Boost Reconstruction

SLD B Mixing Review

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Outline

Boost and B mixing

Optimize the Boost

Results for Dipole and Ds

Conclusions

Boost and B mixing

- **Key ingredients of B mixing analysis**

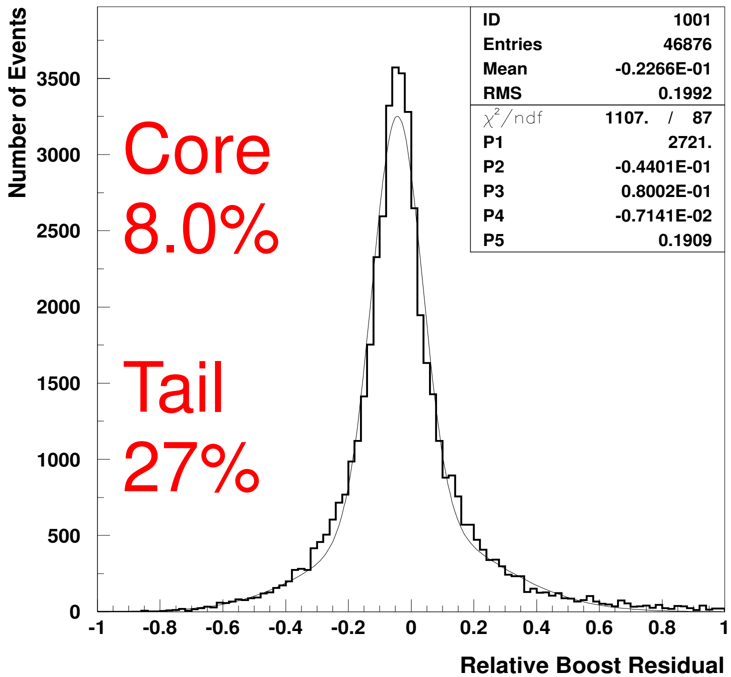
  - Decay proper time
  - Initial- and final-state tag
  - Bs fraction
  - Statistics

- **Reconstruction of decay proper time, τ = D/B, requires good resolutions on both D and B:**

$$\left(\frac{\sigma_\tau}{\tau}\right)^2 = \left(\frac{\sigma_D}{D}\right)^2 + \left(\frac{\sigma_B}{B}\right)^2 + C$$

- **Decays with short proper time most critical to mixing.**
- **At short decay length, σ_D dominates the resolution.**
- **At larger decay length, high boost B most significant.**

Characterizing the boost resolution



RMS = 20%

Core = 8%

Tail = 27%

1) 60% core and 40% tail Double Gaussian fit,

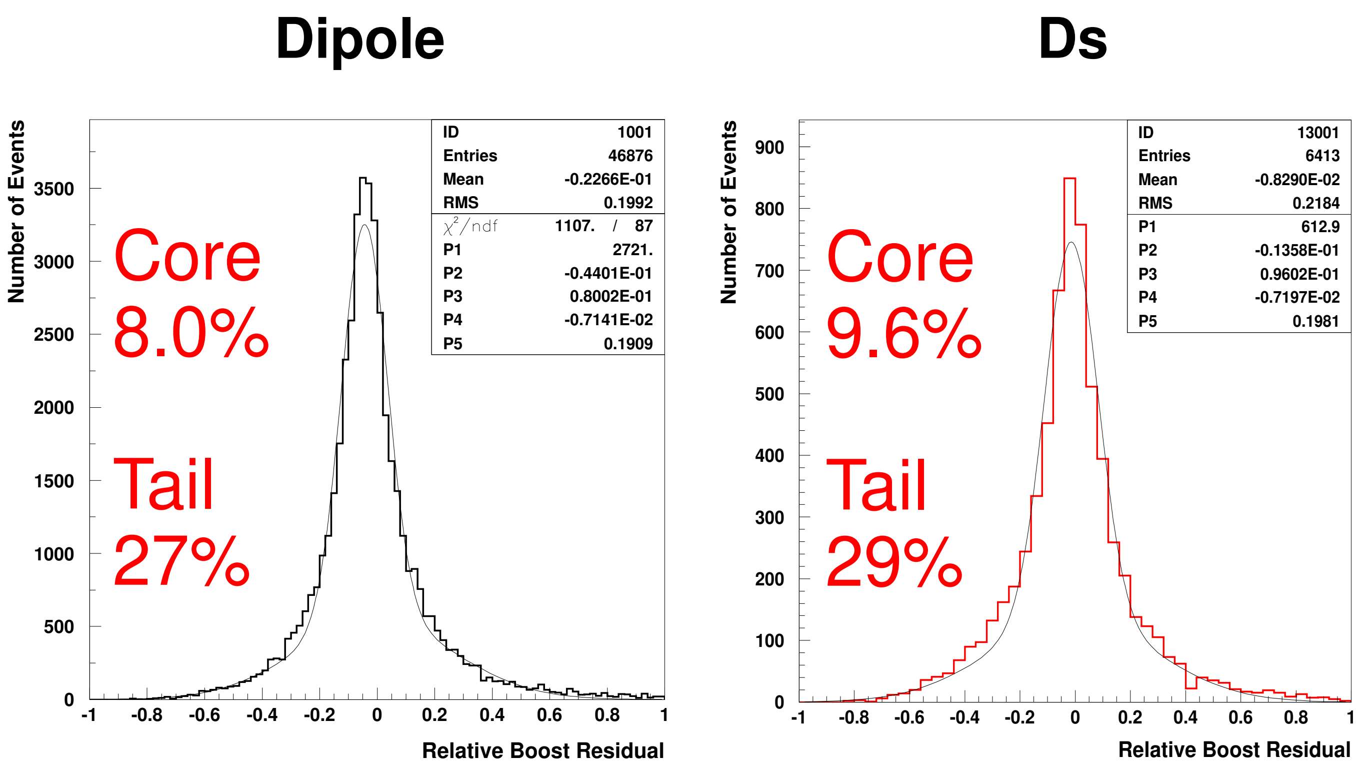
2) overall standard deviation (RMS),

3) fraction of events in the core.

Here we use 60% core Double Gaussian Fit.

Status of Boost Algorithms

- BTBOOST (by Tom Moore) has been used.
- Boost resolution is best for lepton analyses.



(fixed 60% core fraction)

Reasonably sharp core, but big tail.

Our Goals

1) better overall resolution

2) better event-by-event estimate of the resolution

Methods

- Use all 5 algorithms (instead of just boost 1)
  - --- boost 1, 2, 3 more from BTBOOST (T. Moore)
  - --- boost 4 from hemisphere kinematics (D. Jackson)
  - --- boost 5 from Missing mass (D. Dong)
- Divide events into kinematic sub-samples
- In each sub-sample, perform weighted-average of all algorithms (correlation taken into account).

Ds Analysis

- Cheng-Ju generated the MC true Bs -> Ds Ntuple.
- Events with $m_{0max}^2 < -2$ have poor resolutions. (12%)
- Divide remaining events into 2 categories

1) Overflow (Boost 5 > 45.6 GeV) (9%)

   Boost 5 is not used in the average.

