$K^+K^-\pi^0$ update

$a_0(980)$ mass parameterization

$a_0(980)$

Using $a_0(980)$ isobar as parameterized by BESIII:

The ordinary intermediate resonance is parametrized by a relativistic Breit-Wigner (BW) propagator with a constant-width

$$BW(s) = \frac{1}{M^2 - s - iM\Gamma}, \quad (4.2)$$

where s is the invariant mass squared of resonances, M and Γ are the corresponding mass and width. For $a_0(980)^0$ with mass near $K\bar{K}$ threshold, we use dispersion integrals to describe its lineshape

The BESIII Collaboration, arXiv:2209.11175v1

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The $a_0(980)$ amplitude is constructed using the following denominator:

$$D_a(s) = m_0^2 - s - \sum_{ch} \Pi_{ch}(s), \qquad (4)$$

M. Ablikim *et. al.* (BESIII Collaboration), Phys. Rev. D **95**, 032002 (2017)

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where m_0 is the $a_0(980)$ mass and $\Pi_{ch}(s)$ in the sum over channels is a complex function, with imaginary part

$$\mathrm{Im}\Pi_{ch}(s) = g_{ch}^2 \rho_{ch}(s) F_{ch}(s), \qquad (5)$$

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$$\mathrm{Im}\Pi_{ch}(s) = g_{ch}^2 \rho_{ch}(s) F_{ch}(s), \qquad (5)$$

while real parts are given by principal value integrals,

$$\mathrm{Re}\Pi_{ch}(s) = \frac{1}{\pi} P \int_{s_{ch}}^{\infty} \frac{\mathrm{Im}\Pi_{ch}(s')ds'}{(s' - s)}. \qquad (6)$$

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$a_0(980)$

In the above expressions $\rho_{ch}(s)$ is the available phase space for a given channel, obtained from the corresponding decay momentum $q_{ch}(s)$: $\rho_{ch}(s) = 2q_{ch}(s)/\sqrt{s}$. The integral in Eq. (6) is divergent when $s \to \infty$, so the phase space is modified by a form factor $F_{ch}(s) = e^{-\beta q_{ch}^2(s)}$, where the parameter β is related to the root-mean-square (rms) size of an emitting source [20]. We use $\beta = 2.0[\mathrm{GeV}/c^2]^{-2}$ corresponding to rms $= 0.68$ fm, and we verify that our results are not sensitive to the value of β. The integration in Eq. (6)

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$a_0(980)$

BESIII

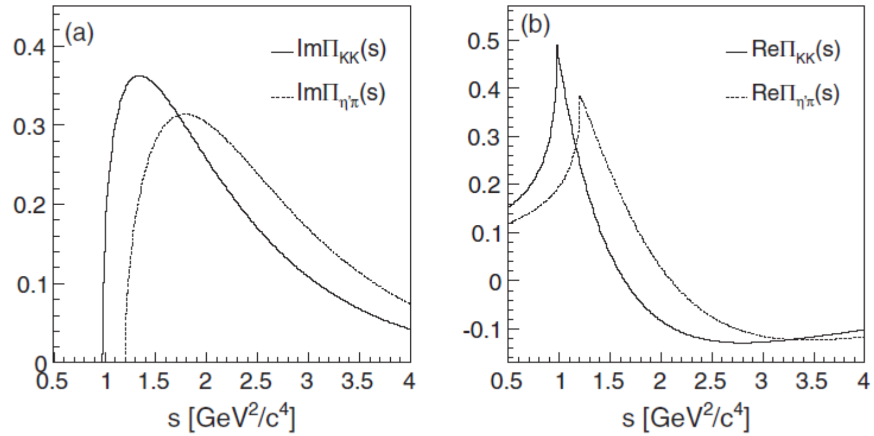
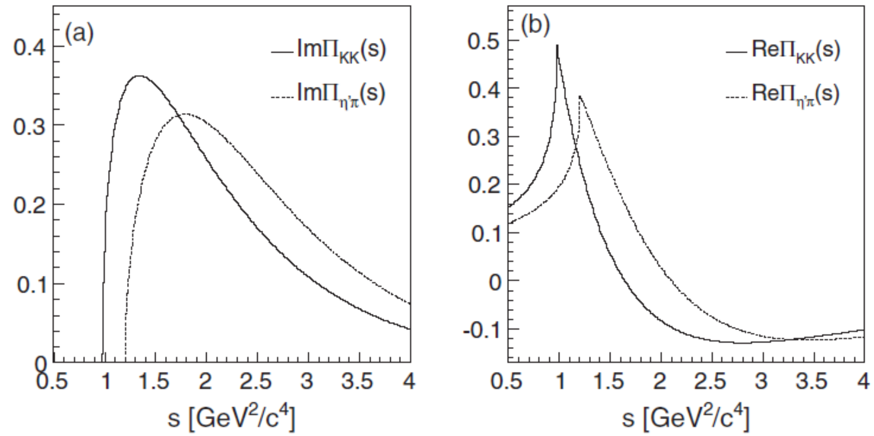


