NODE=M121

# $D_{s1}(2536)^{\pm}$

$I(J^P) = 0(1^+)$
$J$, $P$ need confirmation.

Seen in $D^*(2010)^+ K^0$, $D^*(2007)^0 K^+$, and $D_s^+ \pi^+ \pi^-$. Not seen in $D^+ K^0$ or $D^0 K^+$. $J^P = 1^+$ assignment strongly favored.

NODE=M121

## $D_{s1}(2536)^{\pm}$ MASS

NODE=M121M

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.

NODE=M121M

NODE=M121M
NEW

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **2535.12±0.06 OUR FIT** | | | | | |
| [2535.11 ± 0.06 MeV OUR 2025 FIT] | | | | | |
| **2535.21±0.28 OUR AVERAGE** | | | | | |
| 2537.7 ±0.5 ±3.1 | 24 | [1] ABLIKIM | 19P | BES3 | 4.6 $e^+ e^- \to D_s^+ \overline{D}^0 K^-$ |
| 2535.7 ±0.6 ±0.5 | 46 | [2] ABAZOV | 09G | D0 | $B_s^0 \to D_{s1}^- \mu^+ \nu_\mu X$ |
| 2534.78±0.31±0.40 | 182 | AUBERT | 08B | BABR | $B \to \overline{D}^{(*)} D^* K$ |
| 2534.6 ±0.3 ±0.7 | 193 | AUBERT | 06P | BABR | 10.6 $e^+ e^- \to D_s^+ \pi^+ \pi^- X$ |
| 2535.3 ±0.7 | 92 | [3] HEISTER | 02B | ALEP | $e^+ e^- \to D^{*+} K^0 X$, $D^{*0} K^+ X$ |
| 2534.2 ±1.2 | 9 | ASRATYAN | 94 | BEBC | $\nu N \to D^* K^0 X, D^{*0} K^{\pm} X$ |
| 2535 ±0.6 ±1 | 75 | FRABETTI | 94B | E687 | $\gamma \mathrm{Be} \to D^{*+} K^0 X$, $D^{*0} K^+ X$ |
| 2535.2 ±0.5 ±1.5 | 28 | ALBRECHT | 92R | ARG | 10.4 $e^+ e^- \to D^{*0} K^+ X$ |
| 2536.6 ±0.7 ±0.4 | | AVERY | 90 | CLEO | $e^+ e^- \to D^{*+} K^0 X$ |
| 2535.9 ±0.6 ±2.0 | | ALBRECHT | 89E | ARG | $D_{s1}^* \to D^*(2010) K^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| 2534.1 ±0.6 | 116 | [4] AUSHEV | 11 | BELL | $B \to D_{s1}(2536)^+ D^{(*)}$ |
| 2535.08±0.01±0.15 | 8038 | [5] LEES | 11B | BABR | 10.6 $e^+ e^- \to D^{*+} K_S^0 X$ |
| $2535.57^{+0.44}_{-0.41}$±0.10 | 236 | [6] CHEKANOV | 09 | ZEUS | $e^{\pm} p \to D^{*+} K_S^0 X$, $D^{*0} K^+ X$ |
| 2535.3 ±0.2 ±0.5 | 134 | [7] ALEXANDER | 93 | CLE2 | $e^+ e^- \to D^{*0} K^+ X$ |
| 2534.8 ±0.6 ±0.6 | 44 | [8] ALEXANDER | 93 | CLE2 | $e^+ e^- \to D^{*+} K^0 X$ |
| 2535 ± 28 | | [9] ASRATYAN | 88 | HLBC | $\nu N \to D_s \gamma\gamma X$ |

OCCUR=2

[1] From a fit of the $D_s^+$ recoil mass distribution with an incoherent sum of the $S$-wave and $D$-wave Breit-Wigner line shapes. NODE=M121M;LINKAGE=D

[2] Using the $D^*(2010)^{\pm}$ mass of 2010.0 ± 0.4 MeV from PDG 06. NODE=M121M;LINKAGE=AB

