# $\chi_{b0}(2P)$

$I^G(J^{PC}) = 0^+(0^{++})$
$J$ needs confirmation.

Observed in radiative decay of the $\Upsilon(3S)$, therefore $C = +$. Branching ratio requires E1 transition, M1 is strongly disfavored, therefore $P = +$.

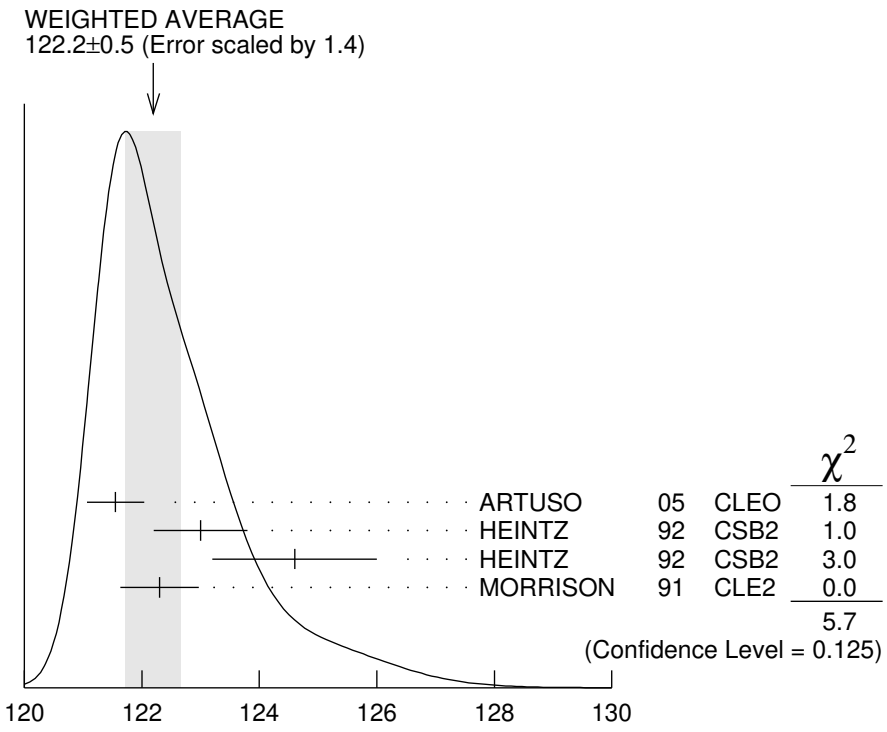
## $\chi_{b0}(2P)$ MASS

| VALUE (GeV) | DOCUMENT ID |
|---|---|
| **10.2325 ± 0.0004 ± 0.0005 OUR EVALUATION** | From $\gamma$ energy below, using $\Upsilon(3S)$ mass = 10355.2 ± 0.5 MeV |

## $\gamma$ ENERGY IN $\Upsilon(3S)$ DECAY

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **121.9 ±0.4 OUR EVALUATION** | | Treating systematic errors as correlated | | | |
| **122.2 ±0.5 OUR AVERAGE** | | Error includes scale factor of 1.4. See the ideogram below. | | | |
| 121.55 ± 0.16 ± 0.46 | | ARTUSO | 05 | CLEO | $\Upsilon(3S) \to \gamma X$ |
| 123.0 ±0.8 | 4959 | [1] HEINTZ | 92 | CSB2 | $e^+e^- \to \gamma X$ |
| 124.6 ±1.4 | 17 | [2] HEINTZ | 92 | CSB2 | $e^+e^- \to \ell^+\ell^-\gamma\gamma$ |
| 122.3 ±0.3 ±0.6 | 9903 | MORRISON | 91 | CLE2 | $e^+e^- \to \gamma X$ |

[1] A systematic uncertainty on the energy scale of 0.9% not included. Supersedes NARAIN 91.
[2] A systematic uncertainty on the energy scale of 0.9% not included. Supersedes HEINTZ 91.