FIG. 4. Line shapes of (a) $\mathrm{Im}\Pi(s)$ and (b) $\mathrm{Re}\Pi(s)$ for the $K\bar{K}$ and $\eta'\pi$ production with arbitrary normalization.

$a_0(980)$

BESIII



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I used Mathematica to perform the principal value integrals

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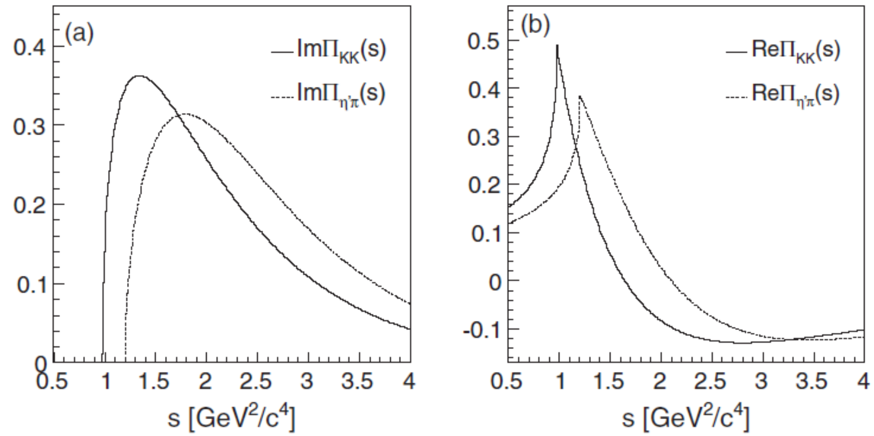
BESIII



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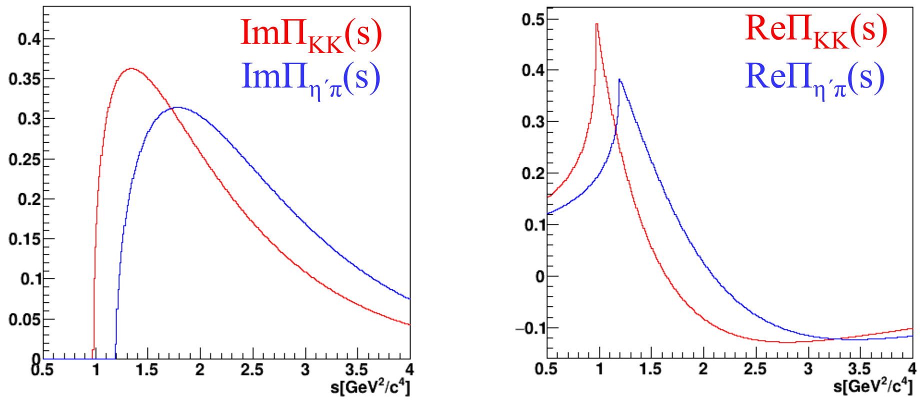
GlueX



