

X(4140)

$$I^G(J^{PC}) = 0^+(?^{?+})$$

Seen by AALTONEN 09AH, ABAZOV 14A, CHATRCHYAN 14M in $B^+ \rightarrow XK^+$, $X \rightarrow J/\psi\phi$, and by ABAZOV 15M separately in both prompt (4.7σ) and non-prompt (5.6σ) production in $p\bar{p} \rightarrow J/\psi\phi + \text{anything}$. Not seen by SHEN 10 in $\gamma\gamma \rightarrow J/\psi\phi$, AAIJ 12AA in $B^+ \rightarrow J/\psi\phi K^+$, and ABLIKIM 15 in $e^+e^- \rightarrow \gamma J/\psi\phi$ at $\sqrt{s} = 4.23, 4.26, 4.36$ GeV.

X(4140) MASS

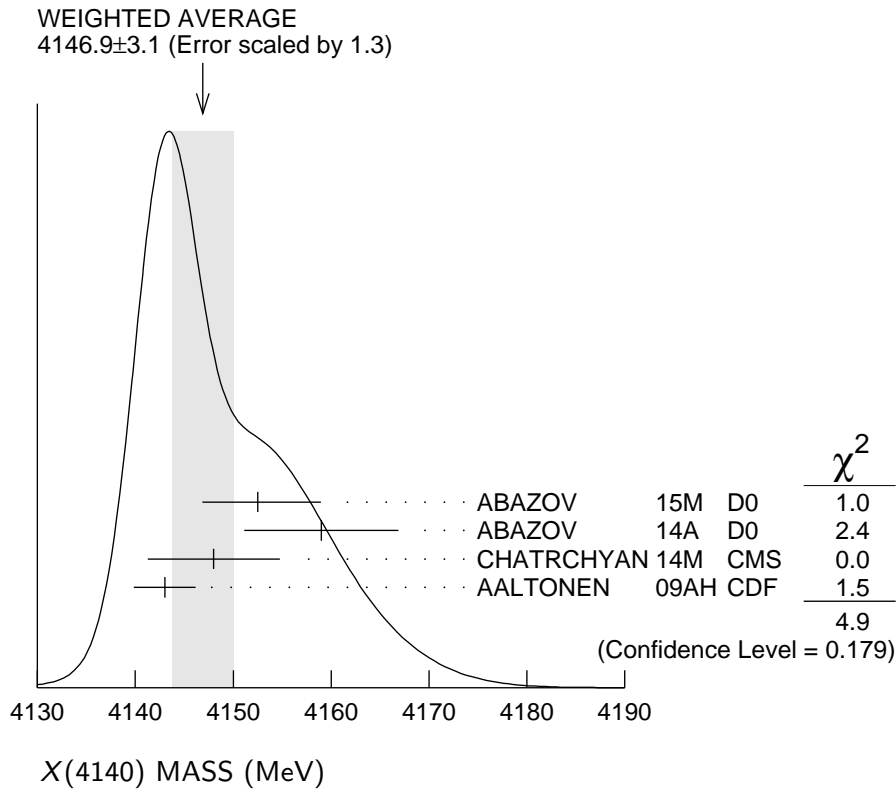
| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|------|------------------|--------|---|
| 4146.9±3.1 OUR AVERAGE Error includes scale factor of 1.3. See the ideogram below. | | | | |
| $4152.5 \pm 1.7^{+6.2}_{-5.4}$ | 616 | 1 ABAZOV | 15M D0 | $p\bar{p} \rightarrow J/\psi\phi + \text{anything}$ |
| $4159.0 \pm 4.3 \pm 6.6$ | 52 | 2 ABAZOV | 14A D0 | $B^+ \rightarrow J/\psi\phi K^+$ |
| $4148.0 \pm 2.4 \pm 6.3$ | 0.3k | 3 CHATRCHYAN 14M | CMS | $B^+ \rightarrow J/\psi\phi K^+$ |
| $4143.0 \pm 2.9 \pm 1.2$ | 14 | 4 AALTONEN 09AH | CDF | $B^+ \rightarrow J/\psi\phi K^+$ |

¹ Statistical significance of more than 6σ .

² Statistical significance of 3.1σ .

³ From a fit assuming an S-wave relativistic Breit-Wigner shape above a three-body phase-space non-resonant component with statistical significance of more than 5σ .

⁴ Statistical significance of 3.8σ .