[3] Calculated using $m(D^*(2010)^{\pm}) = 2010.0 \pm 0.5$ MeV, $m(D^*(2007)^0) = 2006.7 \pm 0.5$ MeV, and the mass difference below. NODE=M121M;LINKAGE=HI

[4] Systematic uncertainties not evaluated. NODE=M121M;LINKAGE=AU

[5] Calculated using the mass difference $m(D_{s1}^+) - m(D^{*+})_{PDG}$ below and $m(D^{*+})_{PDG} = 2010.25 \pm 0.14$ MeV. Assuming $S$-wave decay of the $D_{s1}(2536)$ to $D^{*+} K_S^0$, using a Breit-Wigner line shape corresponding to L=0. NODE=M121M;LINKAGE=LE

[6] Calculated using the mass difference $m(D_{s1}^+) - m(D^{*+})_{PDG}$ reported below and $m(D^{*+})_{PDG} = 2010.27 \pm 0.17$ MeV. NODE=M121M;LINKAGE=CH

[7] Calculated using $m(D^*(2007)^0)$=2006.6 ± 0.5 MeV and the mass difference below. NODE=M121M;LINKAGE=A

[8] Calculated using $m(D^*(2010)^{\pm})$=2010.1 ± 0.6 MeV and the mass difference below. NODE=M121M;LINKAGE=C

[9] Not seen in $D^* K$. NODE=M121M;LINKAGE=B

## $m_{D_{s1}(2536)^{\pm}} - m_{D_s^*(2111)}$

NODE=M121DM

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.

NODE=M121DM

NODE=M121DM

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **422.9± 0.4 OUR FIT** | | | | |
| **424 ±28** | ASRATYAN | 88 | HLBC | $D_s^{*\pm} \gamma$ |

## $m_{D_{s1}(2536)^{\pm}} - m_{D^*(2010)^{\pm}}$

NODE=M121DN

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. NODE=M121DN

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT | |
|---|---|---|---|---|---|---|
| **524.85±0.04 OUR FIT** | | | | | | |
| **524.84±0.04 OUR AVERAGE** | | | | | | NODE=M121DN |
| 524.83±0.01±0.04 | 8038 | [10] LEES | 11B | BABR | 10.6 $e^+e^- \to D^{*+}K_S^0X$ | |
| $525.30^{+0.44}_{-0.41}$±0.10 | 236 ± 30 | CHEKANOV | 09 | ZEUS | $e^{\pm}p \to D^{*+}K_S^0X$, $D^{*0}K^+X$ | |
| 525.3 ±0.6 ±0.1 | 41 | HEISTER | 02B | ALEP | $e^+e^- \to D^{*+}K^0X$ | |
| 524.7 ±0.6 ±0.2 | 44 | ALEXANDER | 93 | CLE2 | $e^+e^- \to D^{*+}K_S^0X$ | OCCUR=2 |

[10] Assuming S-wave decay of the $D_{s1}(2536)$ to $D^{*+}K_S^0$, using a Breit-Wigner line shape corresponding to L=0. NODE=M121DN;LINKAGE=LE

## $m_{D_{s1}(2536)^{\pm}} - m_{D^*(2007)^0}$ NODE=M121DP

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. NODE=M121DP

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT | |
|---|---|---|---|---|---|---|
| **528.26±0.05 OUR FIT** Error includes scale factor of 1.1. | | | | | | NODE=M121DP |
| **528.68±0.28 OUR AVERAGE** | | | | | | |
| 528.7 ±1.9 ±0.5 | 51 | HEISTER | 02B | ALEP | $e^+e^- \to D^{*0}K^+X$ | |
| 527.3 ±2.2 | 29 | ACKERSTAFF | 97W | OPAL | $e^+e^- \to D^{*0}K^+X$ | |
| 528.7 ±0.2 ±0.2 | 134 | ALEXANDER | 93 | CLE2 | $e^+e^- \to D^{*0}K^+X$ | OCCUR=2 |