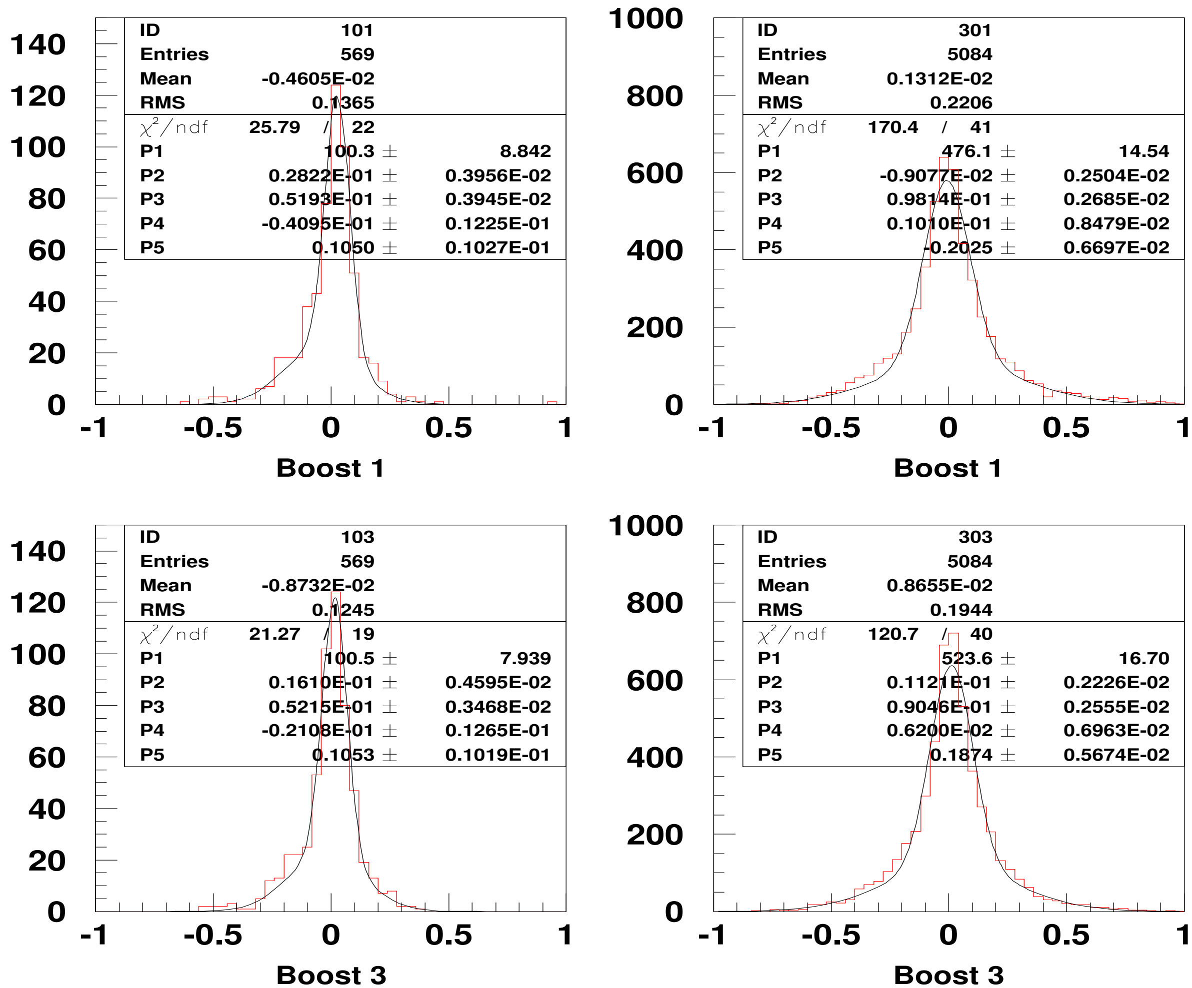
2) Non-overflow events (fraction = 79%)

   All 5 boosts can be used in the average.

Ds Overflow vs Non-overflow

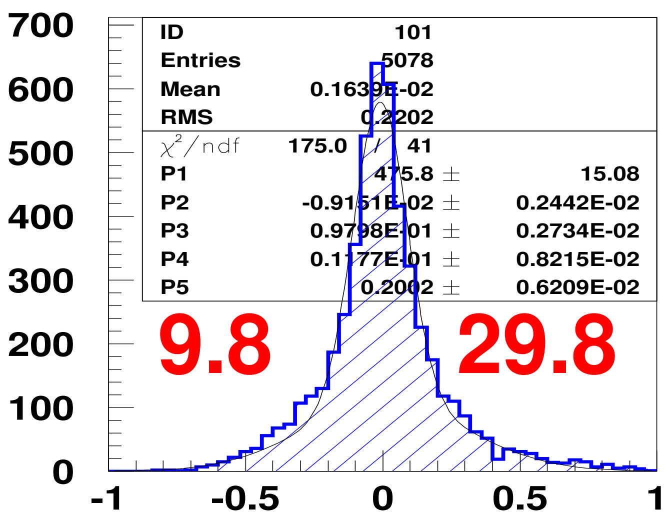
Overflow (good resolution)

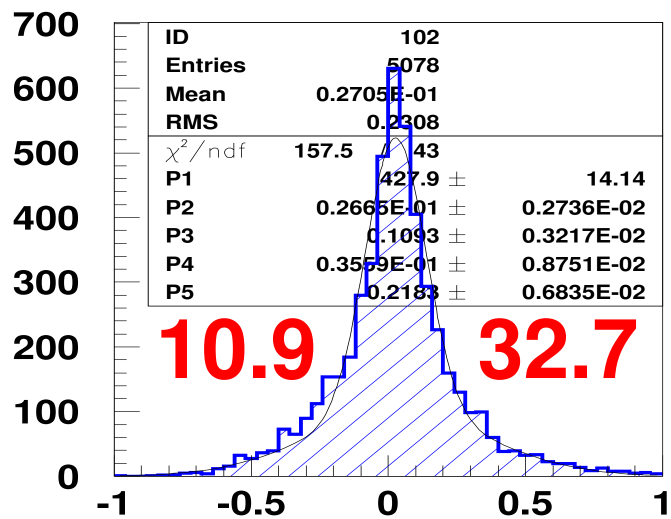
Non-overflow (not as good)

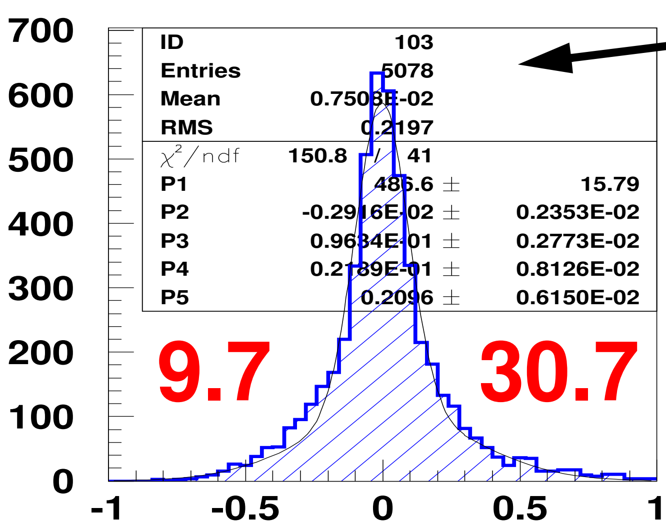


Ds Boost 1 and 2 Highly Correlated

Ds Combine Boost 1 and 2 (Non-Overflow)





