A Study of the $\omega\eta$ System Produced in the Reaction $\pi^- p \to \pi^+\pi^-\pi^o\eta n$ at 18 GeV/*c*

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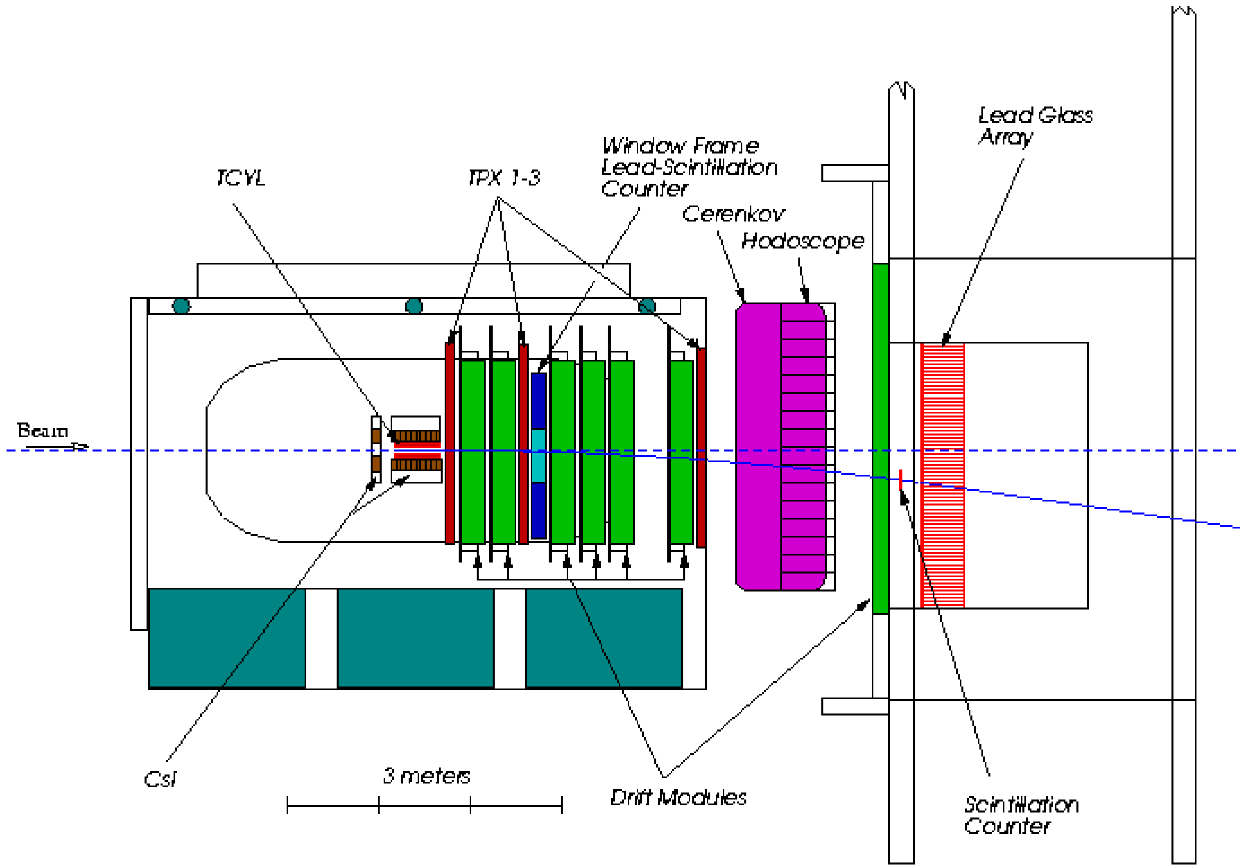
Overview

- BNL–E852 Apparatus & the Data
- Features of the $\pi^+\pi^-\pi^0\eta$ System
- $\omega\eta$ Partial Wave Analysis
- Summary and Future prospects

The E852 Collaboration

- Brookhaven
- Moscow State
- Carnegie Mellon
- Notre Dame
- Indiana
- Northwestern
- IHEP Protvino
- Rensselaer
- Jefferson Lab
- Umass–Dartmouth

