Abstract

We present a study of isospin $I = 3/2$ resonant nucleon-pion scattering in the framework of lattice QCD. The goal of this study is to calculate the $\Delta(1232)$ p-wave resonance parameters.

The scattering analysis is performed using the finite volume formalism originally invented by Lüscher and later improved by several people in the lattice QCD community. This method relates the finite volume energy spectrum to the infinite volume scattering matrix, and so to use this formalism the energy spectrum must be calculated to high precision. To do this we employ two lattice QCD ensembles of gauge configurations with different pion mass generated by the CLS consortium.

To measure the correlation functions we use the stochastic LapH method, enabling an efficient and flexible way of computing large correlation matrices and making the determination of many levels in the elastic scattering region possible. For each determined energy level in the elastic scattering region, the finite volume method allows a determination of the K-matrix. By parametrising the elements of the K-matrix in terms of the resonance parameters of the $\Delta(1232)$ we extract observables such as the resonance width and mass.

Our extracted values of the resonance parameters can be compared both with the values measured from experiment and to other studies of this resonance. Since we are working with a 'heavier-than-physical' pion we do not expect to reproduce the experimental values of these observables, though our results are in reasonable agreement with other preliminary studies of this system. The s-wave scattering length is also extracted on both lattices, and while this value can be compared to a value extracted from experimental data we have not been able to find other lattice QCD determinations at similar pion masses to compare.