## $D_{s1}(2536)^{\pm}$ WIDTH NODE=M121W

| VALUE (MeV) | CL% | EVTS | DOCUMENT ID | | TECN | COMMENT | |
|---|---|---|---|---|---|---|---|
| **0.92±0.05 OUR AVERAGE** | | | | | | | NODE=M121W |
| 1.7 ±1.2 ±0.6 | | 24 | [11] ABLIKIM | 19P | BES3 | 4.6 $e^+e^- \to D_s^+\overline{D}^0K^-$ | |
| 0.92±0.03±0.04 | | 8038 | [12] LEES | 11B | BABR | 10.6 $e^+e^- \to D^{*+}K_S^0X$ | |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | | | |
| 0.75±0.23 | | 116 | [13] AUSHEV | 11 | BELL | $B \to D_{s1}(2536)^+D^{(*)}$ | |
| < 2.5 | 95 | 193 | AUBERT | 06P | BABR | 10.6 $e^+e^- \to D_s^+\pi^+\pi^-X$ | |
| < 3.2 | 90 | 75 | FRABETTI | 94B | E687 | $\gamma$Be $\to D^{*+}K^0X$, $D^{*0}K^+X$ | |
| < 2.3 | 90 | | ALEXANDER | 93 | CLEO | $e^+e^- \to D^{*0}K^+X$ | |
| < 3.9 | 90 | | ALBRECHT | 92R | ARG | 10.4 $e^+e^- \to D^{*0}K^+X$ | |
| < 5.44 | 90 | | AVERY | 90 | CLEO | $e^+e^- \to D^{*+}K^0X$ | |
| < 4.6 | 90 | | ALBRECHT | 89E | ARG | $D_{s1}^* \to D^*(2010)K^0$ | |

[11] From a fit of the $D_s^+$ recoil mass distribution with an incoherent sum of the S-wave and S-wave Breit-Wigner line shapes. NODE=M121W;LINKAGE=A

[12] Assuming S-wave decay of the $D_{s1}(2536)$ to $D^{*+}K_S^0$, using a Breit-Wigner line shape corresponding to L=0. NODE=M121W;LINKAGE=LE

[13] Systematic uncertainties not evaluated. NODE=M121W;LINKAGE=AU

## $D_{s1}(2536)^+$ DECAY MODES NODE=M121215;NODE=M121

Branching fractions are given relative to the one **DEFINED AS 1**. $D_{s1}(2536)^-$ modes are charge conjugates of the modes below. NODE=M121

| | Mode | Fraction ($\Gamma_i/\Gamma$) | Confidence level | |
|---|---|---|---|---|
| $\Gamma_1$ | $D^*(2010)^+K^0$ | (31 ±7 ) % | | DESIG=1 |
| $\Gamma_2$ | $(D^*(2010)^+K^0)_{S-wave}$ | (22 ±5 ) % | | DESIG=7 |
| $\Gamma_3$ | $(D^*(2010)^+K^0)_{D-wave}$ | | | DESIG=9 |
| $\Gamma_4$ | $K_S^0D^*(2010)^+$ | (17 ±4 ) % | | DESIG=10 |
| $\Gamma_5$ | $D^+\pi^-K^+$ | $(10.0\pm2.5)\times10^{-3}$ | | DESIG=8 |
| $\Gamma_6$ | $D^*(2007)^0K^+$ | (36 ±6 ) % | | DESIG=4 |
| $\Gamma_7$ | $D^+K^0$ | < 12 % | 90% | DESIG=2 |
| $\Gamma_8$ | $D^0K^+$ | < 4 % | 90% | DESIG=5 |
| $\Gamma_9$ | $D_s^{*+}\gamma$ | possibly seen | | DESIG=3 |
| $\Gamma_{10}$ | $D_s^+\pi^+\pi^-$ | seen | | DESIG=6 |

