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Improvement in AA Tracking

- TARC studies reveal few problems of AA tracking:

  - Indication of memory leaks;
  - large deviation of the mass of particles (like J/ψ) and widening of their width;
  - significant fraction of mis-reconstructed tracks at large $|\eta|$;
  - reduced tracking efficiency.

- Sources of these problems were identified and fixed.
- New version of AATrack package (starting from v.2.02) implements these fixes.
- In this version the tracking performance is improved significantly.

Memory Leaks

- Memory leak was found not in the tracking itself, but in the part converting AA tracks to GTracks.
- After fixing it, the tracking within framework takes about 400 MB - mainly by the framework (tested on $t\bar{t}$ Monte Carlo).
- AA Tracking itself takes about 60 MB only.

Uniform Magnetic Field

• AATrack version for TARC studies used uniform field model.

• Although good for central tracks, it introduced large bias for the tracks with large $|\eta|$.

• Field is significantly non-uniform e.g. at the edges of CFT or at H-Disks.

• Since the main part of J/ψ sample was taken with large $|\eta|$, the bias due to uniform field model was responsible for the shift of J/ψ mass and its widening.

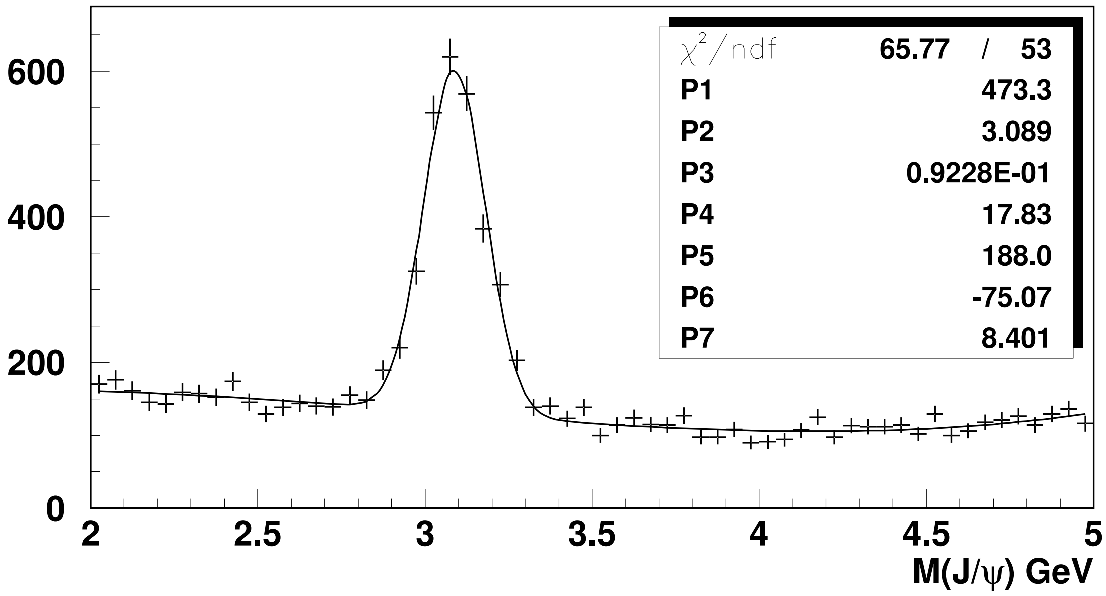
• Due to the same reason the fraction of mis-reconstructed tracks (tracks, which parameters don't match to the parameters of simulated tracks) increased at large $|\eta|$.

Non-uniform Magnetic Field

- Including non-uniform field fixes these problems.

$J/\psi \to \mu^+\mu^-$ parameters (AATrack)

	TARC	v.2.02
M(J/ψ) (Mev)	3204	3089
$\sigma(J/\psi)$ (Mev)	135	92



Details of selection:

- TARC dimuon sample
- inclusive (no muon identification)
- p_t (track) > 2.5 GeV

Reduced performance of AATrack - TARC version
Numbers from TARC Meeting, Talk of E.Chabalina)

Reconstruction efficiency in top MC events

0.5 mb (~500 events)

