b

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

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

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b-QUARK MASS

The first value is the "running mass" $\overline{m}_b(\mu = \overline{m}_b)$ in the $\overline{\rm MS}$ scheme, and the second value is the *1S* mass, which is half the mass of the $\Upsilon(1S)$ in perturbation theory. For a review of different quark mass definitions and their properties, see EL-KHADRA 02. The *1S* mass is better suited for use in analyzing B decays than the $\overline{\rm MS}$ mass because it gives a stable perturbative expansion. We have converted masses in other schemes to the $\overline{\rm MS}$ mass and *1S* mass using two-loop QCD perturbation theory with $\alpha_s(\mu = \overline{m}_b) = 0.223 \pm 0.008$. The values 4.18 ± 0.03 GeV for the $\overline{\rm MS}$ mass and 4.65 ± 0.03 GeV for the *1S* mass correspond to 4.78 ± 0.06 GeV for the pole mass, using the two-loop conversion formula. A discussion of masses in different schemes can be found in the "Note on Quark Masses."

$\overline{\rm MS}$ *MASS* (GeV)	*1S MASS* (GeV)	*DOCUMENT ID*	*TECN*
4.18 ±0.03 OUR EVALUATION of $\overline{\rm MS}$ Mass. See the ideogram below.			
4.65 ±0.03 OUR EVALUATION of $1S$ Mass. See the ideogram below.			
4.171±0.009	4.642 ± 0.010	[1] BODENSTEIN 12	THEO
4.29 ±0.14	4.77 ± 0.16	[2] DIMOPOUL... 12	LATT
4.177±0.011	4.649 ± 0.012	[3] NARISON 12	THEO
$4.18\ ^{+0.05}_{-0.04}$	$4.65\ ^{+0.06}_{-0.04}$	[4] LASCHKA 11	THEO
4.186±0.044±0.015	4.659 ± 0.050 ± 0.017	[5] AUBERT 10A	BABR
4.164±0.023	4.635 ± 0.026	[6] MCNEILE 10	LATT
4.163±0.016	4.633 ± 0.018	[7] CHETYRKIN 09	THEO
5.26 ±1.2	5.85 ± 1.3	[8] ABDALLAH 08D	DLPH
4.243±0.049	4.723 ± 0.055	[9] SCHWANDA 08	BELL
4.19 ±0.40	4.66 ± 0.45	[10] ABDALLAH 06D	DLPH
4.205±0.058	4.68 ± 0.06	[11] BOUGHEZAL 06	THEO
4.20 ±0.04	4.67 ± 0.04	[12] BUCHMULLER 06	THEO
4.19 ±0.06	4.66 ± 0.07	[13] PINEDA 06	THEO
4.17 ±0.03	4.68 ± 0.03	[14] BAUER 04	THEO
4.22 ±0.11	4.72 ± 0.12	[15,16] HOANG 04	THEO
4.19 ±0.05	4.66 ± 0.05	[17] BORDES 03	THEO
4.20 ±0.09	4.67 ± 0.10	[18] CORCELLA 03	THEO
4.24 ±0.10	4.72 ± 0.11	[19] EIDEMULLER 03	THEO
4.207±0.031	4.682 ± 0.035	[20] ERLER 03	THEO
4.33 ±0.06 ±0.10	4.82 ± 0.07 ± 0.11	[21] MAHMOOD 03	CLEO
4.190±0.032	4.663 ± 0.036	[22] BRAMBILLA 02	THEO
4.346±0.070	4.837 ± 0.078	[23] PENIN 02	THEO
• • • We do not use the following data for averages, fits, limits, etc. • • •			
4.212±0.032	4.688 ± 0.036	[24] NARISON 12	THEO
4.171±0.014	4.642 ± 0.016	[25] NARISON 12A	THEO

4.173±0.010	4.645 ± 0.011	[26] NARISON	10	THEO
4.42 ±0.06 ±0.08	4.92 ± 0.07 ± 0.09	[27] GUAZZINI	08	LATT
4.347±0.048±0.08	4.838 ± 0.053 ± 0.09	[28] DELLA-MOR...	07	LATT
4.164±0.025	4.635 ± 0.028	[29] KUHN	07	THEO
4.4 ±0.3	4.9 ± 0.3	[15,30] GRAY	05	LATT
4.22 ±0.06	4.72 ± 0.07	[31] AUBERT	04X	THEO
4.25 ±0.11	4.76 ± 0.12	[15,32] MCNEILE	04	LATT
4.22 ±0.09	4.74 ± 0.10	[33] BAUER	03	THEO
4.33 ±0.10	4.84 ± 0.11	[15,34] DEDIVITIIS	03	LATT