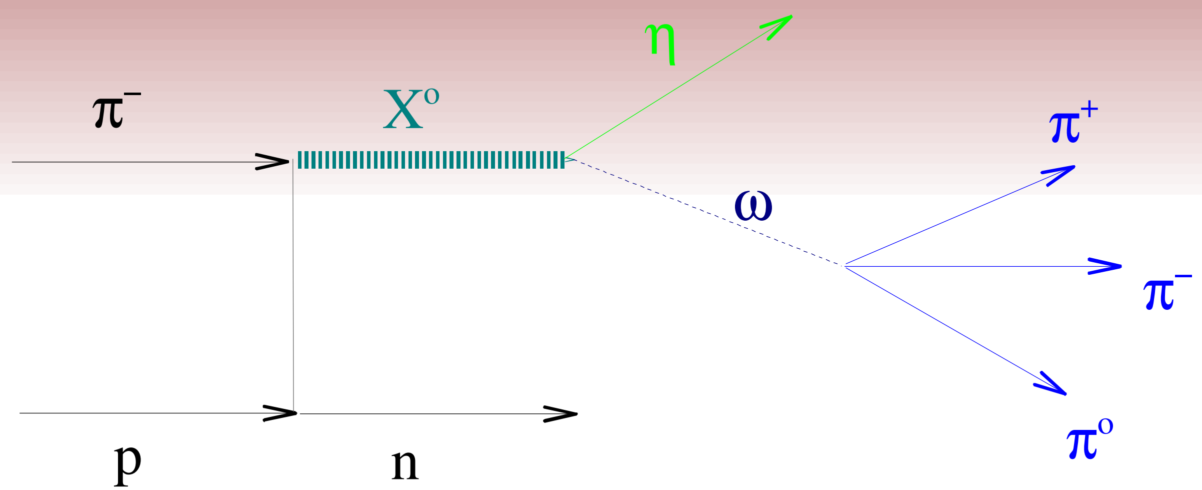
E852 Plan View



Data & Cuts

- Data from the 1995 Brookhaven E852 Run
- 108 Million Triggers of this type
- Events reconstructed with:
  - 4 photons
  - 2 forward tracks with vertex at the beam
  - Absence of recoil track
  - Fiducial volume (target & LGD)
  - DEA rejection & CsI barrel rejection
  - Hadron tagging at the LGD