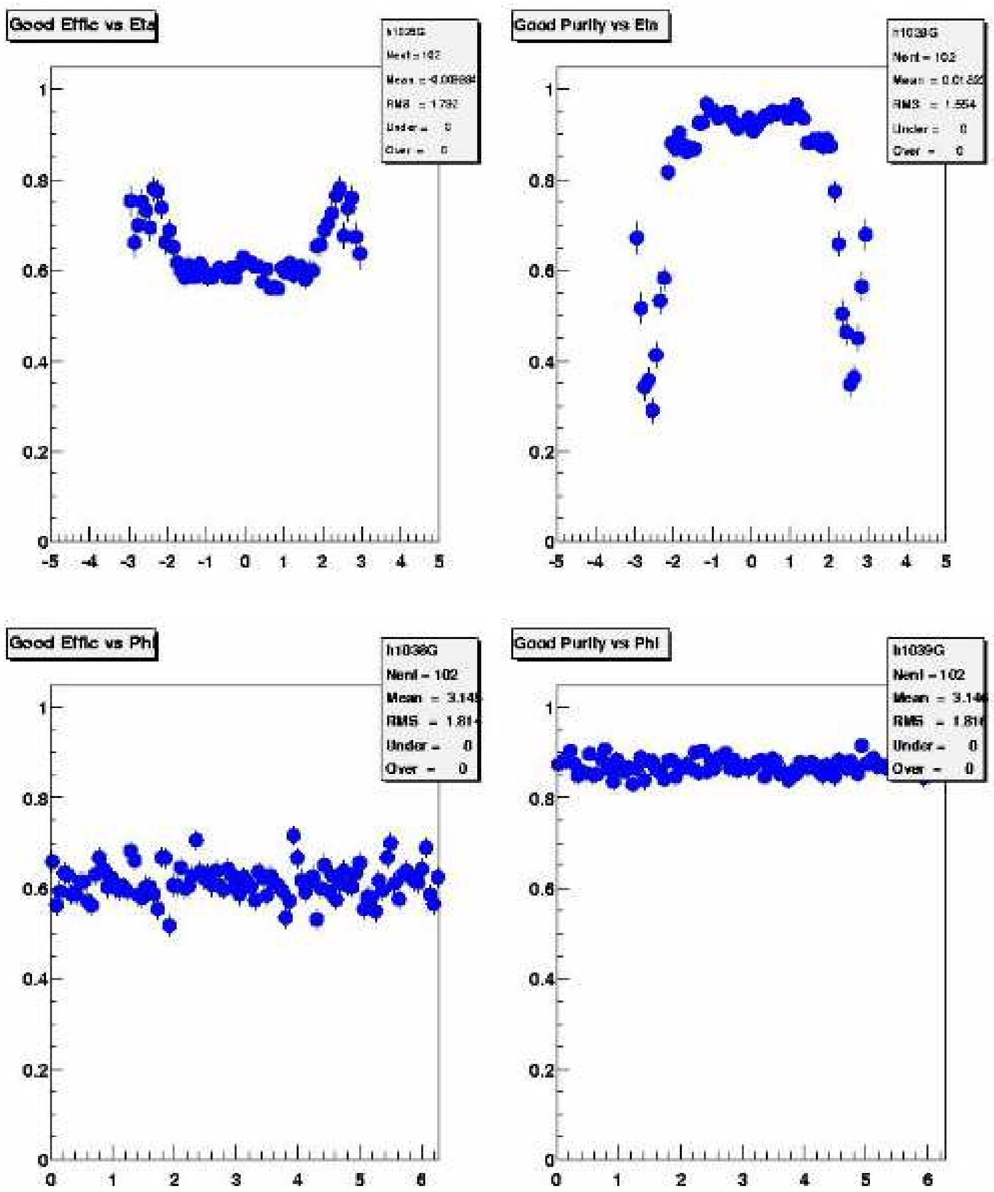
	gtr	htf	gtrela	htfela	gtrhtf	aa
eff	0.769	0.856	0.834	0.898	0.878	0.776
purity	0.959	0.974	0.948	0.960	0.967	0.984
goodeff	0.617	0.742	0.658	0.698	0.777	0.602
misreco	0.069	0.073	0.094	0.088	0.072	0.118
fake	0.041	0.026	0.052	0.040	0.033	0.016

2.5 mb (> 1000 events)

	gtr	htf	gtrela	htfela	gtrhtf	aa	AA v.2.02
eff	0.753	0.854	0.819	0.898	0.873	0.776	0.903
purity	0.954	0.961	0.937	0.948	0.947	0.988	0.985
goodeff	0.584	0.690	0.615	0.675	0.691	0.595	0.779
misreco	0.064	0.069	0.089	0.085	0.069	0.137	0.069
fake	0.046	0.039	0.061	0.052	0.053	0.012	0.015

