

$$I(J^P) = 1(\frac{1}{2}^+) \text{ Status: } ****$$

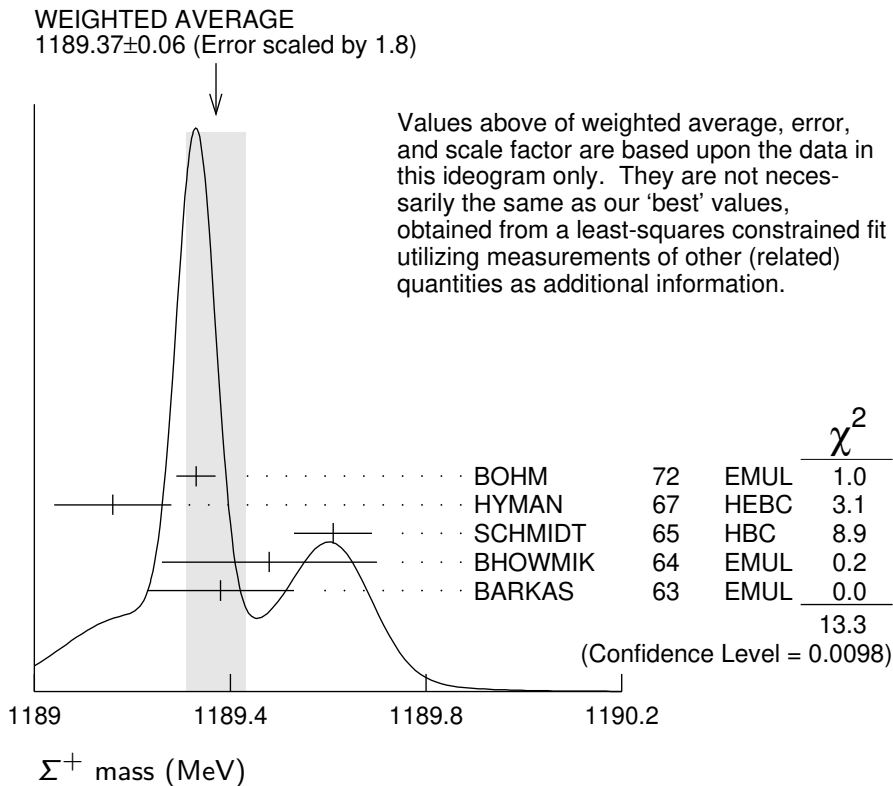
We have omitted some results that have been superseded by later experiments. See our earlier editions.

Σ^+ MASS

The fit uses Σ^+ , Σ^0 , Σ^- , and Λ mass and mass-difference measurements.

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
1189.37±0.07 OUR FIT				Error includes scale factor of 2.2.
1189.37±0.06 OUR AVERAGE				Error includes scale factor of 1.8. See the ideogram below.
1189.33±0.04	607	¹ BOHM	72	EMUL
1189.16±0.12		HYMAN	67	HEBC
1189.61±0.08	4205	SCHMIDT	65	HBC See note with Λ mass
1189.48±0.22	58	² BHOWMIK	64	EMUL
1189.38±0.15	144	² BARKAS	63	EMUL

- ¹ BOHM 72 is updated with our 1973 K^- , π^- , and π^0 masses (Reviews of Modern Physics **45** S1 (1973)).
- ² These masses have been raised 30 keV to take into account a 46 keV increase in the proton mass and a 21 keV decrease in the π^0 mass (note added 1967 edition, Reviews of Modern Physics **39** 1 (1967)).



Σ^+ MEAN LIFE

Measurements with fewer than 1000 events have been omitted.

<u>VALUE (10^{-10} s)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.8018 ± 0.0026 OUR AVERAGE				
0.8038 ± 0.0040 ± 0.0014		BARBOSA	00	E761 hyperons, 375 GeV
0.8043 ± 0.0080 ± 0.0014		¹ BARBOSA	00	E761 hyperons, 375 GeV
0.798 ± 0.005	30k	MARRAFFINO	80	HBC $K^- p$ 0.42–0.5 GeV/c
0.807 ± 0.013	5719	CONFORTO	76	HBC $K^- p$ 1–1.4 GeV/c
0.795 ± 0.010	20k	EISELE	70	HBC $K^- p$ at rest
0.803 ± 0.008	10664	BARLOUTAUD	69	HBC $K^- p$ 0.4–1.2 GeV/c
0.83 ± 0.032	1300	² CHANG	66	HBC

¹ This is a measurement of the $\bar{\Sigma}^-$ lifetime. Here we assume *CPT* invariance; see below for the fractional $\Sigma^+ - \bar{\Sigma}^-$ lifetime difference obtained by BARBOSA 00.