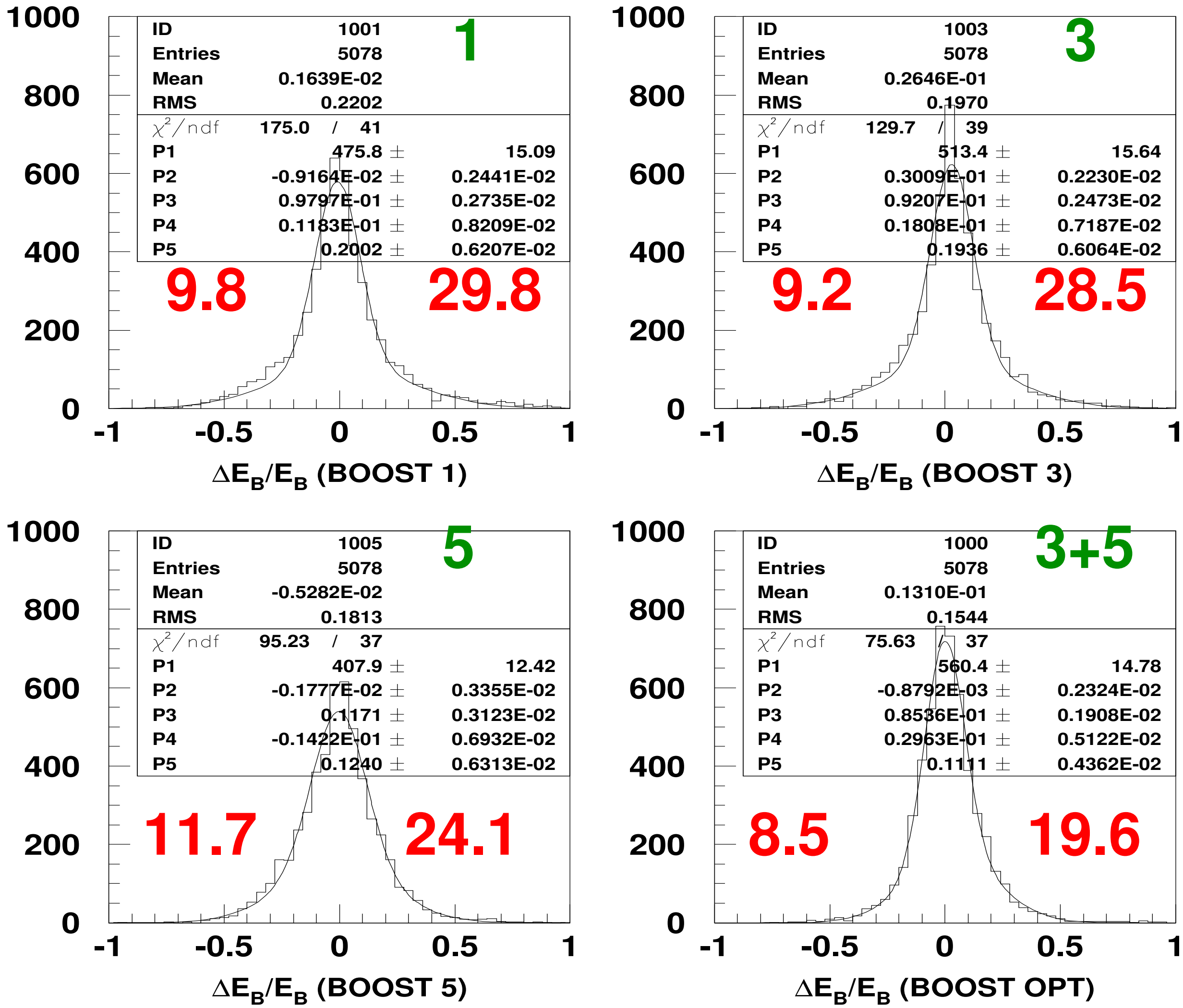


Combining 1 and 2

gains very little,

if at all.

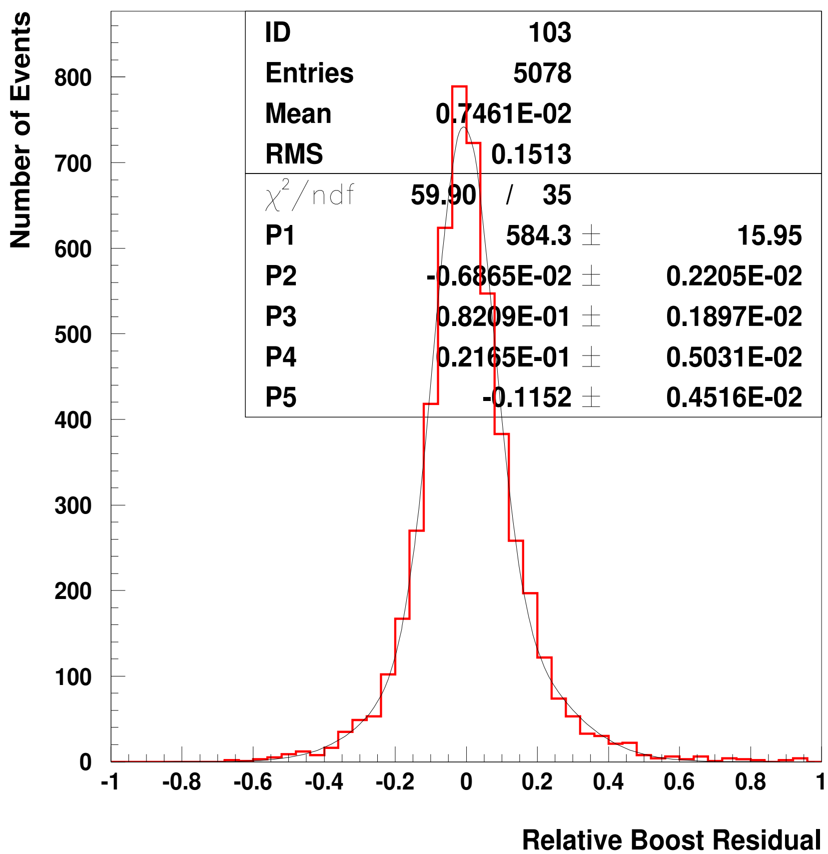
Ds Combining 3 and 5 (Non-Overflow)



Boost	RMS
1	22.0
3	19.7
5	18.1
3+5	15.4

Combining 3 and 5 improves core by 13% and tail by 35%, relative to boost 1.

Ds Combine All 5 Boosts (Non-Overflow)



