Primary Vertex Studies in Data

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- **Description of algorithm**
- **Efficiency with new data**
- **Resolutions, pulls in data**
- **Vertex Errors**
- **Conclusions and plans**

PrimeVtxFinder Algorithm

CTVMFT-based algorithm to find Primary Vtx

- Start with an input (x_0, y_0, z_0)
  - Data: beamline plus z_0 from ZVertexCollection
- Use PADTracks, apply further track selection
  - Algorithms: OI, OIS, OIZ
  - $P_T \geq 0.5$ GeV
  - $|d_0| \leq 1.0$ cm, $|d_0|/\sigma \leq 4.0$
  - COT: 2 Axial, 2 Stereo segments, $\geq$6 hits each
  - Silicon: OI - $\geq$3 hits
  - Silicon: OIS, OIZ - $\geq$5 hits, $\geq$3 $r - \phi$, $\geq$2 stereo, $\geq$2 Z

Fitting Algorithm

- Order tracks by decreasing P_T
- Pass highest P_T tracks passing cuts (up to 30) to CTVMFT to fit vertex
- Pruning:
  - Remove track with worst χ^2 relative to vertex, above cut ($\chi^2 > 10$)
  - Give remaining tracks to CTVMFT to fit
  - Stop when no tracks have $\chi^2 > 10$ relative to vertex
- Return results of last CTVMFT fit

Data Sample

All data from August, before 152595

- Focus on MultiJet data
  - Official Samples from 4.8.4 production
  - Run TrackRefitModule
  - Top Multi-jet Trigger

    4 jets with Et>15 Gev at L2 and Et>10 GeV at L3

    Sumet>125 Gev
  - $\geq$132k Events total

Efficiencies

PrimeVertexFit Efficiency				
Sample	ϵ_{accept}	ϵ_{track}	ϵ_{fit}	ϵ_{total}
Multijet Data	84.0	96.9	99.6	96.5
Z_BB Data	92.0	97.4	99.0	96.4
$Z \to b\bar{b}$ MC	81.6	84.9	98.1	83.3

- Acceptance: $\epsilon_{\text{accept}} = \frac{N_{\text{accept}}}{N_{\text{total}}}$

  N_{total} = Total number of events generated

  N_{accept} = # events passing acceptance cuts – $|z_0| < 40$ cm, 3 silicon tracks

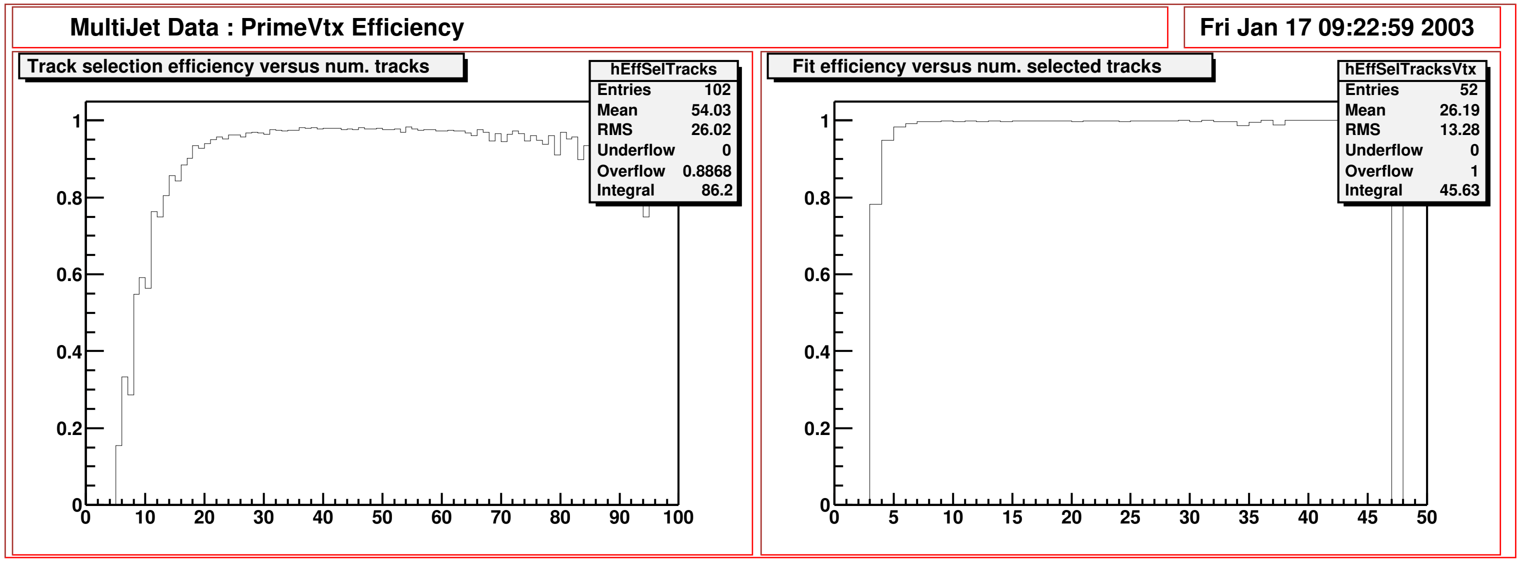
- Track selection efficiency: $\epsilon_{\text{track}} = \frac{N_{\text{select}}}{N_{\text{accept}}}$

  N_{select} = Subset of N_{accept} which have at least 3 tracks passing the selection cuts.

- Vertex fit efficiency: $\epsilon_{\text{fit}} = \frac{N_{\text{vtx}}}{N_{\text{select}}}$

  N_{vtx} = Subset of N_{select} with a successful vertex fit by PrimeVertexFit.

