

$\chi_{c0}(1P)$ 

$$J^{PC} = 0^{+}(0^{++})$$

 **$\chi_{c0}(1P)$  MASS**

| VALUE (MeV)                     | DOCUMENT ID            | TECN     | COMMENT                              |
|---------------------------------|------------------------|----------|--------------------------------------|
| <b>3417.3 ± 2.8 OUR AVERAGE</b> |                        |          |                                      |
| 3417.8 ± 0.4 ± 4                | <sup>1</sup> GAISER    | 86 CBAL  | $\psi(2S) \rightarrow \gamma X$      |
| 3422 ± 10                       | <sup>2</sup> BARTEL    | 78B CNTR | $e^+ e^- \rightarrow J/\psi 2\gamma$ |
| 3416 ± 3 ± 4                    | <sup>2</sup> TANENBAUM | 78 MRK1  | $e^+ e^-$                            |
| 3415 ± 9                        | <sup>2</sup> BIDDICK   | 77 CNTR  | $e^+ e^- \rightarrow \gamma X$       |

<sup>1</sup> Using mass of  $\psi(2S) = 3686.0$  MeV.<sup>2</sup> Mass value shifted by us by amount appropriate for  $\psi(2S)$  mass = 3686 MeV and  $J/\psi(1S)$  mass = 3097 MeV. **$\chi_{c0}(1P)$  WIDTH**

| VALUE (MeV)             | DOCUMENT ID | TECN    | COMMENT   |
|-------------------------|-------------|---------|---|
| <b>13.5 ± 3.3 ± 4.2</b> | GAISER      | 86 CBAL | $\psi(2S) \rightarrow \gamma X, \gamma \pi^0 \pi^0$ |

 **$\chi_{c0}(1P)$  DECAY MODES**

| Mode   | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|--|--------------------------------|------------------|
| <b>Hadronic decays</b>                         |                                |                  |
| $\Gamma_1$ $2(\pi^+ \pi^-)$                    | (3.7 ± 0.7) %                  |                  |
| $\Gamma_2$ $\pi^+ \pi^- K^+ K^-$               | (3.0 ± 0.7) %                  |                  |
| $\Gamma_3$ $\rho^0 \pi^+ \pi^-$                | (1.6 ± 0.5) %                  |                  |
| $\Gamma_4$ $3(\pi^+ \pi^-)$                    | (1.5 ± 0.5) %                  |                  |
| $\Gamma_5$ $K^+ \bar{K}^*(892)^0 \pi^- + c.c.$ | (1.2 ± 0.4) %                  |                  |
| $\Gamma_6$ $\pi^+ \pi^-$                       | $(7.5 \pm 2.1) \times 10^{-3}$ |                  |
| $\Gamma_7$ $K^+ K^-$                           | $(7.1 \pm 2.4) \times 10^{-3}$ |                  |
| $\Gamma_8$ $\pi^+ \pi^- p \bar{p}$             | $(5.0 \pm 2.0) \times 10^{-3}$ |                  |
| $\Gamma_9$ $\pi^0 \pi^0$                       |                                |                  |
| $\Gamma_{10}$ $\eta \eta$                      |                                |                  |
| $\Gamma_{11}$ $p \bar{p}$                      | < 9.0 × 10 <sup>-4</sup>       | 90%              |
| <b>Radiative decays</b>                        |                                |                  |
| $\Gamma_{12}$ $\gamma J/\psi(1S)$              | $(6.6 \pm 1.8) \times 10^{-3}$ |                  |
| $\Gamma_{13}$ $\gamma \gamma$                  | < 5 × 10 <sup>-4</sup>         | 95%              |

$\chi_{c0}(1P)$  PARTIAL WIDTHS

| $\Gamma(\gamma\gamma)$  |     |             |          |                                      | $\Gamma_{13}$ |
|---|-----|-------------|----------|--------------------------------------|---------------|
| VALUE (keV)   | CL% | DOCUMENT ID | TECN     | COMMENT                              |               |
| < 6.2   | 95  | CHEN        | 90B CLEO | $e^+e^- \rightarrow e^+e^-\chi_{c0}$ |               |
| 4.0±2.8   |     | LEE         | 85 CBAL  | $\psi' \rightarrow \text{photons}$   |               |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |          |                                      |               |
| <17   | 95  | AIHARA      | 88D TPC  | $e^+e^- \rightarrow e^+e^-\chi$      |               |

