Level 3 Primary Vertexing

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April 24, 2002
L3 Algorithms meeting

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Introduction

Why do we need a level 3 vertexer?

- Calorimeter jet triggers require primary vertex for E_t determination
- Physics tools may require primary vertices
- Eventually vertexing will be refined and used in B-tagging

L3TCFTVertex

- Written by Ray Beuselinck, maintained by Per Jonsson (Imperial College)
- Algorithm has two separate parts:
  - takes average Z_0 for tracks satisfying
    $p_t \geq$ 2.0 Gev/c (default)
    8 stereo hits
    6 axial hits
    axial χ^2 per dof $\leq$ 5
    stereo χ^2 per dof $\leq$ 5
  - events with all tracks failing the last three cuts enter a histogramming algorithm
- Runs with CFT and Global tracks

Monte Carlo, Definitions

residual z distance between reconstructed vertex and MC primary vertex

min bias distance z distance between reconstructed vertex and closest MC minimum bias vertex

good match residual < 1cm

minbias matched residual ≥ 1cm + minbias distance < 1cm

no match residual ≥ 1cm + minbias distance ≥ 1cm

- efficiency = number of good vertices/number of MC events
- purity = number of good vertices/number of reco vertices

Monte Carlo, Results

Efficiencies and Purities

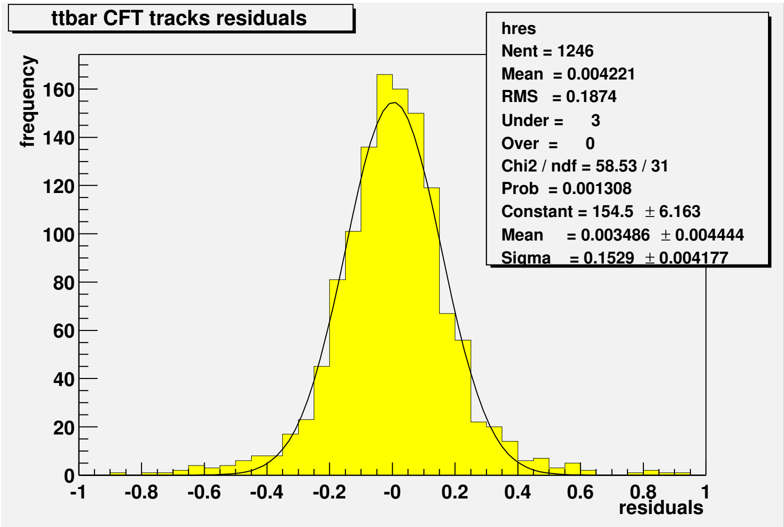
	CFT		Global		modified Global	
	eff	pur	eff	pur	eff	pur
$Z \to \mu\mu$	0.665	0.993	0.745	0.988	0.727	0.988
$Z \to \mu\mu$ 2.5 mb	0.562	0.884	0.67	0.856	0.661	0.872
ttbar	0.994	0.988	0.951	0.953	0.938	0.938
ttbar 2.5 mb	0.940	0.947	0.832	0.832	0.818	0.818
$Wh \to \mu\nu + hbb$	0.978	0.992	0.966	0.969	0.961	0.965
$Wh \to \mu\nu + hbb$ 2.5 mb	0.909	0.950	0.858	0.861	0.865	0.870
$b \to$J$/\psi$	0.883	0.977	0.929	0.986	0.918	0.990