Track Efficiency

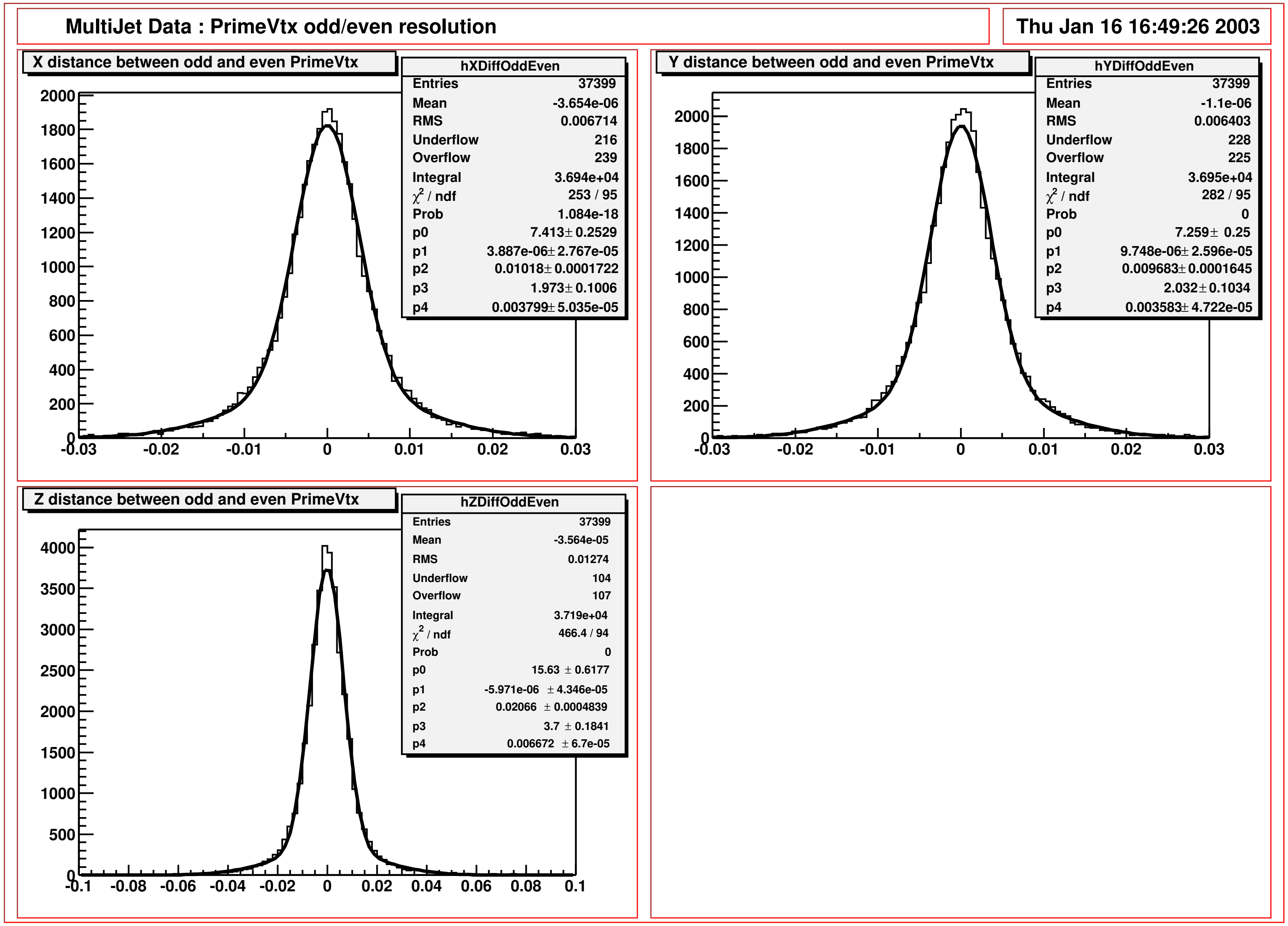


Measuring Pulls, Resolution

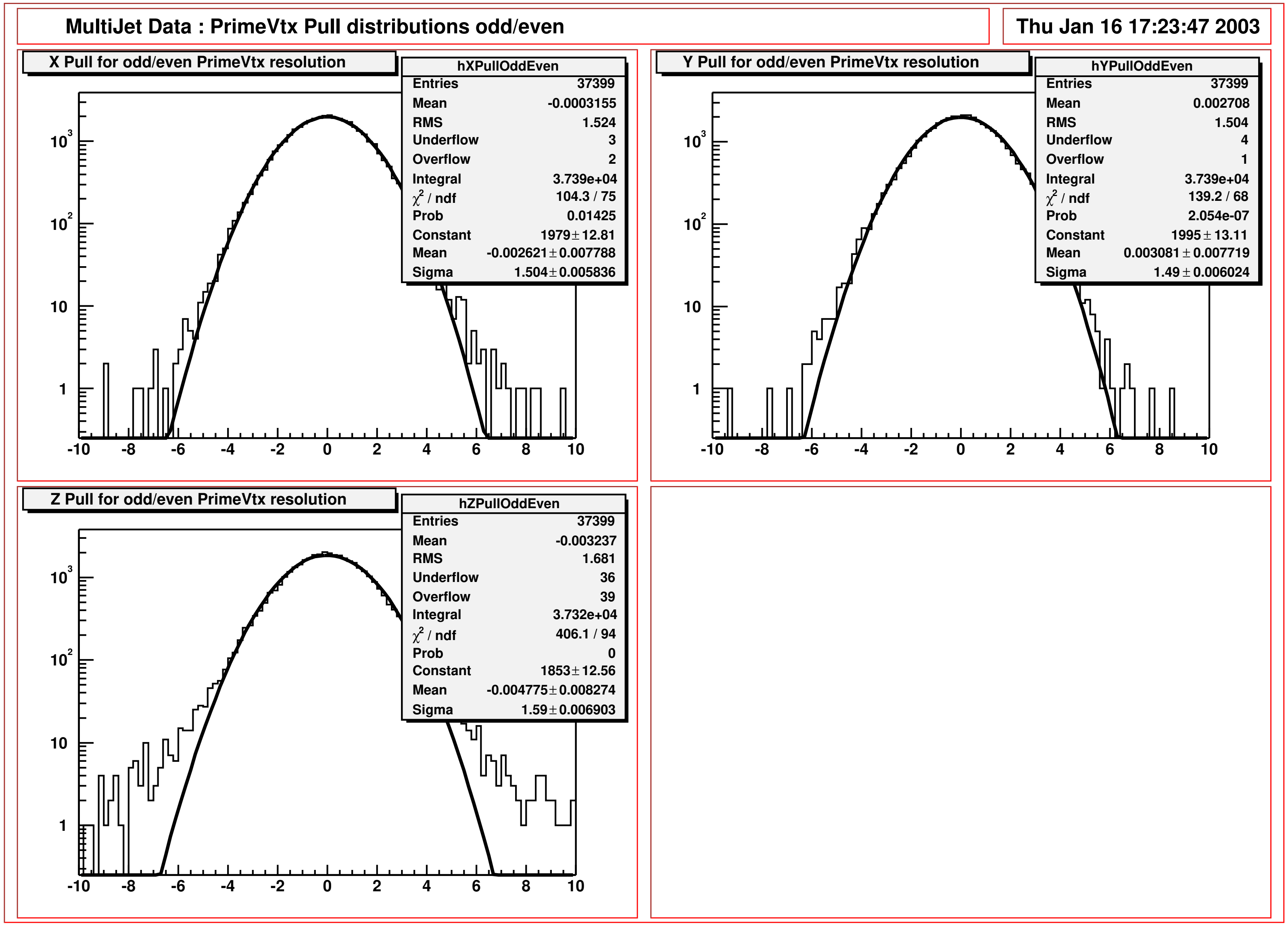
Method: Fit two vertices in event, each using half of tracks

- Divide tracks into two independent sets
  - Apply standard selection
  - For each pair, randomly choose which track goes to which trackset
- Fit both vertices and compare x, y, z positions
- Resolution:
  - Fit gaussian to $x_1 - x_2$ distribution
  - Divide σ by $\sqrt{2}$
- Pulls:
  - Use $\frac{x_1 - x_2}{\sqrt{\sigma_1^2 + \sigma_2^2}}$
  - Fit gaussian and look at σ