RMS = 15.1%

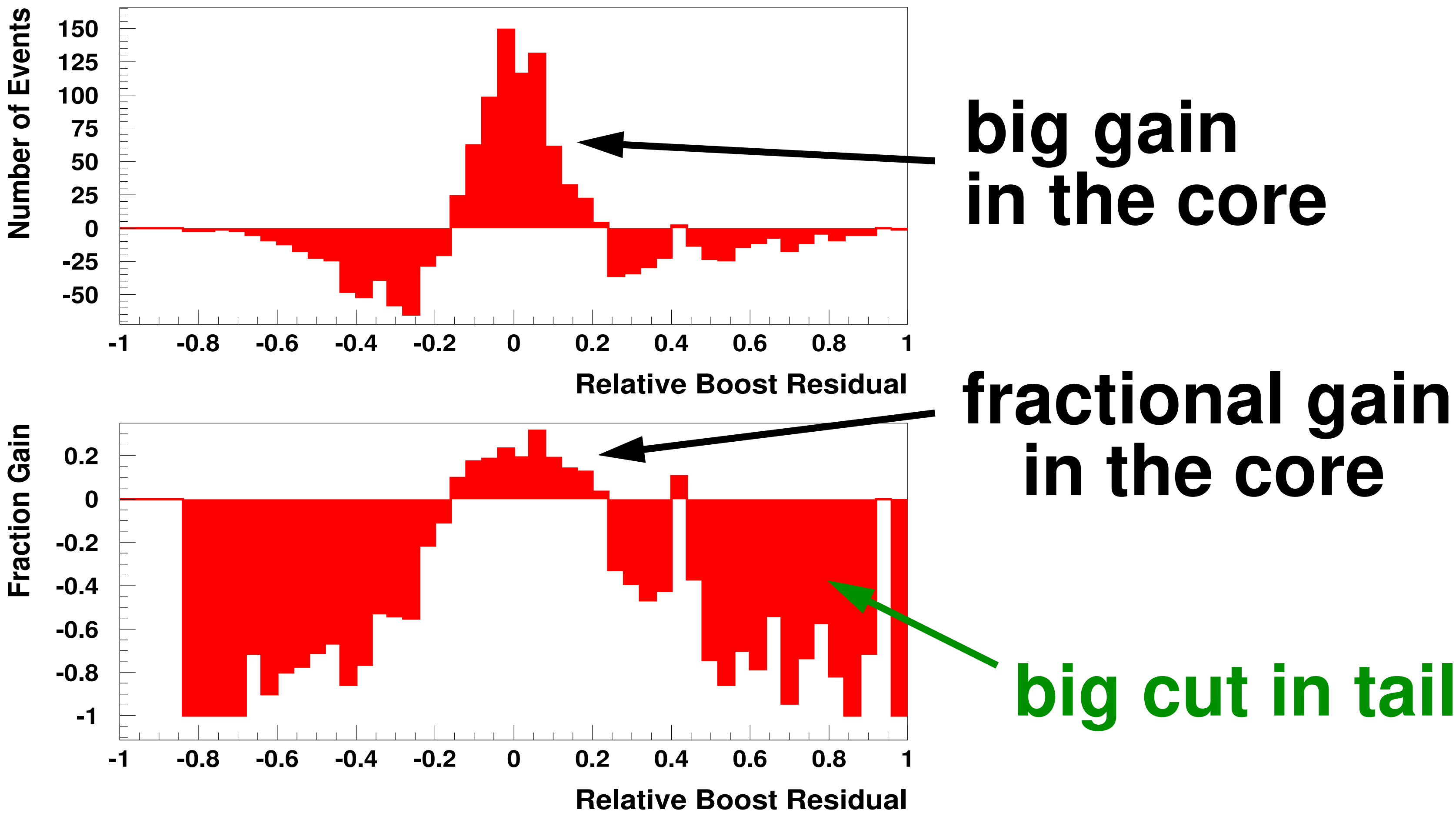
core width = 8.2%

tail width = 19.7%

peak well centered

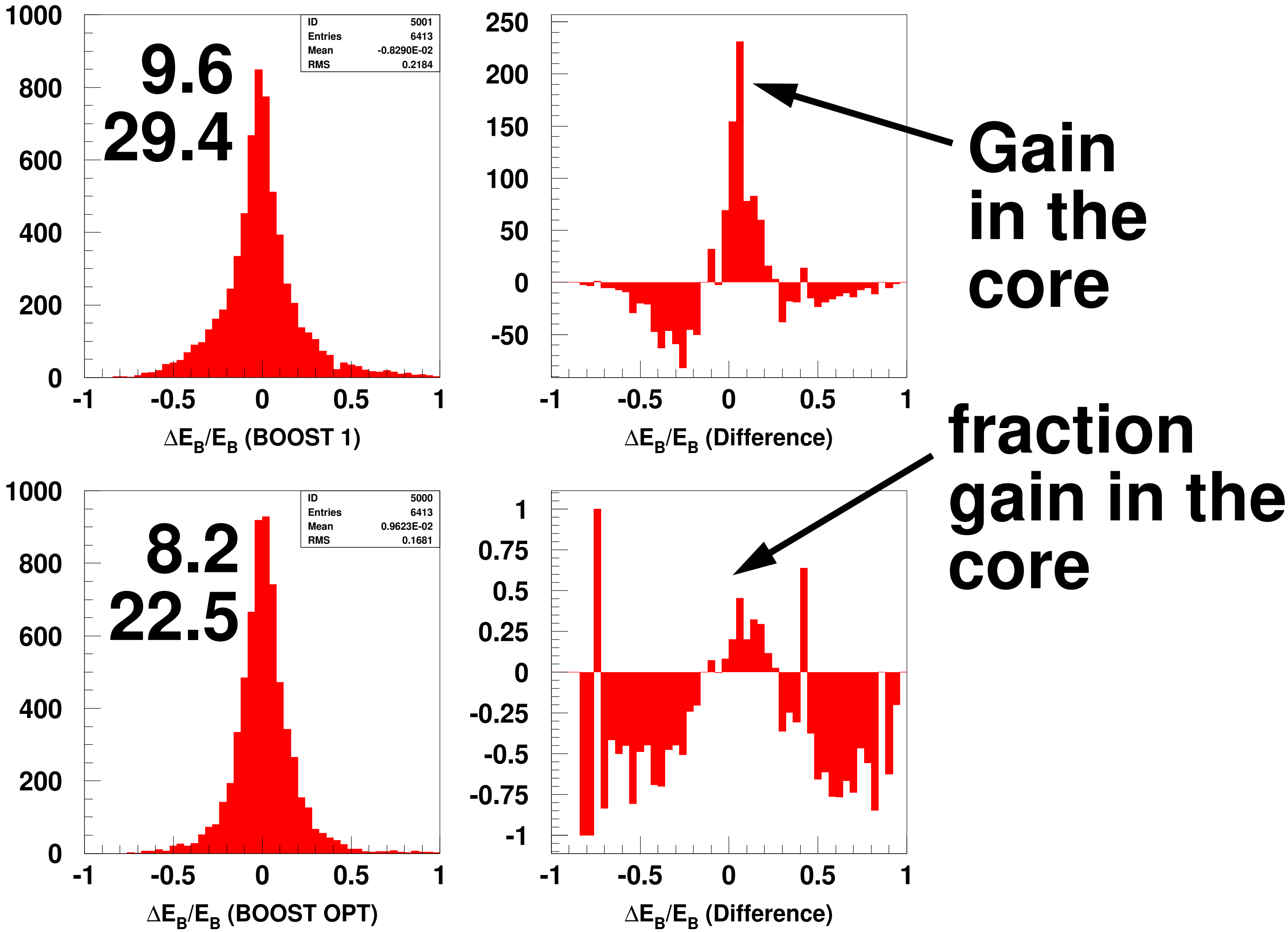
Core better by 16%,
Tail by 34%

Ds Combine All 5 Boosts (Non-Overflow)

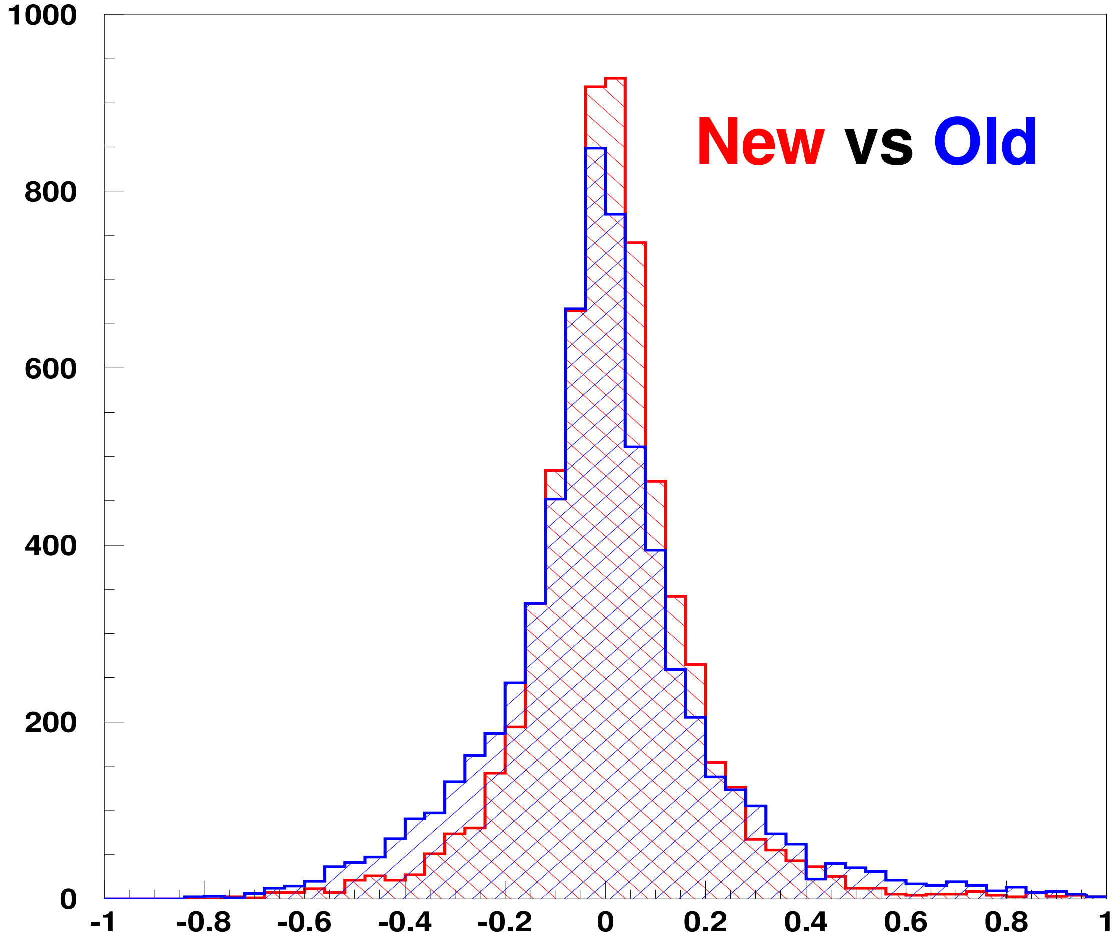


10-20% gain the core
significantly reduced tail

Ds Improvement (All Events)