Features of the $\omega\eta$ System

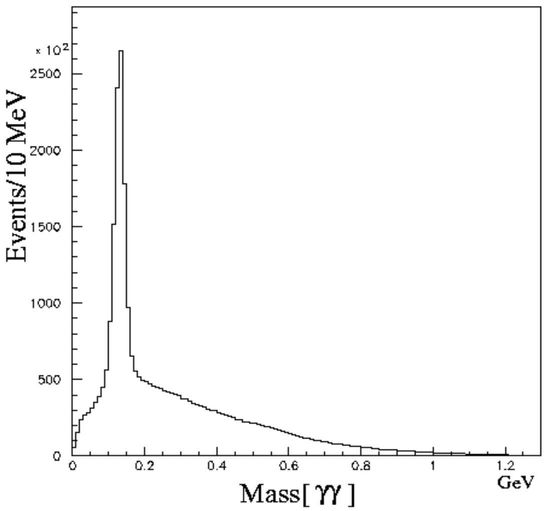


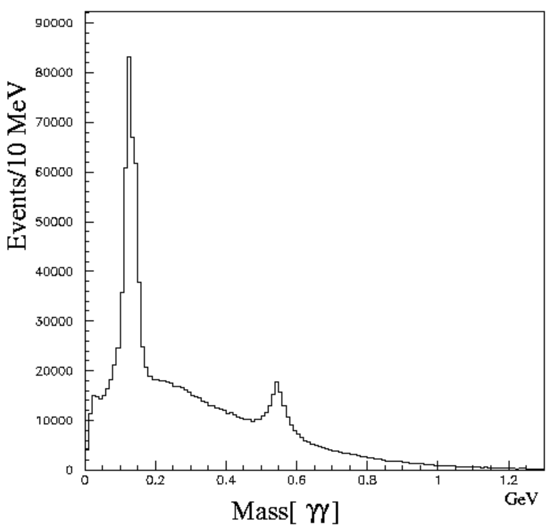
19,500 kinematic fitted events

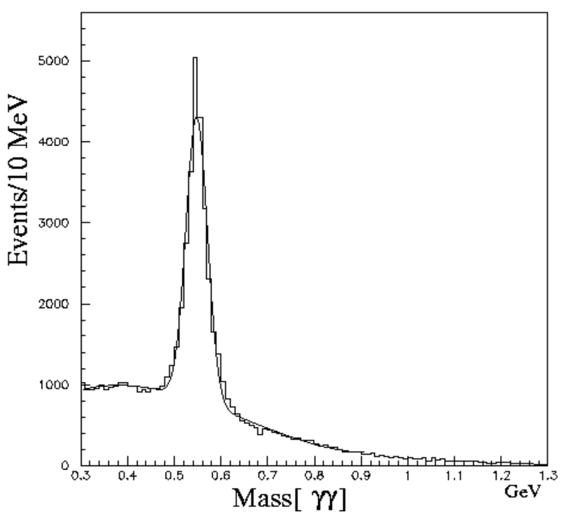
Allowed J^{PC}

$0^{--}, 1^{--}, 1^{+-}, 2^{--}, 2^{+-}, 3^{--}, 3^{+-}, \ldots$

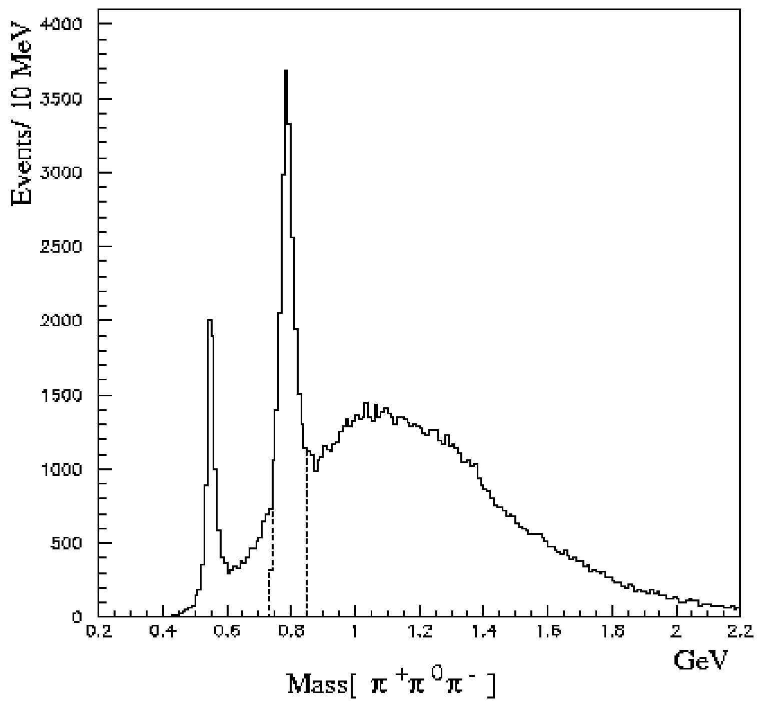
$\eta \rightarrow \gamma\gamma$





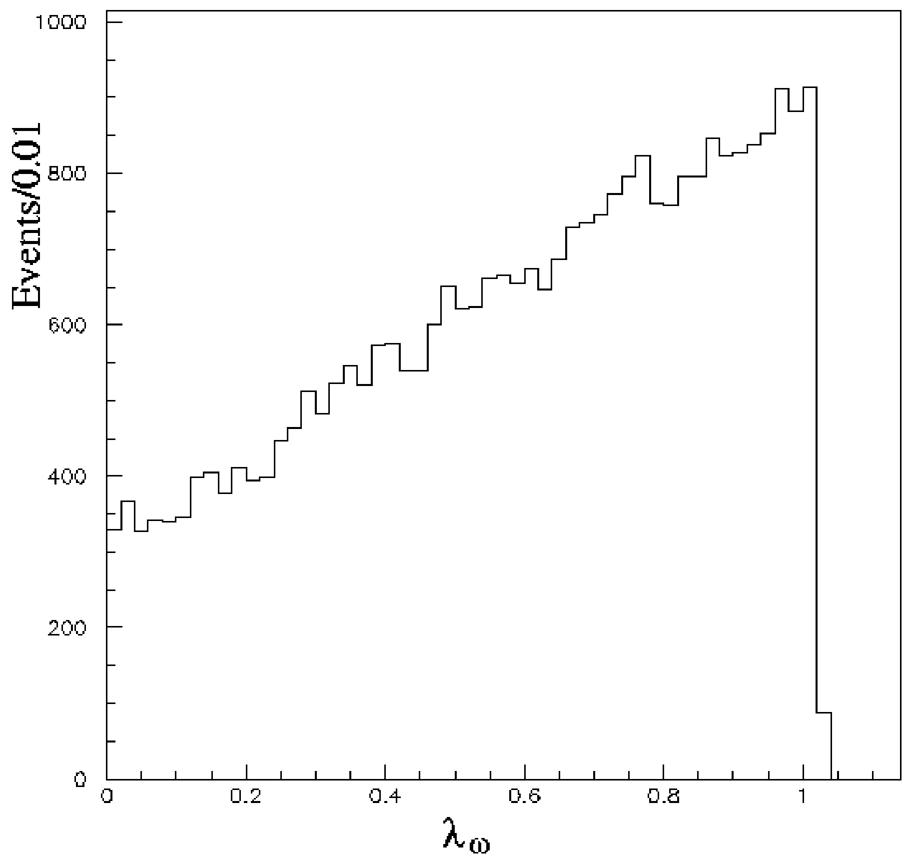


$\pi^+\pi^-\pi^o$ Effective Mass

