Open beauty mesons at non-zero temperature from LQCD

Rachel Horohan D'Arcy
FASTSUM

Maynooth University, Department of Physics

Methods of Effective Field Theory and Lattice Field Theory
14–27 Sep 2025

Motivation

Temperature dependence of B-mesons: $B^+ : u\bar{b}$, $B^0 : d\bar{b}$, $B_s : s\bar{b}$, $B_c : c\bar{b}$

- Probes for QGP & relativistic heavy-ion collisions
- Too heavy to be created by thermal fluctuation
- Complement the heavy quarkonium studies

Lattice Setup

- anisotropic lattice $a_s \neq a_\tau$
- $T = (a_\tau N_\tau)^{-1}$, fixed a_τ
- $m_s \approx m_{s,phys}$
- $m_l > m_{l,phys}$

ξ	a_s (fm)	a_τ(fm)	m_π MeV	T_c MeV
3.45	0.121	0.035	390	181

N_τ	128	48	40	36	32	28	24
Gen2 T(MeV)	44	117	140	156	175	201	235

B-Mesons

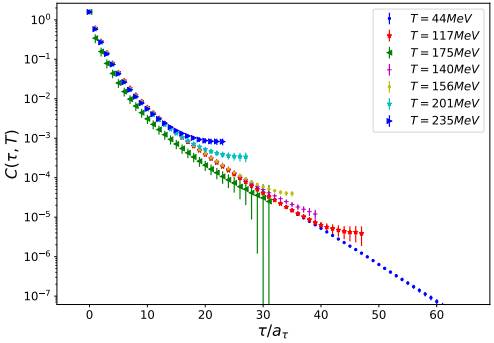
- NRQCD heavy quarks
- Wilson light quarks

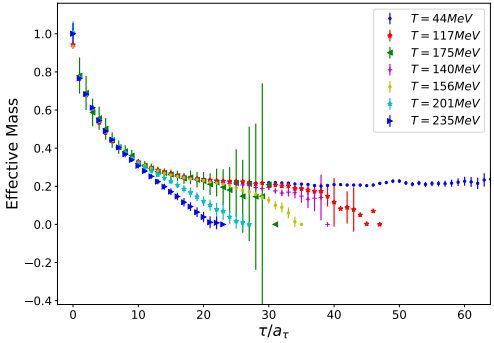
$$\Psi_q = \begin{pmatrix} \psi_q^f \\ \psi_q^b \end{pmatrix}, \Psi_Q = \begin{pmatrix} \psi_Q^b \\ 0 \end{pmatrix}.$$

$$\begin{aligned} \left\langle \mathrm{O}(n)\bar{\mathrm{O}}(m) \right\rangle &= \left\langle \bar{\psi}_Q(n)\Gamma\psi_q(n)\bar{\psi}_q(m)\Gamma\psi_Q(m) \right\rangle \\ &= -Tr\left(\Gamma S_q^\dagger(m,n)\Gamma S_Q(m,n)\right). \end{aligned}$$

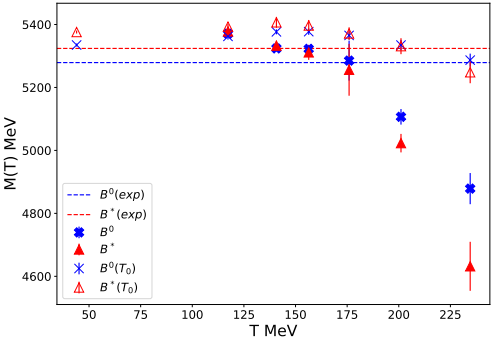
Where we sum over only two spin indices of the light propagator.

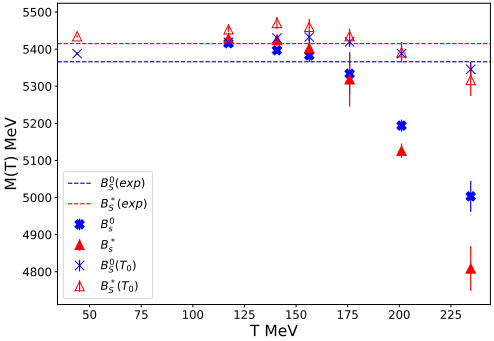
Correlators & Effective Mass





Temperature-dependence





Outlook

- ensembles with $m_\pi \approx 240$ MeV
- ensembles with half the temporal lattice spacing
- spectral function reconstruction

Thank you!