c

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

Charge $= \frac{2}{3}\, e$ Charm $= +1$

c-QUARK MASS

The c-quark mass corresponds to the "running" mass m_c ($\mu = m_c$) in the $\overline{\mathrm{MS}}$ scheme. We have converted masses in other schemes to the $\overline{\mathrm{MS}}$ scheme using two-loop QCD perturbation theory with $\alpha_s(\mu{=}m_c) = 0.39$. The range 1.0–1.4 GeV for the $\overline{\mathrm{MS}}$ mass corresponds to 1.47–1.83 GeV for the pole mass (see the "Note on Quark Masses").

VALUE (GeV)	DOCUMENT ID		TECN	COMMENT
$1.29^{+0.05}_{-0.11}$ (1.18–1.34) OUR EVALUATION See the ideogram below.				
1.196±0.059 ±0.050	[1] AUBERT	10A	BABR	$\overline{\mathrm{MS}}$ scheme
1.28 ±0.04	[2] BLOSSIER	10	LATT	$\overline{\mathrm{MS}}$ scheme
1.299±0.0026	[3] BODENSTEIN	10	THEO	$\overline{\mathrm{MS}}$ scheme
1.271±0.008	[4] MCNEILE	10	LATT	$\overline{\mathrm{MS}}$ scheme
1.261±0.018	[5] NARISON	10	THEO	$\overline{\mathrm{MS}}$ scheme
1.279±0.013	[6] CHETYRKIN	09	THEO	$\overline{\mathrm{MS}}$ scheme
1.25 ±0.04	[7] SIGNER	09	THEO	$\overline{\mathrm{MS}}$ scheme
1.286±0.013	[8] KUHN	07	THEO	$\overline{\mathrm{MS}}$ scheme
1.295±0.015	[9] BOUGHEZAL	06	THEO	$\overline{\mathrm{MS}}$ scheme
1.24 ±0.09	[10] BUCHMULLER	06	THEO	$\overline{\mathrm{MS}}$ scheme
1.224±0.017 ±0.054	[11] HOANG	06	THEO	$\overline{\mathrm{MS}}$ scheme
1.33 ±0.10	[12] AUBERT	04X	THEO	$\overline{\mathrm{MS}}$ scheme
1.29 ±0.07	[13] HOANG	04	THEO	$\overline{\mathrm{MS}}$ scheme
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.268±0.009	[14] ALLISON	08	LATT	$\overline{\mathrm{MS}}$ scheme
1.319±0.028	[15] DEDIVITIIS	03	LATT	$\overline{\mathrm{MS}}$ scheme
1.19 ±0.11	[16] EIDEMULLER	03	THEO	$\overline{\mathrm{MS}}$ scheme
1.289±0.043	[17] ERLER	03	THEO	$\overline{\mathrm{MS}}$ scheme
1.26 ±0.02	[18] ZYABLYUK	03	THEO	$\overline{\mathrm{MS}}$ scheme
1.26 ±0.04 ±0.12	[19] BECIREVIC	02	LATT	$\overline{\mathrm{MS}}$ scheme
1.301±0.034	[20] ROLF	02	LATT	$\overline{\mathrm{MS}}$ scheme
1.243±0.045	[21] BRAMBILLA	01	THEO	$\overline{\mathrm{MS}}$ scheme
1.23 ±0.09	[22] EIDEMULLER	01	THEO	$\overline{\mathrm{MS}}$ scheme
1.304±0.027	[23] KUHN	01	THEO	$\overline{\mathrm{MS}}$ scheme
1.04 ±0.04	[24] MARTIN	01	THEO	$\overline{\mathrm{MS}}$ scheme
1.1 ±0.04	[25] NARISON	01B	THEO	$\overline{\mathrm{MS}}$ scheme
1.37 ±0.09	[26] PENARROCHA	01	THEO	$\overline{\mathrm{MS}}$ scheme
1.210±0.070 ±0.080	[27] PINEDA	01	THEO	$\overline{\mathrm{MS}}$ scheme
1.3 ±0.3 ±0.3	[28] ASTIER	00D	NOMD	
1.79 ±0.38	[29] VILAIN	99	THEO	$\overline{\mathrm{MS}}$ scheme

[1] 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 $\overline{\mathrm{MS}}$ scheme).

[2] BLOSSIER 10 determines quark masses from a computation of the hadron spectrum using $N_f{=}2$ dynamical twisted-mass Wilson fermions.