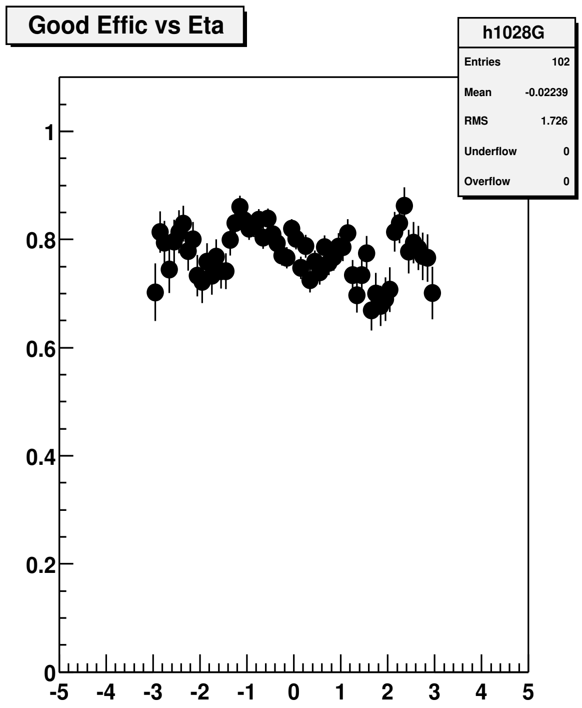
AATrack TARC version, $t\bar{t}$ + 2.5 MB events