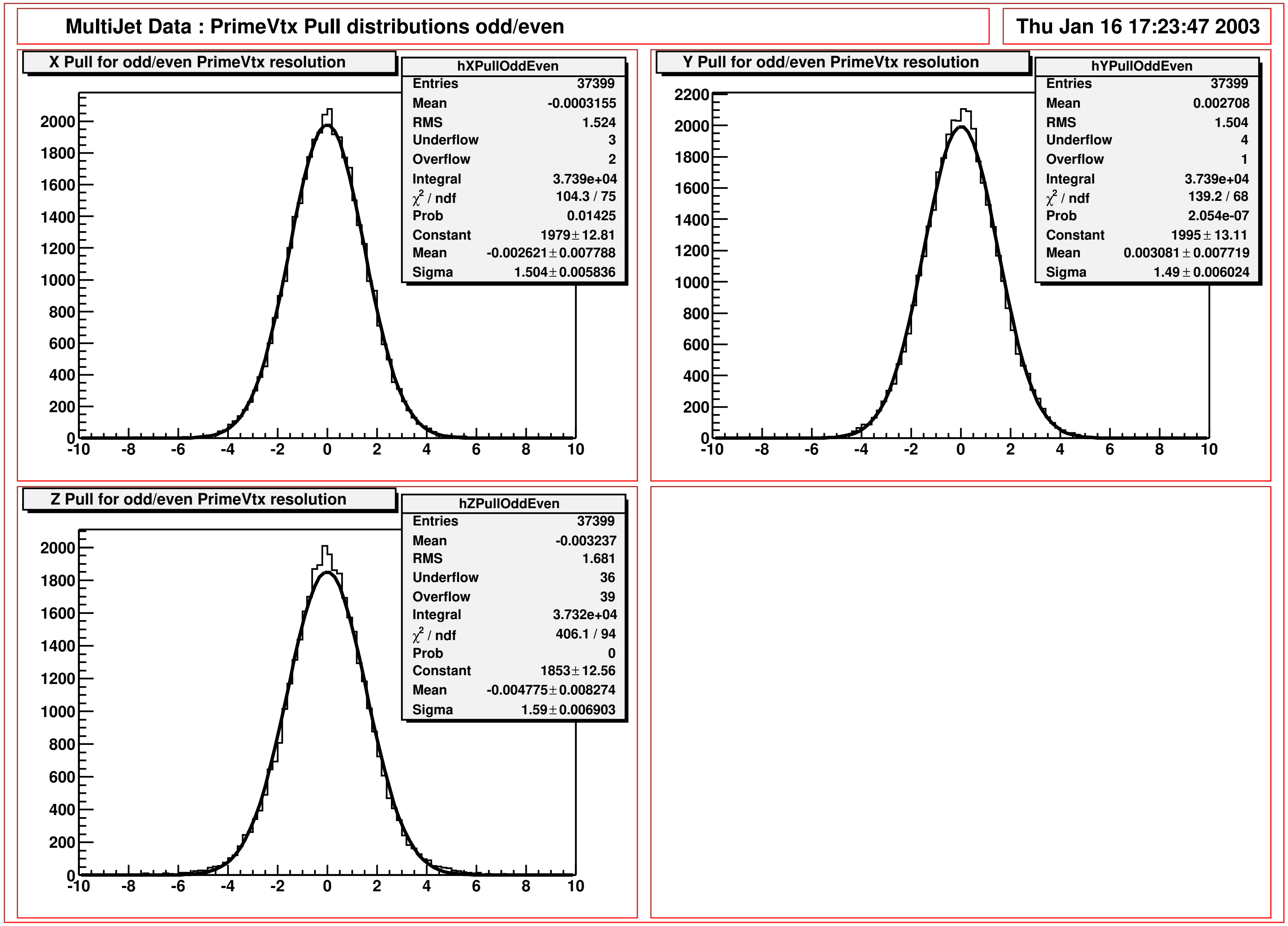
Multijet Data - Resolution



Multijet Data - Pulls



Multijet Data - Pulls

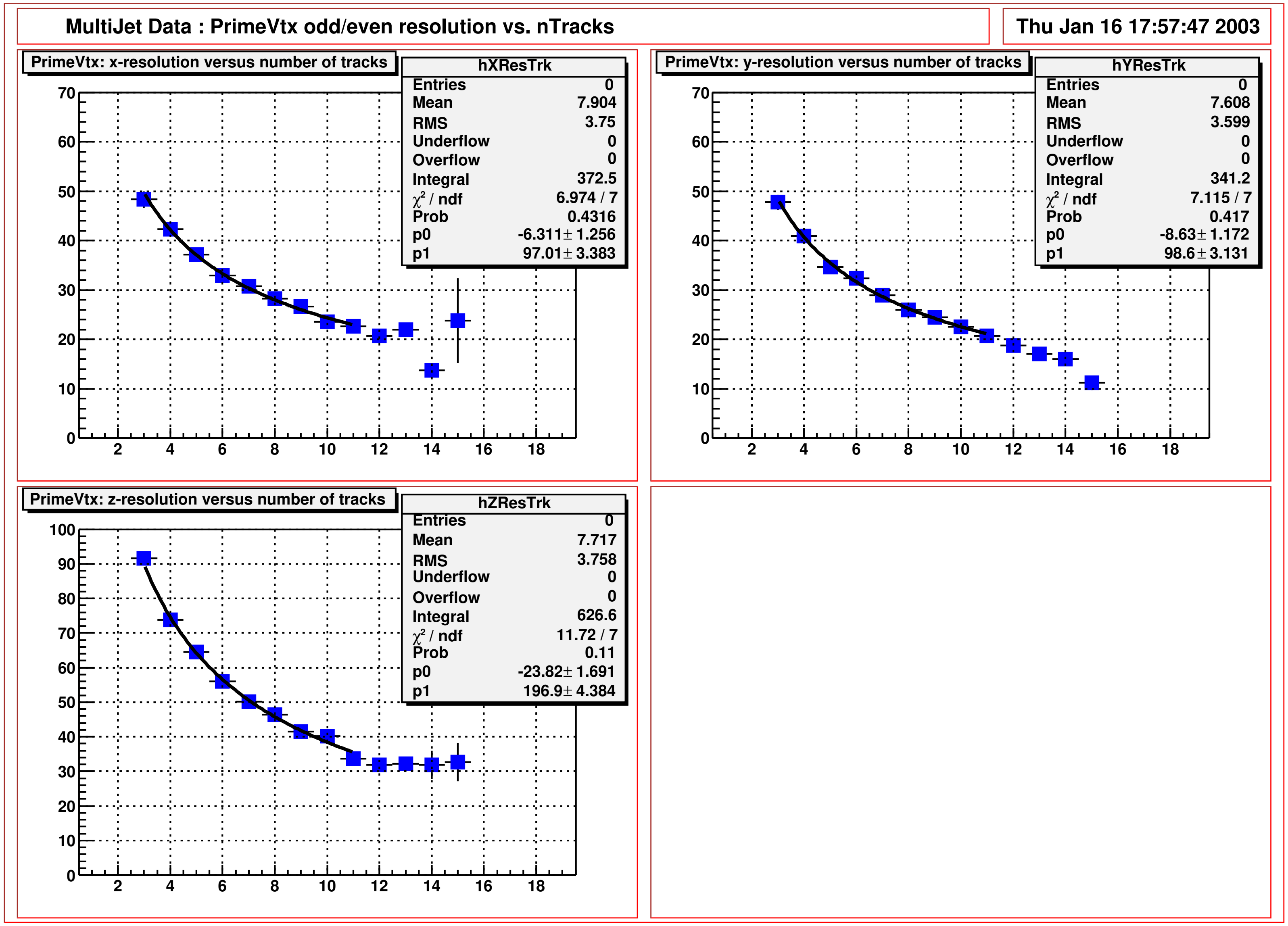


