Flux Normalized π^0 Yield

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- Overview: Analysis Strategy
- Yield Analysis: Algorithms, cuts, and Bkgd subtractions
- Recent Results
- Summary and Future Work

Data Summary Trees

- Created using pass1 skim files: Events with ≥ 2 clusters and $m_{\gamma\gamma} > 85$ MeV.
- DST cuts: Cluster x,y ≥ 3.8 cm and trigphoton tagm times must be within ± 100 ns of TSbit2 trigthit time (HyCal total sum time); all other cuts are default including flux counting and beam-trip cutting.
- DST filling algorithm: For each event, form list of valid cluster pair candidates (any combination with $m_{\gamma\gamma} > 85$ MeV); for each candidate, loop over all selected trigphotons and fill data tree.
- No kinematic fitting or gain monitoring corrections applied.
- Coordinate reconstruction algorithm #1 (logarithmic) used.

Run/Flux Statistics

Table 1: Fall 2004 π^0 Production Runs included in yield analysis

target	RadiatorB		Radiator A
	# of Runs	Total Flux	# of Runs
^{12}C	172	$2.542x10^{12}$ γ's	95
^{208}Pb	76	$1.405x10^{12}$ γ's	0

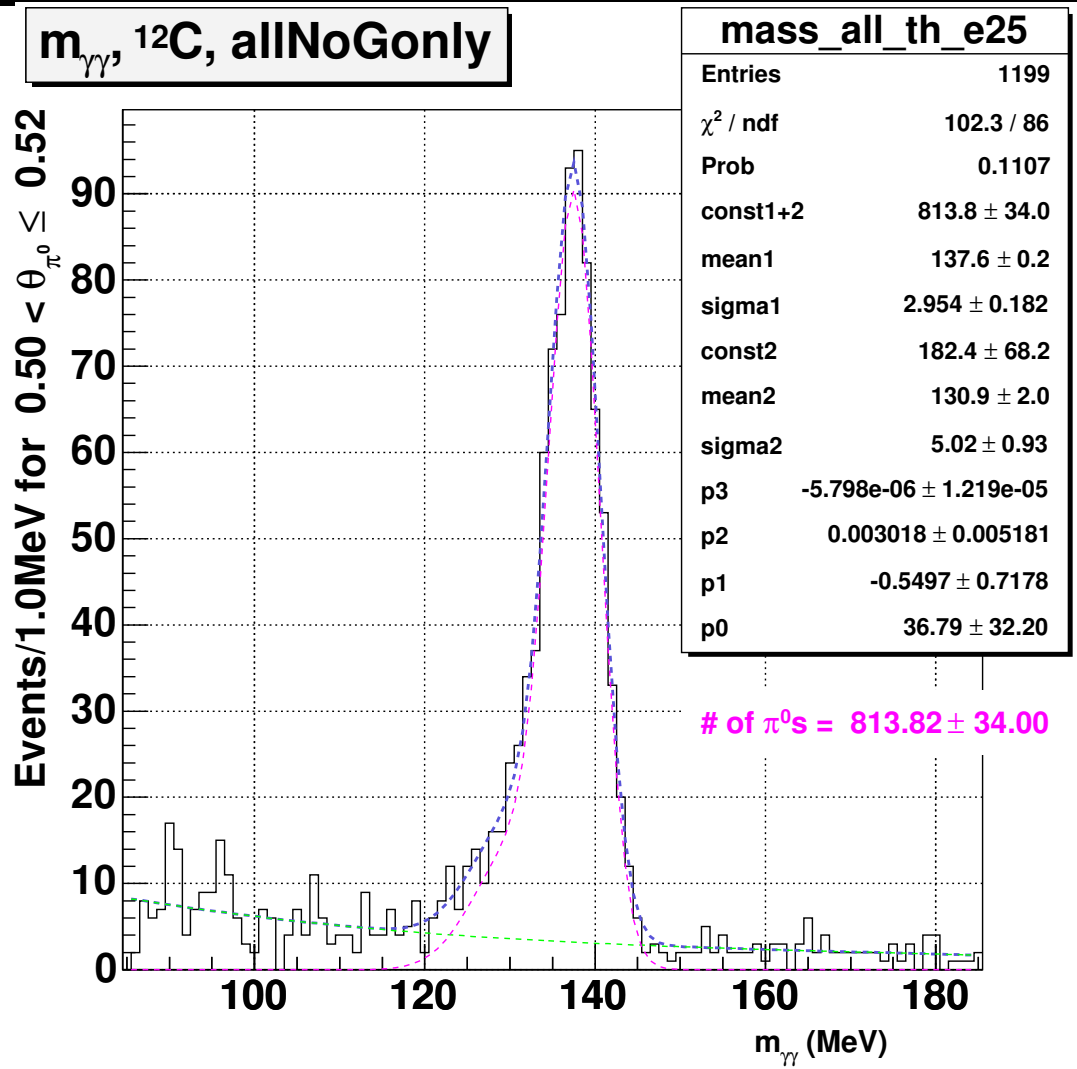
Yield Analyzer: Overview

- Data separated into 5 groups based on HyCal fiducial acceptance: All, Wonly, Mixed, Gonly, and AllNoGonly.
- General cuts (applied to all datasets): $E_{cluster} \geq 0.500$ GeV, $3.50 \leq E_{pair} \leq 6.5$ GeV, # of veto hits != 2 for cluster pair.
- Inelastic background calculated explicitly for each 0.10° π^0 production angle bin (from elasticity bkgd function integral within cut limits).
- Timing-accidental background correction not yet implemented; method will be ∼same as for inelastic bkgd.