Included waves

- Uniform background

Included waves

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- $J = 0$:
  - $a_0\pi^0$
  - $K^{*+}K^-$
  - $K^{*-}K^+$

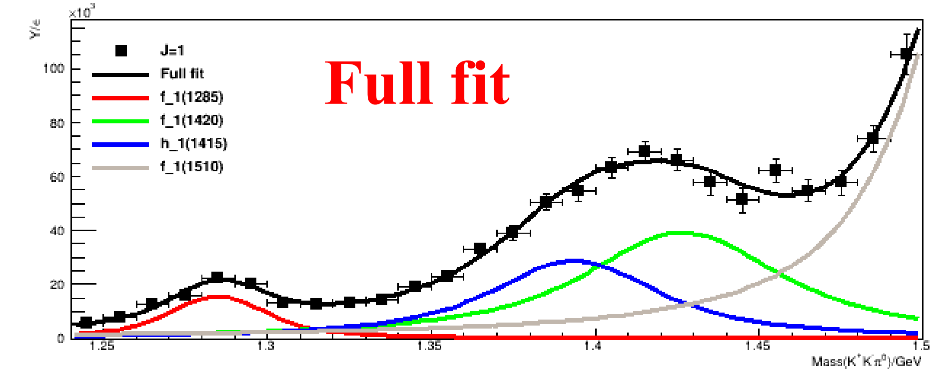
Included waves

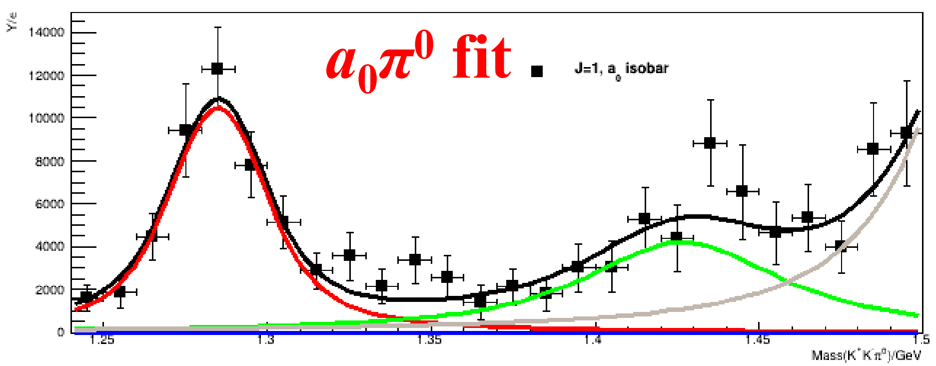
- Uniform background
- $J = 0$:
  - $a_0\pi^0$
  - $K^{*+}K^-$
  - $K^{*-}K^+$
- $J = 1$:
  - $a_0\pi^0$
  - $K^{*+}K^-$ (L=0, and L=1)
  - $K^{*-}K^+$ (L=0, and L=1)