² We have increased the CHANG 66 error of 0.018; see our 1970 edition, *Reviews of Modern Physics* **42** 87 (1970).

$$(\tau_{\Sigma^+} - \tau_{\bar{\Sigma}^-}) / \tau_{\Sigma^+}$$

A test of *CPT* invariance.

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
(−6 ± 12) × 10^{−4}	BARBOSA	00	E761 hyperons, 375 GeV

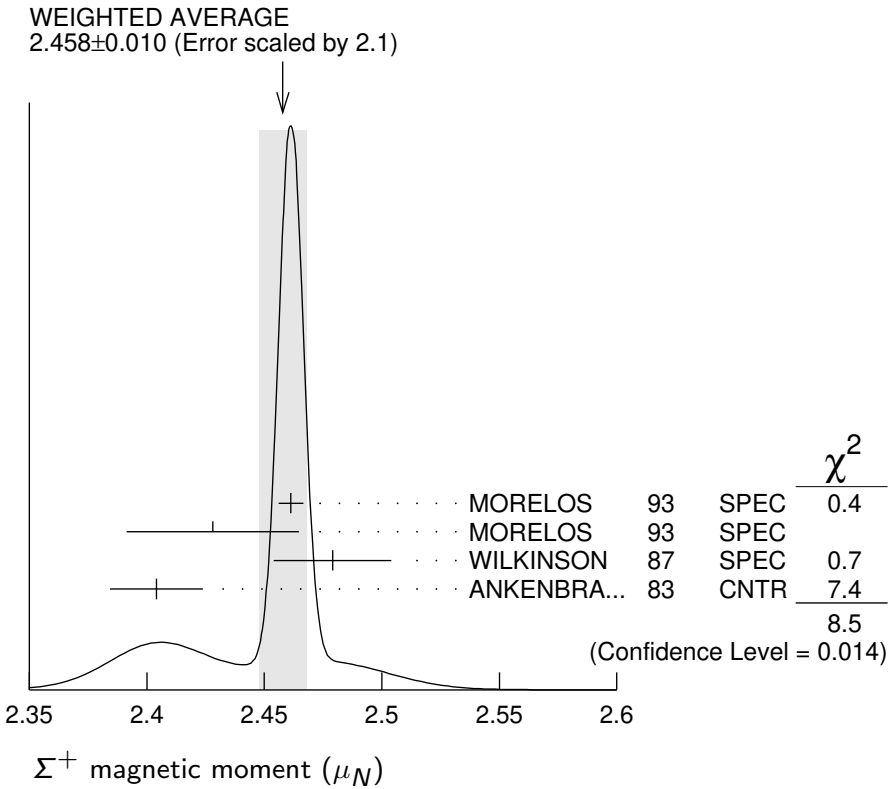
 Σ^+ MAGNETIC MOMENT

See the “Quark Model” review. Measurements with an error $\geq 0.1 \mu_N$ have been omitted.

<u>VALUE (μ_N)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
2.458 ± 0.010 OUR AVERAGE Error includes scale factor of 2.1. See the ideogram below.				
2.4613 ± 0.0034 ± 0.0040	250k	MORELOS	93	SPEC p Cu 800 GeV
2.428 ± 0.036 ± 0.007	12k	¹ MORELOS	93	SPEC p Cu 800 GeV
2.479 ± 0.012 ± 0.022	137k	WILKINSON	87	SPEC p Be 400 GeV
2.4040 ± 0.0198	44k	² ANKENBRA...	83	CNTR p Cu 400 GeV

¹ We assume *CPT* invariance: this is (minus) the $\bar{\Sigma}^-$ magnetic moment as measured by MORELOS 93. See below for the moment difference testing *CPT*.