[1] BODENSTEIN 12 determine m_b using sum rules for the vector current correlator and the $e^+e^- \rightarrow Q\overline{Q}$ total cross-section. We have converted $\overline{m}_b(\overline{m}_b)$ to the 1S scheme.

[2] DIMOPOULOS 12 determine quark masses from a lattice computation using $N_f = 2$ dynamical flavors of twisted mass fermions. We have converted $\overline{m}_b(\overline{m}_b)$ to the 1S scheme.

[3] Determines m_b to order α_s^3, including the effect of gluon condensates up to dimension eight combining the methods of NARISON 12 and NARISON 12A. We have converted $\overline{m}_b(\overline{m}_b)$ to the 1S scheme.

[4] LASCHKA 11 determine the b mass from the charmonium spectrum. The theoretical computation uses the heavy $Q\overline{Q}$ potential to order $1/m_Q$ obtained by matching the short-distance perturbative result onto lattice QCD result at larger scales. We have converted $\overline{m}_b(\overline{m}_b)$ to the 1S scheme.

[5] AUBERT 10A determine the b- and c-quark masses from a fit to the inclusive decay spectra in semileptonic B decays in the kinetic scheme (and convert it to the $\overline{\text{MS}}$ scheme). We have converted this to the 1S scheme.

[6] MCNEILE 10 determines m_b by comparing four-loop perturbative results for the pseudoscalar current to lattice simulations with $N_f = 2+1$ sea-quarks by the HPQCD collaboration. We have converted $\overline{m}_b$ $(\overline{m}_b)$ to the 1S scheme.

[7] CHETYRKIN 09 determine m_c and m_b from the $e^+e^- \rightarrow Q\overline{Q}$ cross-section and sum rules, using a four-loop computation of the heavy quark vacuum polarization. We have converted their m_b to the 1S scheme.

[8] ABDALLAH 08D determine $\overline{m}_b(M_Z) = 3.76 \pm 1.0$ GeV from a leading order study of four-jet rates at LEP. We have converted this to $\overline{m}_b(\overline{m}_b)$ and m_b^{1S}.

[9] SCHWANDA 08 measure moments of the inclusive photon spectrum in $B \rightarrow X_s\gamma$ decay to determine m_b^{1S}. We have converted this to $\overline{\text{MS}}$ scheme.

[10] ABDALLAH 06D determine $m_b(M_Z) = 2.85 \pm 0.32$ GeV from Z-decay three-jet events containing a b-quark. We have converted this to $\overline{m}_b(\overline{m}_b)$ and m_b^{1S}.

[11] BOUGHEZAL 06 $\overline{\text{MS}}$ scheme result comes from the first moment of the hadronic production cross-section to order α_s^3. We have converted it to the 1S scheme.

[12] BUCHMULLER 06 determine m_b and m_c by a global fit to inclusive B decay spectra. We have converted this to the 1S scheme.

[13] PINEDA 06 $\overline{\text{MS}}$ scheme result comes from a partial NNLL evaluation (complete at NNLO) of sum rules of the bottom production cross-section in e^+e^- annihilation. We have converted it to the 1S scheme.

[14] BAUER 04 determine m_b, m_c and m_b-m_c by a global fit to inclusive B decay spectra.

[15] We have converted m_b to the 1S scheme.

[16] HOANG 04 determines $\overline{m}_b(\overline{m}_b)$ from moments at order α_s^2 of the bottom production cross-section in e^+e^- annihilation.

[17] BORDES 03 determines m_b using QCD finite energy sum rules to order α_s^2.

[18] CORCELLA 03 determines $\overline{m}_b$ using sum rules computed to order α_s^2. Includes charm quark mass effects.

[19] EIDEMULLER 03 determines $\overline{m}_b$ and $\overline{m}_c$ using QCD sum rules.