Resolution and Pulls

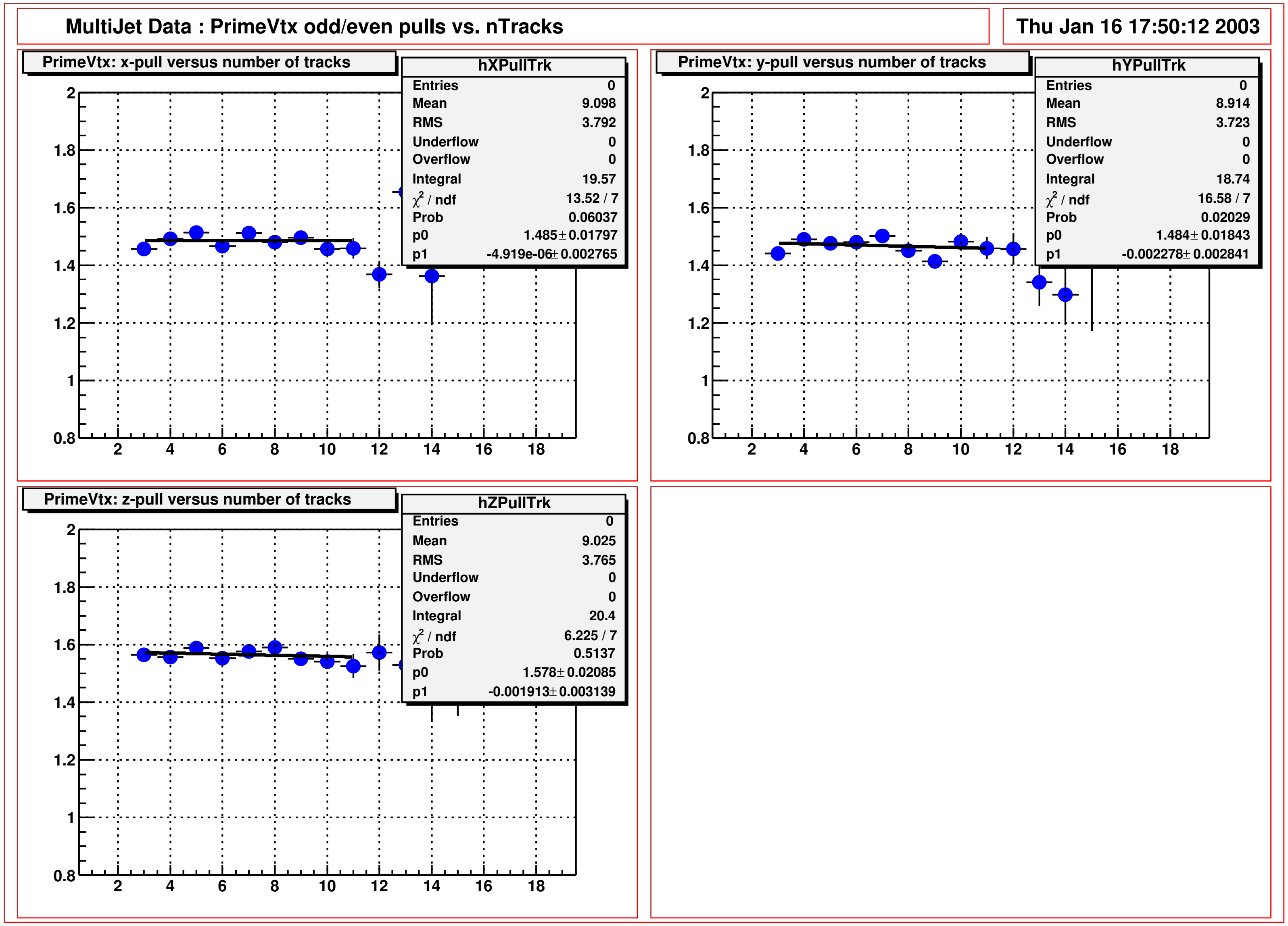
Multijet Data		
Sample	$\sigma(\mu\mathrm{m})$	Pull
x	26.9	1.50
y	25.3	1.49
z	47.2	1.59