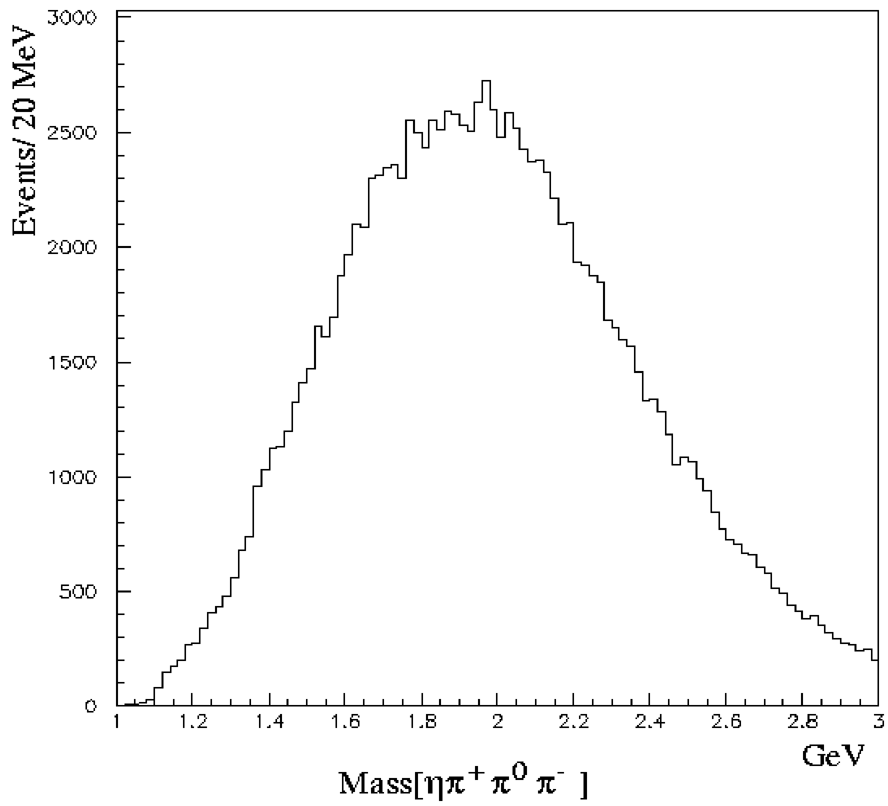


Omega Decay Matrix Element^2

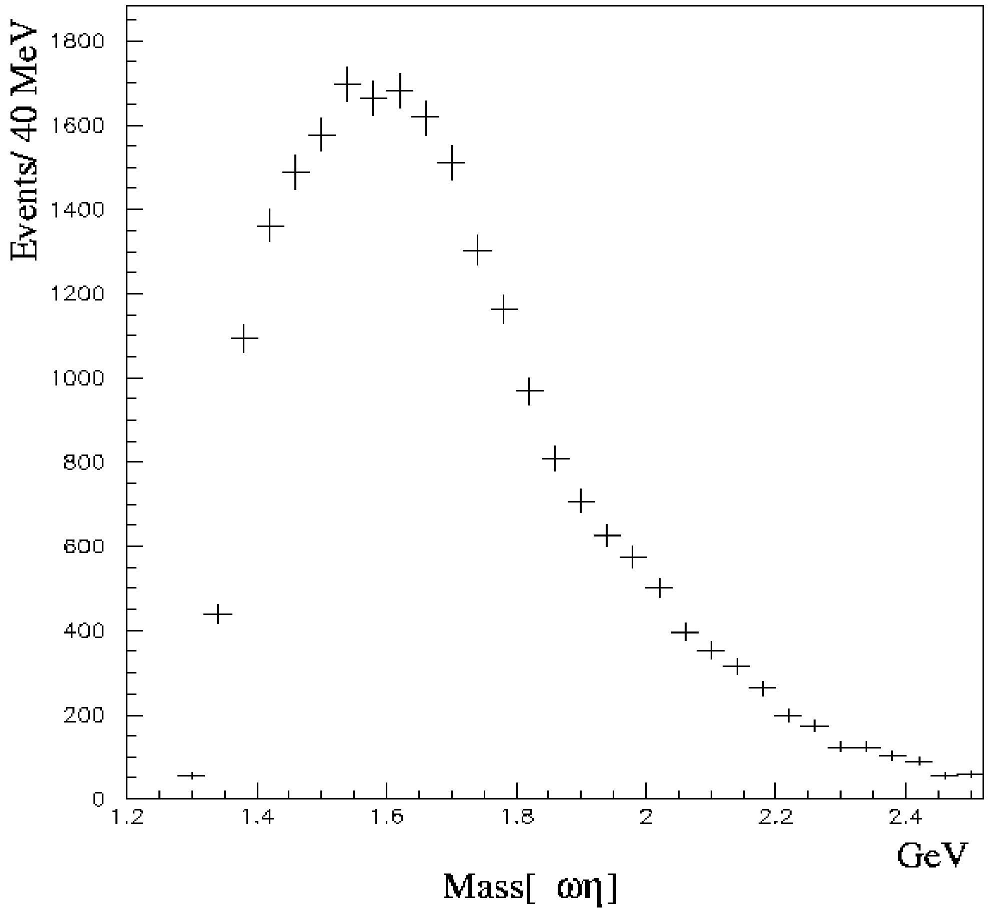
$$\lambda \propto |\vec{P}_{\pi+} \times \vec{P}_{\pi-}|^2$$



$\eta\pi^+\pi^-\pi^o$ Effective Mass

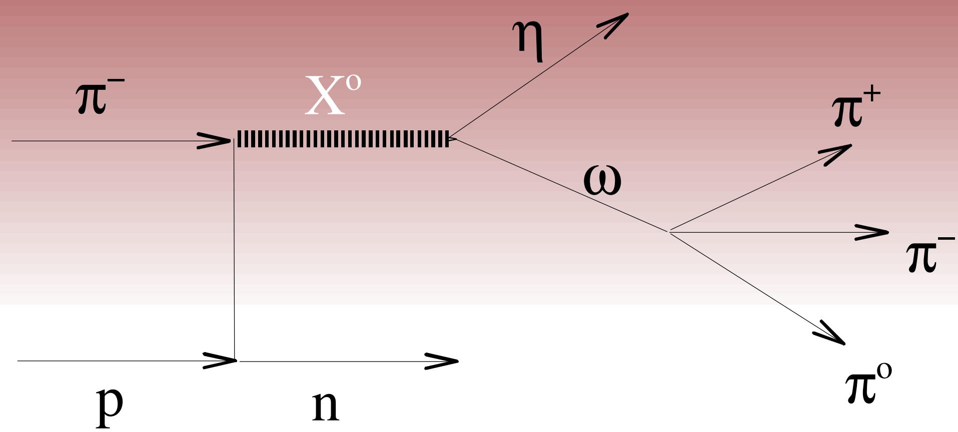


ωη Effective Mass



PWA Formalism

Isobar Decay



Intensity Distribution

$$I(\tau) = \Sigma_{k\,\varepsilon} \,|\, \Sigma_b \, V^{\varepsilon}_{bk} A^{\varepsilon}_{b}(\tau)|^2$$