## $D_{s1}(2536)^+$ BRANCHING RATIOS

NODE=M121220

### $\Gamma((D^*(2010)^+ K^0)_{S-wave})/\Gamma(D^*(2010)^+ K^0)$ — $\Gamma_2/\Gamma_1$

NODE=M121R8

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **0.72±0.05±0.01** | 5485 | BALAGURA | 08 | BELL | 10.6 $e^+ e^- \to D^{*+} K^0 X$ |

### $\Gamma(K^0_S D^*(2010)^+)/\Gamma(D^*(2007)^0 K^+)$ — $\Gamma_4/\Gamma_6$

NODE=M121R00

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **0.48±0.07±0.02** | GAO | 23 | BELL | $e^+ e^-$ at 10.52 GeV |

### $\Gamma(D^+ \pi^- K^+)/\Gamma(D^*(2010)^+ K^0)$ — $\Gamma_5/\Gamma_1$

NODE=M121R9

| VALUE (units $10^{-2}$) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **3.27±0.18±0.37** | 1264 | BALAGURA | 08 | BELL | 10.6 $e^+ e^- \to D^+ \pi^- K^+ X$ |

### $\Gamma(D^*(2007)^0 K^+)/\Gamma_{total}$ — $\Gamma_6/\Gamma$

NODE=M121R01

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **35.9±4.8±3.5** | [14] ABLIKIM | 24BN | BES3 | $e^+ e^- \to D_s^+ D_{s1}(2536)^-$ |

[14] Determined as ratio of exclusive $e^+ e^- \to D_s^+ [\overline{D}^{*0} K^-]$ and inclusive $e^+ e^- \to D_s^+ X$ measurements.

NODE=M121R01;LINKAGE=A

### $\Gamma(D^*(2007)^0 K^+)/\Gamma(D^*(2010)^+ K^0)$ — $\Gamma_6/\Gamma_1$

NODE=M121R6

| VALUE | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **1.18±0.16 OUR AVERAGE** | | | | | |
| 0.88±0.24±0.08 | 116 | AUSHEV | 11 | BELL | $B \to D_{s1}(2536)^+ D^{(*)}$ |
| 2.3 ±0.6 ±0.3 | 236 ± 30 | CHEKANOV | 09 | ZEUS | $e^\pm p \to D^{*+} K^0_S X$, $D^{*0} K^+ X$ |
| 1.32±0.47±0.23 | 92 | [15] HEISTER | 02B | ALEP | $e^+ e^- \to D^{*+} K^0 X$, $D^{*0} K^+ X$ |
| 1.9 $^{+1.1}_{-0.9}$ ±0.4 | 35 | [15] ACKERSTAFF | 97W | OPAL | $e^+ e^- \to D^{*0} K^+ X$, $D^{*+} K^0 X$ |
| 1.1 ±0.3 | | ALEXANDER | 93 | CLEO | $e^+ e^- \to D^{*0} K^+ X$, $D^{*+} K^0 X$ |
| 1.4 ±0.3 ±0.2 | | [16] ALBRECHT | 92R | ARG | 10.4 $e^+ e^- \to D^{*0} K^+ X$, $D^{*+} K^0 X$ |

[15] Ratio of the production rates measured in $Z^0$ decays.
[16] Evaluated by us from published inclusive cross-sections.

NODE=M121R6;LINKAGE=6A
NODE=M121R6;LINKAGE=A

### $\Gamma(D^+ K^0)/\Gamma(D^*(2010)^+ K^0)$ — $\Gamma_7/\Gamma_1$

NODE=M121R1

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.40** | 90 | ALEXANDER | 93 | CLEO | $e^+ e^- \to D^{*+} K^0 X$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <0.43 | 90 | ALBRECHT | 89E | ARG | $D^*_{s1} \to D^*(2010) K^0$ |

### $\Gamma(D^0 K^+)/\Gamma(D^*(2007)^0 K^+)$ — $\Gamma_8/\Gamma_6$

NODE=M121R4

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.12** | 90 | ALEXANDER | 93 | CLEO | $e^+ e^- \to D^{*0} K^+ X$ |

