Calculating observables as a ***weighted average*** over ***all possible time windows*** provides ***comparable accuracy*** to ***choosing a single*** optimal window in ***correlator fits.***

Calculating B-meson Masses, with $SU(3)_f$ Symmetry Breaking and Weighted Averaging

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Overview

Tuning a heavy b-quark action**[1]** requires calculation of a large number of correlators.

Correlator measurements typically require optimising the choice of fitting window.

Analyst choice is not feasible for the ≈ 1600 unique correlators required for our model.

We propose fitting correlators via a weighted average over all possible windows.
Poorly performing fits are algorithmically surpressed without additional analyst input

Method

We simulate $B/B^*/B_s/B^*_s$ mesons using QCDSF N_f=2+1 gauge fields.

Light quarks are treated with a clover-improved Wilson action and b quarks with Fermilab action.

We fit the correlator with 496 different time windows via $C(t)=A[exp(-mt)+exp(-m(N_t-t)]$

Each window is assigned a Bayesian-derived weight**[2]** according to $w_i=exp(-0.5\chi^2_{\nu,i}+N_{DOF,i})$

The weight of each window is normalised and applied to the corresponding fit to evaluate the weighted-average sum via $m_{wavg}=\Sigma_i\ (w_i m_i/w_{tot})$

Results

Correlator	m (GeV/c^2) t∈[5,14]	m (GeV/c^2) weighed avg.
B	**5.2996±0.0042**	**5.2975±0.0053**
B^*	**5.3491±0.0045**	**5.3463±0.0034**
B_s	**5.3462±0.0034**	**5.3425±0.0056**
B_s^*	**5.3964±0.0037**	**5.3937±0.0038**

Table 1: Comparison of single-window and weighted average fit results.

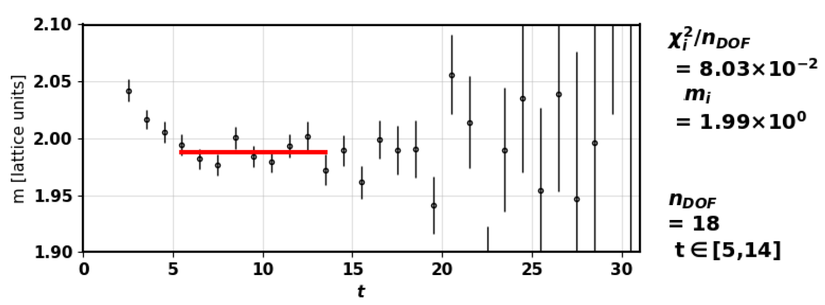

Figure 1: Example analyst choice fit window, for B correlator, with weight w_i=1.97x10^{-13}

β	5.5
volume	32^3x64
a	0.074 fm
# samples	758
m_π	357 MeV/c^2
m_K	505 MeV/c^2

Table 2: Lattice parameters

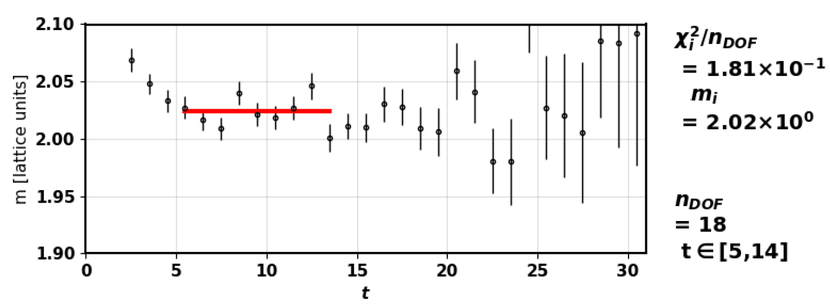

Figure 2: Example analyst choice fit window, for B_s correlator, with weight w_i=1.97x10^{-13}*

Discussion

The correlator fit in the window t∈[5,14] is chosen as a cross-check with the weighted average method, across all types of B correlators.
The single-window and weighted average derived masses demonstrate reasonable agreement in both central value and statistical error, suggesting the viability of this method.
However, Figure 3 demonstrates that the window t∈[5,14] is not weighted highly, and that windows with the largest plateau length are preferred, despite the amount of noise in these regions of the fits.

Introducing additional terms to disincentivise these fits may be needed.

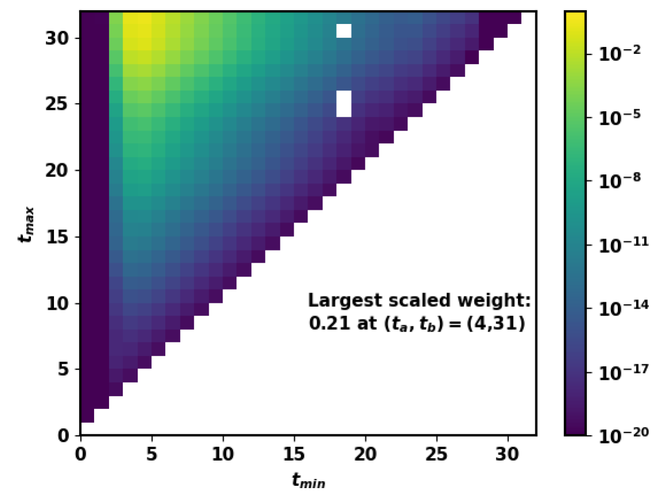

Figure 3: Weights implemented in weighted average, for all fitted windows of the B correlator.

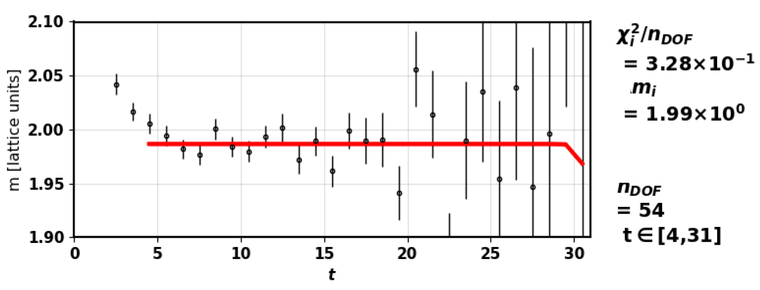

Figure 4: Fit window assigned largest weight, for B correlator, w_i=0.21

[1] *arXiv:1206.2554*
[2] *arXiv:2008.01069*

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