Track Multiplicity $=$ 6.7

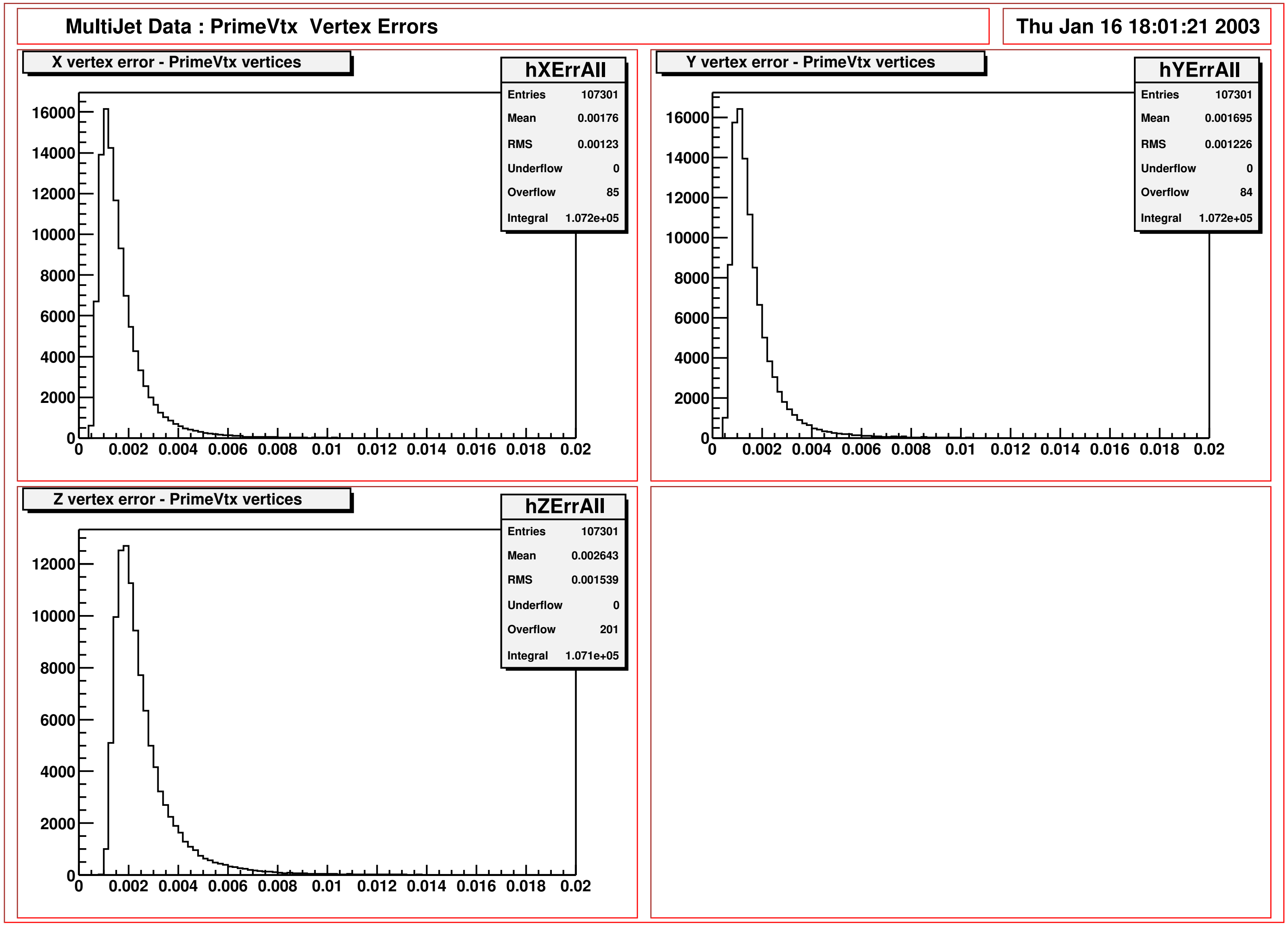
Multijet Data - Resolution vs # Tracks



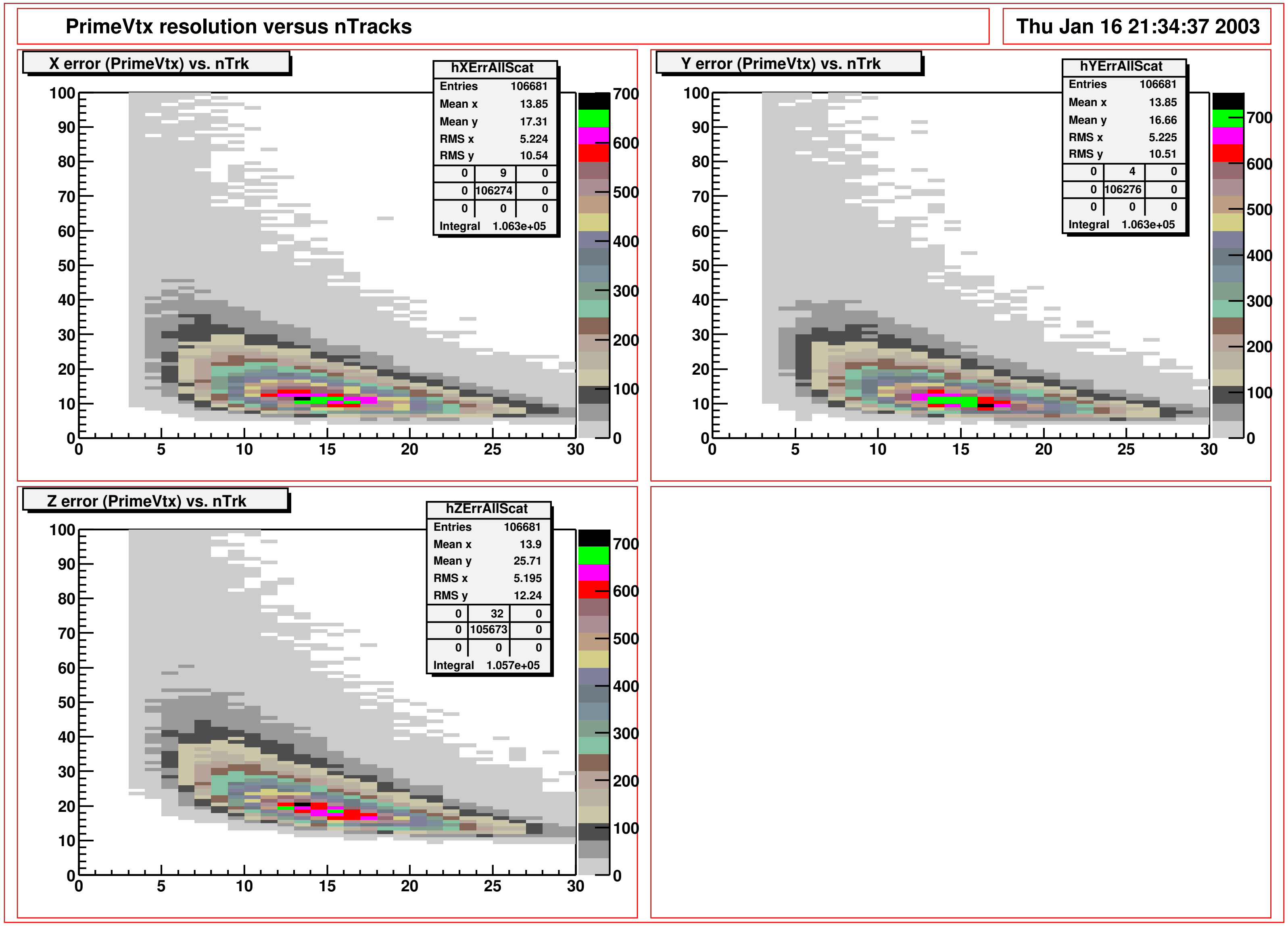
Multijet Data - Pulls vs # Tracks



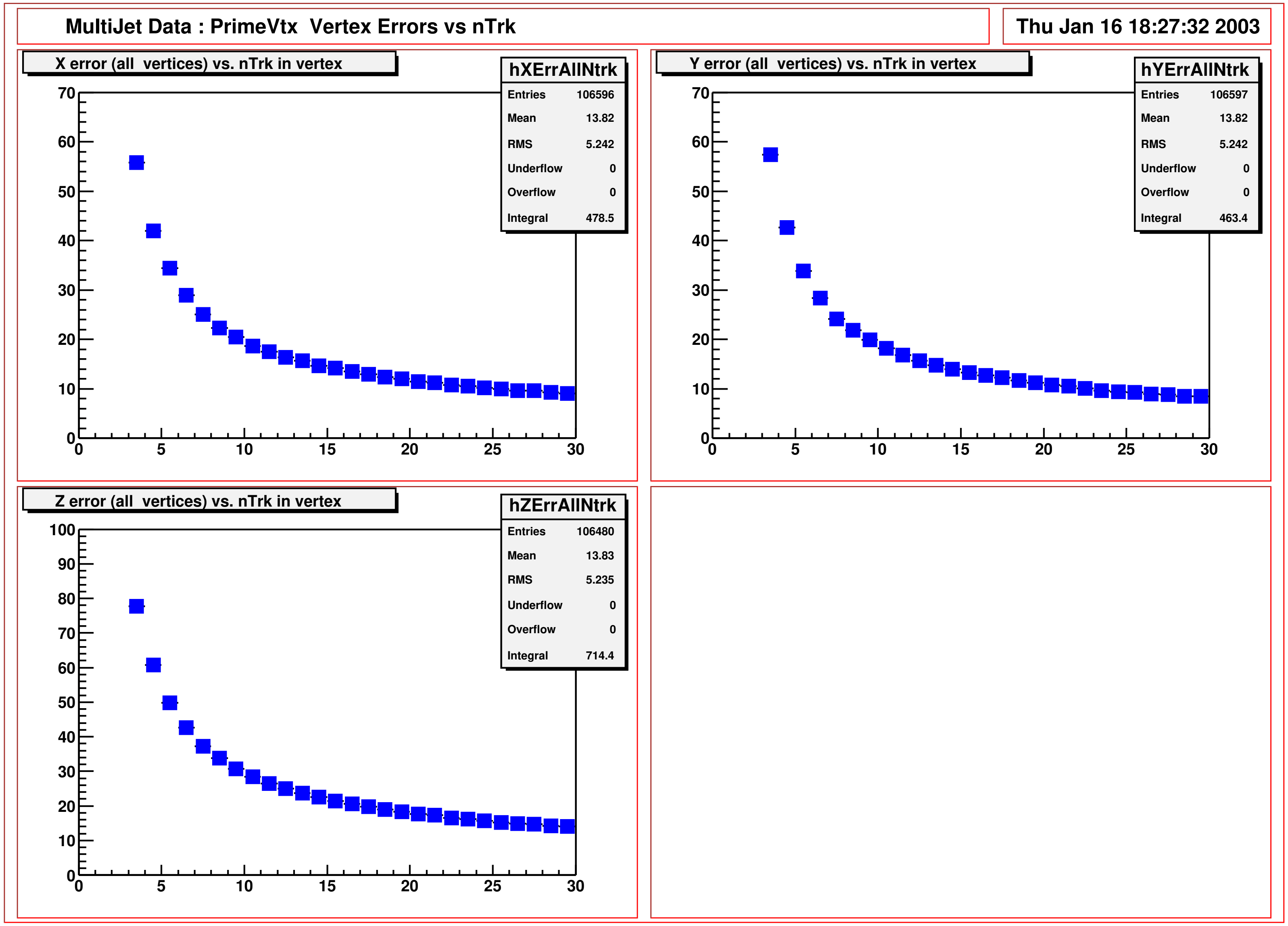
Multijet Data - Vertex Errors from PrimeVtx