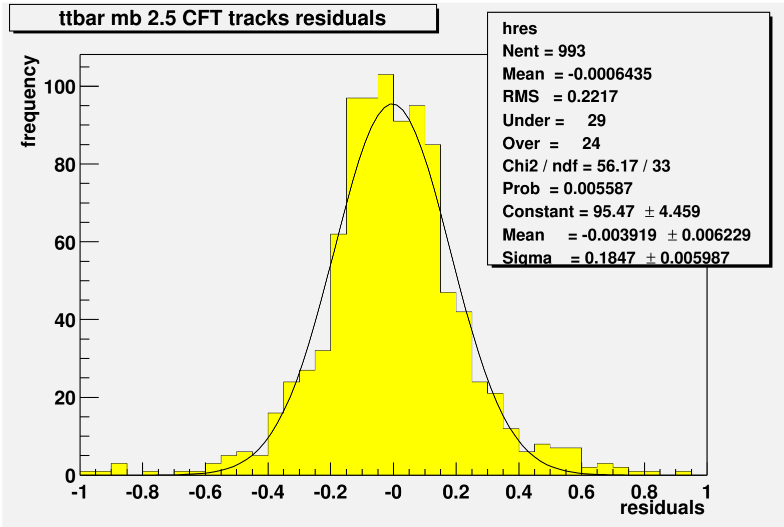
Minimum bias vertex efficiency

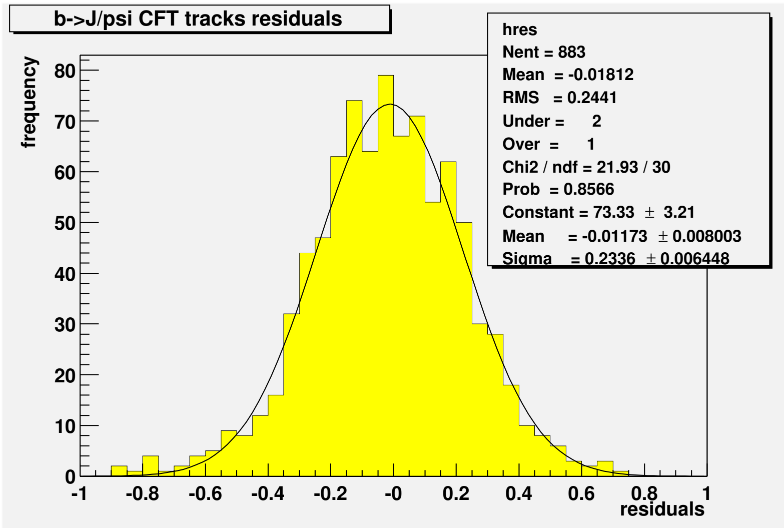
	CFT	Global	Global mod
$Z \to \mu\mu$ 2.5 mb	0.021	0.03	0.03
ttbar 2.5 mb	0.005	0.011	0.018
$Wh \to \mu\nu + hbb$ 2.5 mb	0.002	0.004	0.007

