b

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

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

b-QUARK MASS

The first value is the "running mass" $\overline{m}_b(\mu = \overline{m}_b)$ in the $\overline{\text{MS}}$ 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 $\overline{\text{MS}}$ mass because it gives a stable perturbative expansion. We have converted masses in other schemes to the $\overline{\text{MS}}$ mass and $1S$ mass using two-loop QCD perturbation theory with $\alpha_s(\mu = \overline{m}_b) = 0.22$. The range 4.1–4.4 for the $\overline{\text{MS}}$ mass corresponds to 4.6–4.9 for the $1S$ mass and 4.7–5.0 GeV for the pole mass.

$\overline{\text{MS}}$ *MASS* (GeV)	*1S MASS* (GeV)	*DOCUMENT ID*		*TECN*
4.20 ±0.07 OUR EVALUATION of $\overline{\text{MS}}$ Mass				
4.70 ±0.07 OUR EVALUATION of $1S$ Mass				
4.19 ±0.40	4.66 ± 0.45	[1] ABDALLAH	06D	DLPH
4.205±0.058	4.68 ± 0.06	[2] BOUGHEZAL	06	THEO
4.19 ±0.06	4.66 ± 0.07	[3] PINEDA	06	THEO
4.4 ±0.3	4.9 ± 0.3	[4,5] GRAY	05	LATT
4.22 ±0.06	4.72 ± 0.07	[6] AUBERT	04X	THEO
4.17 ±0.03	4.68 ± 0.03	[7] BAUER	04	THEO
4.22 ±0.11	4.72 ± 0.12	[5,8] HOANG	04	THEO
4.25 ±0.11	4.76 ± 0.12	[5,9] MCNEILE	04	LATT
4.22 ±0.09	4.74 ± 0.10	[10] BAUER	03	THEO
4.19 ±0.05	4.66 ± 0.05	[11] BORDES	03	THEO
4.20 ±0.09	4.67 ± 0.10	[12] CORCELLA	03	THEO
4.33 ±0.10	4.84 ± 0.11	[5,13] DEDIVITIIS	03	LATT
4.24 ±0.10	4.72 ± 0.11	[14] EIDEMULLER	03	THEO
4.207±0.031	4.682 ± 0.035	[15] ERLER	03	THEO
4.33 ±0.06 ±0.10	4.82 ± 0.07 ± 0.11	[16] MAHMOOD	03	THEO
4.346±0.070	4.837 ± 0.078	[17] PENIN	02	THEO
3.95 ±0.57	4.40 ± 0.63	[18] ABBIENDI	01S	OPAL
4.21 ±0.05	4.69 ± 0.06	[19] KUHN	01	THEO
4.05 ±0.06	4.51 ± 0.07	[20] NARISON	01B	THEO
4.210±0.090±0.025	4.69 ± 0.100 ± 0.028	[21] PINEDA	01	THEO
4.7 ±0.74	5.23 ± 0.82	[22] BARATE	00V	ALEP
4.20 ±0.06	4.71 ± 0.03	[23] HOANG	00	THEO
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$4.437^{+0.045}_{-0.029}$	$4.938^{+0.050}_{-0.032}$	[24] LUCHA	00	THEO
$4.454^{+0.045}_{-0.029}$	$4.957^{+0.050}_{-0.032}$	[24] PINEDA	00	THEO
4.25 ±0.08	4.73 ± 0.09	[25] BENEKE	99	THEO
$3.8^{+0.77}_{-2.0}$	$4.23^{+0.86}_{-2.0}$	[26] BRANDENB...	99	
4.25 ±0.09	4.73 ± 0.10	[27] HOANG	99	THEO
4.2 ±0.1	4.67 ± 0.11	[28] MELNIKOV	99	THEO

4.21 ±0.11	4.69 ± 0.12	[29] PENIN	99	THEO
3.91 ±0.67	4.35 ± 0.75	[30] ABREU	98I	DLPH
4.14 ±0.04	4.61 ± 0.05	[31] KUEHN	98	THEO
4.15 ±0.05 ±0.20	4.62 ± 0.06 ± 0.22	[32] GIMENEZ	97	LATT
4.19 ±0.06	4.66 ± 0.07	[33] JAMIN	97	THEO
4.16 ±0.32 ±0.60	4.63 ± 0.36 ± 0.67	[34] RODRIGO	97	THEO

[1] 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}.

[2] BOUGHEZAL 06 $\overline{\rm MS}$ 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.

[3] PINEDA 06 $\overline{\rm MS}$ 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.

[4] 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.

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

[6] 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 $\overline{\rm MS}$ value has been provided by the BABAR collaboration, and we have converted this to the 1S scheme.

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

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

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

[10] 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 $B \rightarrow X_c \ell \nu_\ell$ decay, and the inclusive photon spectrum in $B \rightarrow X_s \gamma$ decay. The theoretical expressions used are of order $1/{\rm m}^3$, and $\alpha_s^2 \beta_0$.

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

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

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

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

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

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

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

[18] ABBIENDI 01S find $\overline{m}_b$ (M_Z) to be 2.67 ± 0.4 GeV from an analysis of $Z \rightarrow b$ decays.

[19] KUHN 01 uses an analysis of the $e^+ e^-$ total cross section to hadrons.

[20] NARISON 01B uses pseudoscalar sum rules in the B and D meson channels.

[21] PINEDA 01 uses the $\Upsilon(1S)$ system to determine the quark mass. The errors are due to theory, and the uncertainty in α_s.

[22] BARATE 00V obtain the b quark mass $\overline{m}_b(M_Z) = 3.27 \pm 0.22({\rm stat}) \pm 0.22({\rm exp}) \pm 0.38({\rm had}) \pm 0.16({\rm thy})$ from an analysis of event shape variables in Z decays. We have converted this to $\mu = \overline{m}_b$.

[23] HOANG 00 uses a NNLO calculation of the vacuum polarization function to determine spectral moments of the masses and electronic decay widths of the Υ mesons.

[24] LUCHA 00, PINEDA 00 obtain the b-quark mass from a perturbative calculation of the Υ spectrum and decay widths to order α_s^4.

[25] BENEKE 99 uses a calculation of the $b\overline{b}$ production cross section and the mass of the Υ meson at NNLO.

[26] BRANDENBURG 99 obtain a b-quark mass of $\overline{m}_b(M_Z)= 2.56 \pm 0.27 {}^{+0.28}_{-0.38} {}^{+0.49}_{-1.48}$ from a study of three-jet events at the Z. We have converted this to $\mu=\overline{m}_b$.

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

[28] MELNIKOV 99 compute the quark mass using Υ sum rules at NNLO.

[29] PENIN 99 compute the quark mass using Υ sum rules at NNLO.

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

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

[32] 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).

[33] JAMIN 97 apply the QCD moment method to the Υ system. They also find a pole mass of 4.60 ± 0.02.

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

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