[20] ERLER 03 determines $\overline{m}_b$ and $\overline{m}_c$ using QCD sum rules. Includes recent BES data.

[21] MAHMOOD 03 determines m_b^{1S} by a fit to the lepton energy moments in $B \to X_c \ell \nu_\ell$ decay. The theoretical expressions used are of order $1/\mathrm{m}^3$ and $\alpha_s^2 \beta_0$. We have converted their result to the $\overline{\mathrm{MS}}$ scheme.

[22] BRAMBILLA 02 determine $\overline{m}_b(\overline{m}_b)$ from a computation of the $\Upsilon(1S)$ mass to order α_s^4, including finite m_c corrections. We have converted this to the 1S scheme.

[23] PENIN 02 determines $\overline{m}_b$ from the spectrum of the Υ system.

[24] NARISON 12 determines m_b using exponential sum rules for the vector current correlator to order α_s^3, including the effect of gluon condensates up to dimension eight. We have converted $\overline{m}_b(\overline{m}_b)$ to the 1S scheme.

[25] NARISON 12A determines m_b using sum rules for the vector current correlator to order α_s^3, including the effect of gluon condensates up to dimension eight. We have converted $\overline{m}_b(\overline{m}_b)$ to the 1S scheme.

[26] NARISON 10 determines m_b from ratios of moments of vector current correlators computed to order α_s^3 and including the dimension-six gluon condensate. These values are taken from the erratum to that reference.

[27] GUAZZINI 08 determine $\overline{m}_b(\overline{m}_b)$ from a quenched lattice simulation of heavy meson masses. The ±0.08 is an estimate of the quenching error. We have converted these values to the $1S$ scheme.

[28] DELLA-MORTE 07 determine $\overline{m}_b(\overline{m}_b)$ from a computation of the spin-averaged B meson mass using quenched lattice HQET at order $1/m$. The ±0.08 is an estimate of the quenching error.

[29] KUHN 07 determine $\overline{m}_b(\mu = 10\ \mathrm{GeV}) = 3.609 \pm 0.025$ GeV and $\overline{m}_b(\overline{m}_b)$ from a four-loop sum-rule computation of the cross-section for $e^+ e^- \to$ hadrons in the bottom threshold region. We have converted this to the 1S scheme.

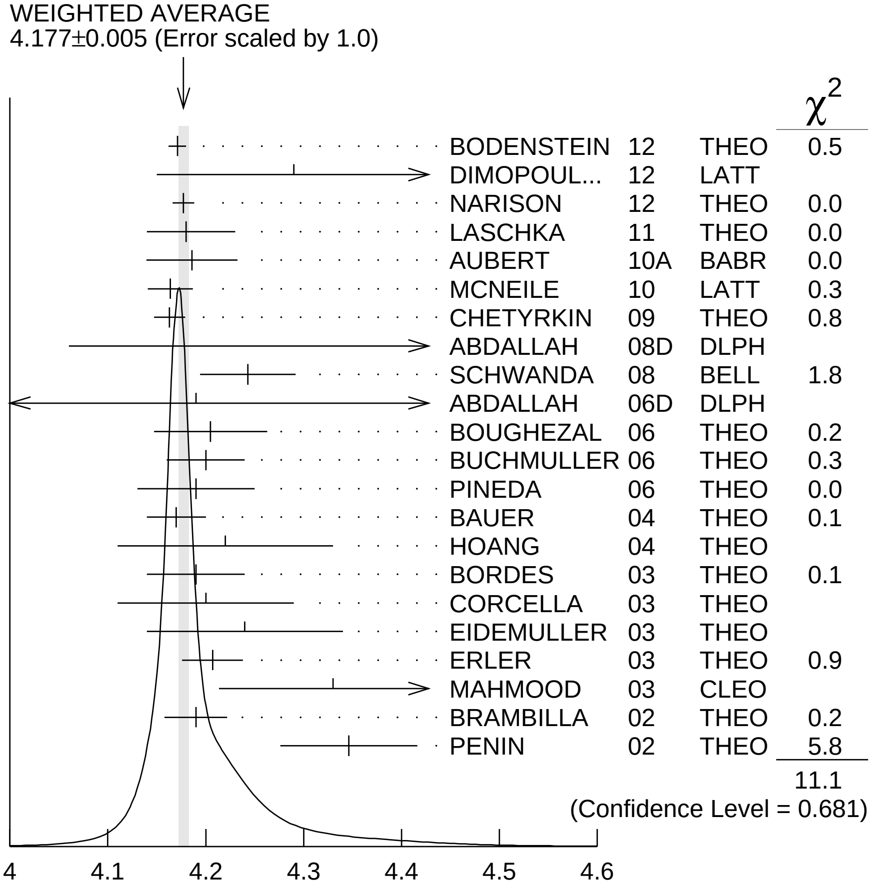
[30] GRAY 05 determines $\overline{m}_b(\overline{m}_b)$ from a lattice computation of the Υ spectrum. The simulations have 2+1 dynamical light flavors. The b quark is implemented using NRQCD.