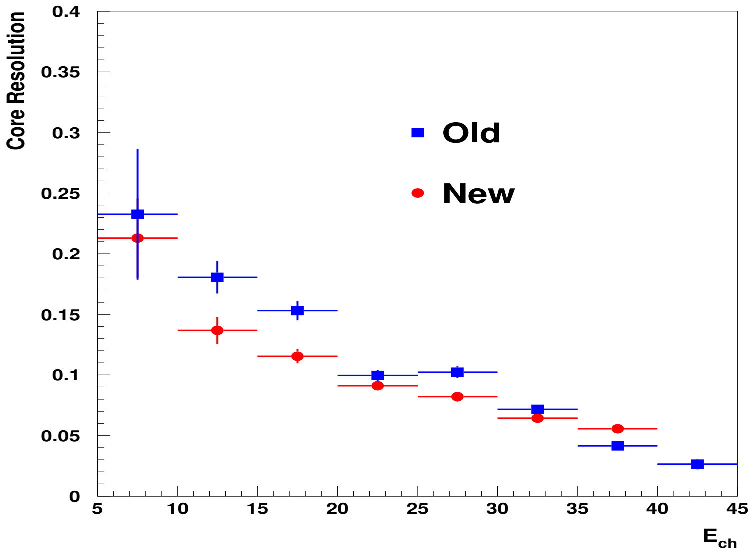
Ds Improvement (All Events)



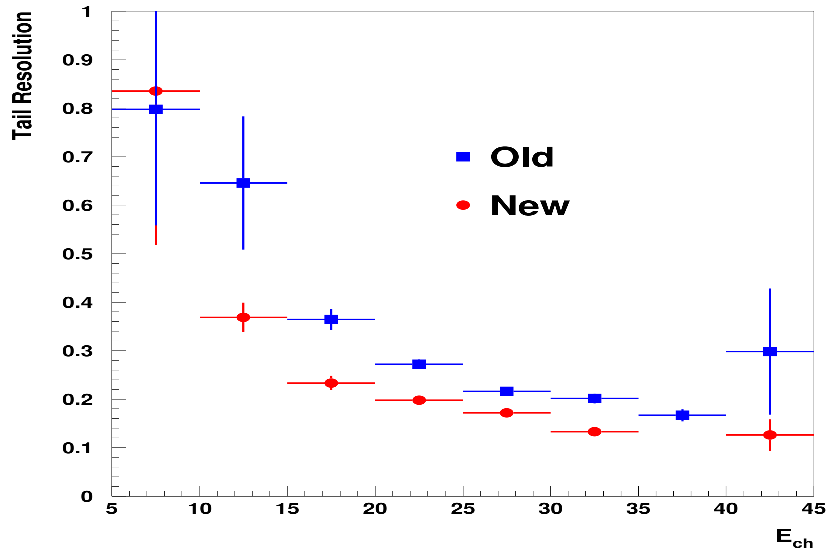
Core Improvement: 15 %
Tail Improvement: 24 %

Ds Optimized (New) vs Boost 1 (Old)

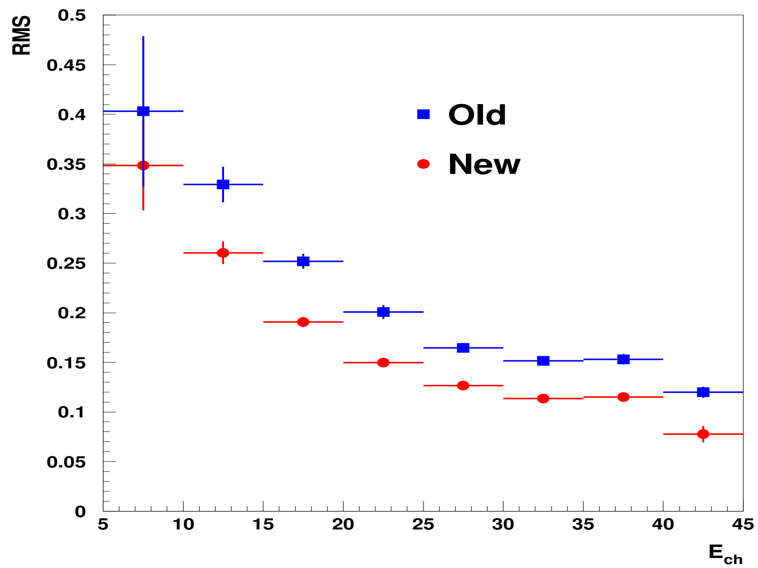
Core



Tail

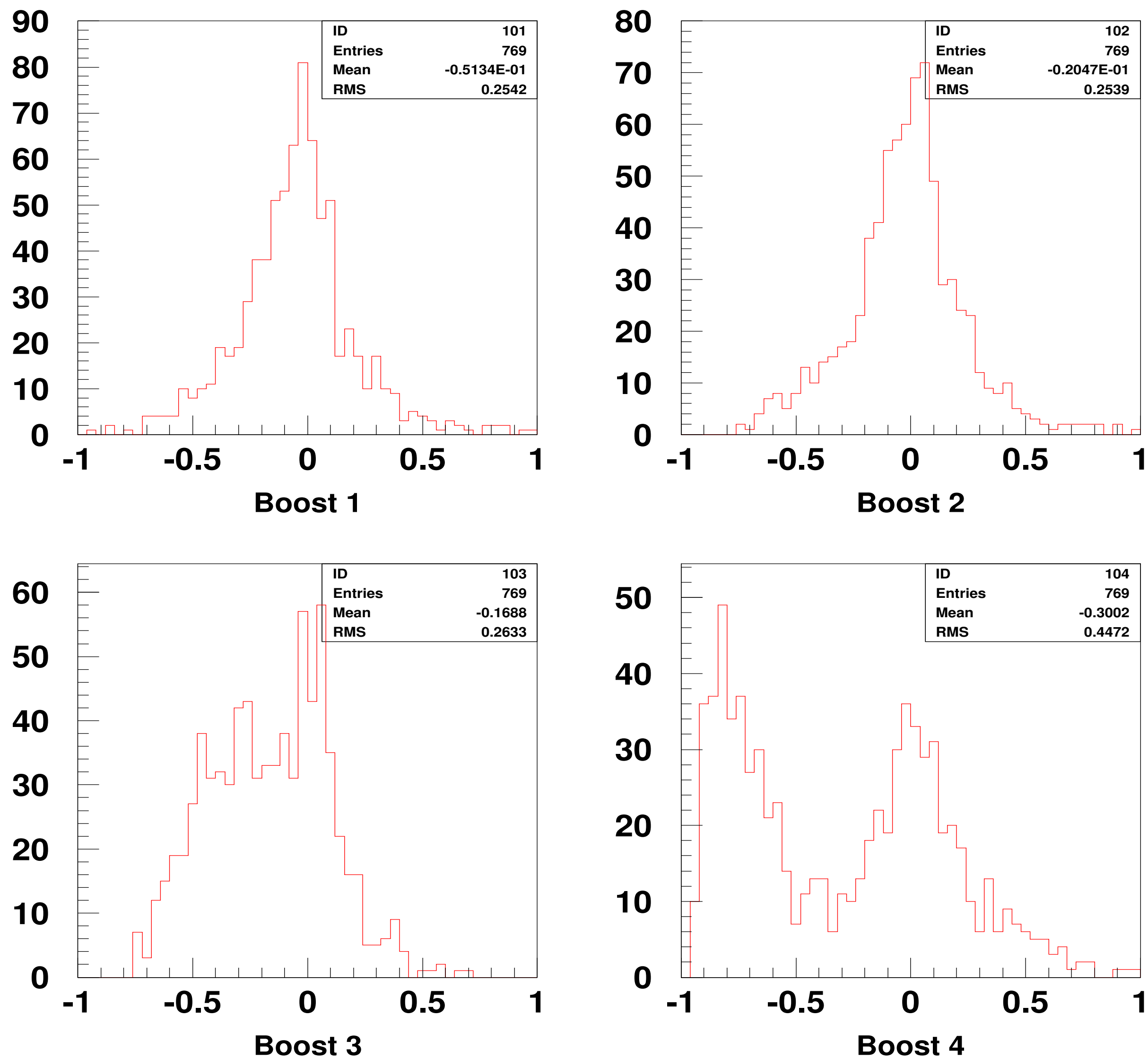


RMS



Ds Events with Terrible Resolution (11.9%)

Events with m0max^2< -2



Dipole Analysis

- Divide into 2 categories

1) Overflow events: boost 5 > upper threshold (18%)

   Boost 5 excluded from the averaging procedure.

