# MTHS24 – Exercise sheet 11

Morning: Christian Fischer

Afternoon:

Friday, 26 July 2024

## Lecture material

**Discussed topics**:

- Functional methods
- Dynamical Chiral Symmetry Breaking
- Spectra of conventional and exotic hadrons
- (optional: g-2, form factors,...)

**References**:

- Eichmann et al., "Baryons as relativistic three-quark bound states," PPNP **91** (2016), 1-100 arXiv:1606.09602 [hep-ph]].
- Eichmann et al. "Four-Quark States from Functional Methods," FBS **61** (2020) no.4, 38 arXiv:2008.10240 [hep-ph].

## Exercices

### 11.1 Diquarks

Write down spin, color and flavour wave functions for a scalar and an axialvector diquark built from

(a) two light quarks (what is the resulting isospin ?)

(b) two strange, charm or bottom quarks

(c) a heavy-(not-so-heavy) combination such as bc, bs or cs.

*Hint: carefully think about symmetries...*

### 11.2 Four-quark states

Now think about a four-quark state with two heavy quarks and two light anti-quarks in the two flavour combinations $bb\bar{q}\bar{q}$ and $bc\bar{q}\bar{q}$. Suppose, the quarks and antiquarks are arranged in scalar (S) and axialvector (A) diquarks. Which diquark combinations are possible for the following quantum numbers?

(a) $I(J) = 0(1)$

(b) $I(J) = 1(1)$

(c) $I(J) = 0(0)$

*Hint: again carefully think about symmetries...*