# *b*

$I(J^P) = 0(\frac{1}{2}^+)$

Charge $= -\frac{1}{3}\ e$ Bottom $= -1$

## *b*-QUARK MASS

The *b*-quark mass is estimated from bottomonium and *B* masses. It corresponds to the "running" mass $m_b$ ($\mu = m_b$) in the $\overline{\text{MS}}$ scheme. We have converted masses in other schemes to the $\overline{\text{MS}}$ scheme using one-loop QCD pertubation theory with $\alpha_s(\mu{=}m_b) = 0.22$. The range 4.1–4.5 GeV for the $\overline{\text{MS}}$ mass corresponds to 4.5–4.9 GeV for the pole mass (see the "Note on Quark Masses").

| *VALUE* (GeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **4.1 to 4.4 OUR EVALUATION** | | | | |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 4.25 ±0.09 | [1] HOANG | 99 | THEO | $\overline{\text{MS}}$ scheme |
| 3.91 ±0.67 | [2] ABREU | 98I | DLPH | $\overline{\text{MS}}$ scheme |
| 4.14 ±0.04 | [3] KUEHN | 98 | THEO | $\overline{\text{MS}}$ scheme |
| 4.15 ±0.05 ±0.20 | [4] GIMENEZ | 97 | LATT | $\overline{\text{MS}}$ scheme |
| 4.13 ±0.06 | [5] JAMIN | 97 | THEO | $\overline{\text{MS}}$ scheme |
| 4.16 ±0.32 ±0.60 | [6] RODRIGO | 97 | THEO | $\overline{\text{MS}}$ scheme |
| 4.22 ±0.05 | [7] NARISON | 95B | THEO | $\overline{\text{MS}}$ scheme |
| 4.415±0.006 | [8] VOLOSHIN | 95 | THEO | $\overline{\text{MS}}$ scheme |
| 4.0 ±0.1 | [9] DAVIES | 94 | THEO | $\overline{\text{MS}}$ scheme |
| $\geq$ 4.26 | [10] LIGETI | 94 | THEO | $\overline{\text{MS}}$ scheme |
| $\geq$ 4.2 | [11] LUKE | 94 | THEO | $\overline{\text{MS}}$ scheme |
| 4.23 ±0.04 | [12] NARISON | 94 | THEO | $\overline{\text{MS}}$ scheme |
| 4.397±0.025 | [13] TITARD | 94 | THEO | $\overline{\text{MS}}$ scheme |
| 4.32 ±0.05 | [14] DOMINGUEZ | 92 | THEO | |
| 4.24 ±0.05 | [15] NARISON | 89 | THEO | |
| 4.18 ±0.02 | [16] REINDERS | 88 | THEO | |
| 4.30 ±0.13 | [17] NARISON | 87 | THEO | |
| 4.25 ±0.1 | [18] GASSER | 82 | THEO | |

[1] HOANG 99 uses a NNLO calculation of the vacuum polarization function to determine spectral moments of the masses and electronic decay widths of the $\Upsilon$ mesons.

[2] ABREU 98I determines the $\overline{\text{MS}}$ mass $m_b = 2.67 \pm 0.25 \pm 0.34 \pm 0.27$ GeV at $\mu{=}M_Z$ from three jet heavy quark production at LEP. ABREU 98I have rescaled the result to $\mu = m_b$ using $\alpha_s{=}0.118 \pm 0.003$.

[3] KUEHN 98 uses a calculation of the vacuum polarization function, including resumming threshold effects, to determine spectral moments of the masses of the $\Upsilon$ mesons. We have converted their extracted value of 4.75 ± 0.04 for the pole mass to the $\overline{\text{MS}}$ scheme.

[4] GIMENEZ 97 uses lattice computations of the *B*-meson propagator and the *B*-meson binding energy $\overline{\Lambda}$ in the HQET. Their systematic (second) error for the $\overline{\text{MS}}$ mass is an estimate of the effects of higher-order corrections in the matching of the HQET operators (renormalon effects).

[5] JAMIN 97 apply the QCD moment method to the $\Upsilon$ system. They also find a pole mass of 4.60 ± 0.02.

[6] RODRIGO 97 determines the $\overline{\text{MS}}$ mass $m_b = 2.85 \pm 0.22 \pm 0.20 \pm 0.36$ GeV at $\mu{=}M_Z$ from three jet heavy quark production at LEP. We have rescaled the result.

[7] NARISON 95B uses finite energy sum rules to two-loop accuracy to determine a *b*-quark pole mass of 4.61 ± 0.05 GeV.