Reflectivity Basis

Partial Waves

S wave

1^{+-}

P wave

0^{--}, 1^{--}, 2^{--}

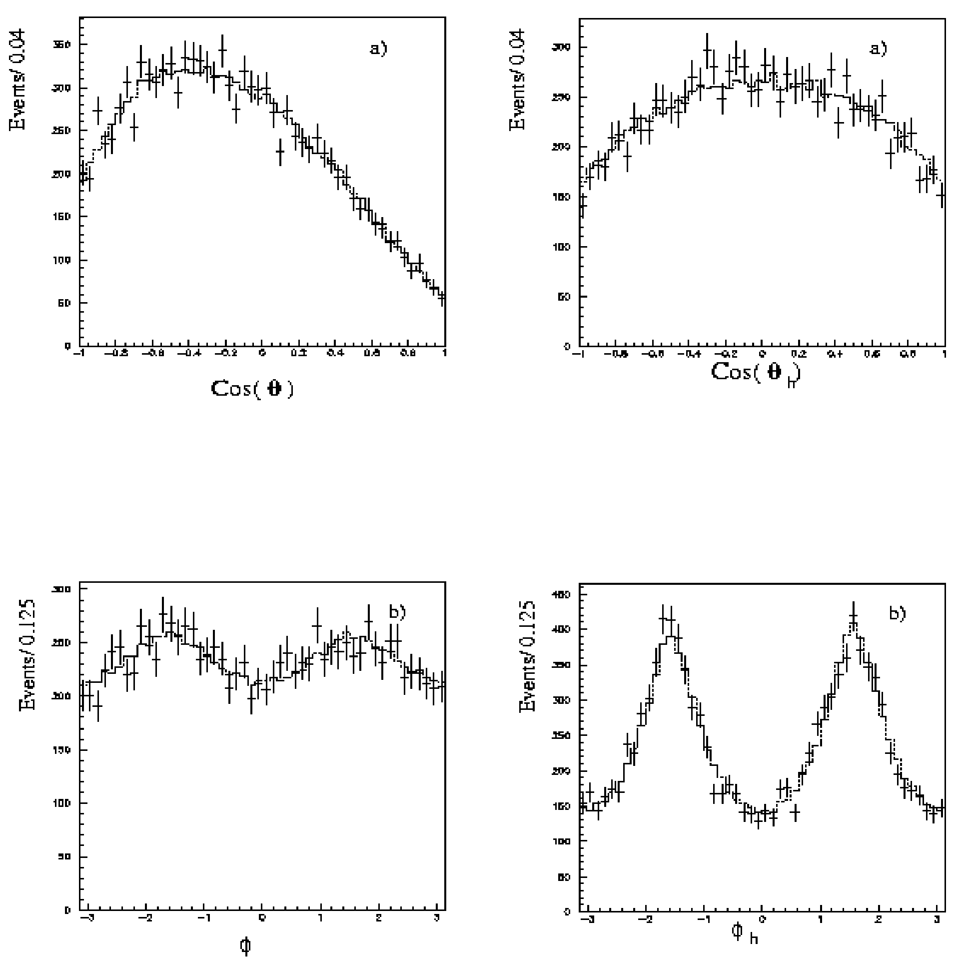
D wave

2^{--}, 3^{--}, 4^{--}

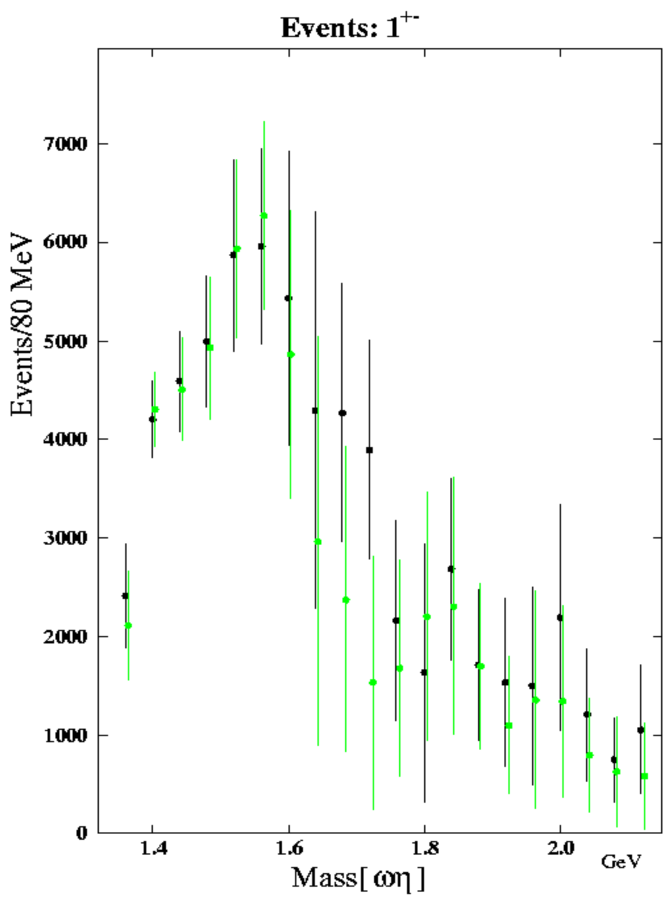
F wave