2) Non-overflow events (82%)

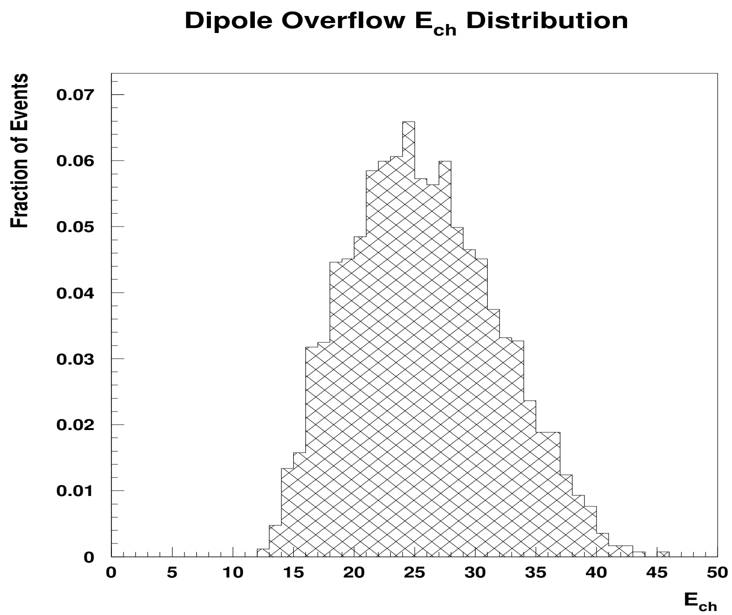
   Further divide events into 9 bins of Ech.

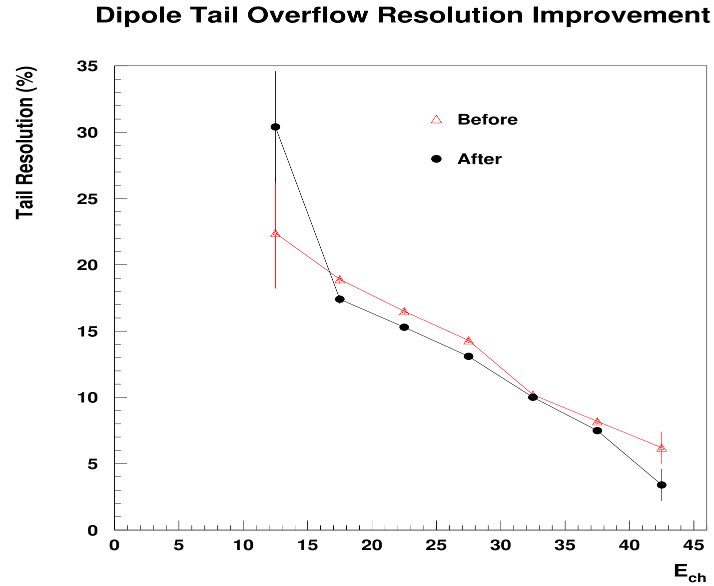
   Use boost 3, 4, and 5 in the averaging procedure.

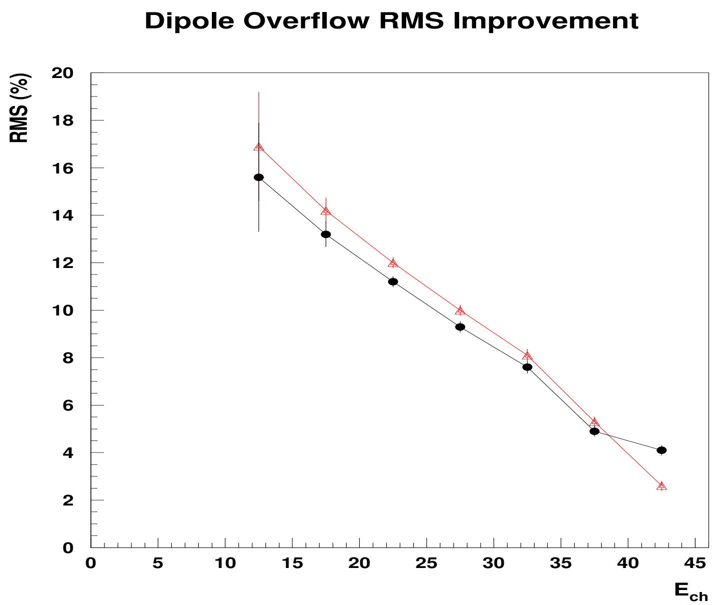
   (Boost 1 and 2 very highly correlated with Boost 3

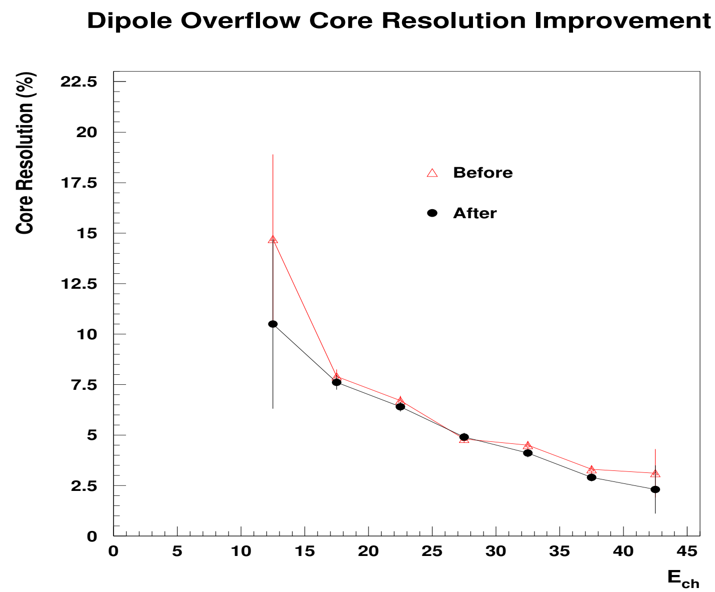
   and do not help improve the average boost.)

