1. Introducing Lattice QCD
- Quantum Chromodynamics (QCD) is a theory which describes the interactions between the constituent particles of nuclei and mesons: quarks.
- Quarks interact via gauge fields called gluons, and the kinds of subatomic processes that can occur are very hard to calculate.
- Lattice QCD is an ab initio method for simulating difficult QCD problems on supercomputers, using a box of discrete momenta values.
- Although Lattice QCD is very successful, the computational intensiveness means that calculations are limited to heavy quark masses or small box sizes.
- This leads to systematic errors in results, such as finite-volume effects.

“Aim: Use χEFT to predict the physical mass of the quenched ρ meson”

3. Meson Cloud Diagrams
- The quenched ρ meson is surrounded by a cloud of other particles which contribute to its mass.
- The most important contributions are the single and double hairpin η’ graphs, which correspond to integrals:

\[
\begin{align*}
\eta' & = 2 \sum_{m=1}^{\infty} \frac{m^2}{k^2 + m^2} + \frac{m^2}{k^2 + m_\pi^2} \\
\eta'' & = \sum_{m=1}^{\infty} \frac{m^2}{k^2 + m^2}
\end{align*}
\]

4. Regularisation
- Quantum Field Theory integrals are often divergent and renormalisation is required.
- Therefore, a cutoff function \( u(k^2) \) is introduced to regulate the U.V. energy region.
- We use Finite-Range Regularisation, with convergence properties superior to standard techniques.

“Missing data points in the low energy region can be obtained from χEFT”

5. Conclusion
- The result obtained from χEFT differs from the naïve fit non-trivially.
- The χEFT result can also be corrected for an infinite volume lattice box.

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