

Theory Session Summary Talk

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European Centre for Theoretical Studies
in Nuclear Physics and Related Areas
Trento

ATHOS, Camogli April 2012

BARYONS AND THE N^* FAMILY

Various group/models: EBAC, Juelich model, etc.

CONSTRAINTS

- Gauge invariance
- Unitarity and analyticity
- Covariance
- Electromagnetic (γN) and strong interactions (πN)

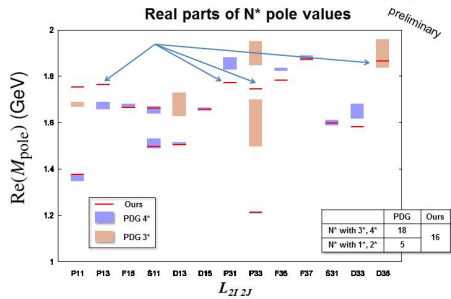
- Confrontation with exp. might lead to faster code
- Mainly direct production πN and γN but inelastic data are now taken into account
- No uniformisation of data
- How can studies can be useful for exp. ?

PROBLEMS

- Coupled channels analysis mandatory
- simple models do not work
- Numerically involved
- 'one-shot' results

Spectrum of N^* resonances

Kamano, Nakamura, Lee, Sato, 2012



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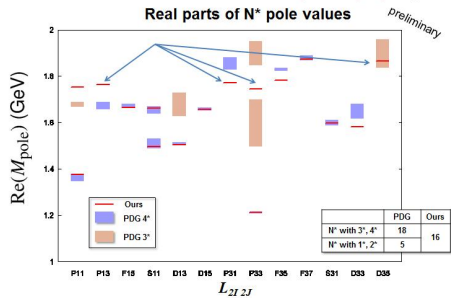
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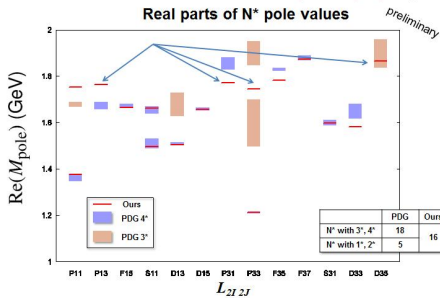
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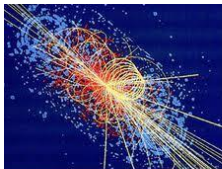
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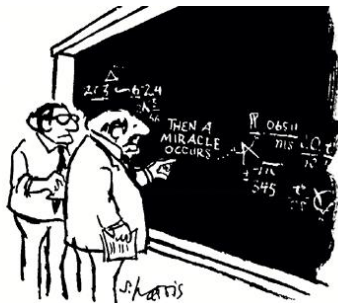
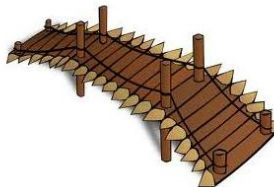


International Workshop on
 NEW PARTIAL WAVE ANALYSIS
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AMPLITUDES

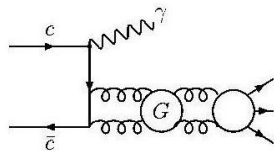


"I THINK YOU SHOULD BE MORE EXPLICIT
 HERE IN STEP TWO."

- What status for the $f_0(1370)$? implication for glueball searches (extra-numerous states)
- Bugg: $f_0(1370)$ well-established in $p\bar{p}$ and $\bar{p}d$
- Some others (Klempt ?) would disagree
- No $f_0(1370)$ in BES data in $J/\psi \rightarrow \gamma\pi\pi$ (Liu's talk)

BUT one peak at 1445 MeV

RESULTS from Crystal Barrel ($p\bar{p}$), OBELIX ($p\bar{p}$), WA102 (pp) and BES (J/ψ) (**Alice ?**)



Name	Masse (MeV)	Width (MeV)	Decays	Production
$f_0(1370)$	1200 – 1500	200 – 500	$\pi\pi, K\bar{K}, \eta\eta$	$p\bar{p} \rightarrow PPP, pp \rightarrow pp(PP)$ weak signal in $J/\psi \rightarrow \gamma(PP)$
$f_0(1500)$	1505 ± 6	109 ± 7	$\pi\pi, K\bar{K}, \eta\eta$	$J/\psi \rightarrow \gamma(PP), pp \rightarrow pp(PP)$ $p\bar{p} \rightarrow PPP$
$f_0(1710)$	1720 ± 6	135 ± 8	$\pi\pi, K\bar{K}, \eta\eta$	$J/\psi \rightarrow \gamma(PP), pp \rightarrow pp(PP)$ not seen in $p\bar{p}$

How can we find a clear answer/common definition for that state ?