Monte Carlo, CFT Residuals

Residuals for ttbar, ttbar 2.5 mb and $b \rightarrow J/\psi$



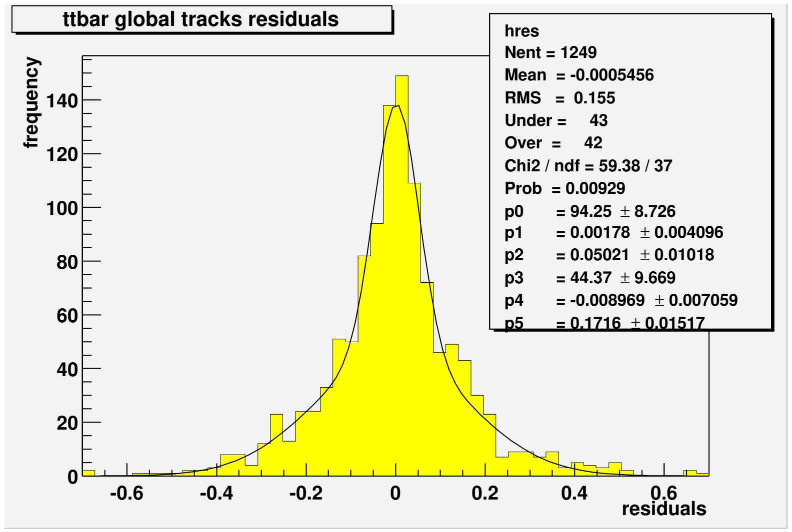


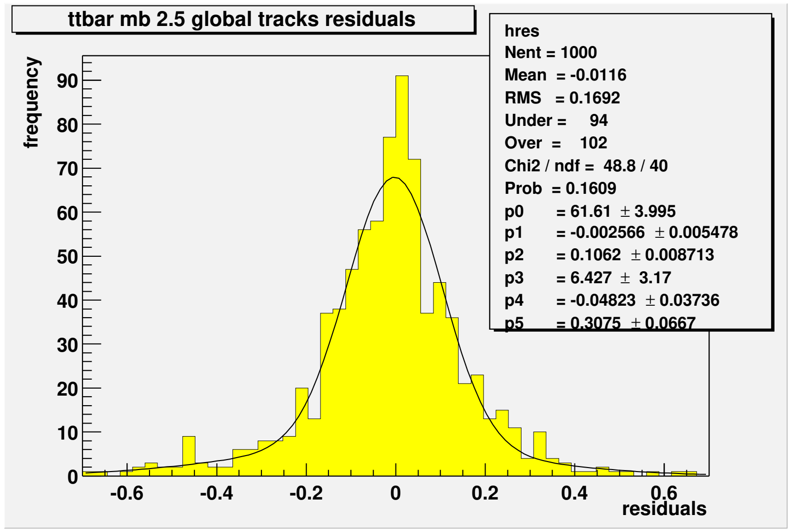


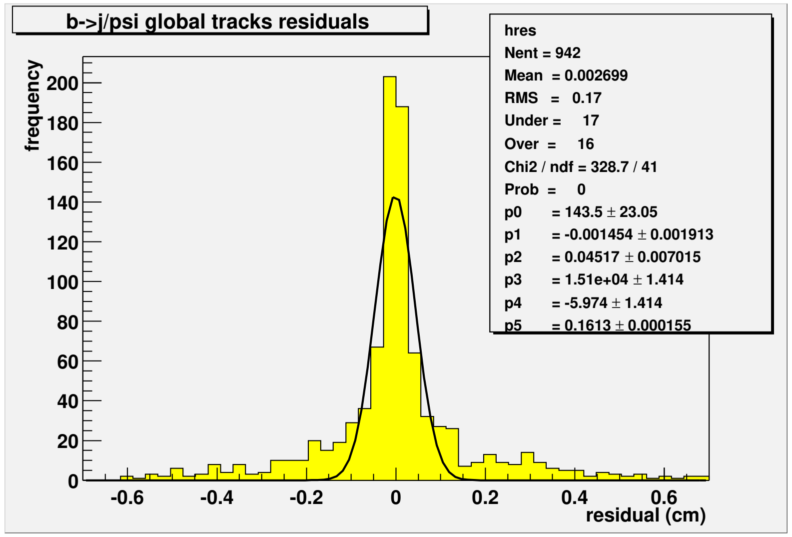
$\sigma \sim 0.2\text{cm}$

Monte Carlo, Global Residuals

Residuals for ttbar, ttbar 2.5 mb and $b \rightarrow J/\psi$



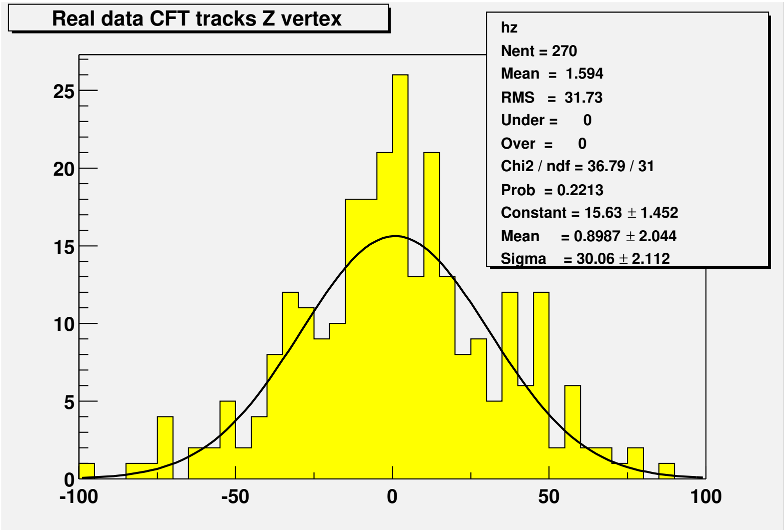


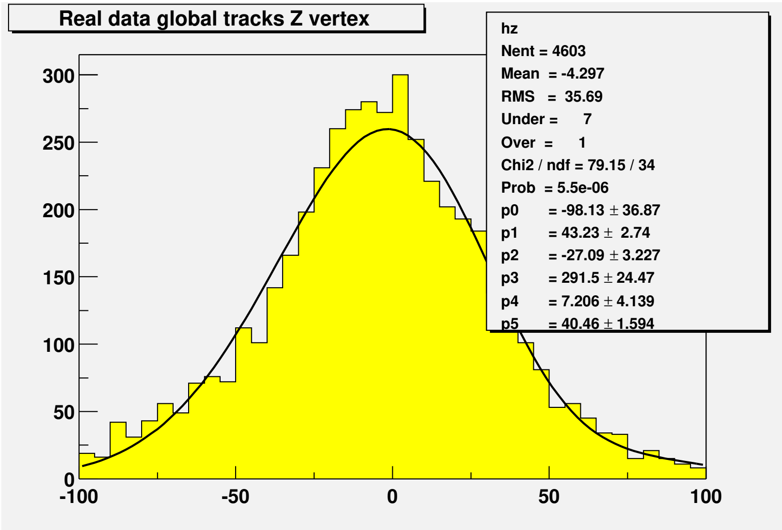


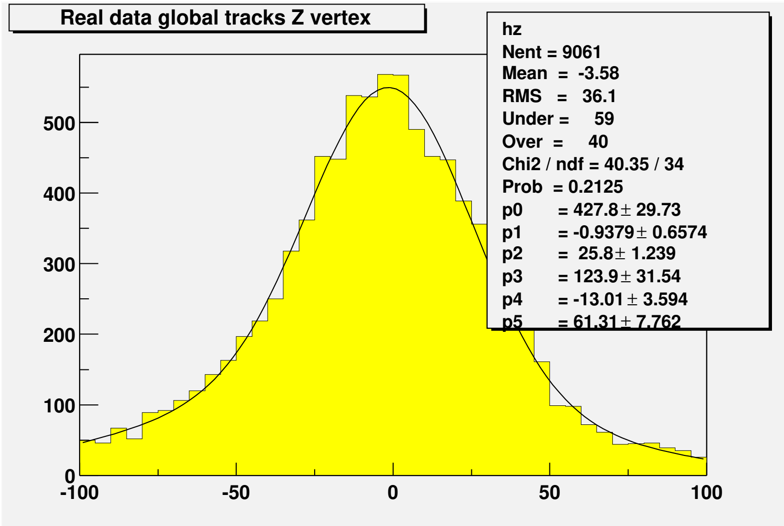