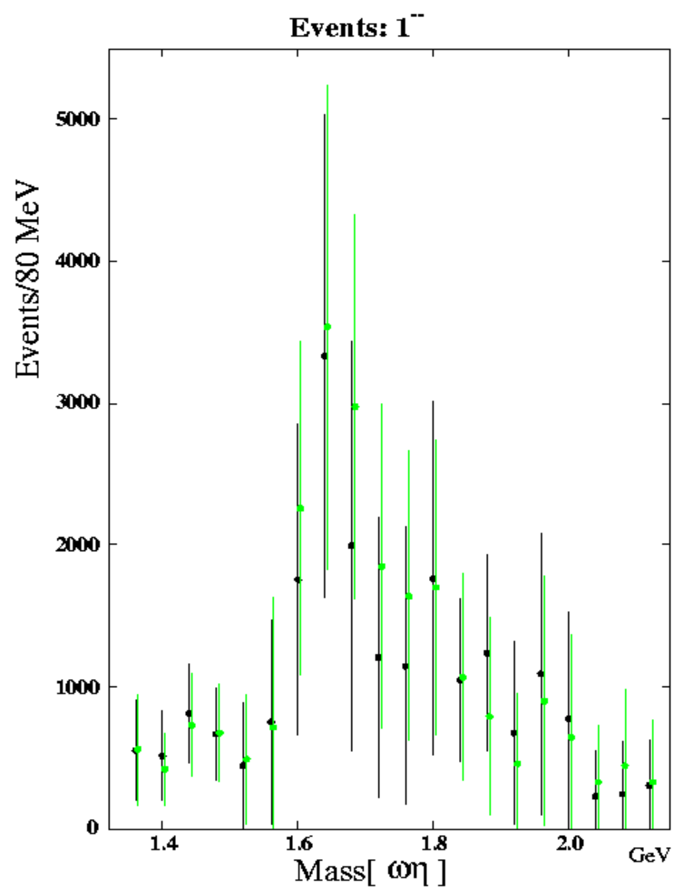
1^{+-}, 2^{+-}, 3^{+-}

Quality of the Fit

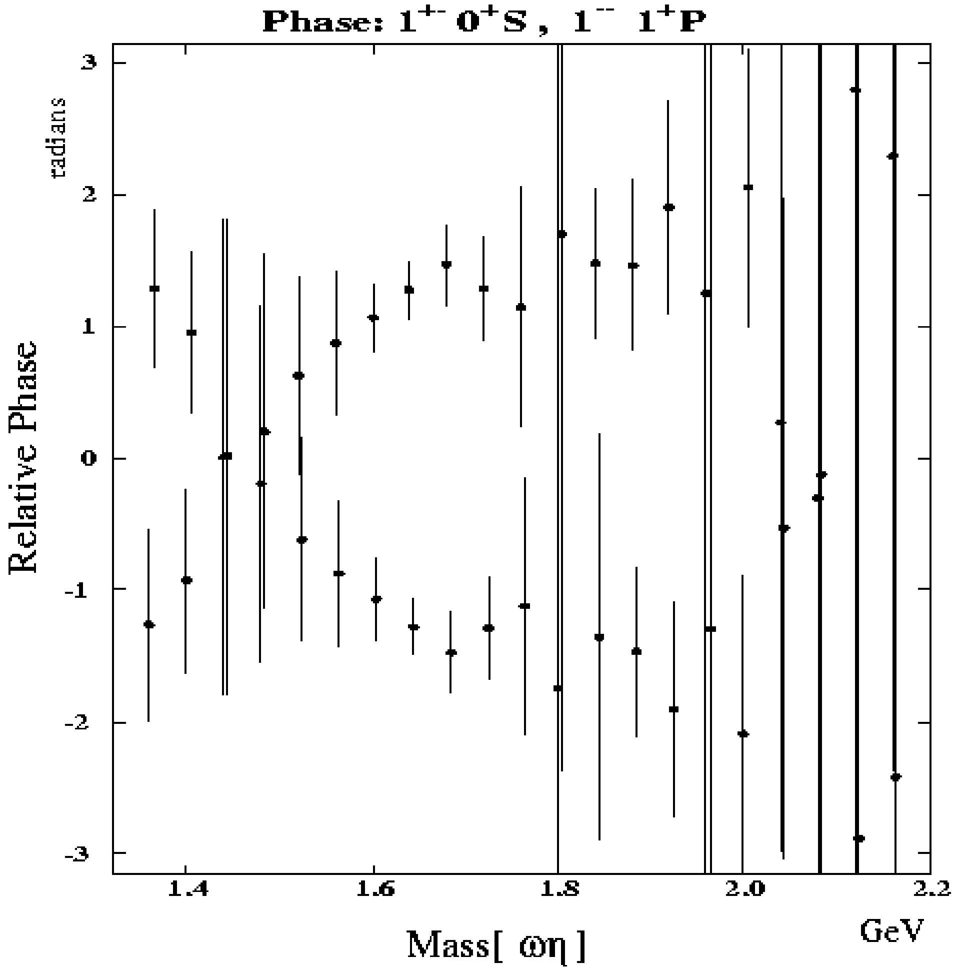


Dominant Partial Waves





Relative Phase
$1^{+-}0^{+}S$, $1^{--}1^{+}P$