PrimeVtx Vertex Error vs. # Tracks

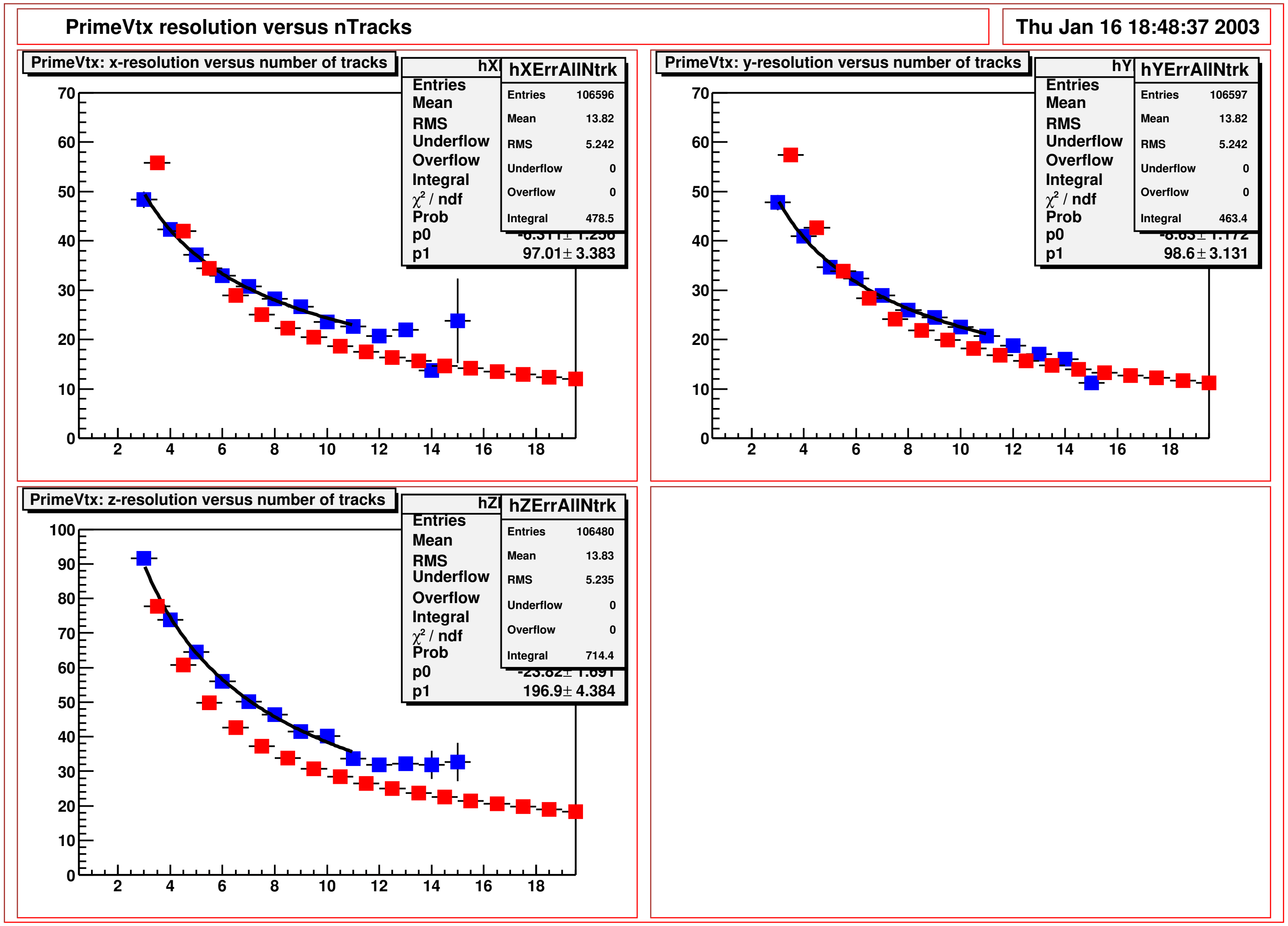


PrimeVtx Vertex Mean Error vs. # Tracks

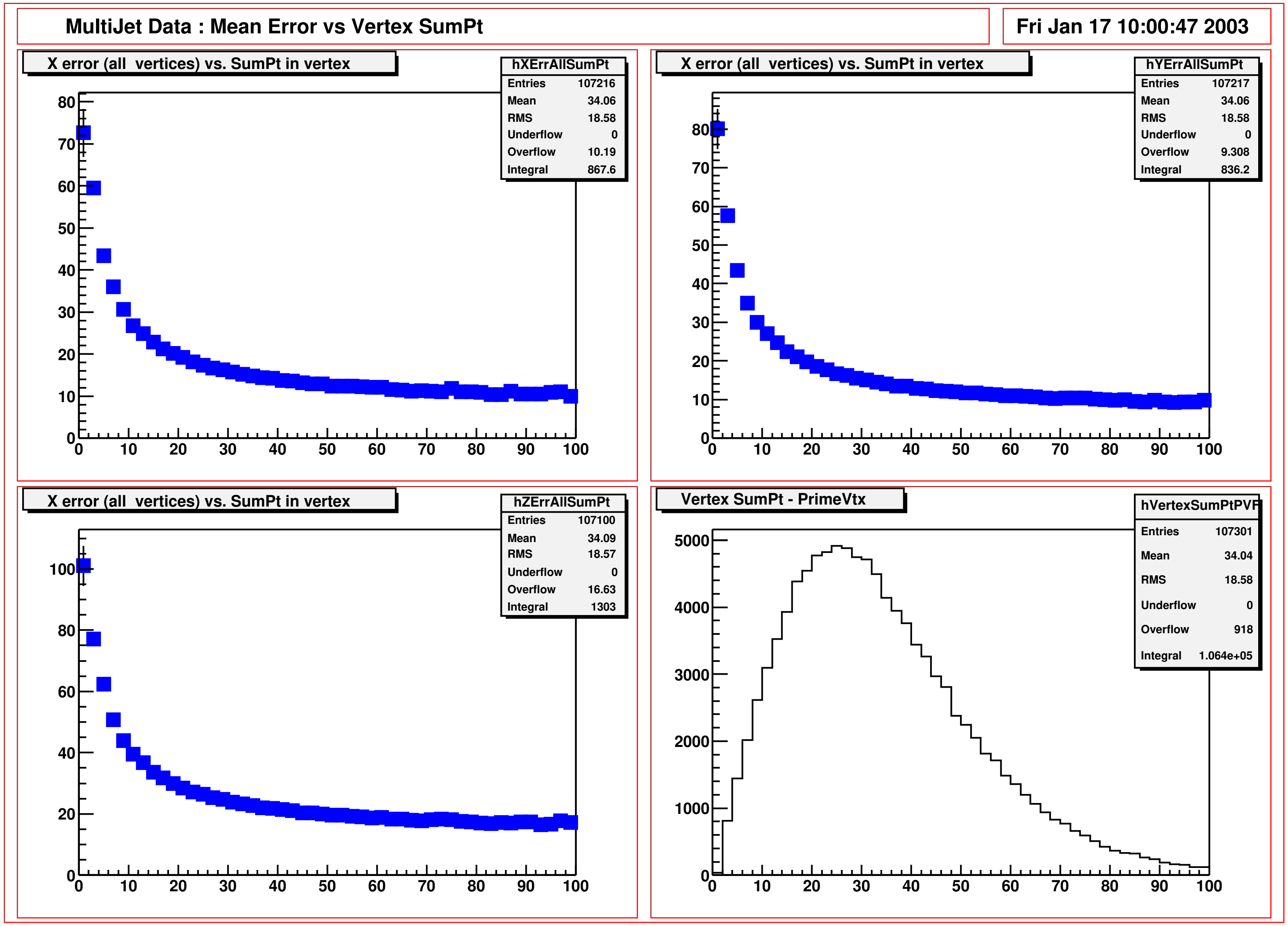


PrimeVtx Odd/Even resolution vs Mean Error

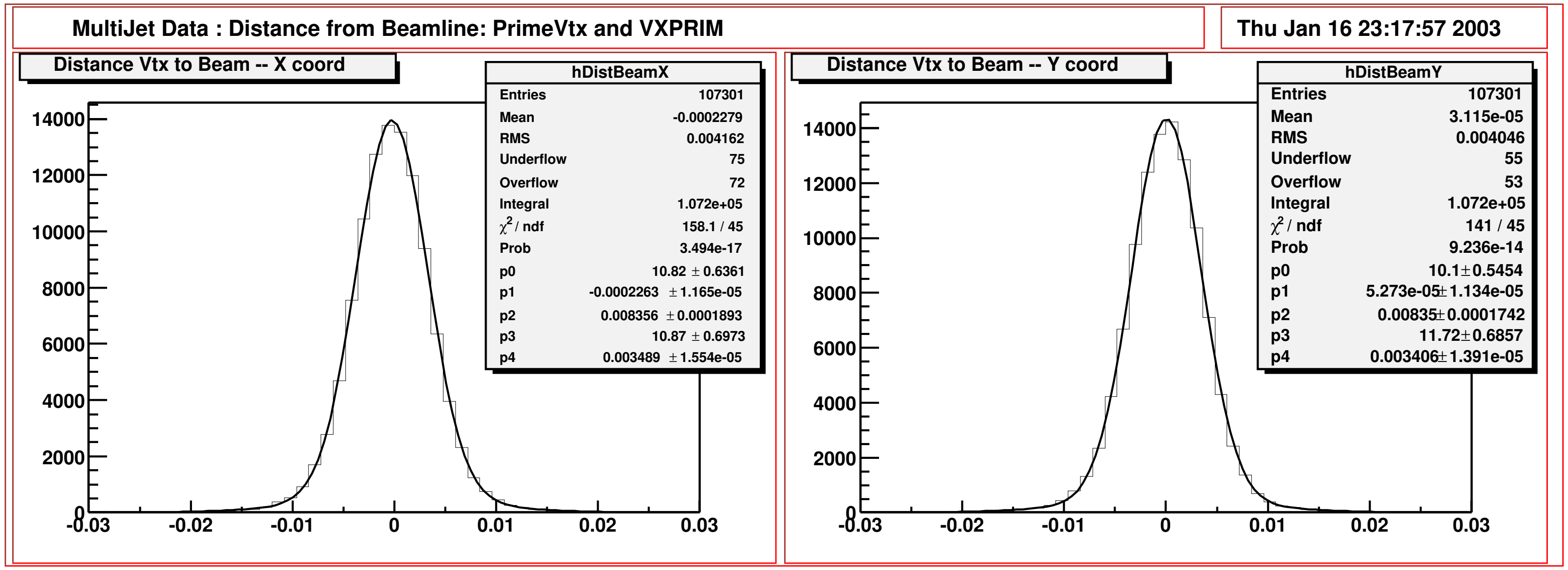