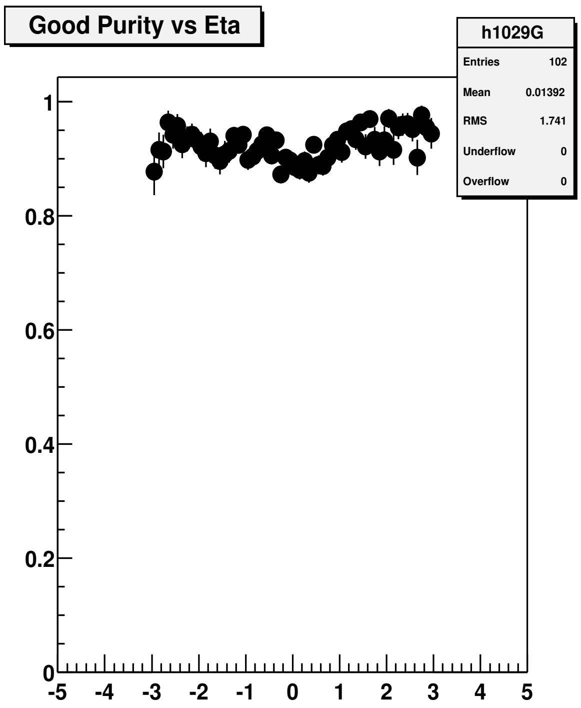
η- dependance

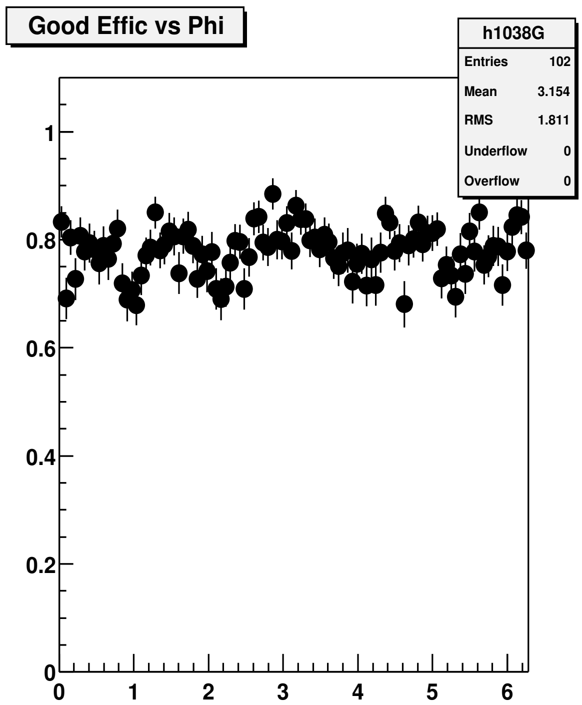


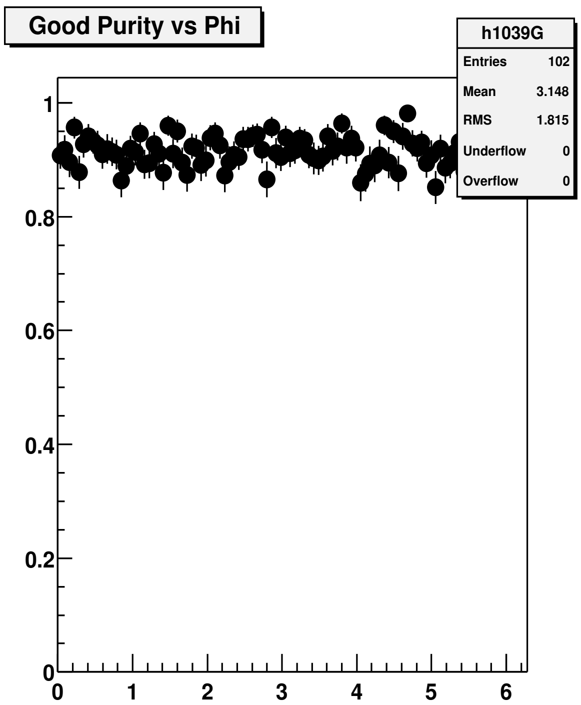
AA v.2.02 for $t\bar{t}$ + 2.5 MB events
(results of M.Doidge)

Same $t\bar{t}$ + 2.5 minimum bias sample, which was used for TARC studies, η dependence









Reduced Track Efficiency

Identified reason - requirement of at least 3 SMT (axial+stereo) hits per track.

In the new AATrack version the track with any number of SMT hits is reconstructed (including CFT only tracks).

To make this possible, the track reconstruction should start from CFT and then be extended to SMT.

Main problem reconstructing CFT tracks:

Large combinatorics in CFT-stereo hit selection, which results in significant increase of time/event.

To implement the CFT track search and keep the high AATrack reconstruction speed, the special procedure was developped.

Implementation of CFT Track Search

AATrack search is performed in few steps:

Step 1: exactly as before
(3 SMT hits, extrapolation to CFT);

Step 2: find primary vertices using found tracks;

Step 3: Select 3 CFT Axial + Stereo hits in any 3 layers of CFT, such that the track constructed from these 3 hits passes some primary vertex ($d_{axial} < 1.5$ cm, $d_{stereo} < 1.5$ cm);

Step 4: Search for additional hits in CFT from inner to outer layers;

Step 5: Extrapolate track to SMT and associate all SMT hits.

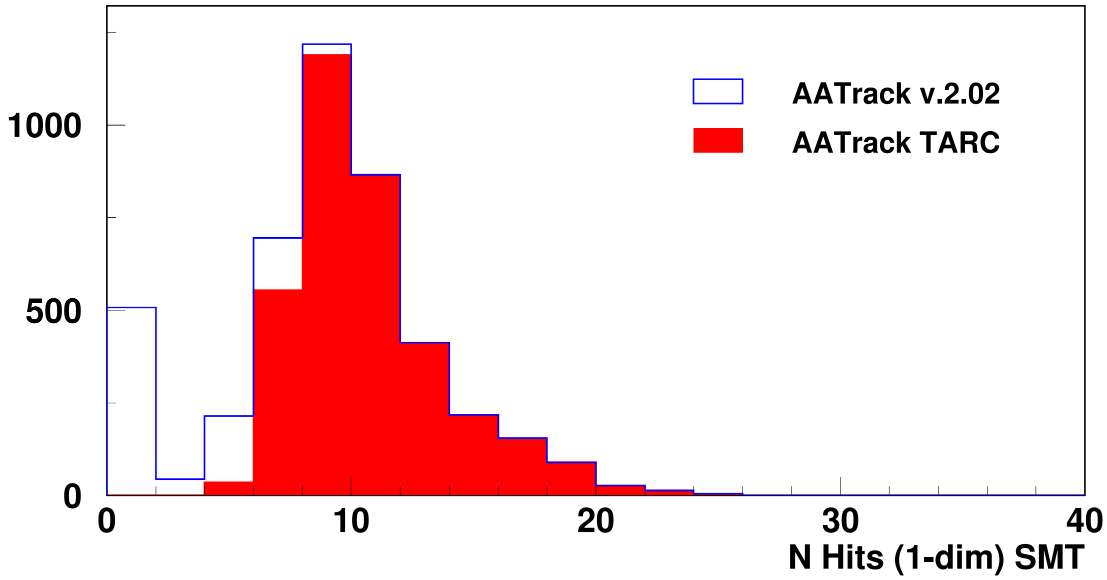
This algorithm allows to find all tracks missed at Step 1 with minimal increase of time.

Reduction of combinatorics is achieved by requiring CFT track hypothesis to pass near some primary vertex.

