NODE=M097

$D_1(2420)^0$

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

$D_1(2420)^0$ MASS

NODE=M097M

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=M097M

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
2421.8±0.6 OUR FIT Error includes scale factor of 1.8. [2420.8 ± 0.5 MeV OUR 2020 FIT Scale factor = 1.3]					
2421.8±0.8 OUR AVERAGE Error includes scale factor of 2.2. See the ideogram below. [2420.5 ± 0.6 MeV OUR 2020 AVERAGE Scale factor = 1.3]					
$2424.8 \pm 0.1 \pm 0.7$	79k	[1] AAIJ	20D	LHCB	$B^- \to D^{*+}\pi^-\pi^-$
$2419.6 \pm 0.1 \pm 0.7$	210k	AAIJ	13CC	LHCB	$pp \to D^{*+}\pi^- X$
$2423.1 \pm 1.5^{+0.4}_{-1.0}$	2.7k	[2] ABRAMOWICZ	13	ZEUS	$e^{\pm}p \to D^{(*)+}\pi^- X$
$2420.1 \pm 0.1 \pm 0.8$	103k	DEL-AMO-SA..	10P	BABR	$e^+e^- \to D^{*+}\pi^- X$
$2426 \pm 3 \pm 1$	151	ABE	05A	BELL	$B^- \to D^0\pi^+\pi^-\pi^-$
$2421.4 \pm 1.5 \pm 0.9$		[3] ABE	04D	BELL	$B^- \to D^{*+}\pi^-\pi^-$
$2421\ ^{+1}_{-2} \pm 2$	286	AVERY	94C	CLE2	$e^+e^- \to D^{*+}\pi^- X$
$2422 \pm 2 \pm 2$	51	FRABETTI	94B	E687	$\gamma\,\mathrm{Be} \to D^{*+}\pi^- X$
$2428 \pm 3 \pm 2$	279	AVERY	90	CLEO	$e^+e^- \to D^{*+}\pi^- X$
$2414 \pm 2 \pm 5$	171	ALBRECHT	89H	ARG	$e^+e^- \to D^{*+}\pi^- X$
$2428 \pm 8 \pm 5$	171	ANJOS	89C	TPS	$\gamma N \to D^{*+}\pi^- X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$2420.5 \pm 2.1 \pm 0.9$	3110 ± 340	[4] CHEKANOV	09	ZEUS	$e^{\pm}p \to D^{*+}\pi^- X$
$2421.7 \pm 0.7 \pm 0.6$	7.5k	ABULENCIA	06A	CDF	1900 $p\overline{p} \to D^{*+}\pi^- X$
2425 ± 3	235	[5] ABREU	98M	DLPH	e^+e^-

[1] From a full four-body amplitude analysis of the $B^- \to D^{*+}\pi^-\pi^-$ decay.

NODE=M097M;LINKAGE=B

[2] From the combined fit of the $M(D^+\pi^-)$ and $M(D^{*+}\pi^-)$ distributions. and A_{D_2} fixed to the theoretical prediction of -1.

NODE=M097M;LINKAGE=AR

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

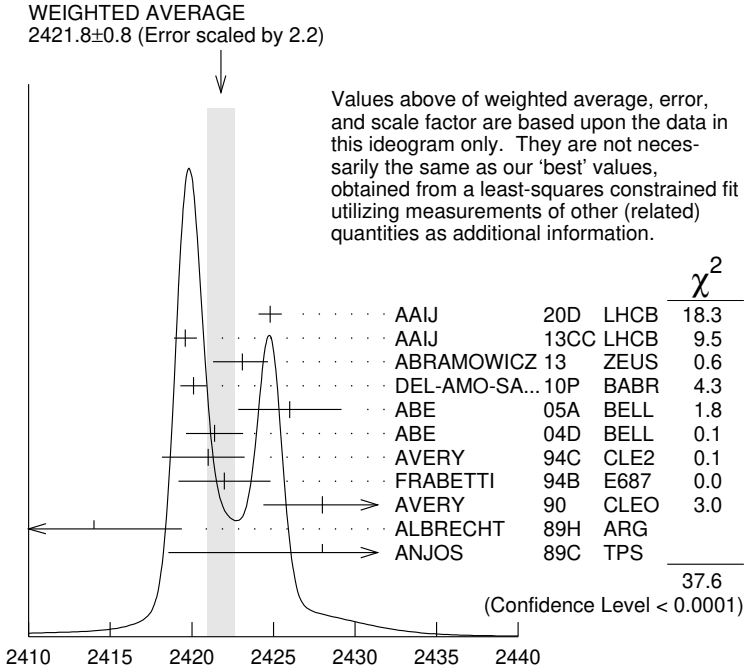
NODE=M097M;LINKAGE=AB

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

NODE=M097M;LINKAGE=CH

[5] No systematic error given.