 $\chi_{c0}(1P)$  BRANCHING RATIOS

## HADRONIC DECAYS

| $\Gamma(2(\pi^+\pi^-))/\Gamma_{\text{total}}$                          |  |                            |      |  | $\Gamma_1/\Gamma$ |
|--|--|----------------------------|------|--|-------------------|
| VALUE  |  | DOCUMENT ID                | TECN | COMMENT                                |                   |
| 0.037±0.007  |  | <sup>3</sup> TANENBAUM 78  | MRK1 | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |                   |
| $\Gamma(\pi^+\pi^-K^+K^-)/\Gamma_{\text{total}}$                       |  |                            |      |  | $\Gamma_2/\Gamma$ |
| VALUE  |  | DOCUMENT ID                | TECN | COMMENT                                |                   |
| 0.030±0.007  |  | <sup>3</sup> TANENBAUM 78  | MRK1 | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |                   |
| $\Gamma(\rho^0\pi^+\pi^-)/\Gamma_{\text{total}}$                       |  |                            |      |  | $\Gamma_3/\Gamma$ |
| VALUE  |  | DOCUMENT ID                | TECN | COMMENT                                |                   |
| 0.016±0.005  |  | <sup>3</sup> TANENBAUM 78  | MRK1 | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |                   |
| $\Gamma(3(\pi^+\pi^-))/\Gamma_{\text{total}}$                          |  |                            |      |  | $\Gamma_4/\Gamma$ |
| VALUE  |  | DOCUMENT ID                | TECN | COMMENT                                |                   |
| 0.015±0.005  |  | <sup>3</sup> TANENBAUM 78  | MRK1 | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |                   |
| $\Gamma(K^+\bar{K}^*(892)^0\pi^- + \text{c.c.})/\Gamma_{\text{total}}$ |  |                            |      |  | $\Gamma_5/\Gamma$ |
| VALUE  |  | DOCUMENT ID                | TECN | COMMENT                                |                   |
| 0.012±0.004  |  | <sup>3</sup> TANENBAUM 78  | MRK1 | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |                   |
| $\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$                             |  |                            |      |  | $\Gamma_6/\Gamma$ |
| VALUE (units $10^{-4}$ )   |  | DOCUMENT ID                | TECN | COMMENT                                |                   |
| 75±21 OUR AVERAGE  |  |                            |      |  |                   |
| 70±30  |  | <sup>3</sup> BRANDELIK 79B | DASP | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |                   |
| 80±30  |  | <sup>3</sup> TANENBAUM 78  | MRK1 | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |                   |
| $\Gamma(K^+K^-)/\Gamma_{\text{total}}$                                 |  |                            |      |  | $\Gamma_7/\Gamma$ |
| VALUE (units $10^{-4}$ )   |  | DOCUMENT ID                | TECN | COMMENT                                |                   |
| 71±24 OUR AVERAGE  |  |                            |      |  |                   |
| 60±30  |  | <sup>3</sup> BRANDELIK 79B | DASP | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |                   |
| 90±40  |  | <sup>3</sup> TANENBAUM 78  | MRK1 | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |                   |
| $\Gamma(\pi^+\pi^-\rho\bar{\rho})/\Gamma_{\text{total}}$               |  |                            |      |  | $\Gamma_8/\Gamma$ |
| VALUE  |  | DOCUMENT ID                | TECN | COMMENT                                |                   |
| 0.005 ±0.002   |  | <sup>3</sup> TANENBAUM 78  | MRK1 | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |                   |

$\Gamma(\pi^0\pi^0)/\Gamma_{\text{total}}$   $\Gamma_9/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |                  |    |                                  |
|-------------|------------------|----|----------------------------------|
| 3.1±0.4±0.5 | <sup>4</sup> LEE | 85 | CBAL $\psi' \rightarrow$ photons |
|-------------|------------------|----|----------------------------------|