X(4140) WIDTH

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--|--------------------|-------------------------|----------|---|
| 15 $\pm \frac{6}{5}$ | OUR AVERAGE | | | |
| 16.3 \pm 5.6 \pm 11.4 | 616 | ¹ ABAZOV | 15M D0 | $p\bar{p} \rightarrow J/\psi\phi + \text{anything}$ |
| 20 \pm 13 $\pm \frac{3}{8}$ | 52 | ² ABAZOV | 14A D0 | $B^+ \rightarrow J/\psi\phi K^+$ |
| 28 $\pm \frac{15}{11} \pm$ 19 | 0.3k | ³ CHATRCHYAN | 14M CMS | $B^+ \rightarrow J/\psi\phi K^+$ |
| 11.7 $\pm \frac{8.3}{5.0} \pm$ 3.7 | 14 | ⁴ AALTONEN | 09AH CDF | $B^+ \rightarrow J/\psi\phi K^+$ |

¹ Statistical significance of more than 6 σ .² Statistical significance of 3.1 σ .³ From a fit assuming an S-wave relativistic Breit-Wigner shape above a three-body phase-space non-resonant component with statistical significance of more than 5 σ .⁴ Statistical significance of 3.8 σ .**X(4140) DECAY MODES**

| Mode | Fraction (Γ_i/Γ) |
|---------------------------|--------------------------------|
| Γ_1 $J/\psi\phi$ | seen |
| Γ_2 $\gamma\gamma$ | not seen |

X(4140) $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

| $\Gamma(\gamma\gamma) \times \Gamma(J/\psi\phi)/\Gamma_{\text{total}}$ | CL% | DOCUMENT ID | TECN | COMMENT | $\Gamma_2\Gamma_1/\Gamma$ |
|---|-----|-------------------|---------|---|---------------------------|
| <41 | 90 | ¹ SHEN | 10 BELL | 10.6 $e^+e^- \rightarrow e^+e^- J/\psi\phi$ | |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| < 6 | 90 | ² SHEN | 10 BELL | 10.6 $e^+e^- \rightarrow e^+e^- J/\psi\phi$ | |
| ¹ For $J^P = 0^+$. | | | | | |
| ² For $J^P = 2^+$. | | | | | |

X(4140) BRANCHING RATIOS

| $\Gamma(J/\psi\phi)/\Gamma_{\text{total}}$ | EVTS | DOCUMENT ID | TECN | COMMENT | Γ_1/Γ |
|---|------|-------------------------|-----------|---|-------------------|
| seen | 616 | ¹ ABAZOV | 15M D0 | $p\bar{p} \rightarrow J/\psi\phi + \text{anything}$ | |
| seen | 52 | ² ABAZOV | 14A D0 | $B^+ \rightarrow J/\psi\phi K^+$ | |
| seen | 0.3k | ³ CHATRCHYAN | 14M CMS | $B^+ \rightarrow J/\psi\phi K^+$ | |
| seen | 14 | ⁴ AALTONEN | 09AH CDF | $B^+ \rightarrow J/\psi\phi K^+$ | |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| not seen | | ⁵ ABLIKIM | 15 BES3 | $e^+e^- \rightarrow \gamma\phi J/\psi$ | |
| not seen | | ⁶ AAIJ | 12AA LHCB | $p\bar{p} \rightarrow B^+ X$ at 7 TeV | |

¹ Statistical significance of more than 6 σ .² ABAZOV 14A reports $B(B^+ \rightarrow X(4140)K^+ \rightarrow J/\psi\phi K^+)/B(B^+ \rightarrow J/\psi\phi K^+) = (19 \pm 7 \pm 4)\%$ with 3.1 σ significance.

³ From a fit assuming an *S*-wave relativistic Breit-Wigner shape above a three-body phase-space non-resonant component with statistical significance of more than 5σ .

⁴ Statistical significance of 3.8σ .

⁵ Reported $\sigma(e^+e^- \rightarrow \gamma X(4140)) \cdot B(X(4140) \rightarrow J/\psi\phi) < 0.35, 0.28,$ and 0.33 pb at 4.23, 4.26, and 4.36 GeV, respectively, at 90% CL.

⁶ Reported $B(B^+ \rightarrow X(4140)K^+) \cdot B(X(4140) \rightarrow J/\psi\phi) / B(B^+ \rightarrow J/\psi\phi K^+) < 0.07$ at 90% CL.

| $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ | | | | Γ_2/Γ |
|--|--------------------|-------------|----------------|---|
| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| not seen | SHEN | 10 | BELL | $10.6 e^+e^- \rightarrow e^+e^- J/\psi\phi$ |

X(4140) REFERENCES

| | | | | |
|------------|------|----------------|-----------------------------|-------------------|
| ABAZOV | 15M | PRL 115 232001 | V.M. Abazov <i>et al.</i> | (D0 Collab.) |
| ABLIKIM | 15 | PR D91 032002 | M. Ablikim <i>et al.</i> | (BES III Collab.) |
| ABAZOV | 14A | PR D89 012004 | V.M. Abazov <i>et al.</i> | (D0 Collab.) |
| CHATRCHYAN | 14M | PL B734 261 | S. Chatrchyan <i>et al.</i> | (CMS Collab.) |
| AAIJ | 12AA | PR D85 091103 | R. Aaij <i>et al.</i> | (LHCb Collab.) |
| SHEN | 10 | PRL 104 112004 | C.P. Shen <i>et al.</i> | (BELLE Collab.) |
| AALTONEN | 09AH | PRL 102 242002 | T. Aaltonen <i>et al.</i> | (CDF Collab.) |