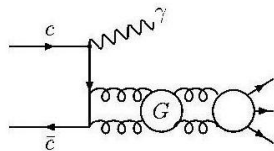
From Exp.: give to the theorists the analytical expression for the amplitude/the fit

From Theory: Which processes should we explore ?

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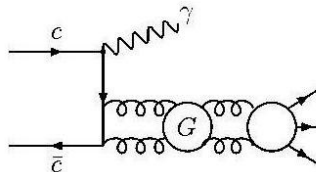
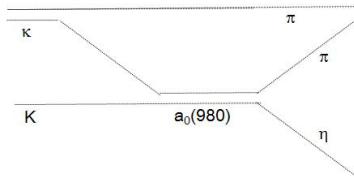
- Bugg: $\eta(1405)$ due to $K\kappa$ rescattering to $\eta\pi\pi$
- or $\eta(1405)$ glueball partner to the η and η'
- Implementation of effective Lagrangian for BES physics

Inclusion of a gluonic state *via* the θ -term and the anomaly

$$\mathcal{L} = \frac{f^2}{8} \left\langle \partial_\mu \pi^\dagger \partial^\mu \pi + B(m\pi^\dagger + \pi m^\dagger) \right\rangle - \frac{\alpha}{2} (\eta_1 + \theta)^2 - \frac{1}{2} m_\theta^2 \theta^2 + \frac{1}{2} \partial_\mu \theta \partial^\mu \theta$$

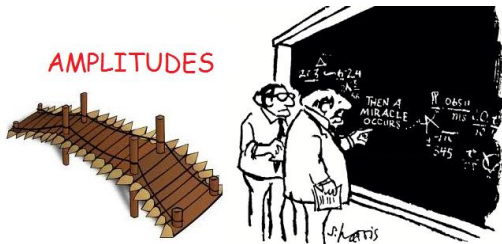
More theoretical effort to understand rescattering effects

More data on the $\eta(1405)$ (please !)



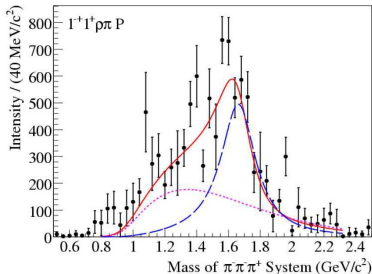
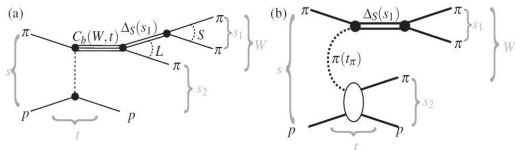
SCALAR MESONS

- σ has (once again) changed name for $f_0(500)$
- the σ pole should **NOT** to be fitted by a Breit-Wigner form.
- Other existing prescription already exist in the literature (or in Bugg's Fortran code)
- **STOP** fitting every bumps/structures by Breit-Wigner resonances
- worth for everything: hybrid mesons, tensor glueball, pentaquark, etc
- study the background
- provide the **amplitude**
- crossing symmetry and duality
- FESR



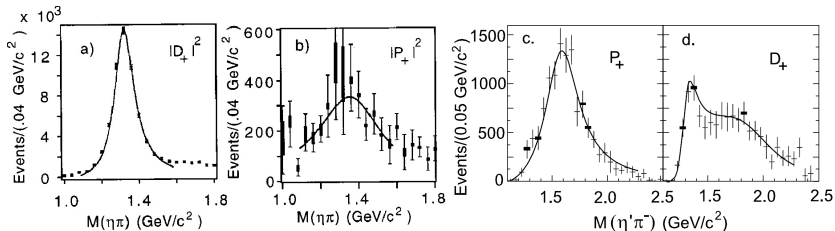
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- **Deck effect** provided by Szczepaniak
- match the data out in the exotic wave 1^{-+}
- background in high partial wave 4^{++} and 6^{++}
- generalize to other final states
- provide the amplitude to the exp.
- same methodology applies for **GlueX** (and PANDA, etc)

