How to find the glueball among the f0s with QCD counting rules

A model-independent method to ascertain the leading valence composition of a hadron to measure the energy dependence of its production cross section in a fixed angle interval. By the QCD Brodsky-Farrar counting rules, the descent steepness at high energy depends on the hadron’s leading quark and gluon composition.

A reaction that could help classify the f0 mesons with an easily reconstructible final state:

exclusive \( e^+e^- \rightarrow \phi + f_0 \)

Some f0s may have a glueball gg component in their wavefunction; this will dominate at high energy over higher twist \( q\bar{q} \) components (which must be in a p-wave) or hybrid/tetraquark components (because of the higher number of particles in the final state). We discuss the prospects for Belle II.

How to distinguish glueballs from other mesons?

- Not \( J^P \) exotic: 0+, 2+, 0... lowest states
- Not flavor exotic: isospin 0
- \( J^P = 2^+ \) at 3 GeV (because of pomeron & lattice)

What about the lightest, 0+ glueball?

LORE: “J/ψ decays are gluon rich, a good place to search for the glueball”

DUBIOUS: At 1-2 GeV interactions are strong and Watson’s final state theorem renders same spectrum

Estimates for an experimental search at Belle II

- \( \sigma(0^+ \rightarrow \phi + f_0) \) as case study:
  - at 3 GeV cannot yet identify the glueball
  - \( \sigma = \text{constant} \)

- \( \sigma(\phi + f_0) \) as case study:
  - \( \sigma = \text{constant} \)

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- Belle II will get 5 abnr/yr, but mostly on Y resonances

- With 1 ab \( \rightarrow s' \) off-peak & \( \phi \) decay at 9 GeV, expect 70 000 events


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