Selection window is wide enough for the most of physics applications

Increased track efficiency

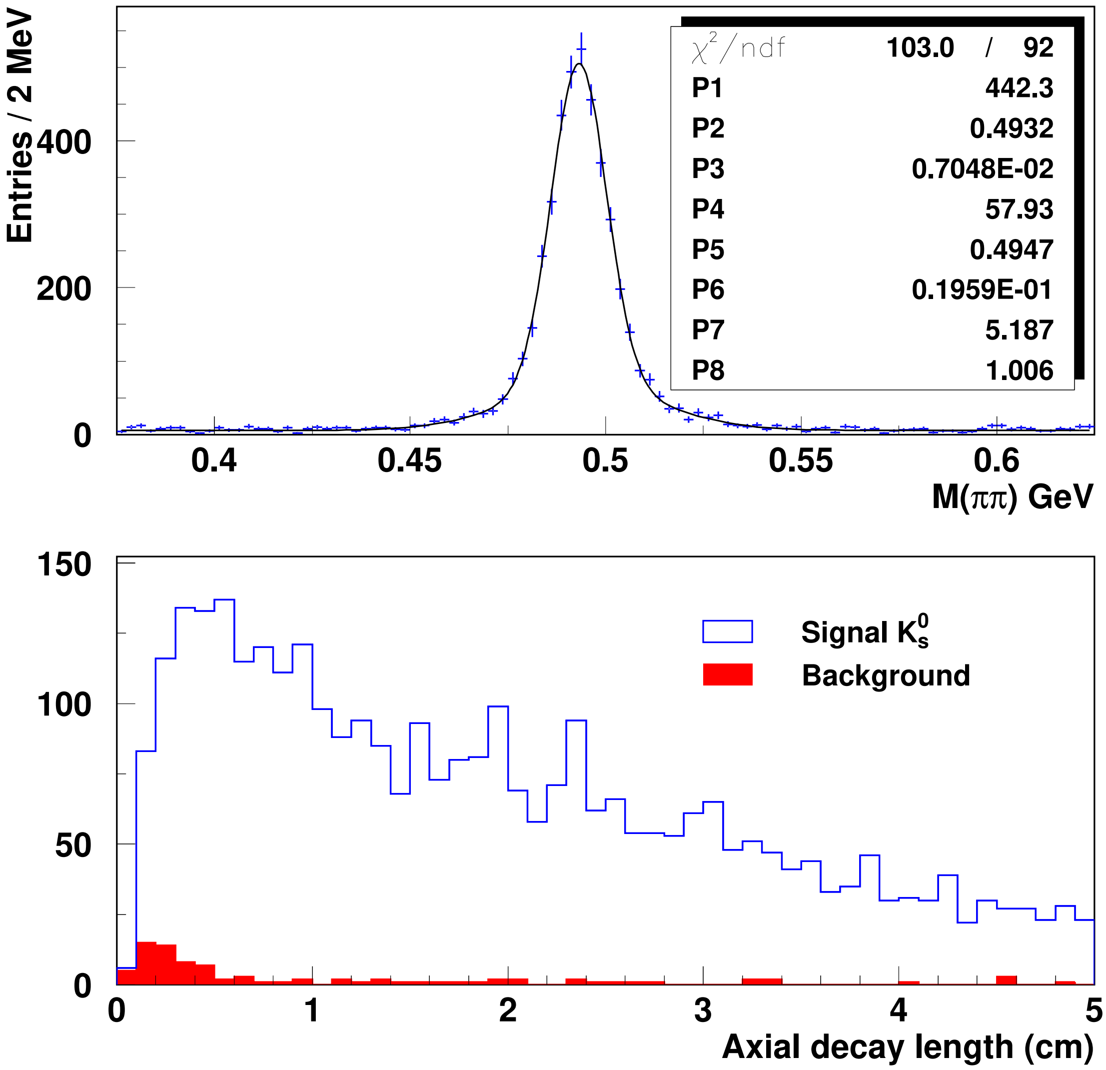
Number of reconstructed tracks is increased by 25-30%.



Reconstruction rate of all particles
(K_s^0, Λ, $J/\psi \to \mu^+\mu^-$, $Z \to \mu^+\mu^-$)
is increased by 70% - 90%.

Increase of time/event: Data: +45%, MC: +10%

Low fake rate: example of $K_s^0 \to \pi^+\pi^-$



Conclusions

- Modified version of AATrack shows much better performance;
- Significant increase of the reconstruction efficiency;
- Reduced rate of mis-reconstructed tracks;
- Fake rate is kept on the same low level;
- The new version of AATrack (v.2.02) is ready for use;