² ANKENBRANDT 83 gives the value $2.38 \pm 0.02 \mu_N$. MORELOS 93 uses the same hyperon magnet and channel and claims to determine the field integral better, leading to the revised value given here.



$$(\mu_{\Sigma^+} + \mu_{\Sigma^-}) / \mu_{\Sigma^+}$$

A test of *CPT* invariance.

VALUE	DOCUMENT ID	TECN	COMMENT
0.014±0.015	¹ MORELOS	93	SPEC p Cu 800 GeV

¹This is our calculation from the MORELOS 93 measurements of the Σ^+ and Σ^- magnetic moments given above. The statistical error on μ_{Σ^-} dominates the error here.

Σ^+ DECAY MODES

Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1 $p\pi^0$	(51.47±0.30) %	
Γ_2 $n\pi^+$	(48.43±0.30) %	
Γ_3 $p\gamma$	(1.04±0.06) × 10 ⁻³	S=2.4
Γ_4 $n\pi^+\gamma$	[a] (4.5 ±0.5) × 10 ⁻⁴	
Γ_5 $\Lambda e^+\nu_e$	(2.3 ±0.4) × 10 ⁻⁵	

$\Delta S = \Delta Q$ (SQ) violating modes or $\Delta S = 1$ weak neutral current (S1) modes

Γ_6 $ne^+\nu_e$	SQ	< 5	× 10 ⁻⁶	CL=90%
Γ_7 $n\mu^+\nu_\mu$	SQ	< 3.0	× 10 ⁻⁵	CL=90%
Γ_8 pe^+e^-	S1	< 7	× 10 ⁻⁶	
Γ_9 $p\mu^+\mu^-$	S1	(1.09±0.17)	× 10 ⁻⁸	

$$\Gamma_{10} \quad p\gamma_{dark} \quad < \quad 3.2 \quad \times 10^{-5} \quad \text{CL}=90\%$$

[a] See the Listings below for the pion momentum range used in this measurement.

CONSTRAINED FIT INFORMATION

An overall fit to 3 branching ratios uses 15 measurements and one constraint to determine 3 parameters. The overall fit has a $\chi^2 = 22.0$ for 13 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$, in percent, from the fit to the branching fractions, $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$. The fit constrains the x_i whose labels appear in this array to sum to one.

$$\begin{array}{c} x_2 \\ x_3 \end{array} \left| \begin{array}{cc} -100 & \\ 5 & -7 \end{array} \right. \begin{array}{c} \\ x_1 \\ x_2 \end{array}$$

Σ^+ BRANCHING RATIOS

$$\Gamma(n\pi^+) / \Gamma(N\pi) \qquad \qquad \qquad \Gamma_2 / (\Gamma_1 + \Gamma_2)$$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.4848 ± 0.0030 OUR FIT				
0.4836 ± 0.0030 OUR AVERAGE				
0.4828 ± 0.0036	10k	¹ MARRAFFINO 80	HBC	$K^- p$ 0.42–0.5 GeV/c
0.488 ± 0.008	1861	NOWAK 78	HBC	
0.484 ± 0.015	537	TOVEE 71	EMUL	
0.488 ± 0.010	1331	BARLOUTAUD 69	HBC	$K^- p$ 0.4–1.2 GeV/c
0.46 ± 0.02	534	CHANG 66	HBC	
0.490 ± 0.024	308	HUMPHREY 62	HBC	

¹ MARRAFFINO 80 actually gives $\Gamma(p\pi^0) / \Gamma(\text{total}) = 0.5172 \pm 0.0036$.