NODE=M097M;LINKAGE=K



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

NODE=M097DM

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=M097DM

NODE=M097DM

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
411.5±0.6 OUR FIT Error includes scale factor of 1.7. [410.6 ± 0.5 MeV OUR 2020 FIT Scale factor = 1.3]					
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 $p\bar{p} \to D^{*+}\pi^- X$

NODE=M097DM

NEW

$D_1(2420)^0$ WIDTH

NODE=M097W

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
31.8± 2.2 OUR AVERAGE Error includes scale factor of 3.1. See the ideogram below. [31.7 ± 2.5 MeV OUR 2020 AVERAGE Scale factor = 3.5]					
33.6± 0.3± 2.7	79k	[1] AAIJ	20D	LHCB	$B^- \to D^{*+}\pi^-\pi^-$
35.2± 0.4± 0.9	210k	AAIJ	13CC	LHCB	$pp \to D^{*+}\pi^- X$
38.8± 5.0$^{+\ 1.9}_{-\ 5.4}$	2.7k	[2] ABRAMOWICZ	13	ZEUS	$e^{\pm} p \to D^{(*)+}\pi^- X$
31.4± 0.5± 1.3	103k	DEL-AMO-SA..	10P	BABR	$e^+e^- \to D^{*+}\pi^- X$
20.0± 1.7± 1.3	7.5k	ABULENCIA	06A	CDF	1900 $p\bar{p} \to D^{*+}\pi^- X$
24 ± 7 ± 8	151	ABE	05A	BELL	$B^- \to D^0\pi^+\pi^-\pi^-$
23.7± 2.7± 4.0		[3] ABE	04D	BELL	$B^- \to D^{*+}\pi^-\pi^-$
20 $^{+\ 6}_{-\ 5}$ ± 3	286	AVERY	94C	CLE2	$e^+e^- \to D^{*+}\pi^- X$
15 ± 8 ± 4	51	FRABETTI	94B	E687	$\gamma\text{Be} \to D^{*+}\pi^- X$
23 $^{+\ 8}_{-\ 6}$ $^{+10}_{-\ 3}$	279	AVERY	90	CLEO	$e^+e^- \to D^{*+}\pi^- X$
13 ± 6 $^{+10}_{-\ 5}$	171	ALBRECHT	89H	ARG	$e^+e^- \to D^{*+}\pi^- X$
• • • 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	$e^{\pm} p \to D^{*+}\pi^- X$
58 ±14 ±10	171	ANJOS	89C	TPS	$\gamma N \to D^{*+}\pi^- X$

NEW

[1] From a full four-body amplitude analysis of the $B^- \to D^{*+}\pi^-\pi^-$ decay.

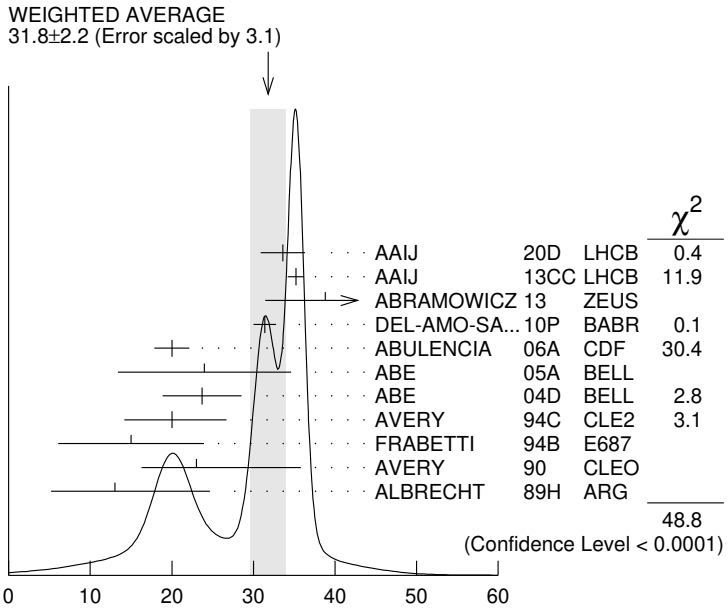
NODE=M097W;LINKAGE=B

[2] From the combined fit of the $M(D^+\pi^-)$ and $M(D^{*+}\pi^-)$ distributions. and A_{D_2} fixed to the theoretical prediction of -1.