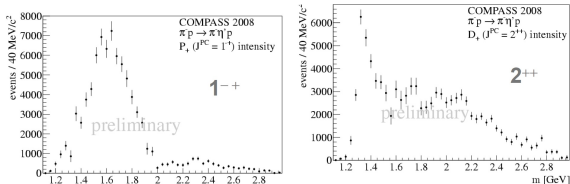


ANALYSIS OF $\pi + p \rightarrow (\pi\eta') + p$

E852: $\eta'\pi$ PRL86 (2001) ; $\eta\pi$ PRL79 (1997)



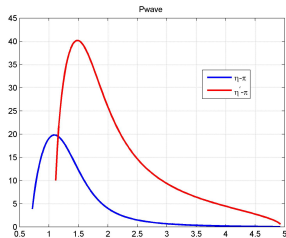
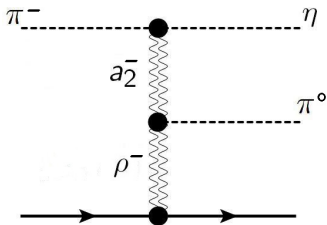
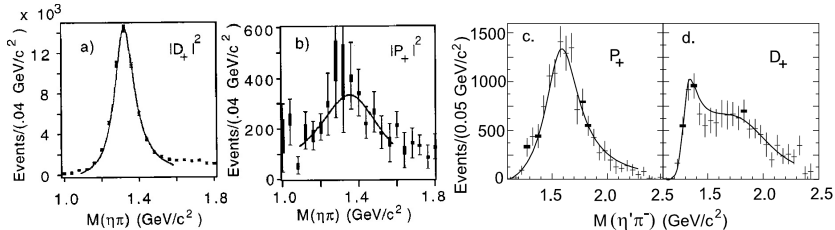
COMPASS, $\eta'\pi$
arXiv:1108.6191 [hep-ex]



Observation of the meson $a_2(1320)$ at the same mass in $\eta\pi$ and $\eta'\pi$
Peaks the exotic partial wave at 1.3 GeV for $\eta\pi$ and 1.6 GeV for $\eta'\pi$

RESULTS $\pi^- p \rightarrow \eta \pi^- p$

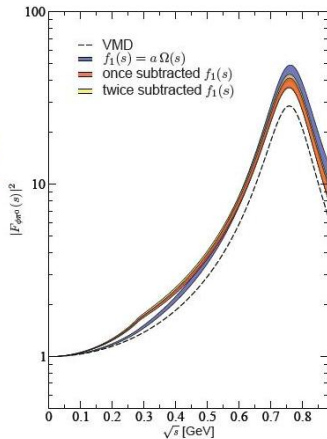
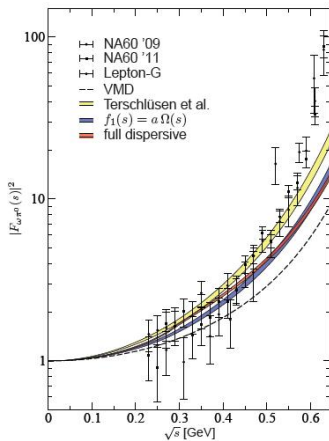
E852: $\eta' \pi$ PRL86 (2001) ; $\eta \pi$ PRL79 (1997) ; COMPASS, $\eta' \pi$ arXiv:1108.6191 [hep-ex]



$$\omega \rightarrow \pi\gamma^* \text{ AND } \phi \rightarrow \pi\gamma^*$$

Schneider's talk

Discrepancy between theory and experiment
call for data on $\phi \rightarrow \pi\gamma^*$

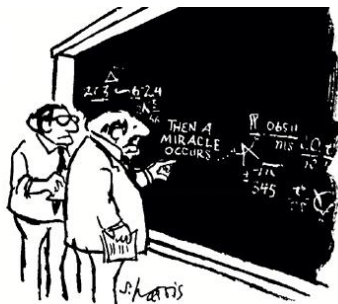
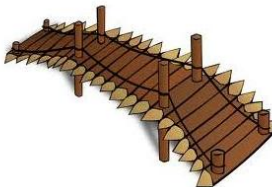


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