中国科学院高能物理研究所

Institute of High Energy Physics Chinese Academy of Sciences

Chung-Yao Chao Fellowship Interview 2018

Zhuoran Huang
27 March

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Current Institute

- Institute of High Energy Physics (IHEP), CAS, Co-supervisor: Prof Caidian Lu

Education

- Ph.D., Zhejiang University, Theoretical Physics, 2011-2017, Supervisor: Prof. Hongying Jin

- Joint Ph.D., University of Saskatchewan, Theoretical Physics, 2015-2016, Supervisor: Prof. Tom Steele

- B.Sc., Hunan Normal University, Physics, 2007-2011, Supervisor: Prof. Xianhui Zhong

Areas of Research

- Hadronic Physics, Flavor Physics

Publications

- New predictions on the mass of the 1^{-+} light hybrid meson from QCD sum rules — Huang, Zhuo-Ran et al. ***JHEP*** 1504 (2015) 004

- Revisiting the $b_1\pi$ and $\rho\pi$ decay modes of the 1^{-+} light hybrid meson from light-cone QCD sum rules — Huang, Zhuo-Ran et al. ***Phys.Rev. D*** 94 (2016) no.5, 054037

- Investigation of the light four-quark states with exotic $J^{PC} = 0^{--}$ — Huang, Zhuo-Ran et al. ***Phys.Rev. D*** 95 (2017) no.7, 076017

- A comprehensive revisit of the ρ meson with improved Monte-Carlo based QCD sum rules — Wang, Qi-Nan et al. ***Chin.Phys. C*** 41 (2017) no.7, 074107 (selected in the list of **CPC's Highlights 2017**）

- Constraint on the light quark mass m_q from QCD sum rules in the $I = 0$ scalar channel — Yuan, Jian-Min et al. ***Phys.Rev. D*** 96 (2017) no.1, 014034

Conference Proceedings

- The mass and decay properties of the 1^{-+} light hybrid meson — Huang, Zhuo-Ran *et al.*, Proceedings for QCD 17 in Monpelier, France, to be pubished in ***Elsevier Nucl. Phys. Proceedings***

Professional Practice

- EPJC Referee (2017)

Awards and Funding

- Zhejiang University-funded Program on International Cooperation of Doctoral Students

- Excellent Doctoral Thesis Funding Program in Zhejiang University

- Subsidy for Excellent Ph.D. Students in Zhejiang University

- Yingcai Scholarship in Zhejiang University

New Predictions on the Mass of the 1^{-+} Light Hybrid Meson from QCD Sum Rules

Abstract

We improve the QCD sum rule study of the 1^{-+} light hybrid meson by calculating the complete form of the dimension-8 condensate contributions in the correlation function considering the operator mixing under renormalization.

Summary

• We find the inclusion of the higher power corrections increases the mass predictions for the 1^{-+} light hybrid meson in QCD sum rules.

• We obtain a conservative mass range $1.72-2.60$ GeV, which covers the mass of the $\pi_1(2015)$ and disfavors the $\pi_1(1600)$ and the $\pi_1(1400)$ to be pure hybrid states.

Revisiting the $b_1\pi$ and $\rho\pi$ Decay Modes of the 1^{-+} Light Hybrid Meson from Light-cone QCD Sum Rules

Abstract

We study the $b_1\pi$ and $\rho\pi$ decay patterns of the 1^{-+} light hybrid with light-cone QCD sum rules using the tensor and derivative interpolating currents.

Summary

• We obtain partial decay widths $\Gamma(\pi_1 \to b_1\pi)$ compatible with the hybrid explanation of the $\pi_1(1600)$ and the $\pi_1(2015)$.

• We find the partial decay width of the $\rho\pi$ mode is small due to the absence of the leading twist contribution in the light-cone expansion of the correlation function, suggesting the importance of the $\rho\pi$ decay mode in identifying the 1^{-+} hybrid.

Investigation of the Light Four-quark States with Exotic $J^{PC} = 0^{--}$

Abstract

We study the $J^{PC} = 0^{--}$ and 1^{+-} light four-quark states in Laplace sum rules (LSR) and finite energy sum rules (FESR). We use the standard sum rule stability criteria in the mass determination.

Summary

• We obtain the optimal mass prediction 1.76 ± 0.15 GeV, which slightly support the $\rho\pi$ dominance in D_0 decay to be a four-quark state.

• We find $a_0\pi$ is the only S-wave decay mode of the isoscalar and isovector 0^{--} four-quark states.

• We conservatively estimate the mass of the 1^{+-} four-quark state to be in the range 1.18–1.44 GeV, which merely covers $b_1(1235)$.

Revisit of the Vector and Scalar Channels with Improved Monte-Carlo Based QCD Sum Rules

Abstract

We improve the Monte-Carlo based QCD sum rules by introducing the rigorous Holder-inequality-determined sum rule window and a Breit-Wigner type parametrization for the phenomenological spectral function.

Summary

- We successfully use the new methodology in the ρ meson channel: the obtained ρ mass and width are highly consistent with the experimental values.

- We confirm the former results of the radiative corrections of the dimension-4 condensates of the two-point correlation function of the vector current.

- We obtain from the scalar channel a light quark mass $m_q(2\ GeV) = 4.7 \pm 0.7$ GeV consistent with the PDG value within the errors.

Future Plan

- Calculation of radiative corrections in the perturbative expansion and higher power corrections in the operator product expansion of the hybrid correlation functions, renormalization of the hybrid currents for various exotic and non-exotic quantum numbers.

- Further determination of the heavy and light hybrid and multi-quark spectra in QCD sum rules with inclusion of higher order α_s corrections and power corrections to the correlators and improvement of numerical analysis.

- Further analysis of new physics effects on the recent reported anomalies, such as $R(K^{(*)})$, $R(D^{(*)})$ and $R(J\psi)$ etc. in the semi-leptonic B decays, discrimination of the various NP senarios.

Thank you!