Dipole Overflow Events

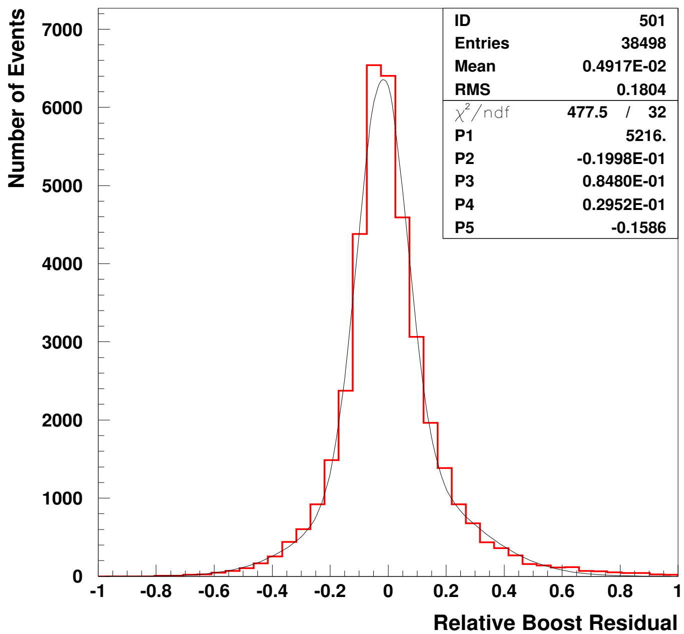


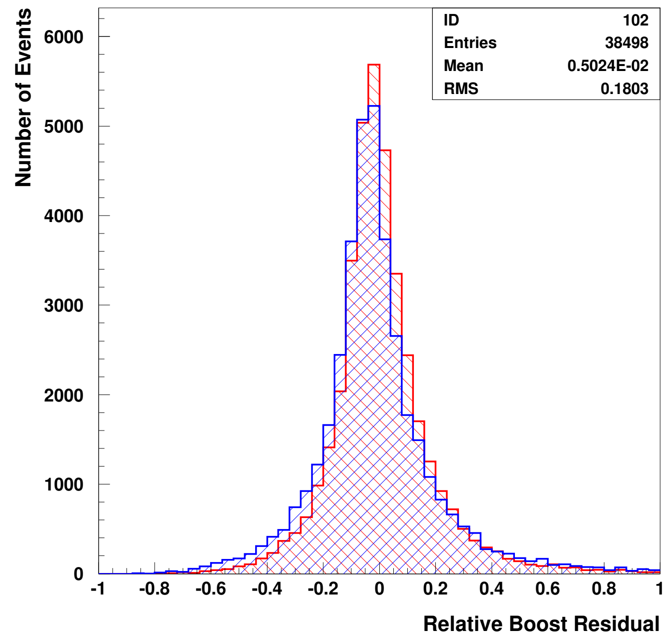






Dipole Non-Overflow Events

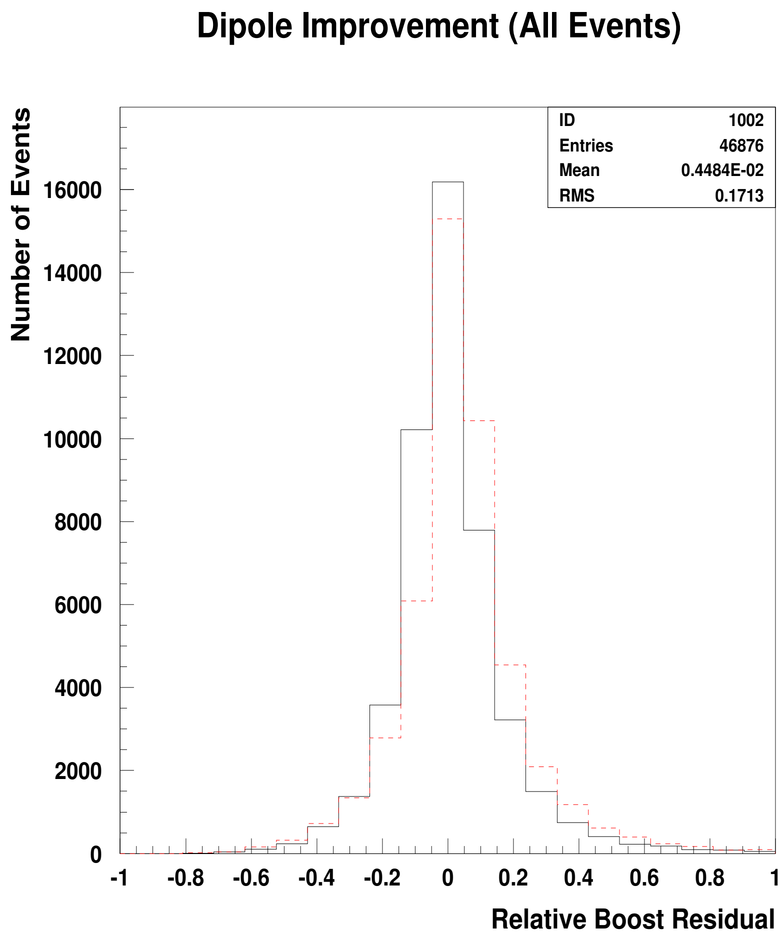


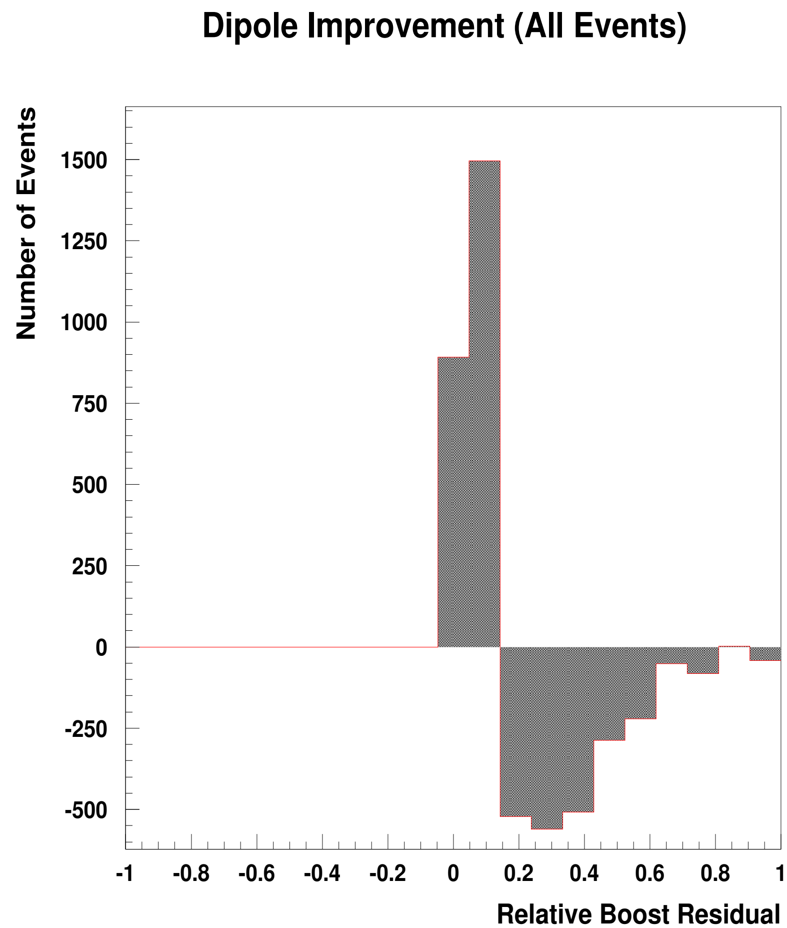


	Old	New	Improvement (%)
RMS	21.3	18.0	15.5
Core	9.0	8.5	5.5
Tail	28.9	24.4	15.6

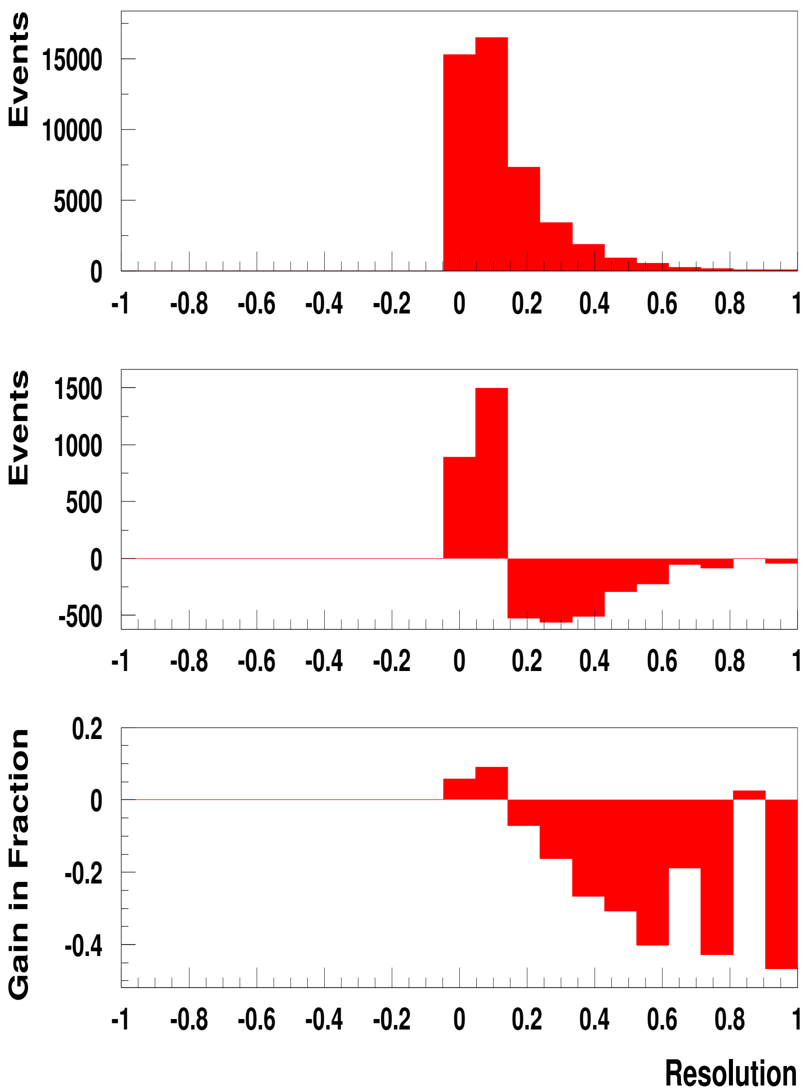
Dipole All Events

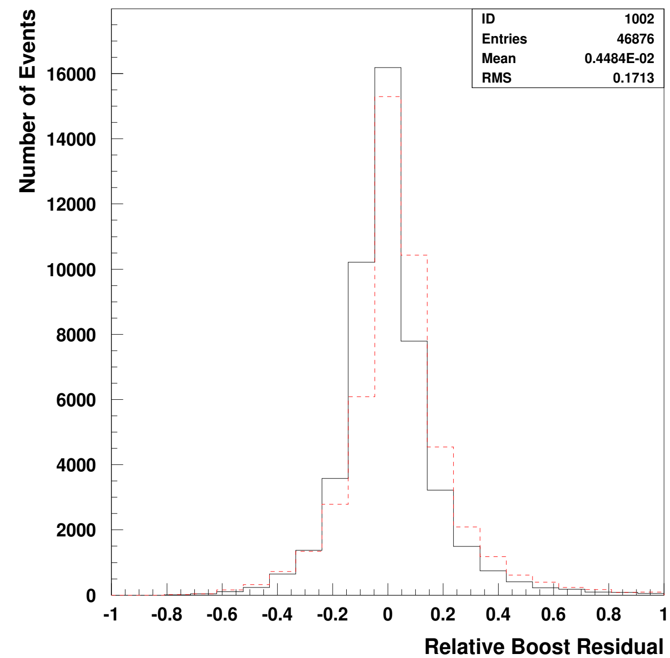
Dipole Comparison (New and Old)





Dipole Improvement (All Events)