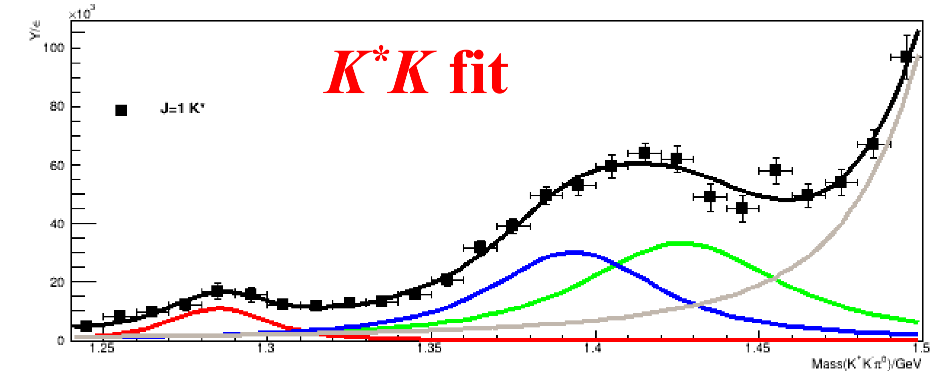
Comparison of OLD to NEW

- Previous results I showed in October had standard Breit-Wigner for $a_0(980)$
- New results have BESIII style $a_0(980)$