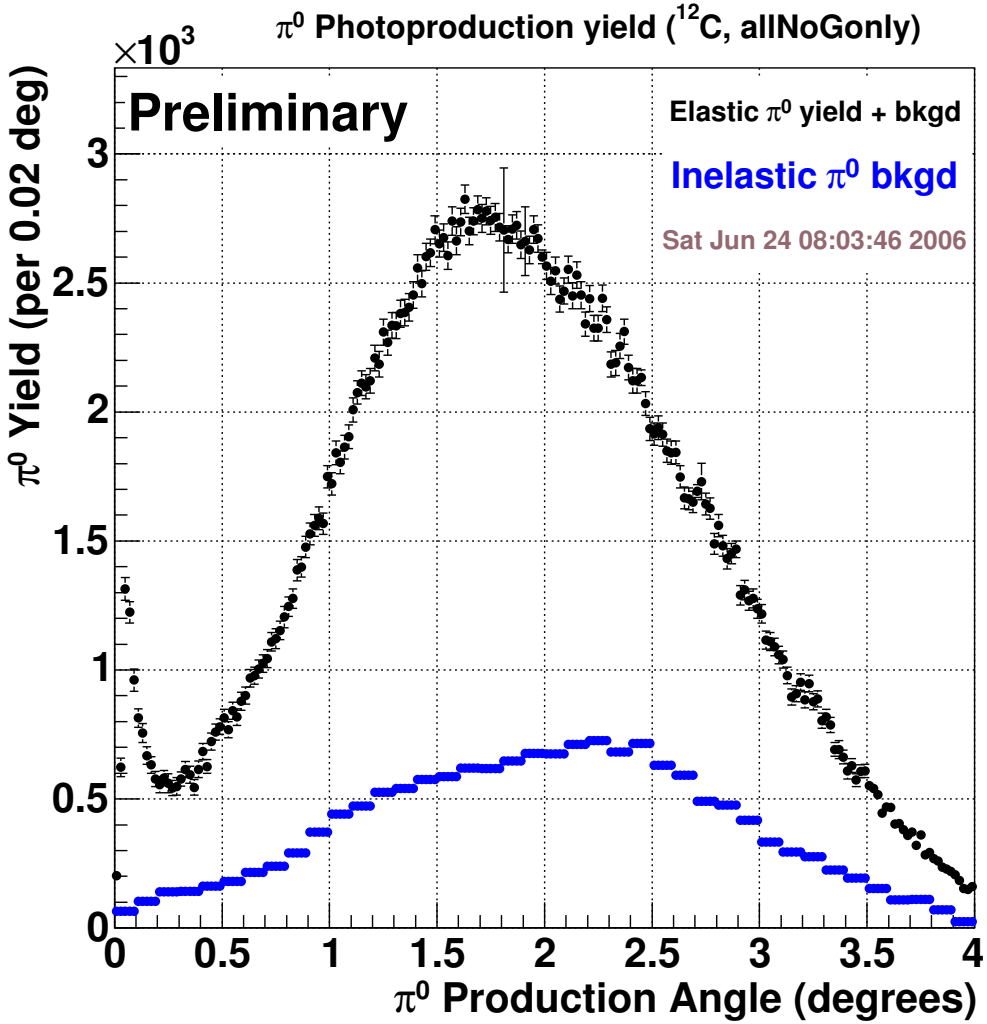
Yield Analyzer: $dN/d\theta_{\pi^0}$

- π^0 production angle broken up into 200 bins between 0° and 4° =>(0.02° bin size)
- First apply timing cut (±6 ns around coincidence Tdiff peak), then elasticity cut [0.9,1.1].
