# $D_1(2420)^0$

$I(J^P) = \frac{1}{2}(1^+)$
$I$, $J$, $P$ need confirmation.

Seen in $D^*(2010)^+\pi^-$. $J^P = 1^+$ according to ALBRECHT 89H.

## $D_1(2420)^0$ MASS

The fit includes $D^\pm$, $D^0$, $D_s^\pm$, $D^{*\pm}$, $D^{*0}$, $D_s^{*\pm}$, $D_1(2420)^0$, $D_2^*(2460)^0$, and $D_{s1}(2536)^\pm$ mass and mass difference measurements.

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **2422.0±0.6 OUR FIT** | | | | | |
| **2422.3±1.3 OUR AVERAGE** | Error includes scale factor of 1.2. | | | | |
| 2426 ±3 ±1 | 151 | ABE | 05A | BELL | $B^- \to D^0\pi^+\pi^-\pi^-$ |
| 2421.4±1.5±0.9 | | [1] ABE | 04D | BELL | $B^- \to D^{*+}\pi^-\pi^-$ |
| 2421 $^{+1}_{-2}$ ±2 | 286 | AVERY | 94C | CLE2 | $e^+e^- \to D^{*+}\pi^-$X |
| 2422 ±2 ±2 | 51 | FRABETTI | 94B | E687 | $\gamma$Be $\to D^{*+}\pi^-$X |
| 2428 ±3 ±2 | 279 | AVERY | 90 | CLEO | $e^+e^- \to D^{*+}\pi^-$X |
| 2414 ±2 ±5 | 171 | ALBRECHT | 89H | ARG | $e^+e^- \to D^{*+}\pi^-$X |
| 2428 ±8 ±5 | 171 | ANJOS | 89C | TPS | $\gamma N \to D^{*+}\pi^-$X |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 2420.5±2.1±0.9 | 3110±340 | [2] CHEKANOV | 09 | ZEUS | $e^\pm p \to D^{*+}\pi^-X$ |
| 2421.7±0.7±0.6 | 7.5k | ABULENCIA | 06A | CDF | 1900 $p\overline{p} \to D^{*+}\pi^-X$ |
| 2425 ±3 | 235 | [3] ABREU | 98M | DLPH | $e^+e^-$ |

[1] Fit includes the contribution from $D_1^*(2430)^0$.

[2] Calculated using the mass difference $m(D_1^0) - m(D^{*+})_{PDG}$ reported below and $m(D^{*+})_{PDG}$ = 2010.27 ± 0.17 MeV. The 0.17 MeV uncertainty of the PDG mass value should be added to the experimental uncertainty of 0.9 MeV.

[3] No systematic error given.

## $m_{D_1^0} - m_{D^{*+}}$

The fit includes $D^\pm$, $D^0$, $D_s^\pm$, $D^{*\pm}$, $D^{*0}$, $D_s^{*\pm}$, $D_1(2420)^0$, $D_2^*(2460)^0$, and $D_{s1}(2536)^\pm$ mass and mass difference measurements.

| *VALUE* | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **411.7±0.6 OUR FIT** | | | | | |
| **411.5±0.8 OUR AVERAGE** | | | | | |
| 410.2±2.1±0.9 | 3110±340 | CHEKANOV | 09 | ZEUS | $e^\pm p \to D^{*+}\pi^-X$ |
| 411.7±0.7±0.4 | 7.5k | ABULENCIA | 06A | CDF | 1900 $p\overline{p} \to D^{*+}\pi^-X$ |

## $D_1(2420)^0$ WIDTH

| *VALUE* (MeV) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **20.4± 1.7 OUR AVERAGE** | | | | | |
| 20.0± 1.7± 1.3 | 7.5k | ABULENCIA | 06A | CDF | 1900 $p\overline{p} \to D^{*+}\pi^-X$ |
| 24 ± 7 ± 8 | 151 | ABE | 05A | BELL | $B^- \to D^0\pi^+\pi^-\pi^-$ |
| 23.7± 2.7± 4.0 | | [4] ABE | 04D | BELL | $B^- \to D^{*+}\pi^-\pi^-$ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 20 | $^{+\ 6}_{-\ 5}$ | ± 3 | 286 | AVERY | 94C | CLE2 | $e^+e^- \rightarrow D^{*+}\pi^-X$ |
| 15 | ± 8 | ± 4 | 51 | FRABETTI | 94B | E687 | $\gamma$Be $\rightarrow D^{*+}\pi^-X$ |
| 23 | $^{+\ 8}_{-\ 6}$ | $^{+10}_{-\ 3}$ | 279 | AVERY | 90 | CLEO | $e^+e^- \rightarrow D^{*+}\pi^-X$ |
| 13 | ± 6 | $^{+10}_{-\ 5}$ | 171 | ALBRECHT | 89H | ARG | $e^+e^- \rightarrow D^{*+}\pi^-X$ |

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

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 53.2± 7.2 | $^{+\ 3.3}_{-\ 4.9}$ | 3110 ± 340 | | CHEKANOV | 09 | ZEUS | $e^\pm p \rightarrow D^{*+}\pi^-X$ |
| 58 | ±14 | ±10 | 171 | ANJOS | 89C | TPS | $\gamma N \rightarrow D^{*+}\pi^-X$ |

[4] Fit includes the contribution from $D_1^*(2430)^0$.