## $\chi_{b0}(2P)$ DECAY MODES

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $\gamma\,\Upsilon(2S)$ | (4.6±2.1) % |
| $\Gamma_2$ | $\gamma\,\Upsilon(1S)$ | (9 ±6 ) × $10^{-3}$ |

## $\chi_{b0}(2P)$ BRANCHING RATIOS

### $\Gamma(\gamma\,\Upsilon(2S))/\Gamma_{total}$ $\Gamma_1/\Gamma$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.089** | 90 | [3] CRAWFORD | 92B | CLE2 | $e^+e^- \to \ell^+\ell^-\gamma\gamma$ |
| **0.046±0.020±0.007** | | [4] HEINTZ | 92 | CSB2 | $e^+e^- \to \ell^+\ell^-\gamma\gamma$ |

[3] Using B($\Upsilon(2S) \to \mu^+\mu^-$) = (1.37 ± 0.26)%, B($\Upsilon(3S) \to \gamma\gamma\,\Upsilon(2S)$)×2 B($\Upsilon(2S) \to \mu^+\mu^-$) < $1.19 \times 10^{-4}$, and B($\Upsilon(3S) \to \chi_{b0}(2P)\gamma$) = 0.049.

[4] Using B($\Upsilon(2S) \to \mu^+\mu^-$) = (1.44 ± 0.10)%, B($\Upsilon(3S) \to \gamma\chi_{b0}(2P)$) = (6.0 ± 0.4 ± 0.6)% and assuming $e\mu$ universality. Supersedes HEINTZ 91.

### $\Gamma(\gamma\,\Upsilon(1S))/\Gamma_{total}$ $\Gamma_2/\Gamma$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.025** | 90 | [5] CRAWFORD | 92B | CLE2 | $e^+e^- \to \ell^+\ell^-\gamma\gamma$ |
| **0.009±0.006±0.001** | | [6] HEINTZ | 92 | CSB2 | $e^+e^- \to \ell^+\ell^-\gamma\gamma$ |

[5] Using B($\Upsilon(1S) \to \mu^+\mu^-$) = (2.57 ± 0.07)%, B($\Upsilon(3S) \to \gamma\gamma\,\Upsilon(1S)$)×2 B($\Upsilon(1S) \to \mu^+\mu^-$) < $0.63 \times 10^{-4}$, and B($\Upsilon(3S) \to \chi_{b0}(2P)\gamma$) = 0.049.

[6] Using B($\Upsilon(1S) \to \mu^+\mu^-$) = (2.57 ± 0.07)%, B($\Upsilon(3S) \to \gamma\chi_{b0}(2P)$) = (6.0 ± 0.4 ± 0.6)% and assuming $e\mu$ universality. Supersedes HEINTZ 91.

## $\chi_{b0}(2P)$ REFERENCES


| | | | | |
|---|---|---|---|---|
| ARTUSO | 05 | PRL 94 032001 | M. Artuso *et al.* | (CLEO Collab.) |
| CRAWFORD | 92B | PL B294 139 | G. Crawford, R. Fulton | (CLEO Collab.) |
| HEINTZ | 92 | PR D46 1928 | U. Heintz *et al.* | (CUSB II Collab.) |
| HEINTZ | 91 | PRL 66 1563 | U. Heintz *et al.* | (CUSB Collab.) |
| MORRISON | 91 | PRL 67 1696 | R.J. Morrison *et al.* | (CLEO Collab.) |
| NARAIN | 91 | PRL 66 3113 | M. Narain *et al.* | (CUSB Collab.) |


### OTHER RELATED PAPERS


| | | | | |
|---|---|---|---|---|
| EIGEN | 82 | PRL 49 1616 | G. Eigen *et al.* | (CUSB Collab.) |
| HAN | 82 | PRL 49 1612 | K. Han *et al.* | (CUSB Collab.) |