- Then invariant mass distribution plotted for each angle bin; plot is fit with polynomial bkgd function plus a gaussian.
- To produce spectra (elastic + bkgd), counts in (only) the peak are plotted for each bin.

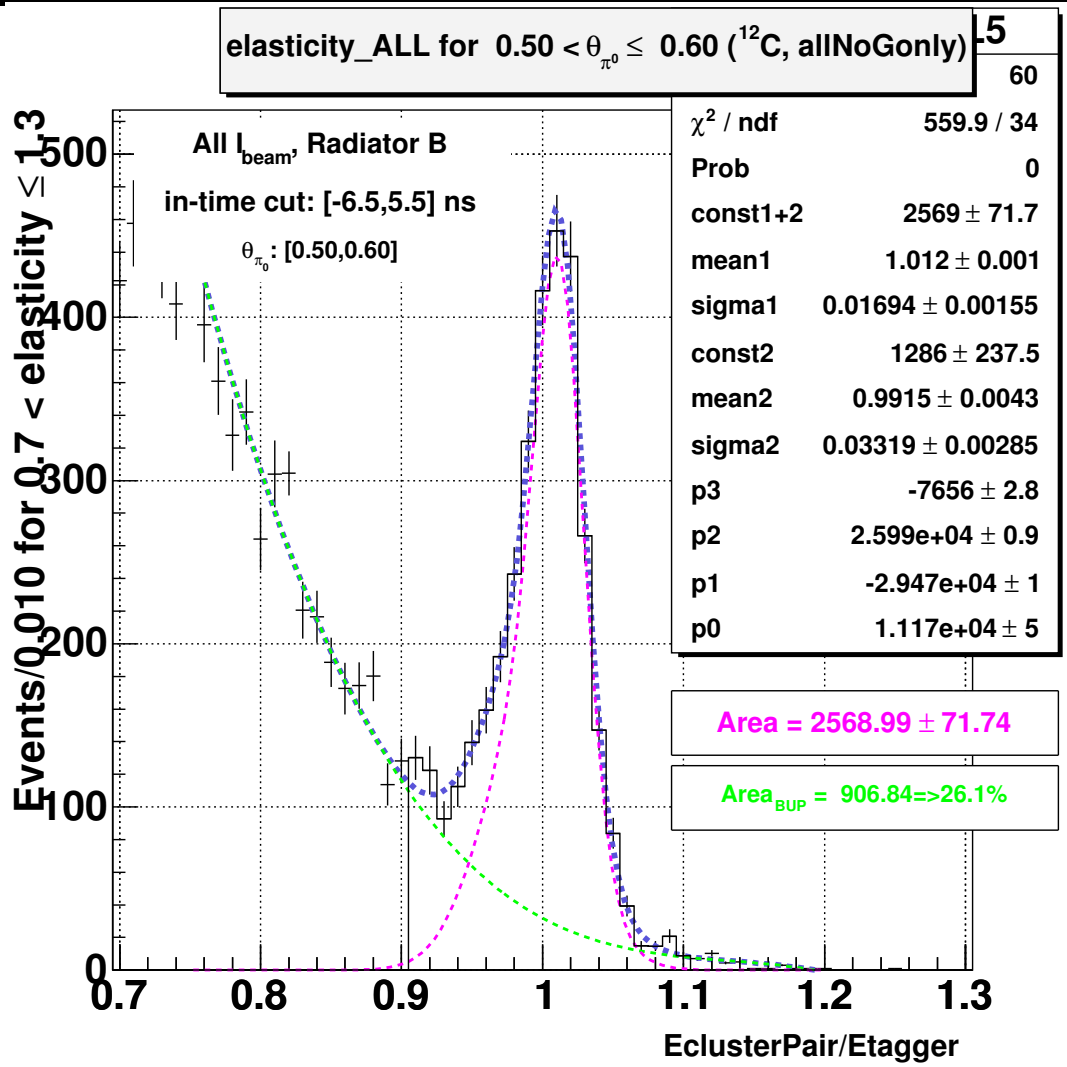
Yield Analyzer: Example $m_{\gamma\gamma}$ for ^{12}C Data (AllNoGonly)