$\sigma \sim$ 0.05cm global tracks

Real Data, Z_{vertex}

Run 149222, 22 March 2002, total events = 23636



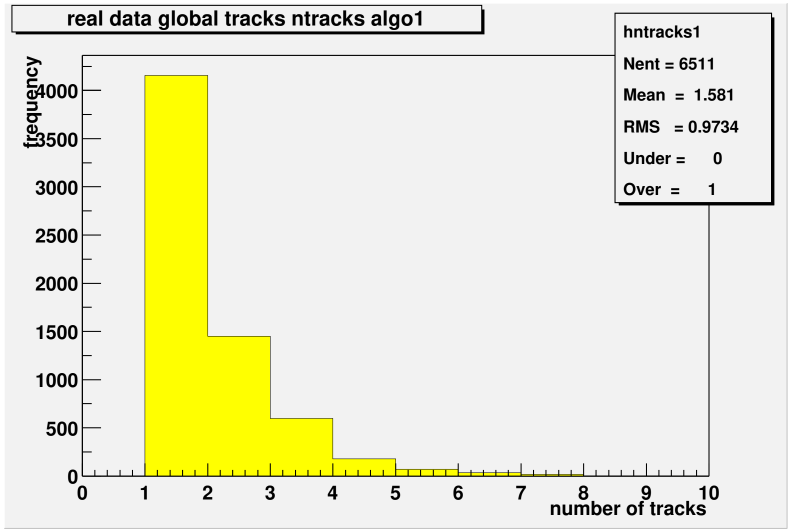




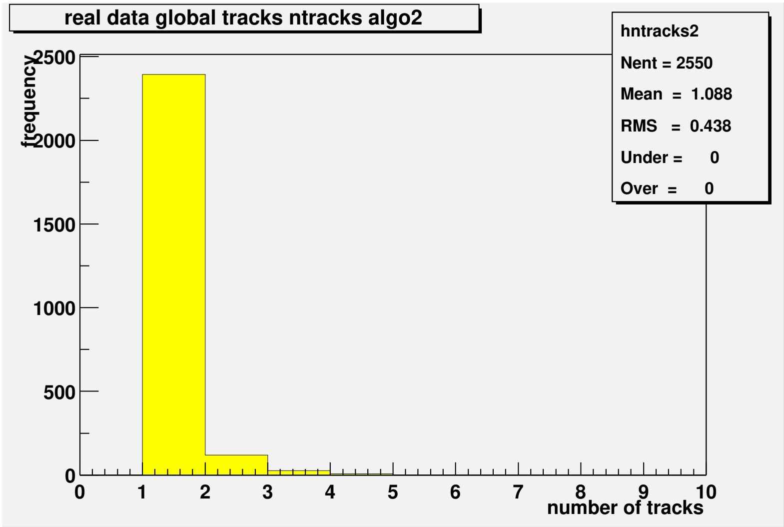
Efficiency of ~ 0.4

Real Data, Number of tracks used

Percentage algorithm 1 used = 71.9%



Percentage algorithm 2 used = 28.1%



Summary

Timing and Stability

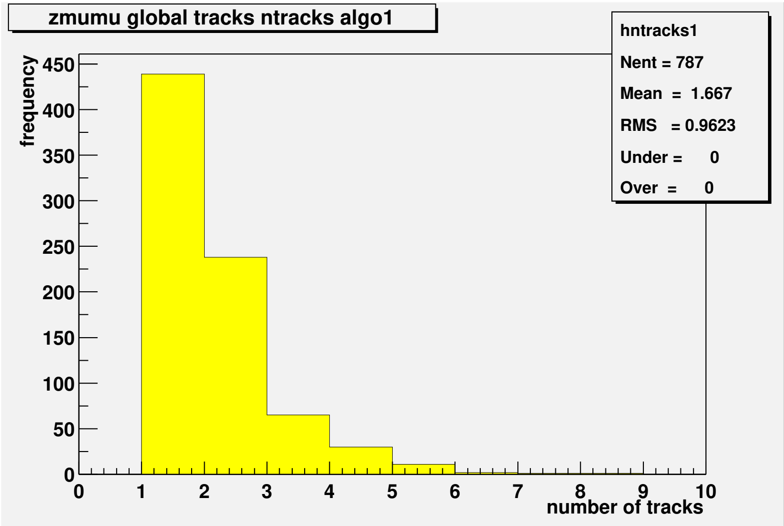
- Excluding unpacking and tracking, vertexing takes < 1ms