[3] BODENSTEIN 10 determines $\overline{m}_c$(3 GeV) = 1.008 ± 0.026 GeV using finite energy sum rules for the vector current correlator. The authors have converted this to $\overline{m}_c(\overline{m}_c)$ using $\alpha_s(M_Z) = 0.1189 \pm 0.0020$.

[4] MCNEILE 10 determines m_c 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 their value $\overline{m}_c$ (3 GeV) = 0.986 ± 0.006 GeV.

[5] NARISON 10 determines m_c from ratios of moments of vector current correlators computed to order α_s^3 and including the dimension-six gluon condensate.

[6] 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. They also determine m_c(3 GeV) = 0.986 ± 0.013GeV.

[7] SIGNER 09 determines the c-quark mass using non-relativistic sum rules to analyze the $e^+ e^- \rightarrow c\overline{c}$ cross-section near threshold. Also determine the PS mass $m_{PS}(\mu_F$= 0.7 GeV) = 1.50 ± 0.04 GeV.

[8] KUHN 07 determine $\overline{m}_c(\mu = 3$ GeV) = 0.986 ± 0.013 GeV and $\overline{m}_c(\overline{m}_c)$ from a four-loop sum-rule computation of the cross-section for $e^+ e^- \rightarrow$ hadrons in the charm threshold region.

[9] BOUGHEZAL 06 result comes from the first moment of the hadronic production cross-section to order α_s^3.

[10] BUCHMULLER 06 determine m_b and m_c by a global fit to inclusive B decay spectra.

[11] HOANG 06 determines $\overline{m}_c(\overline{m}_c)$ from a global fit to inclusive B decay data. The B decay distributions were computed to order $\alpha_s^2\beta_0$, and the conversion between different m_c mass schemes to order α_s^3.

[12] AUBERT 04X obtain m_c from a fit to the hadron mass and lepton energy distributions in semileptonic B decay. The paper quotes values in the kinetic scheme. The $\overline{\text{MS}}$ value has been provided by the BABAR collaboration.

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

[14] ALLISON 08 determine m_c by comparing four-loop perturbative results for the pseudoscalar current correlator to lattice simulations by the HPQCD collaboration.

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

[16] EIDEMULLER 03 determines m_b and m_c using QCD sum rules.

[17] ERLER 03 determines m_b and m_c using QCD sum rules. Includes recent BES data.

[18] ZYABLYUK 03 determines m_c by using QCD sum rules in the pseudoscalar channel and comparing with the η_c mass.

[19] BECIREVIC 02 uses Monte-Carlo calculations of lattice Ward identities and the D_s mass. The authors estimate an error of about 5% for use of the quenched approximation, not included in systematic error of 0.12.

[20] ROLF 02 determines m_c from a quenched lattice calculation of the D_s mass. The error estimate is for all systematics except the quenched approximation, including lattice spacing effects, finite volume effects, excited states contamination, rounding errors, and the scale uncertainty. The authors estimate the uncertainty due to the quenched approximation may be about 3%.

[21] BRAMBILLA 01 determine $\overline{m}_c(\overline{m}_c)$ from a computation of the J/ψ mass.

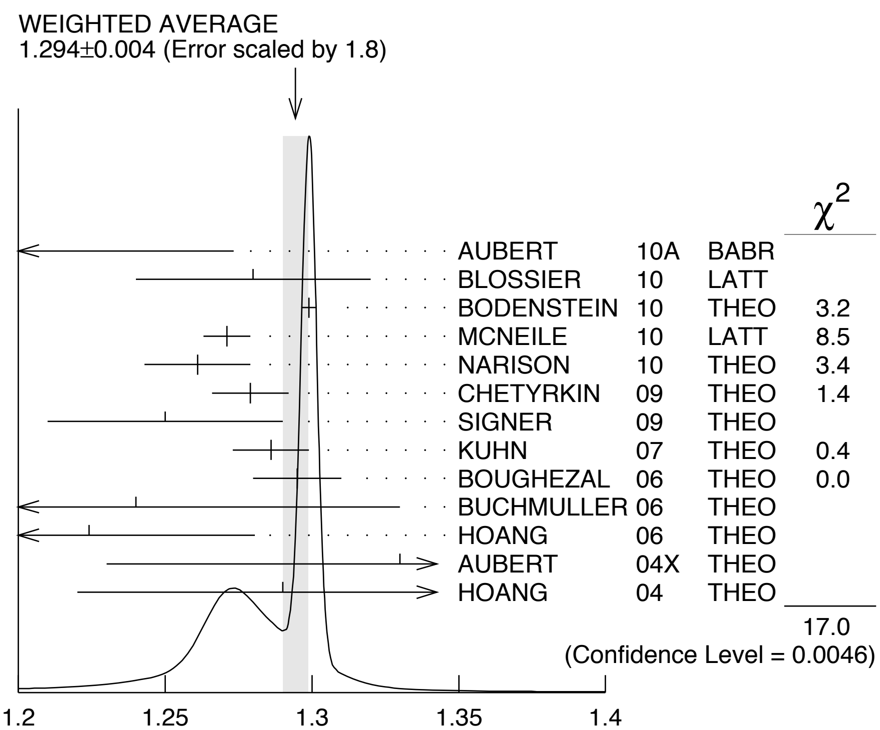
[22] EIDEMULLER 01 result is QCD sum rule analysis of charmonium using NRQCD at next-to-next-to-leading order.