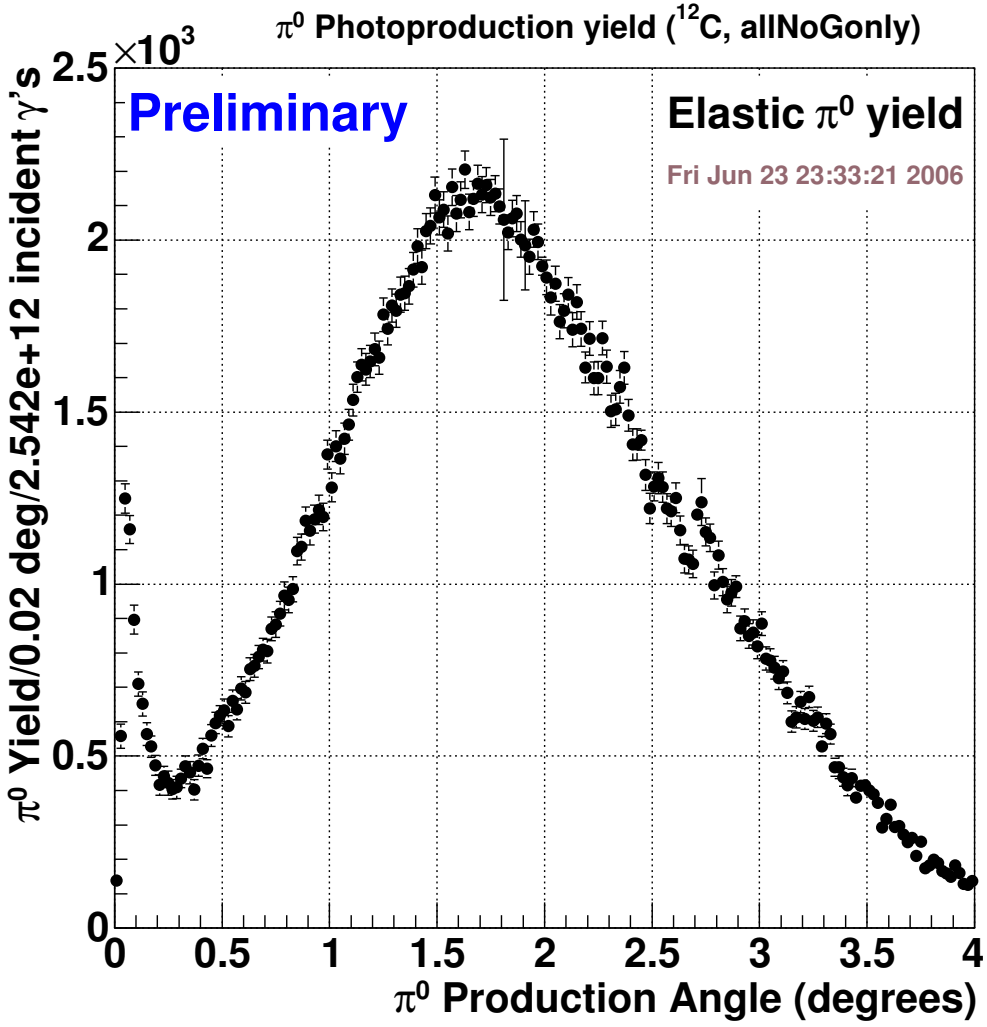
^{12}C π^0 Yield Components: Elastic plus Backgrounds



Yield Analyzer: Example Elasticity for ^{12}C Data (AllNoGonly)