[31] AUBERT 04X obtain m_b from a fit to the hadron mass and lepton energy distributions in semileptonic B decay. The paper quotes values in the kinetic scheme. The $\overline{\mathrm{MS}}$ value has been provided by the BABAR collaboration, and we have converted this to the 1S scheme.

[32] MCNEILE 04 use lattice QCD with dynamical light quarks and a static heavy quark to compute the masses of heavy-light mesons.

[33] BAUER 03 determine the b quark mass by a global fit to B decay observables. The experimental data includes lepton energy and hadron invariant mass moments in semileptonic $B \to X_c \ell \nu_\ell$ decay, and the inclusive photon spectrum in $B \to X_s \gamma$ decay. The theoretical expressions used are of order $1/\mathrm{m}^3$, and $\alpha_s^2 \beta_0$.

[34] DEDIVITIIS 03 use a quenched lattice computation of heavy-heavy and heavy-light meson masses.



b-QUARK $\overline{\mathrm{MS}}$ MASS (GeV)

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b-QUARK REFERENCES

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NARISON	12	PL B707 259	S. Narison	(MONP)
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AUBERT	10A	PR D81 032003	B. Aubert *et al.*	(BABAR Collab.)
MCNEILE	10	PR D82 034512	C. McNeile *et al.*	(HPQCD Collab.)
NARISON	10	PL B693 559	S. Narison	(MONP)
Also		PL B705 544 (errat.)	S. Narison	(MONP)
CHETYRKIN	09	PR D80 074010	K.G. Chetyrkin *et al.*	(KARL, BNL)
ABDALLAH	08D	EPJ C55 525	J. Abdallah *et al.*	(DELPHI Collab.)
GUAZZINI	08	JHEP 0801 076	D. Guazzini, R. Sommer, N. Tantalo	
SCHWANDA	08	PR D78 032016	C. Schwanda *et al.*	(BELLE Collab.)
DELLA-MOR...	07	JHEP 0701 007	M. Della Morte *et al.*	
KUHN	07	NP B778 192	J.H. Kuhn, M. Steinhauser, C. Sturm	
ABDALLAH	06D	EPJ C46 569	J. Abdallah *et al.*	(DELPHI Collab.)
BOUGHEZAL	06	PR D74 074006	R. Boughezal, M. Czakon, T. Schutzmeier	
BUCHMULLER	06	PR D73 073008	O.L. Buchmuller, H.U. Flacher	
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GRAY	05	PR D72 094507	A. Gray *et al.*	(HPQCD, UKQCD Collab.)
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HOANG	04	PL B594 127	A.H. Hoang, M. Jamin	
MCNEILE	04	PL B600 77	C. McNeile, C. Michael, G. Thompson	(UKQCD Collab.)
BAUER	03	PR D67 054012	C.W. Bauer *et al.*	

BORDES	03	PL B562 81	J. Bordes, J. Penarrocha, K. Schilcher	
CORCELLA	03	PL B554 133	G. Corcella, A.H. Hoang	
DEDIVITIIS	03	NP B675 309	G.M. de Divitiis *et al.*	
EIDEMULLER	03	PR D67 113002	M. Eidemuller	
ERLER	03	PL B558 125	J. Erler, M. Luo	
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BRAMBILLA	02	PR D65 034001	N. Brambilla, Y. Sumino, A. Vairo	
EL-KHADRA	02	ARNPS 52 201	A.X. El-Khadra, M. Luke	
PENIN	02	PL B538 335	A. Penin, M. Steinhauser	