[8] VOLOSHIN 95 uses moments of the total cross section for $e^+e^- \to b$ hadrons. We have converted the value of of 4.827 ± 0.007 MeV for the pole mass to the $\overline{\text{MS}}$ scheme using the two-loop formula.
[9] DAVIES 94 uses lattice computation of $\Upsilon$ spectroscopy. They also quote a value of 5.0 ± 0.2 GeV for the $b$-quark pole mass. The numerical computation includes quark vacuum polarization (unquenched); they find that the masses are independent of $n_f$ to within their errors. Their error for the pole mass is larger than the error for the $\overline{\text{MS}}$ mass, because both are computed from the bare lattice quark mass, and the conversion for the pole mass is less accurate.
[10] LIGETI 94 computes lower bound of 4.66 GeV on pole mass using HQET, and experimental data on inclusive $B$ and $D$ decays.
[11] LUKE 94 computes lower bound of 4.60 GeV on pole mass using HQET, and experimental data on inclusive $B$ and $D$ decays.
[12] NARISON 94 uses spectral sum rules to two loops, and $J/\psi(1S)$ and $\Upsilon$ systems.
[13] TITARD 94 uses one-loop computation of the quark potential with nonperturbative gluon condensate effects to fit $J/\psi(1S)$ and $\Upsilon$ states.
[14] DOMINGUEZ 92 determines pole mass to be 4.72 ± 0.05 using next-to-leading order in $1/m$ in moment sum rule.
[15] NARISON 89 determines the Georgi-Politzer mass at $p^2 = -m^2$ to be 4.23 ± 0.05 GeV using QCD sum rules.
[16] REINDERS 88 determines the Georgi-Politzer mass at $p^2 = -m^2$ to be 4.17 ± 0.02 using moments of $\overline{b}\gamma^\mu b$. This technique leads to a value for the mass of the $B$ meson of 5.25 ± 0.15 GeV.
[17] NARISON 87 determines the pole mass to be 4.70 ± 0.14 using QCD sum rules, with $\Lambda(\overline{\text{MS}}) = 180 \pm 80$ MeV.
[18] GASSER 82 uses SVZ sum rules. The renormalization point is $\mu$ = quark mass.

## $m_b - m_c$ MASS DIFFERENCE

The mass difference $m_b - m_c$ in the HQET scheme is 3.4 ± 0.2 GeV (see the "Note on Quark Masses").

| *VALUE* (GeV) | *DOCUMENT ID* | | |
|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| ≥ 3.29 | [19] GROSSE | 78 | |

[19] GROSSE 78 obtain $(m_b - m_c) \geq 3.29$ GeV based on eigenvalue inequalities in potential models.

## *b*-QUARK REFERENCES


| | | | | |
|---|---|---|---|---|
| HOANG | 99 | PR D59 014039 | A.H. Hoang | |
| ABREU | 98I | PL B418 430 | P. Abreu+ | (DELPHI Collab.) |
| KUEHN | 98 | NP B534 356 | J.H. Kuehn, A.A. Penin, A.A. Pivovarov | |
| GIMENEZ | 97 | PL B393 124 | V. Gimenez, G. Martinelli, C.T. Sachrajda | |
| JAMIN | 97 | NP B507 334 | M. Jamin, A. Pich | |
| RODRIGO | 97 | PRL 79 193 | G. Rodrigo, A. Santamaria, M. Bilenky | |
| NARISON | 95B | PL B352 122 | | (MONP) |
| VOLOSHIN | 95 | IJMP A10 2865 | | (MINN) |
| DAVIES | 94 | PRL 73 2654 | +Hornbostel+ | (GLAS, SMU, CORN, EDIN, OSU, FSU) |
| LIGETI | 94 | PR D49 R4331 | +Nir | (REHO) |
| LUKE | 94 | PL B321 88 | +Savage | (TNTO, UCSD, CMU) |
| NARISON | 94 | PL B341 73 | | (CERN, MONP) |
| TITARD | 94 | PR D49 6007 | +Yndurain | (MICH, MADU) |
| DOMINGUEZ | 92 | PL B293 197 | +Paver | (CAPE, TRST, INFN) |
| NARISON | 89 | PL B216 191 | | (ICTP) |
| REINDERS | 88 | PR D38 947 | | (BONN) |
| NARISON | 87 | PL B197 405 | | (CERN) |
| GASSER | 82 | PRPL 87 77 | +Leutwyler | (BERN) |
| GROSSE | 78 | PL 79B 103 | +Martin | (CERN) |