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

4.21 ±0.11		4.69 ± 0.12	[26] PENIN	99	THEO
3.91 ±0.67		4.35 ± 0.75	[27] ABREU	98I	DLPH
4.14 ±0.04		4.61 ± 0.05	[28] KUEHN	98	THEO
4.15 ±0.05	±0.20	4.62 ± 0.06 ± 0.22	[29] GIMENEZ	97	LATT
4.19 ±0.06		4.66 ± 0.07	[30] JAMIN	97	THEO
4.16 ±0.32	±0.60	4.63 ± 0.36 ± 0.67	[31] RODRIGO	97	THEO

[1] 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.

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

[3] 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.

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

[5] 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.

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

[7] 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 $\alpha_s^2\beta_0$.

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

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

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

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

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

[13] 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 $\overline{\rm MS}$ scheme.

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

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

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

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

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

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

[20] 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.

[21] 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.

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

[23] 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 $\mu = \overline{m}_b$.

[24] 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.

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

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

[27] ABREU 98I determines the $\overline{\rm MS}$ 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 $\alpha_s = 0.118 \pm 0.003$.

[28] 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 $\overline{\rm MS}$ scheme.

[29] 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 $\overline{\rm MS}$ mass is an estimate of the effects of higher-order corrections in the matching of the HQET operators (renormalon effects).

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

[31] RODRIGO 97 determines the $\overline{\rm MS}$ 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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