STRONG DECAY OF HYBRID MESONS

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In this work, we calculate the decay rates of some resonances that can be considered as hybrid mesons. This study was carried out using the constituent gluon model. We specifically studied the resonances $\pi_1(1400)$ and $\pi_1(1600)$, since the lightest hybrid meson, with quantum numbers $J^{PC} = 1^{-+}$, is expected to be in this region of hadronic spectrum. The constituent gluon model considers that the hybrid meson is composed by a quark-antiquark pair and a gluon. Thus, the decay occurs via the gluon breaking in a quark-antiquark pair. The constituent gluon model is established in the theory of strong interaction through the coupling between quarks and gluons fields, considering that the force between both is mediated by gluon exchange.

Hybrid meson candidates

- Lightest hybrid meson with 1^{-+} quantum numbers
- Most promising candidates are $\pi_1(1400)$ and $\pi_1(1600)$
- $\pi_1(1400)$
  - Mass = 1354 ± 25 MeV
  - Width = 330 ± 35 MeV
  - $\Gamma(\pi_1(1400) \to \eta'\pi)/\Gamma(\pi_1(1400) \to \eta\pi^0) < 0.80$

PDG, PTEP 083C01 (2020)

Hadron 89

- $\pi_1(1600)$
  - Mass = 1660^{+15}_{-11} MeV
  - Width = 257 ± 60 MeV
  - $/\Gamma(\pi_1(1600) \to f_1(1285)\pi)\Gamma(\pi_1(1600) \to \eta'(958)\pi^-) = 3.80 \pm 0.78$

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Results

$\beta_q = 0.4\,\text{GeV}$

$\alpha_s = 0.7$

$\omega = 0.4\ \text{GeV}$

$\beta_g = 0.403\ \text{GeV}$

$\pi_1(M)$	Mode	Channel	$\Gamma(L=1)$
$\pi_1(1400)$	QE	$\eta\pi^0$	9.664
$\pi_1(1400)$	QE	$\eta\pi^-$	9.638
$\pi_1(1400)$	QE	$\eta'\pi$	3.008
$\Gamma(total)$			22.311

Width = 330 ± 35 MeV

- The results for $\pi_1(1400)$ can not fit the existing experimental data
- The results for $\pi_1(1600)$ can fit the existing experimental data

$\Gamma_{\eta'\pi}/\Gamma_{\eta\pi^0} = 0.311$ Experimental < 0.8

$\pi_1(M)$	Modo	canal	$\Gamma(L=0)$	$\Gamma(L=1)$	$\Gamma(L=2)$
$\pi_1(1600)$	QE	$\rho^0\pi^-$	–	33,991	–
$\pi_1(1600)$	QE	$\eta'\pi^-$	–	7,960	–
$\pi_1(1600)$	GE	$b_1\pi$	193,714	145,285	348,685
$\pi_1(1600)$	GE	$f_1\pi$	40,344	30,258	2,017
$\Gamma(total)$			234,058	217,496	350,702

Width = 257 ± 60 MeV

$\Gamma_{f_1(1285)\pi}/\Gamma_{\eta'(958)\pi^-} = 3{,}80$ Experimental = 3.80 ± 0.78