-Blue:Odd/Even Resolution, Red:Mean Error



PrimeVtx Mean Vertex Error vs. Σp_T



PrimeVtx: Fitting the Beam



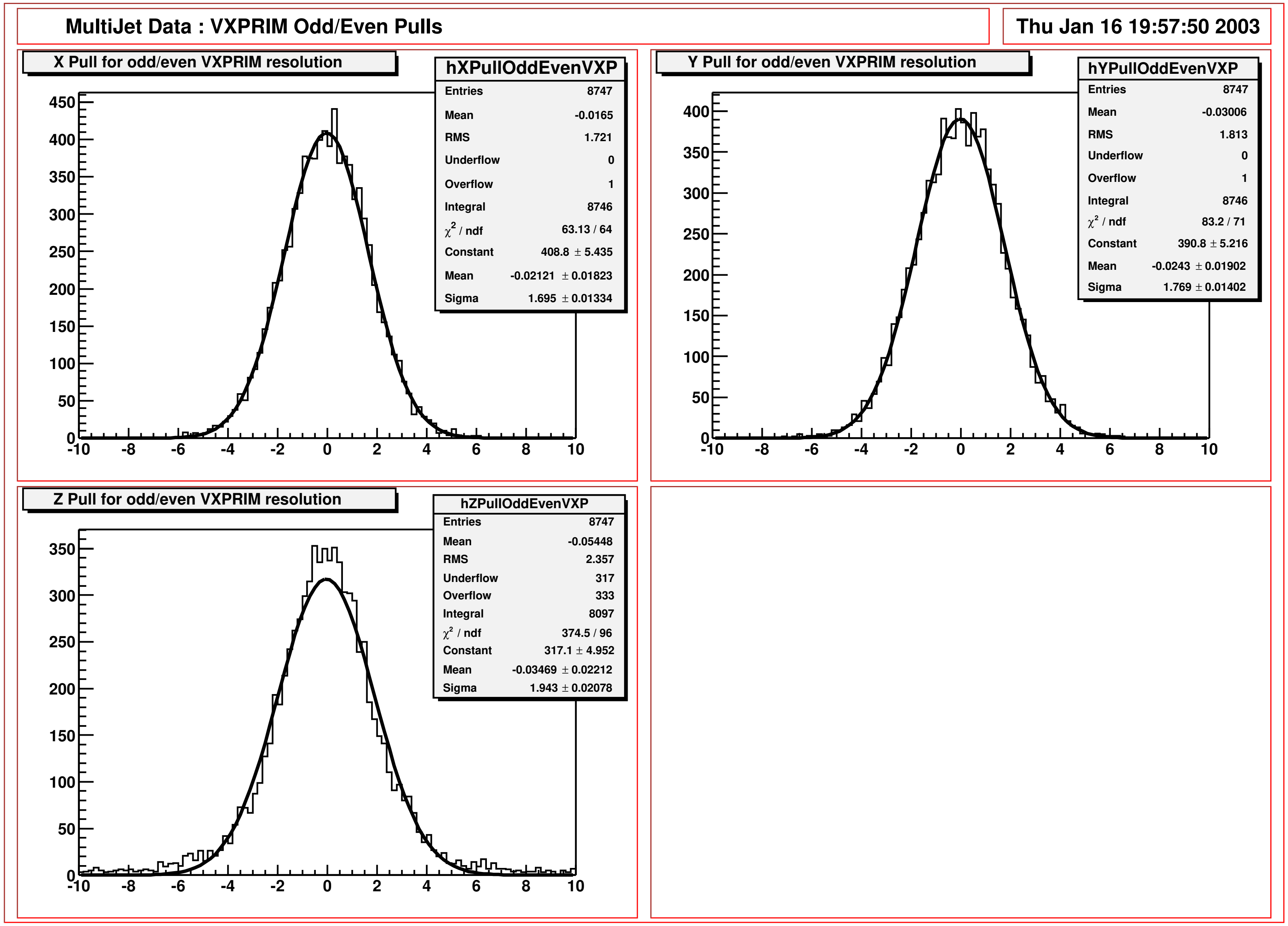
- Plot distance from primary vertex to beamline
- Resolution convoluted with beam width
- $\sigma(x) = 35\ \mu$m, $\sigma(y) = 34\ \mu$m

