

# Update on $\pi^0 \rightarrow 4e$

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P. A. Toale and E. D. Zimmerman  
KTeV Collaboration Meeting  
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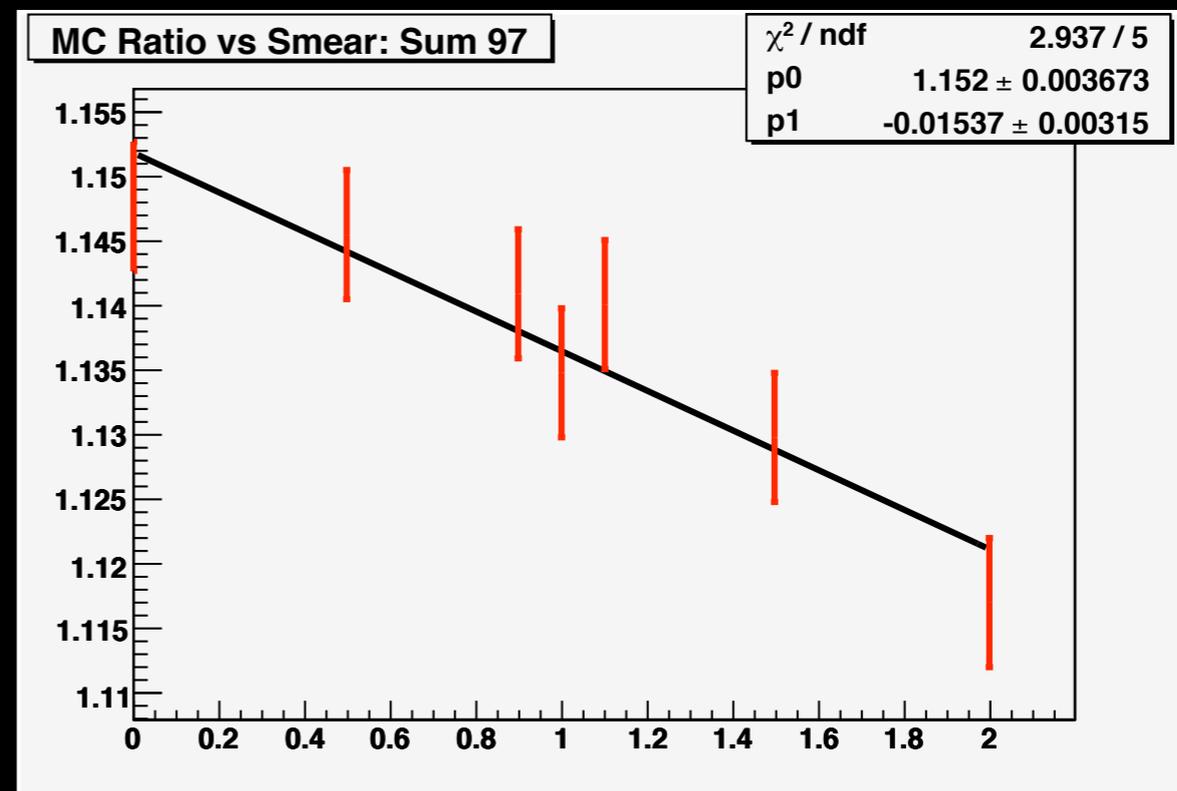
# Update on $\pi^0 \rightarrow 4e$

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- Analysis update: changes since Pat's thesis
- Paper draft

# Analysis update

- Main improvement in branching ratio measurement is from redone chamber resolution study. This was a limiting systematic before. Acceptance resolution vs. smearing/nominal:
  - Resolution error on BR goes from 0.84% to 0.11%
  - Largest BR syst error is now MC statistics (0.25%)



# Analysis update

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- Form factor errors: slope parameter errors haven't changed much.
- The  $\varphi$  distribution: Systematic error on the resolution correction was arbitrarily set at 100%; we don't think this was justified. We can fit the correction parameters to better than 10% uncertainty; this was used to generate the error on  $\eta$ , which is the CPT-violating imaginary part of  $\zeta$  (the fractional scalar contribution to the decay is  $\tan\zeta$ ).
- New result is  $\eta=0.051\pm0.031$

# Paper draft: how we pitch the result

- We believe the  $\pi^0$  parity measurement is the most interesting aspect of this result.
- The parity is one of the most fundamental meson physics parameters that hasn't been measured well:
  - Indirectly known from threshold behavior of  $\pi^-$  capture on deuterons (Panofsky 1951)
  - Last "direct" measurement is from  $4e$  decay (Samios 1962) based on 112 events after cuts. Significance is 3.3-3.6  $\sigma$ .

