Tests on the confidence of the cosh ansatz in the mesonic sector

Sergio Chaves García-Mascaraque

Description

This folder contains scripts and results to study the validity of a cosh ansatz fit in the extraction of effective mass as a function of the temperature in anysotropic lattices. The data studied belongs to the Fastsum collaboration.

The channels available are,

chan = { g5, vec, ax_plus, ax_minus, g0 }

The temperatures studied correspond to the following time extents,

$$N\_\tau = \{128, 64, 56, 48, 40, 36, 32, 28, 24, 20, 16\}.$$

Note that the temperature and the time extent are related by $T = \frac{1}{N_\tau \cdot a_\tau}$.

The flavour structures available are,

fs = { uu, us, uc, ss, sc, cc }.

The types of source available are,

src = { ll, ss }.

Notation used.

In the plots and results inside, there are three main results shown. We will proceed to explain them,

Cosh equation-solved mass ("Effective mass").

In the plots or tables found in this repository, you can find the terms *cosh-mass*, *hyperbolic cosine mass*, *effective mass* and similar. All these terms belong to the same class. We define the hyperbolic cosine equation-solved mass ("effective mass") as the mass extracted from solving the following equation,

$$\frac{\cosh\Big(m \cdot (\tau - N_\tau/2)\Big)}{cosh\Big(m \cdot (\tau + a_\tau - N_\tau/2)\Big)} = \frac{C(\tau)}{C(\tau + a_\tau)}, \tag{1}$$

where τ is the Euclidean time in lattice units, m is the mass, N_τ is the temporal extent and $C(\tau)$ is the correlation function (data) evaluated at time τ.

Sliding window fit mass.

The term *sliding window fit mass* corresponds to the mass extracted by fitting the correlation function data $C(\tau)$ to a *cosh* anstaz of the form,

$$f(A, m) = \cosh\Big(m \cdot (\tau - N_\tau/2)\Big). \tag{2}$$

The raw data $C(\tau)$ has a range from $[0, N\_\tau - 1]$. We define a window $[\tau\_0, N\_\tau - \tau\_0]$, with τ_0 belonging to $\tau\_0 \in [0, N\_\tau/2 - 1]$. The *sliding* corresponds to iterate this process by shrinking the window, that is $\tau\_0 \rightarrow \tau\_0 + n \cdot a\_\tau$ and $N\_\tau - \tau \rightarrow N\_\tau - \tau - \cdot a\_\tau$. For each window we obtain an estimate on the mass.

Estimate of the mass.

The term *est mass* or *estimation of the mass* corresponds to the following process in a given channel, temperature, source and flavour structure,

1. We collect all the sliding window fit results as a function of the window used.
2. The data is then binned into several bins.
3. We take the most repeated bin as our estimate for the mass.
4. The value of the mass is then the average of all the values inside the most repeated bin.
5. The error is the maximum between the average of the statistical erros inside the bin or the following estimation of the systematic error,

$$\Delta\, m = \frac{1}{2}\Big[\max(Values) - \min(Values), \tag{3}$$

where `Values` is the set of values inside the most populated bin in the histogram.

This process has to be reanalysed to make it more robust.

Repository

`Results/` folder

We store all the results in this folder. The distribution inside is the following,

1. `plots/`: This folder contains all the plots for all channels and flavours structures. For a given channel and flavour structure, all the temperature plots are concatenated inside a file named `plot_$fs_llss_coshfit_$chan.pdf`. The plots show the time dependence of the effective mass and sliding window mass as a function of Euclidean time and window used respectively.

2. `table_confidenceCosh.tex`: Source file to generate `table_confidenceCosh.pdf`

3. `table_confidenceCosh.pdf`: File showing the confidence level for all channels, temperatures and flavour structures.

`scripts/` folder

We store all the scripts to generate the plots and the table of confidence.

1. `reorder_plot.sh`: This script generates the plots automatically for a given channel provided the data is in the expected format and contained in the expected folder.

    1. The mass extracted from the cosh ansatz has to be located inside a folder called `eff_mass`. The distribution and names of the files in the folder has to be,

    `eff_mass/fs/$N_\tau$x32/src/effMass_chan_src_N_\taux32.fs`

    2. The sliding window fit data has to be allocated in a folder called `cosh`. The distribution and names of the files in the folder has to be,

    `cosh/src/N_\tau/fs/cleaned_chan.fs_*.dat`

    The script will then generate the data inside a folder called `JointData_cosh`. All the results generated are inside that folder.

    3. The estimation of the mass has to be allocated inside a folder named `mass`. The distribution and names of the files in the folder has to be,

    `mass/fs/params_fs_*_src*dat`