PrimeVtxFinder and VXPrim Comparison

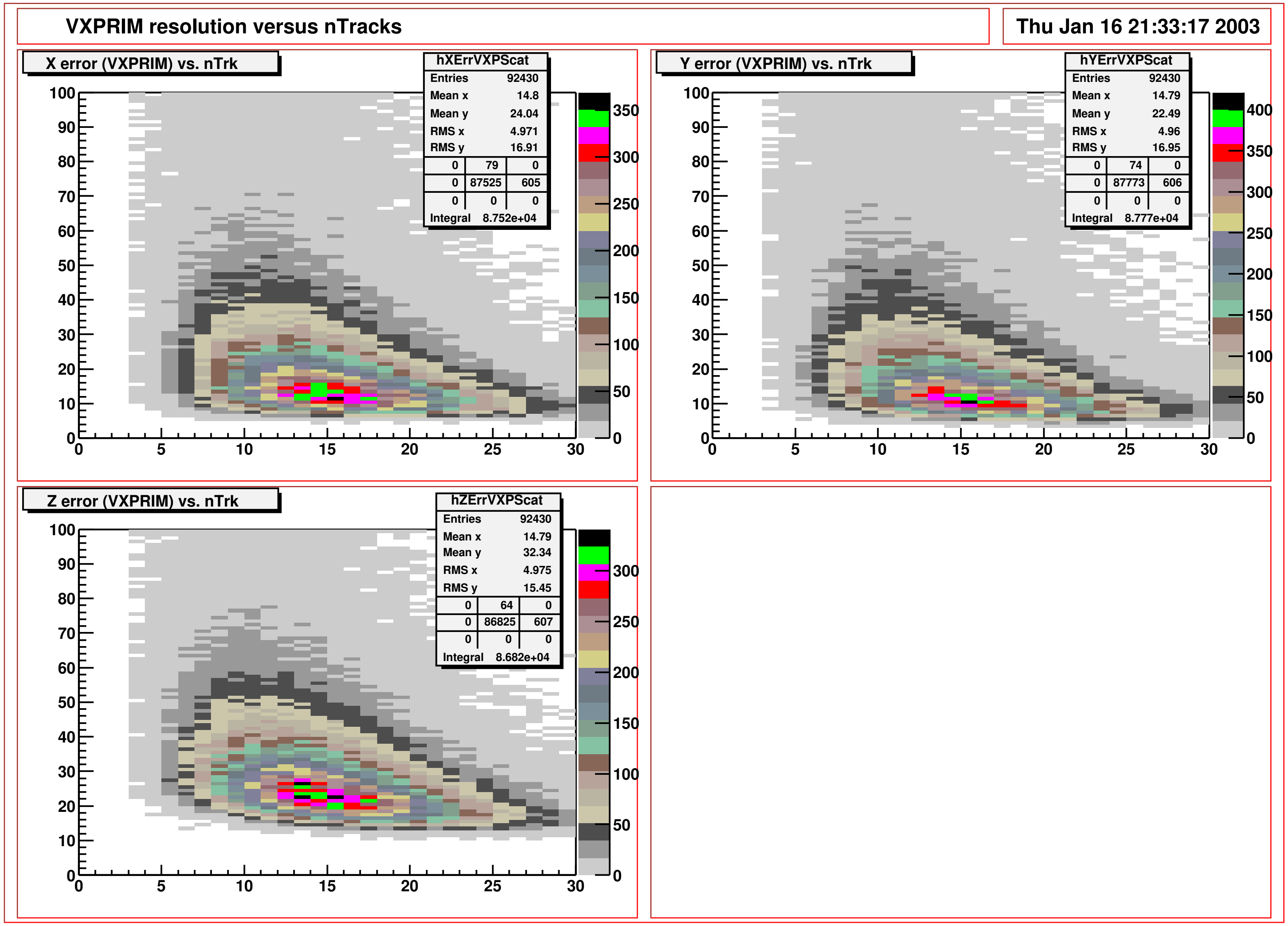
Resolution - Multijet Data			
	x (μm)	y (μm)	z (μm)
PrimeVtx	26.9	25.3	47.2
VXPRIM	30.7	29.2	57.2

Pulls - Multijet Data			
	x	y	z
PrimeVtx	1.50	1.49	1.59
VXPRIM	1.70	1.77	1.94

Multijet Data - VXPRIM Pulls

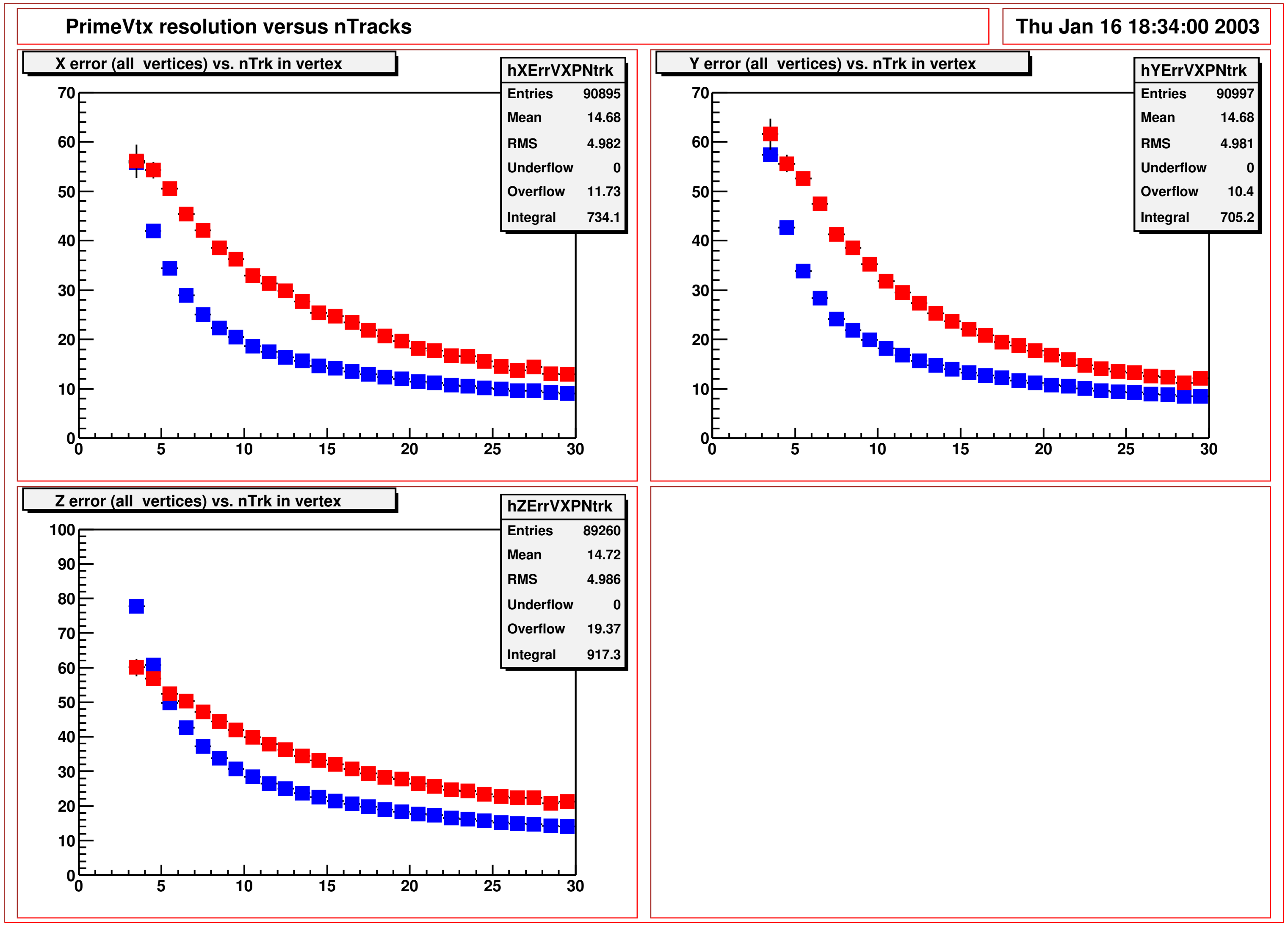


VXPRIM Vertex Error vs. # Tracks



Vertex Errors: PrimeVtx and VXPRIM

-Blue:PrimeVtx, Red:VXPRIM



Conclusions and Plans

- Fit efficiency still high: $\sim$ 99%
- Pulls are stable vs. # Trks
- Mean error better than beamline for $\geq$ 8-10 Tracks

- Module has been committed to VertexMods
- Example/Test module also committed as example
- Results from module checked

- Ready for use by other collaborators
- Sal and Joao already testing with SecVtx