^{12}C Elastic π^0 Yield Corrected for Inelastic and Timing Bkgds



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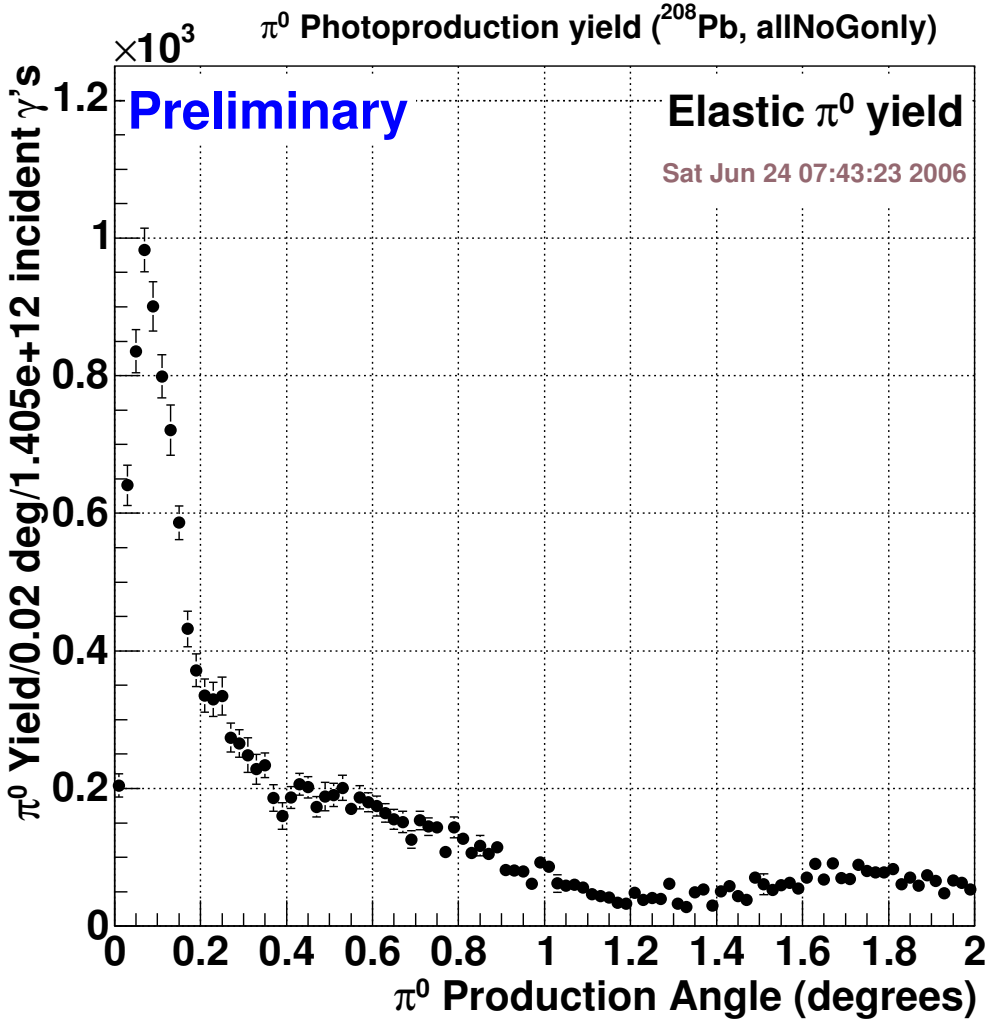

Summary and Future Work

- Yield results presented for almost all Radiator B data ($\sim$ 9k – 10k π^0's:[0,0.3°]).
- New for this analysis: Finer angular bins (0.02° instead of 0.04°), TSBit2 timing, and explicit angular dependant inelastic correction (as opposed to sideband style analysis).
- Plan to analyze Radiator A data and combine with B data.
- Work is ongoing to understand and calculate timing accidental background correction.
- Work ongoing to explore various bkgd + peak fitting functions.
- Work ongoing to produce yields for different beam currents, then normalize to flux measurement; have preliminary results soon.
- Plans to examine Yield at transitions and edges.

- Efficiency of cuts needs further study. Cuts are currently set at the $\pm 3 - 4\sigma$ level.
- Very close to converting yield to cross section $d\sigma/d\Omega$; have total flux and target thickness; developing simulation for calculating detection efficiency (acceptance + reconstruction).
- Studies are underway using primsim with a parameterized (Cornell style) π^0 generator to understand and quantify the response of our experimental setup (hardware + reconstruction software) to various running conditions.
- A tool has been developed for fitting the experimental yields using the parameterized cross section form; the parameters are: $\pi^0 \rightarrow \gamma\gamma$ partial decay width, nuclear coherent amplitude multiplicative constant, primakoff nuclear coherent interference phase angle, and incoherent bkgd amplitude multiplicative constant.