Mass Dependent Analysis

1^{+-} wave

Mass = 1542±13 MeV

Γ = 285±30 MeV

1^{--} wave

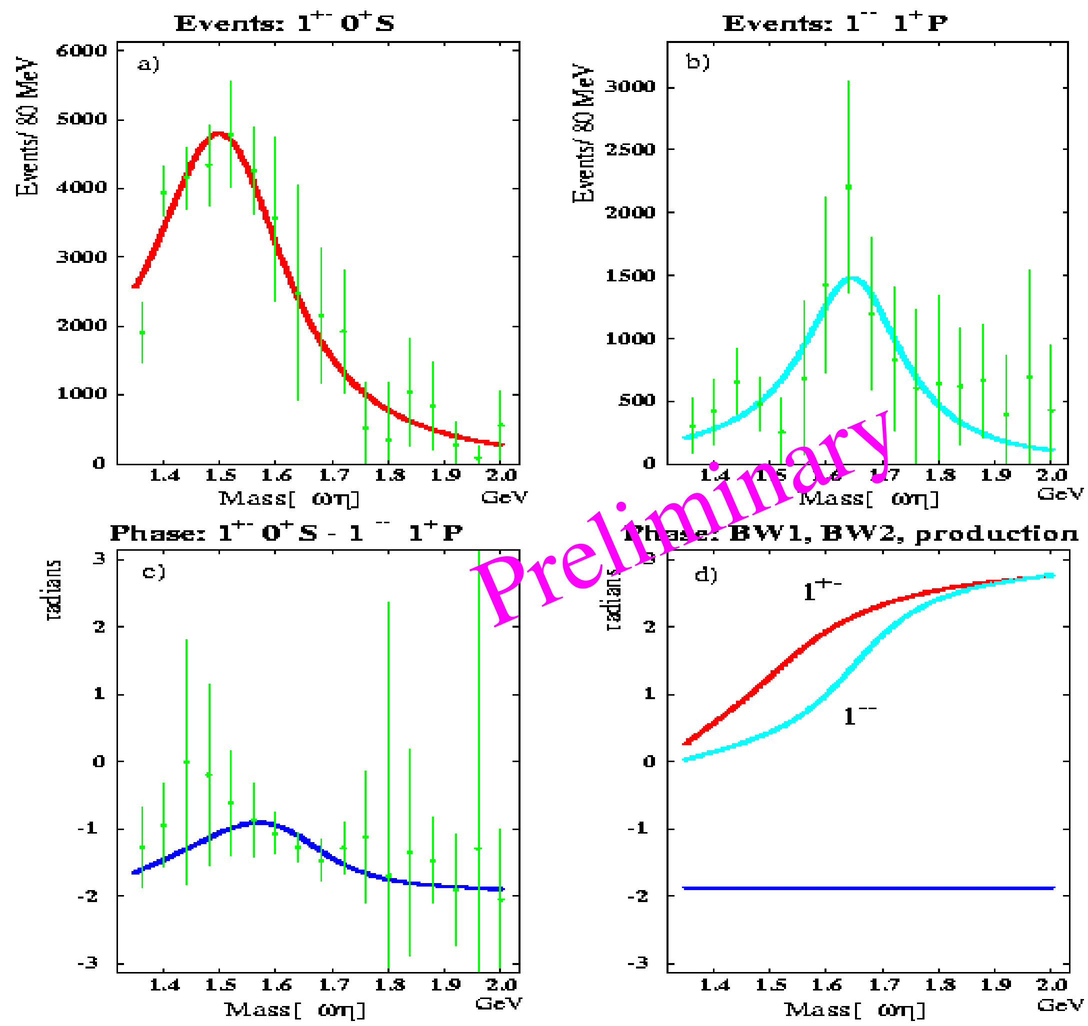
Mass = 1664±24 MeV

Γ = 219±63 MeV

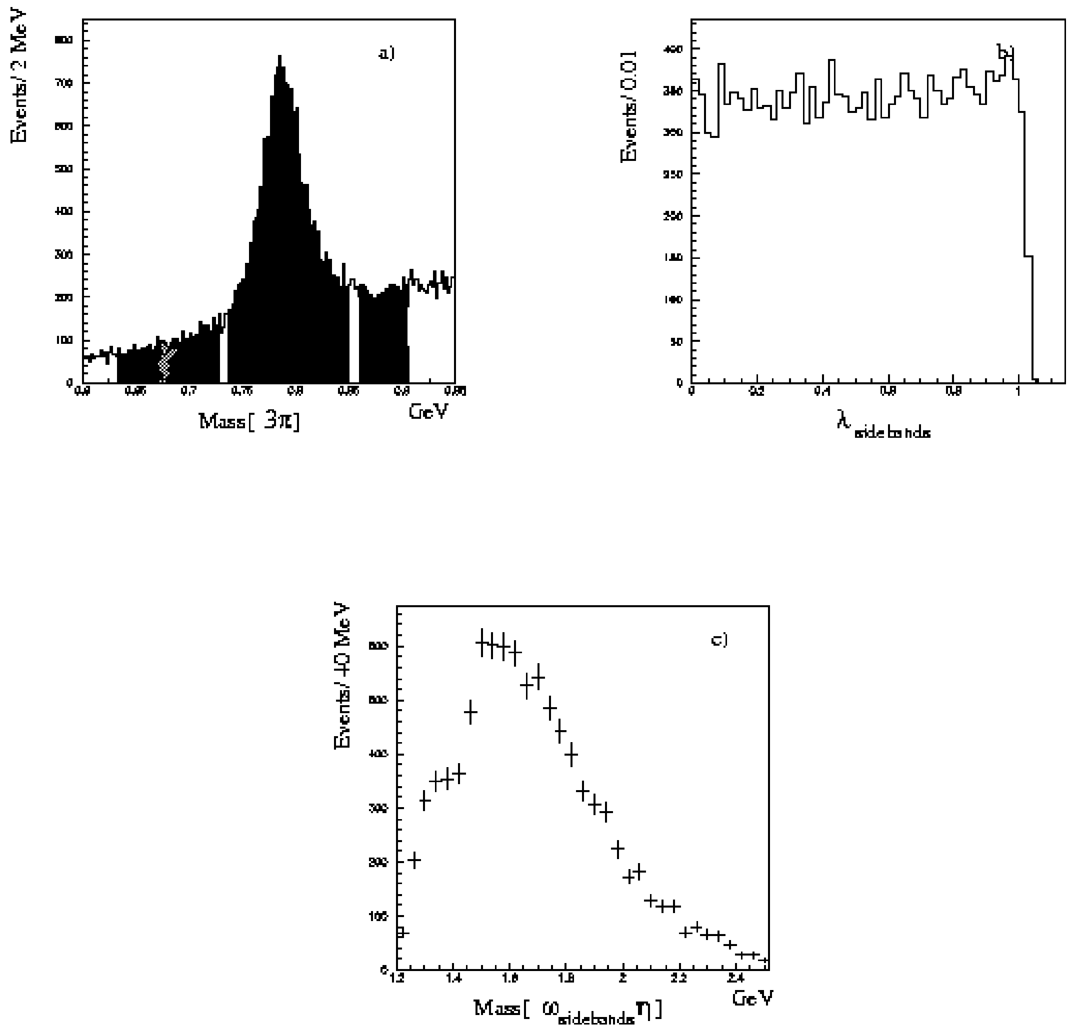
PDG ω(1600)