## $D_1(2420)^0$ DECAY MODES

$\overline{D}_1(2420)^0$ modes are charge conjugates of modes below.

| | Mode | Fraction ($\Gamma_i/\Gamma$) |
|---|---|---|
| $\Gamma_1$ | $D^*(2010)^+\pi^-$ | seen |
| $\Gamma_2$ | $D^0\pi^+\pi^-$ | seen |
| $\Gamma_3$ | $D^0\rho^0$ | |
| $\Gamma_4$ | $D^0 f_0(600)$ | |
| $\Gamma_5$ | $D_0^*(2400)^+\pi^-$ | |
| $\Gamma_6$ | $D^+\pi^-$ | not seen |
| $\Gamma_7$ | $D^{*0}\pi^+\pi^-$ | not seen |

## $D_1(2420)^0$ BRANCHING RATIOS

### $\Gamma(D^*(2010)^+\pi^-)/\Gamma_{total}$ $\Gamma_1/\Gamma$

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **seen** | ACKERSTAFF | 97W | OPAL | $e^+e^- \rightarrow D^{*+}\pi^-X$ |
| **seen** | AVERY | 90 | CLEO | $e^+e^- \rightarrow D^{*+}\pi^-X$ |
| **seen** | ALBRECHT | 89H | ARG | $e^+e^- \rightarrow D^*\pi^-X$ |
| **seen** | ANJOS | 89C | TPS | $\gamma N \rightarrow D^{*+}\pi^-X$ |

### $\Gamma(D^+\pi^-)/\Gamma(D^*(2010)^+\pi^-)$ $\Gamma_6/\Gamma_1$

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.24** | 90 | AVERY | 90 | CLEO | $e^+e^- \rightarrow D^+\pi^-X$ |

## $D_1(2420)^0$ POLARIZATION AMPLITUDE $A_{D_1}$

A polarization amplitude $A_{D_1}$ is a parameter that depends on the initial polarization of the $D_1$ and is sensitive to a possible $S$-wave contribution to its decay. For $D_1$ decays the helicity angle, $\theta_h$, distribution varies like $1 + A_{D_1}\cos^2\theta_h$, where $\theta_h$ is the angle in the $D^*$ rest frame between the two pions emitted by the $D_1 \rightarrow D^*\pi$ and the $D^* \rightarrow D\pi$.

Unpolarized $D_1$ decaying purely via $D$-wave is predicted to give $A_{D_1} = 3$.

| *VALUE* | *DOCUMENT ID* | *TECN* | *COMMENT* |
|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| $3.8 \pm 0.6 \pm 0.8$ | [5] AUBERT | 09Y BABR | $B^+ \to D_1^0 \ell^+ \nu_\ell$ |

[5] Assuming $\Gamma(\Upsilon(4S) \to B^+ B^-) / \Gamma(\Upsilon(4S) \to B^0 \overline{B}^0) = 1.065 \pm 0.026$ and equal partial widths and helicity angle distributions for charged and neutral $D_1$ mesons.

## $D_1(2420)^0$ REFERENCES


| | | | | |
|---|---|---|---|---|
| AUBERT | 09Y | PRL 103 051803 | B. Aubert *et al.* | (BABAR Collab.) |
| CHEKANOV | 09 | EPJ C60 25 | S. Chekanov *et al.* | (ZEUS Collab.) |
| ABULENCIA | 06A | PR D73 051104 | A. Abulencia *et al.* | (CDF Collab.) |
| ABE | 05A | PRL 94 221805 | K. Abe *et al.* | (BELLE Collab.) |
| ABE | 04D | PR D69 112002 | K. Abe *et al.* | (BELLE Collab.) |
| ABREU | 98M | PL B426 231 | P. Abreu *et al.* | (DELPHI Collab.) |
| ACKERSTAFF | 97W | ZPHY C76 425 | K. Ackerstaff *et al.* | (OPAL Collab.) |
| AVERY | 94C | PL B331 236 | P. Avery *et al.* | (CLEO Collab.) |
| FRABETTI | 94B | PRL 72 324 | P.L. Frabetti *et al.* | (FNAL E687 Collab.) |
| AVERY | 90 | PR D41 774 | P. Avery, D. Besson | (CLEO Collab.) |
| ALBRECHT | 89H | PL B232 398 | H. Albrecht *et al.* | (ARGUS Collab.) JP |
| ANJOS | 89C | PRL 62 1717 | J.C. Anjos *et al.* | (FNAL E691 Collab.) |