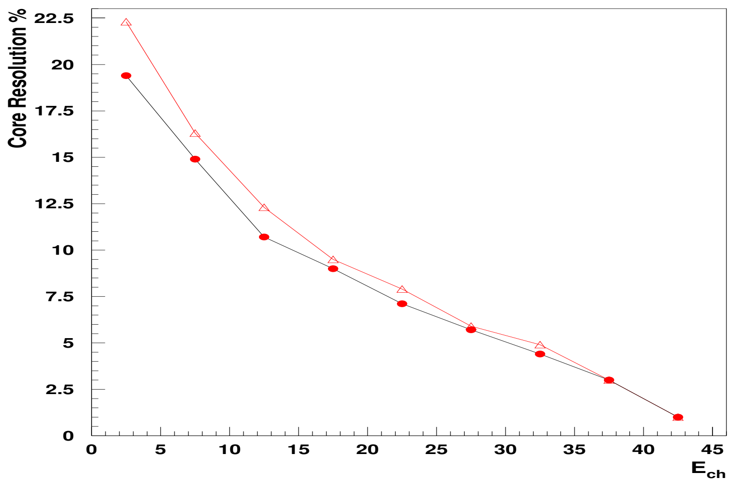




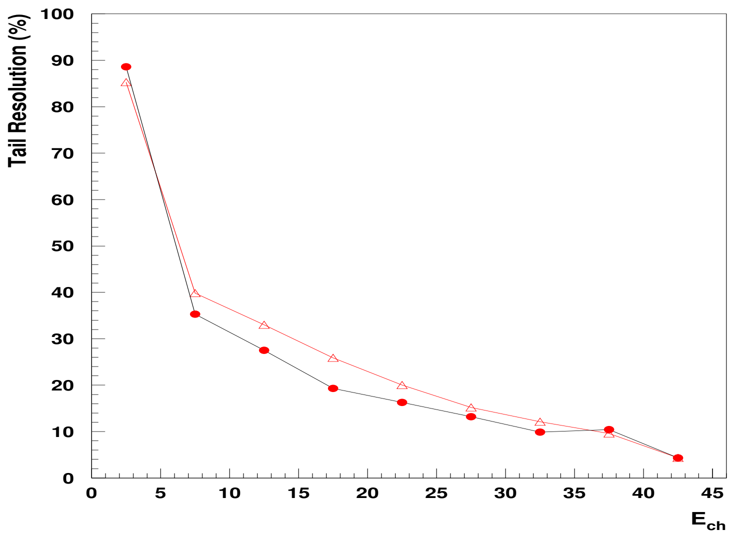
	Old	New	Up by
RMS	18.7	16.9	9.6
core	8.1	7.7	5.0
tail	26.4	22.5	15.0

Dipole Improvement (All Events)

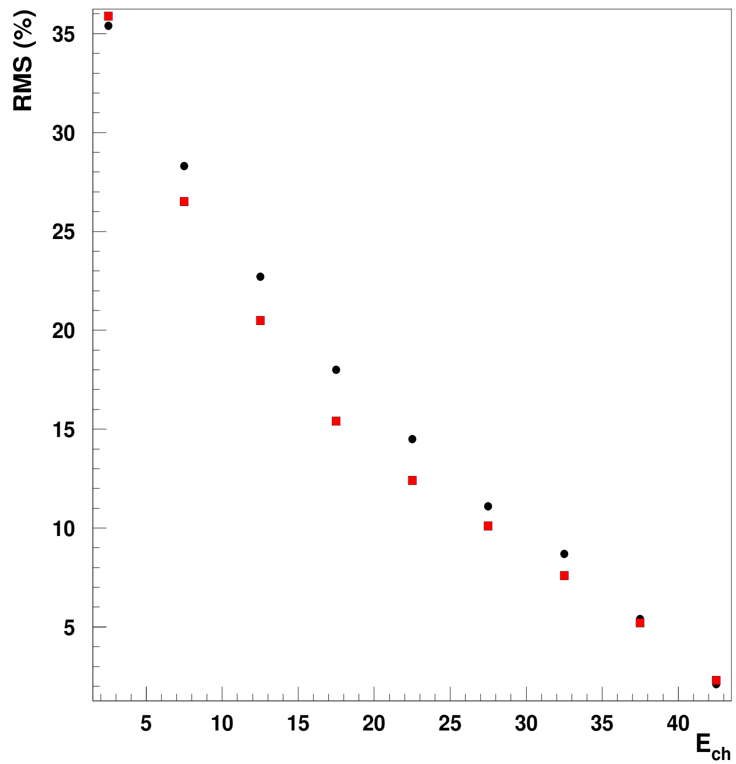
Core



Tail



RMS



Conclusions

- Boost algorithms for Dipole and Ds optimized.
- Good improvement for Dipole analysis
- Significant improvement for Ds analysis
- Routine BOOSTMIX generated for Dipole and Ds
- Plan: extend this to lepton+trks and lepton+D(K)