Mass = 1649±24 MeV

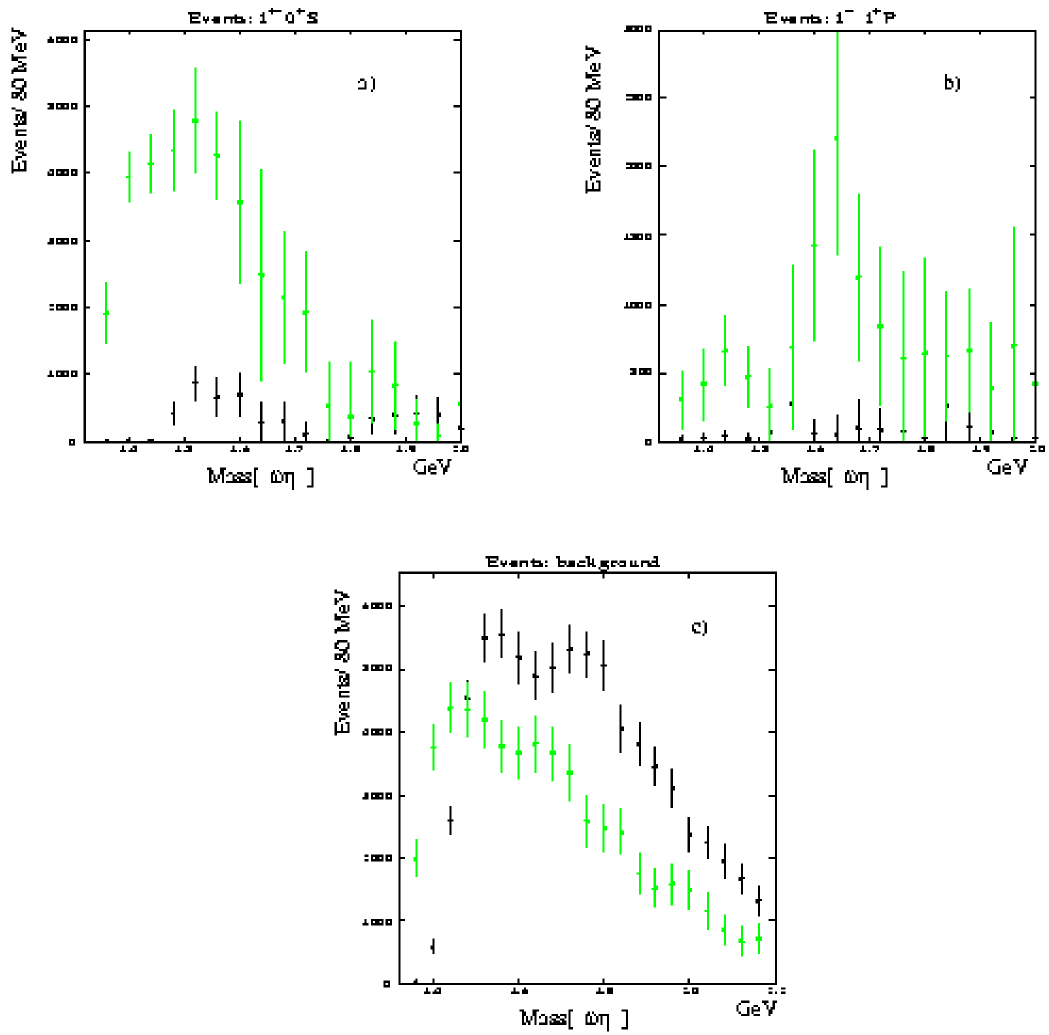
Γ = 220±35 MeV



ω Sideband Study



Sideband PWA



Summary

- Clear η and ω signals
- Dominant $1^{+-}0^{-}$S wave
- Clear relative phase motion
- No obvious resonant structure seen in the $\omega\eta$ mass spectrum
- Significant $1^{--}1^{+}$P wave consistent with $\omega(1600)$

MDA shows that the 2 waves are well described by two interfering Breit–Wigner resonances

1^{+-} wave
Mass $\cong$ 1540 MeV
$\Gamma \cong$ 285 MeV

1^{--} wave
Mass $\cong$ 1665 MeV
$\Gamma \cong$ 220 MeV