OLD fit: Simultaneous fit to $J=1$ isobars





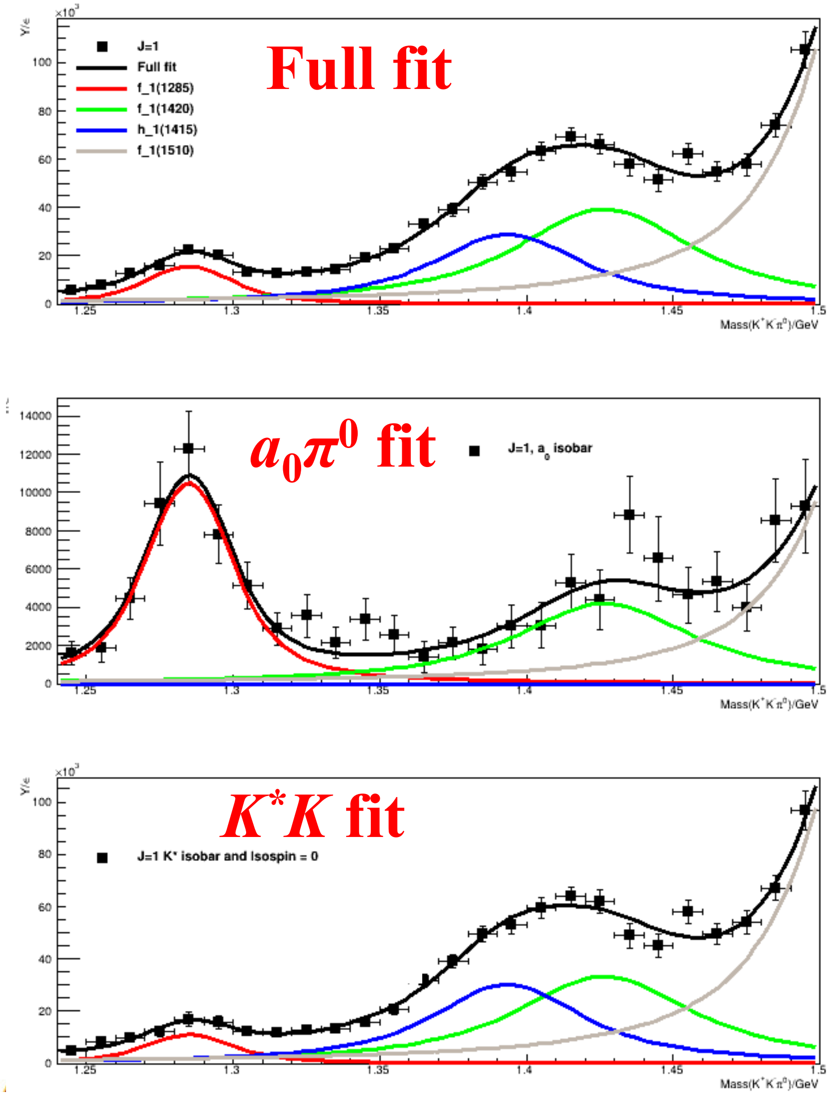


The blue line does not exist in the $a_0\pi^0$

⇒

the blue line is consistent with being an h_1

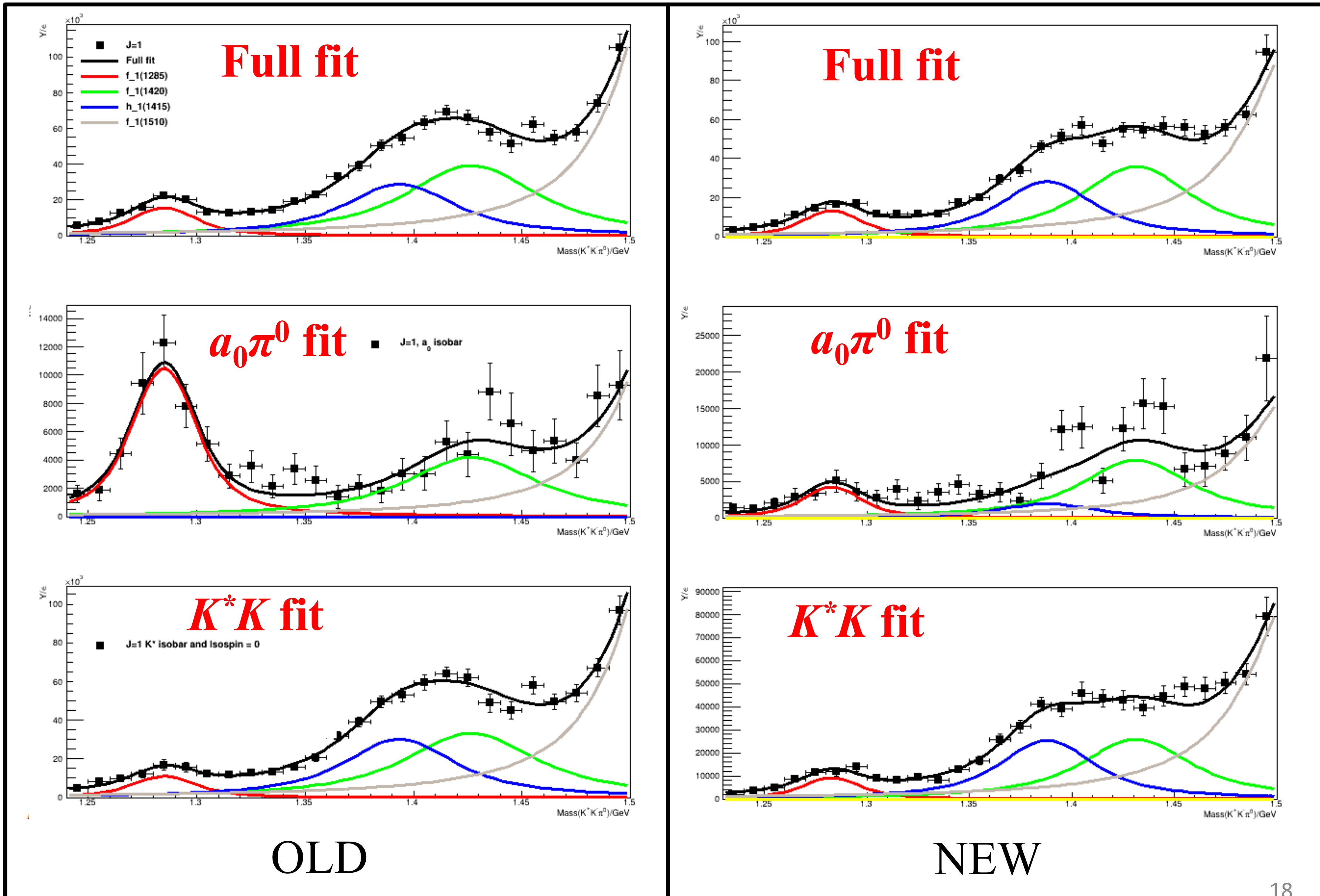
Simultaneous fit to *J=1* isobars



OLD

NEW

Simultaneous fit to $J=1$ isobars



Title