### $\Gamma(D_s^{*+} \gamma)/\Gamma_{total}$ — $\Gamma_9/\Gamma$

NODE=M121R3

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **possibly seen** | ASRATYAN | 88 | HLBC | $\nu N \to D_s \gamma\gamma X$ |

### $\Gamma(D_s^{*+} \gamma)/\Gamma(D^*(2007)^0 K^+)$ — $\Gamma_9/\Gamma_6$

NODE=M121R5

| VALUE | CL% | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **<0.42** | 90 | ALEXANDER | 93 | CLEO | $e^+ e^- \to D^{*0} K^+ X$ |

### $\Gamma(D_s^+ \pi^+ \pi^-)/\Gamma_{total}$ — $\Gamma_{10}/\Gamma$

NODE=M121R7

| VALUE | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **seen** | AUBERT | 06P | BABR | 10.6 $e^+ e^- \to D_s^+ \pi^+ \pi^- X$ |

# $D_{s1}(2536)^{\pm}$ REFERENCES

NODE=M121


| | | | | | |
|---|---|---|---|---|---|
| ABLIKIM | 24BN | PRL 133 171903 | M. Ablikim *et al.* | (BESIII Collab.) | REFID=63015 |
| GAO | 23 | PR D108 112015 | B.S. Gao *et al.* | (BELLE Collab.) | REFID=62519 |
| ABLIKIM | 19P | CP C43 031001 | M. Ablikim *et al.* | (BESIII Collab.) | REFID=59617 |
| AUSHEV | 11 | PR D83 051102 | T. Aushev *et al.* | (BELLE Collab.) | REFID=16505 |
| LEES | 11B | PR D83 072003 | J.P. Lees *et al.* | (BABAR Collab.) | REFID=16773 |
| ABAZOV | 09G | PRL 102 051801 | V.M. Abazov *et al.* | (D0 Collab.) | REFID=52652 |
| CHEKANOV | 09 | EPJ C60 25 | S. Chekanov *et al.* | (ZEUS Collab.) | REFID=52733 |
| AUBERT | 08B | PR D77 011102 | B. Aubert *et al.* | (BABAR Collab.) | REFID=52120 |
| BALAGURA | 08 | PR D77 032001 | V. Balagura *et al.* | (BELLE Collab.) | REFID=52133 |
| AUBERT | 06P | PR D74 032007 | B. Aubert *et al.* | (BABAR Collab.) | REFID=51144 |
| PDG | 06 | JP G33 1 | W.-M. Yao *et al.* | (PDG Collab.) | REFID=51004 |
| HEISTER | 02B | PL B526 34 | A. Heister *et al.* | (ALEPH Collab.) | REFID=48562 |
| ACKERSTAFF | 97W | ZPHY C76 425 | K. Ackerstaff *et al.* | (OPAL Collab.) | REFID=45788 |
| ASRATYAN | 94 | ZPHY C61 563 | A.E. Asratyan *et al.* | (BIRM, BELG, CERN+) | REFID=43667 |
| FRABETTI | 94B | PRL 72 324 | P.L. Frabetti *et al.* | (FNAL E687 Collab.) | REFID=43687 |
| ALEXANDER | 93 | PL B303 377 | J. Alexander *et al.* | (CLEO Collab.) | REFID=43316 |
| ALBRECHT | 92R | PL B297 425 | H. Albrecht *et al.* | (ARGUS Collab.) | REFID=43179 |
| AVERY | 90 | PR D41 774 | P. Avery, D. Besson | (CLEO Collab.) | REFID=41013 |
| ALBRECHT | 89E | PL B230 162 | H. Albrecht *et al.* | (ARGUS Collab.) | REFID=40914 |
| ASRATYAN | 88 | ZPHY C40 483 | A.E. Asratyan *et al.* | (ITEP, SERP) | REFID=40916 |