

Rho-Mesons in Vacuum and Medium

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Determination of mass and coupling constants of the ρ -meson in vacuum and in a medium in terms of quark degrees of freedom

- at low energies QCD effectively is a theory of interacting pions \rightarrow chiral perturbation theory (χ PT)
- the coefficients of χ PT can be calculated from a **chiral quark model**
- on the other hand, **ρ -mesons** show up already at low energies as they **mediate the pion-pion interaction** (like W^- , Z -bosons show up in Fermi's theory)

\hookrightarrow **basic idea: learn about properties of ρ -mesons from the low-energy regime**

- note: chiral symmetry (breaking) is important whereas the role of confinement is diminished as the unphysical quark production thresholds are far away (low energies!)

techniques: → start from chiral quark model

→ integrate out quarks (**heat kernel method**) to obtain effective pion lagrangian (χ PT lagrangian)

→ unitarize χ PT (**inverse amplitude method**) to recover ρ -meson

results: ● vacuum: ρ -mass and ρ -pion coupling

$$M_\rho \approx 790 \pm 30 \text{ MeV}, \quad g \approx 6.0 \pm 0.3$$

● experiment: $M_\rho \approx 771 \text{ MeV}, \quad g \approx 6.05$

● finite temperature:

rising ρ -mass and rising ρ -pion coupling