NODE=M097W;LINKAGE=AR

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

NODE=M097W;LINKAGE=AB



$D_1(2420)^0$ DECAY MODES

NODE=M097215;NODE=M097

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

NODE=M097

	Mode	Fraction (Γ_i/Γ)	
Γ_1	$D^*(2010)^+\pi^-$	seen	DESIG=1
Γ_2	$D^0\pi^+\pi^-$	seen	DESIG=3;OUR EST;→ UNCHECKED ←
Γ_3	$D^0\rho^0$		DESIG=4
Γ_4	$D^0 f_0(500)$		DESIG=5
Γ_5	$D_0^*(2300)^+\pi^-$		DESIG=6
Γ_6	$D^+\pi^-$	not seen	DESIG=2;OUR EST;→ UNCHECKED ←
Γ_7	$D^{*0}\pi^+\pi^-$	not seen	DESIG=7;OUR EST;→ UNCHECKED ←

$D_1(2420)^0$ BRANCHING RATIOS

NODE=M097220

$\Gamma(D^*(2010)^+\pi^-)/\Gamma_{total}$ Γ_1/Γ

NODE=M097R1
NODE=M097R1

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

$\Gamma(D^+\pi^-)/\Gamma(D^*(2010)^+\pi^-)$ Γ_6/Γ_1

NODE=M097R2
NODE=M097R2

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

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

NODE=M097PAH

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, θ_h, distribution varies like $1 + A_{D_1}\cos^2\theta_h$, where θ_h is the angle in the D^* rest frame between the two pions emitted by the $D_1 \to D^*\pi$ and the $D^* \to D\pi$.

NODE=M097PAH

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
5.73±0.25 OUR AVERAGE					
$7.8\ ^{+6.7}_{-2.7}\ ^{+4.6}_{-1.8}$	2.7k	[1] ABRAMOWICZ13		ZEUS	$e^\pm p \to D^{(*)+}\pi^- X$
5.72±0.25	103k	DEL-AMO-SA..10P		BABR	$e^+e^- \to D^{*+}\pi^- X$
$5.9\ ^{+3.0}_{-1.7}\ ^{+2.4}_{-1.0}$		CHEKANOV	09	ZEUS	$e^\pm p \to D^{*+}\pi^- X$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3.30±0.48	210k	[2] AAIJ	13CC	LHCB	$pp \to D^{*+}\pi^- X$
3.8 ±0.6 ±0.8		[3] AUBERT	09Y	BABR	$B^+ \to D_1^0\ell^+\nu_\ell$
$2.74^{+1.40}_{-0.93}$		[4] AVERY	94C	CLE2	$e^+e^- \to D^{*+}\pi^- X$

NODE=M097PAH

[1] From the combined fit of the $M(D^+\pi^-)$ and $M(D^{*+}\pi^-)$ distributions. and A_{D_2} fixed to the theoretical prediction of -1. A pure D-wave not excluded although some S-wave mixing possible.

NODE=M097PAH;LINKAGE=AR

[2] Systematic uncertainty not estimated. Resonance parameters fixed.

NODE=M097PAH;LINKAGE=A

[3] 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.

NODE=M097PAH;LINKAGE=AU

[4] Systematic uncertainties not estimated.

NODE=M097PAH;LINKAGE=AV

$D_1(2420)^0$ REFERENCES

NODE=M097

AAIJ	20D	PR D101 032005	R. Aaij *et al.*	(LHCb Collab.)
AAIJ	13CC	JHEP 1309 145	R. Aaij *et al.*	(LHCb Collab.)
ABRAMOWICZ	13	NP B866 229	H. Abramowicz *et al.*	(ZEUS Collab.)
DEL-AMO-SA...	10P	PR D82 111101	P. del Amo Sanchez *et al.*	(BABAR Collab.)
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.)

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