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

[24] MARTIN 01 obtain a pole mass of 1.33–1.4 GeV from an analysis of R, the rate for $e^+ e^- \rightarrow$ hadrons. We have converted this to the $\overline{\text{MS}}$ scheme using the two-loop formula.

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

[26] PENARROCHA 01 result is from an analysis of the BES-II $e^+ e^-$ data using finite energy sum rules.
[27] PINEDA 01 uses the $\Upsilon(1S)$ system and the B-D mass difference to determine m_c. The errors are due to theory, and the uncertainty in λ_1 and m_b.
[28] Study of opposite sign dimuon events.
[29] VILAIN 99 obtain the charm quark mass from an analysis of charm production in neutrino scattering.



c-QUARK MASS (GeV)

$m_b - m_c$ QUARK MASS DIFFERENCE

VALUE (GeV)	*DOCUMENT ID*		*TECN*
3.38 to 3.48 OUR EVALUATION			
• • • We do not use the following data for averages, fits, limits, etc. • • •			
3.472±0.032	[30] AUBERT	10A	BABR
3.42 ±0.06	[31] ABDALLAH	06B	DLPH
3.44 ±0.03	[32] AUBERT	04X	BABR
3.41 ±0.01	[32] BAUER	04	THEO

[30] 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.
[31] ABDALLAH 06B determine $m_b - m_c$ from moments of the hadron invariant mass and lepton energy spectra in semileptonic inclusive B decays.
[32] Determine $m_b - m_c$ from a global fit to inclusive B decay spectra.

c-QUARK REFERENCES

AUBERT	10A	PR D81 032003	B. Aubert *et al.*	(BABAR Collab.)
BLOSSIER	10	PR D82 114513	B. Blossier *et al.*	(ETM Collab.)
BODENSTEIN	10	PR D82 114013	S. Bodenstein *et al.*	
MCNEILE	10	PR D82 034512	C. McNeile *et al.*	(HPQCD Collab.)
NARISON	10	PL B693 559	S. Narison	(MONP)
CHETYRKIN	09	PR D80 074010	K.G. Chetyrkin *et al.*	(KARL, BNL)
SIGNER	09	PL B672 333	A. Signer	(DURH)
ALLISON	08	PR D78 054513	I. Allison *et al.*	(HPQCD Collab.)
KUHN	07	NP B778 192	J.H. Kuhn, M. Steinhauser, C. Sturm	
ABDALLAH	06B	EPJ C45 35	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	
HOANG	06	PL B633 526	A.H. Hoang, A.V. Manohar	
AUBERT	04X	PRL 93 011803	B. Aubert *et al.*	(BABAR Collab.)
BAUER	04	PR D70 094017	C. Bauer *et al.*	
HOANG	04	PL B594 127	A.H. Hoang, M. Jamin	
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	
ZYABLYUK	03	JHEP 0301 081	K.N. Zyablyuk	(ITEP)
BECIREVIC	02	PL B524 115	D. Beciveric, V. Lubicz, G. Martinelli	
ROLF	02	JHEP 0212 007	J. Rolf, S. Sint	
BRAMBILLA	01	PL B513 381	N. Brambilla, Y. Sumino, A. Vairo	
EIDEMULLER	01	PL B498 203	M. Eidemueller, M. Jamin	
KUHN	01	NP B619 588	J.H. Kuhn, M. Steinhauser	
MARTIN	01	EPJ C19 681	A.D. Martin, J. Outhwaite, M.G. Ryskin	
NARISON	01B	PL B520 115	S. Narison	
PENARROCHA	01	PL B515 291	J. Penarrocha, K. Schilcher	
PINEDA	01	JHEP 0106 022	A. Pineda	
ASTIER	00D	PL B486 35	P. Astier *et al.*	(CERN NOMAD Collab.)
VILAIN	99	EPJ C11 19	P. Vilain *et al.*	(CHARM II Collab.)