 $\Gamma(\eta\eta)/\Gamma_{\text{total}}$   $\Gamma_{10}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |                  |    |                                  |
|-------------|------------------|----|----------------------------------|
| 2.5±0.8±0.8 | <sup>4</sup> LEE | 85 | CBAL $\psi' \rightarrow$ photons |
|-------------|------------------|----|----------------------------------|

 $\Gamma(\rho\bar{\rho})/\Gamma_{\text{total}}$   $\Gamma_{11}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|                |    |                        |     |   |
|----------------|----|------------------------|-----|---|
| <b>&lt;9.0</b> | 90 | <sup>3</sup> BRANDELIK | 79B | DASP $\psi(2S) \rightarrow \gamma\chi_{c0}$ |
|----------------|----|------------------------|-----|---|

<sup>3</sup> Calculated using  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 0.094$ ; the errors do not contain the uncertainty in the  $\psi(2S)$  decay.

<sup>4</sup> Calculated using  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 0.093 \pm 0.008$ .

### ————— RADIATIVE DECAYS —————

 $\Gamma(\gamma J/\psi(1S))/\Gamma_{\text{total}}$   $\Gamma_{12}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**66± 18 OUR AVERAGE**

|         |                        |     |   |
|---------|------------------------|-----|---|
| 60± 18  | GAISER                 | 86  | CBAL $\psi(2S) \rightarrow \gamma\chi_{c0}$ |
| 320±210 | <sup>5</sup> BRANDELIK | 79B | DASP $\psi(2S) \rightarrow \gamma\chi_{c0}$ |
| 150±100 | <sup>5</sup> BARTEL    | 78B | CNTR $\psi(2S) \rightarrow \gamma\chi_{c0}$ |
| 210±210 | <sup>5</sup> TANENBAUM | 78  | MRK1 $\psi(2S) \rightarrow \gamma\chi_{c0}$ |

 $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{13}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |                  |    |                                  |
|-------------|------------------|----|----------------------------------|
| 4.0±2.0±1.1 | <sup>4</sup> LEE | 85 | CBAL $\psi' \rightarrow$ photons |
|-------------|------------------|----|----------------------------------|

<sup>5</sup> Calculated using  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 0.094$ ; the errors do not contain the uncertainty in the  $\psi(2S)$  decay.

### ————— $\chi_{c0}(1P)$ REFERENCES —————

|           |     |               |                                      |                                     |
|-----------|-----|---------------|--------------------------------------|-------------------------------------|
| CHEN      | 90B | PL B243 169   | +McIlwain+                           | (CLEO Collab.)                      |
| AIHARA    | 88D | PRL 60 2355   | +Alston-Garnjost+                    | (TPC Collab.)                       |
| GAISER    | 86  | PR D34 711    | +Bloom, Bulos, Godfrey+              | (Crystal Ball Collab.)              |
| LEE       | 85  | SLAC 282      |                                      | (SLAC)                              |
| BRANDELIK | 79B | NP B160 426   | +Cords+                              | (DASP Collab.)                      |
| BARTEL    | 78B | PL 79B 492    | +Dittmann, Duinker, Olsson, O'Neill+ | (DESY, HEIDP)                       |
| TANENBAUM | 78  | PR D17 1731   | +Alam, Boyarski+                     | (SLAC, LBL)                         |
| Also      | 82  | Private Comm. | Trilling                             | (LBL, UCB)                          |
| BIDDICK   | 77  | PRL 38 1324   | +Burnett+                            | (UCSD, UMD, PAVI, PRIN, SLAC, STAN) |

### ————— OTHER RELATED PAPERS —————

|           |     |             |                                  |                               |
|-----------|-----|-------------|----------------------------------|-------------------------------|
| OREGLIA   | 82  | PR D25 2259 | +Partridge+                      | (SLAC, CIT, HARV, PRIN, STAN) |
| FELDMAN   | 75B | PRL 35 821  | +Jean-Marie, Sadoulet, Vannucci+ | (LBL, SLAC)                   |
| Also      | 75C | PRL 35 1189 | Feldman                          |                               |
| Erratum.  |     |             |                                  |                               |
| TANENBAUM | 75  | PRL 35 1323 | +Whitaker, Abrams+               | (LBL, SLAC)                   |