- Stable on large MC data and real data sets $> 20{,}000$ events
- Run on full triggerlist

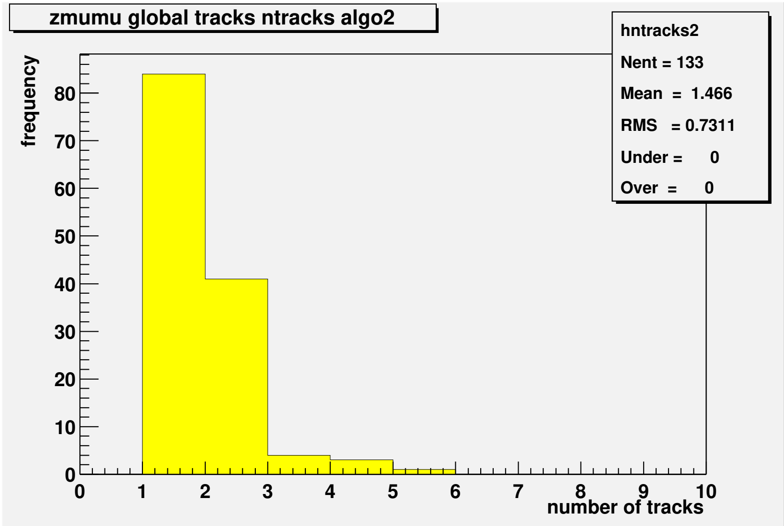
Conclusions

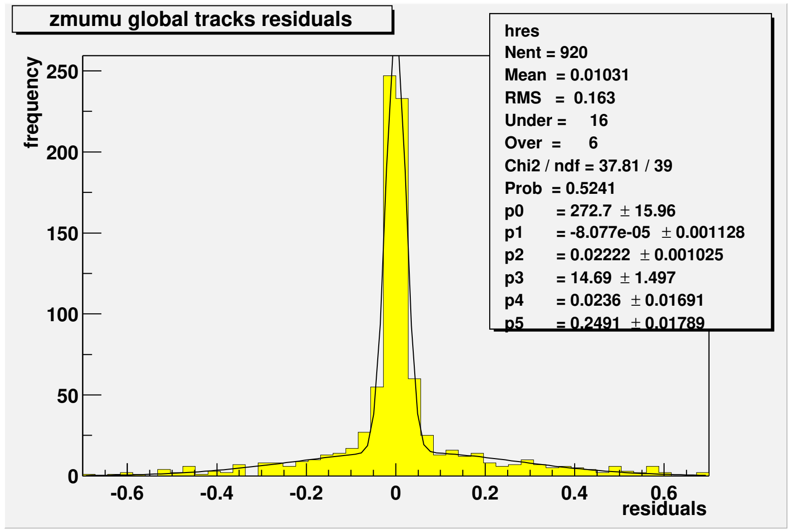
- Fast vertexing tool that can be run online now
- Initial possible resolutions of $\sim 500\ \mu$m
- Algorithms can be improved with further study

- Next step - certification

Monte Carlo, $Z \to \mu\mu$







Monte Carlo, Efficiency vs P_t cut

ttbar mb 2.5