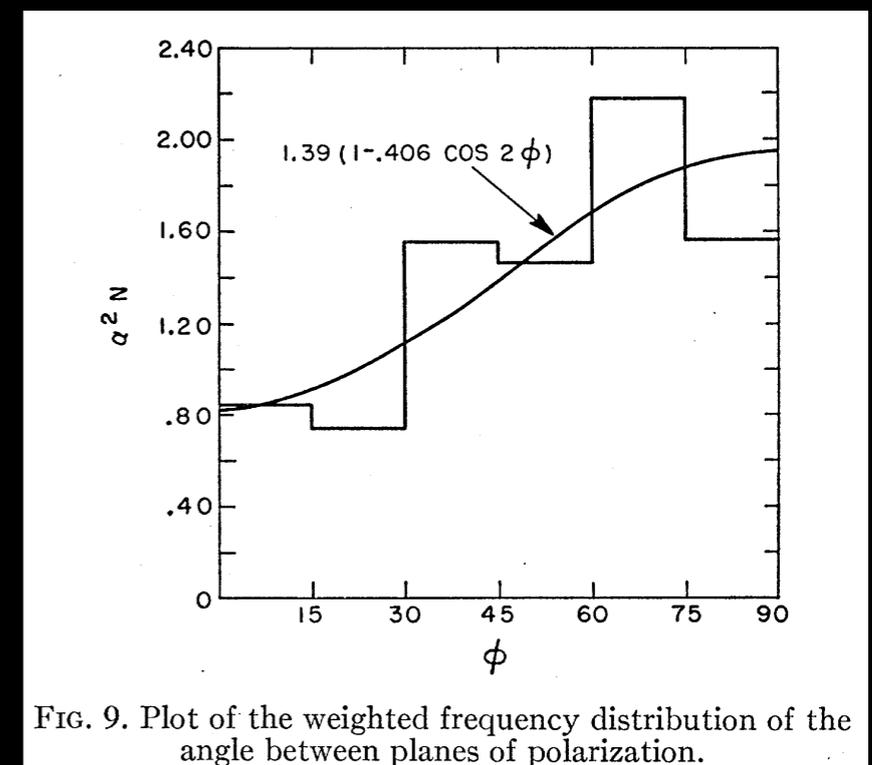
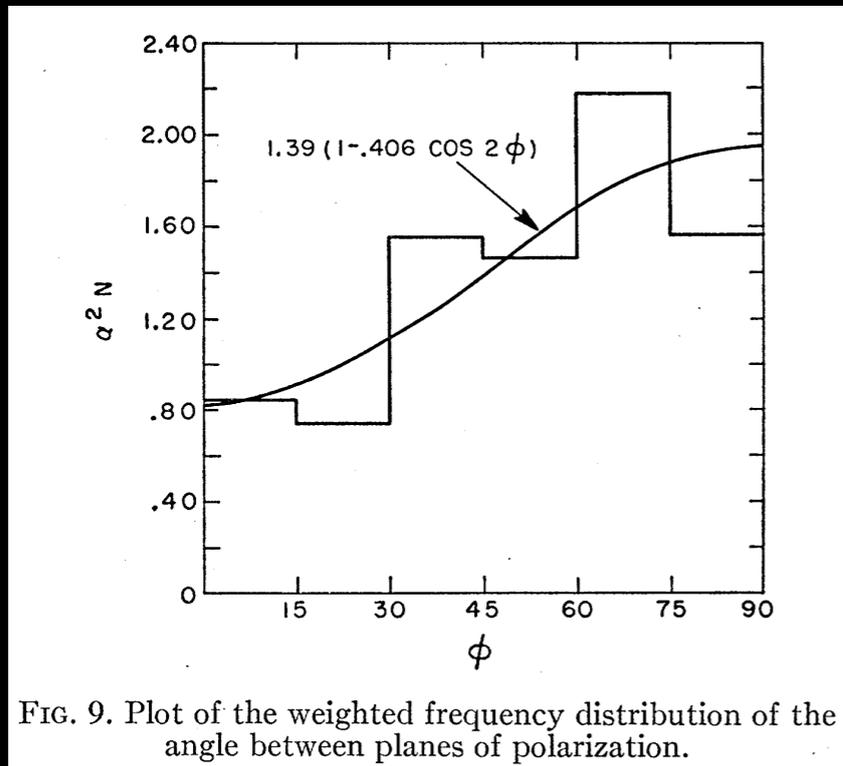
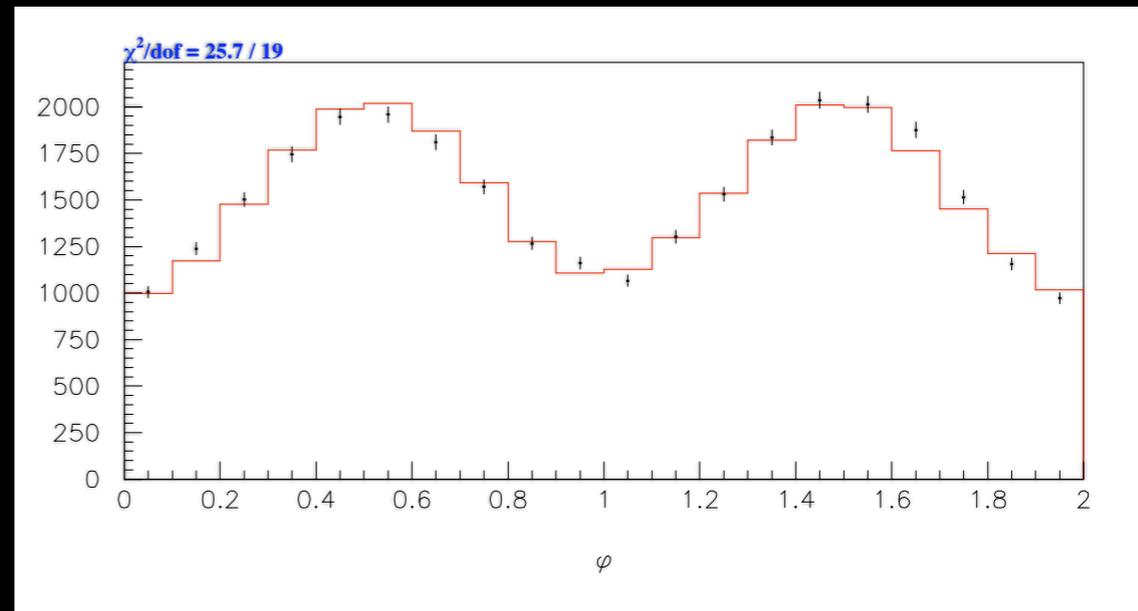


FIG. 9. Plot of the weighted frequency distribution of the angle between planes of polarization.

# The $\varphi$ distribution



Samios 1962



Toale 2004

- Dramatic confirmation of pseudoscalar  $\pi^0$
- Tight limit ( $\zeta < 1.9^\circ$ ) on scalar coupling in this mode

# Paper draft

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- PRL draft has been released to godparents (Nov. 6) (with placeholder figures; working on better ones)
- Good comments from Katsu and Rick K.
  - A few questions about the way the physics is presented; we are addressing these.
  - Rick K. question: too much for a PRL?
    - I think it is important to get this result into PRL.
    - If necessary, drop the detector/reconstruction text.

# Paper draft

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- We are trying to get this paper out as soon as possible
- Depending on back-and-forth with godparents, hope to have a draft to the collaboration before the end of November
- Submit in December!