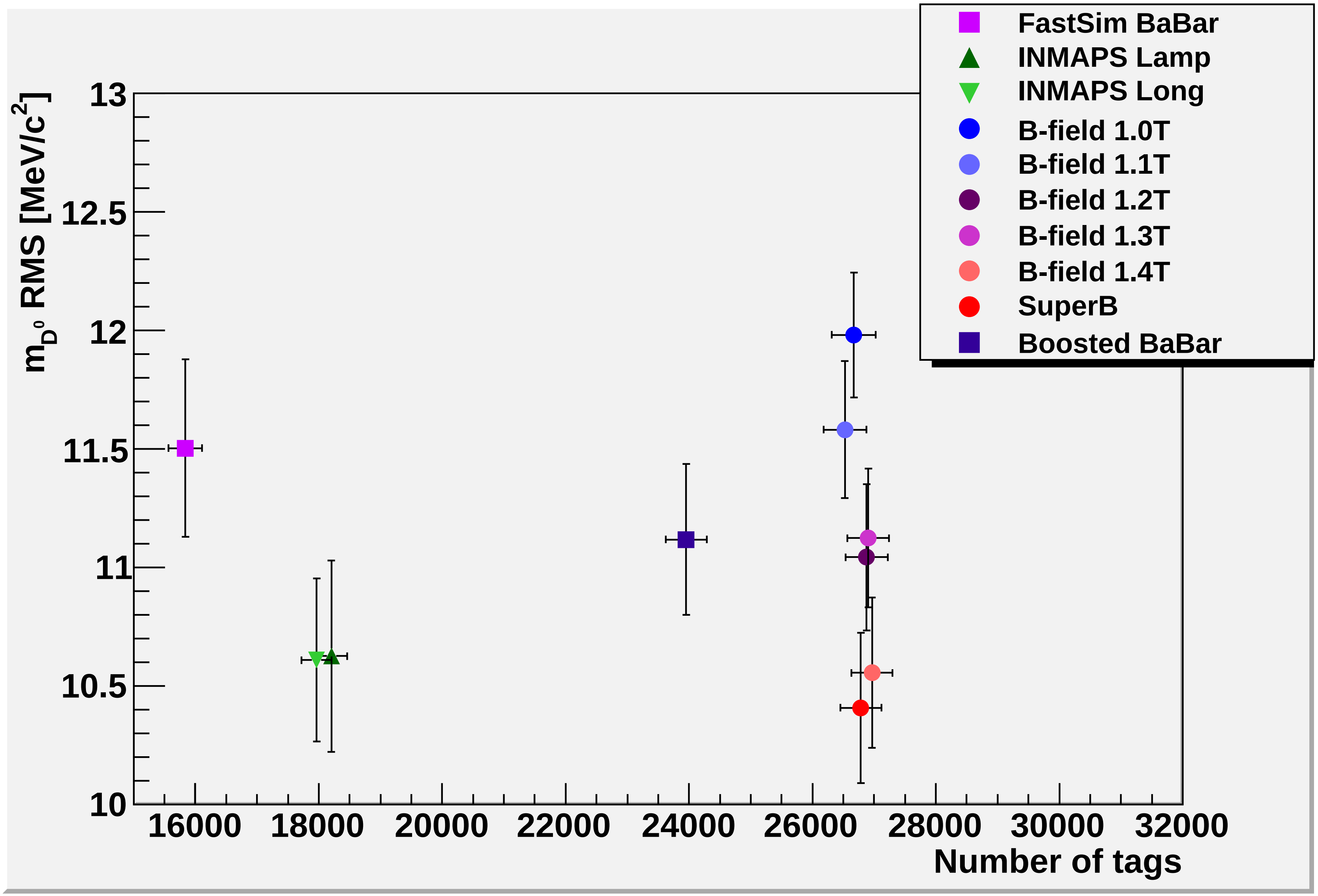


B=1.0T



- **Two Gaussians and threshold function.**

m_{D^*} results



FastSim BaBar
INMAPS Lamp
INMAPS Long
B-field 1.0T
B-field 1.1T
B-field 1.2T
B-field 1.3T
B-field 1.4T
SuperB
Boosted BaBar
m_{D^0} RMS [MeV/c^2]
13
12.5
12
11.5
11
10.5
10
16000
18000
20000
22000
24000
26000
28000
30000
32000
Number of tags

Conclusions and TODO

- **Whatever B-field is used, SuperB has better resolution and efficiency than BaBar.**
- **If a p_T cut is imposed (to ensure tracks reach the tracking volume) then lowering the magnetic field can increase the efficiency, at the price of some loss in resolution.**
- **This effect is less important when no explicit 'tracking cut' is made.**
- **TODO:**
  - **Add more charm analyses?**
  - **Why are INMAPS setups relatively inefficient? Can we get the resolution without the loss of efficiency?**