$$\Gamma(p\gamma) / \Gamma(p\pi^0) \qquad \qquad \qquad \Gamma_3 / \Gamma_1$$

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
2.03 ± 0.11 OUR FIT				Error includes scale factor of 2.4.
2.38 ± 0.10 OUR AVERAGE				
2.32 ± 0.11 ± 0.10	32k	TIMM 95	E761	Σ^+ 375 GeV
2.81 ± 0.39 ^{+0.21} _{-0.43}	408	HESSEY 89	CNTR	$K^- p \rightarrow \Sigma^+ \pi^-$ at rest
2.52 ± 0.28	190	¹ KOBAYASHI 87	CNTR	$\pi^+ p \rightarrow \Sigma^+ K^+$
2.46 ^{+0.30} _{-0.35}	155	BIAGI 85	CNTR	CERN hyperon beam
2.11 ± 0.38	46	MANZ 80	HBC	$K^- p \rightarrow \Sigma^+ \pi^-$
2.1 ± 0.3	45	ANG 69B	HBC	$K^- p$ at rest
2.76 ± 0.51	31	GERSHWIN 69B	HBC	$K^- p \rightarrow \Sigma^+ \pi^-$
3.7 ± 0.8	24	BAZIN 65	HBC	$K^- p$ at rest

¹ KOBAYASHI 87 actually gives $\Gamma(p\gamma) / \Gamma(\text{total}) = (1.30 \pm 0.15) \times 10^{-3}$.

$\Gamma(p\gamma)/\Gamma_{\text{total}}$ Γ_3/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
1.04 ± 0.06 OUR FIT				Error includes scale factor of 2.4.
0.996 ± 0.021 ± 0.018	2.5k	¹ ABLIKIM	23Y BES3	$e^+ e^- \rightarrow J/\psi \rightarrow \Sigma \bar{\Sigma}$

¹This value is quoted by ABLIKIM 23Y for the simultaneous fit to $\Sigma \rightarrow p\gamma$ and $\bar{\Sigma} \rightarrow \bar{p}\gamma$ assuming no CP violation. Individual values for the branching fractions are given as $(1.005 \pm 0.032) \times 10^{-3}$ and $(0.993 \pm 0.030) \times 10^{-3}$, respectively.

$\Gamma(n\pi^+\gamma)/\Gamma(n\pi^+)$ Γ_4/Γ_2

The π^+ momentum cuts differ, so we do not average the results but simply use the latest value in the Summary Table.

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
0.93 ± 0.10	180	EBENHOH	73 HBC	$\pi^+ < 150 \text{ MeV}/c$
• • •				We do not use the following data for averages, fits, limits, etc. • • •
0.27 ± 0.05	29	ANG	69B HBC	$\pi^+ < 110 \text{ MeV}/c$
~ 1.8		BAZIN	65B HBC	$\pi^+ < 116 \text{ MeV}/c$

$\Gamma(\Lambda e^+ \nu_e)/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE (units 10^{-5})	EVTS	DOCUMENT ID	TECN	COMMENT
2.3 ± 0.4 OUR AVERAGE				
2.93 ± 0.74 ± 0.13	16	ABLIKIM	23AA BES3	$e^+ e^- \rightarrow J/\psi \rightarrow \Sigma \bar{\Sigma}$
1.6 ± 0.7	5	BALTAY	69 HBC	$K^- p$ at rest
2.9 ± 1.0	10	EISELE	69 HBC	$K^- p$ at rest
2.0 ± 0.8	6	BARASH	67 HBC	$K^- p$ at rest

$\Gamma(ne^+ \nu_e)/\Gamma(n\pi^+)$ Γ_6/Γ_2

Test of $\Delta S = \Delta Q$ rule. Experiments with an effective denominator less than 100,000 have been omitted.

EFFECTIVE DENOM.	EVTS	DOCUMENT ID	TECN	COMMENT
< 1.1 × 10⁻⁵ OUR LIMIT				Our 90% CL limit = (2.3 events)/(effective denominator sum). [Number of events increased to 2.3 for a 90% confidence level.]
111000	0	¹ EBENHOH	74 HBC	$K^- p$ at rest
105000	0	¹ SECHI-ZORN	73 HBC	$K^- p$ at rest

¹ Effective denominator calculated by us.

$\Gamma(n\mu^+ \nu_\mu)/\Gamma(n\pi^+)$ Γ_7/Γ_2

Test of $\Delta S = \Delta Q$ rule.

EFFECTIVE DENOM.	EVTS	DOCUMENT ID	TECN	COMMENT
< 6.2 × 10⁻⁵ OUR LIMIT				Our 90% CL limit = (6.7 events)/(effective denominator sum). [Number of events increased to 6.7 for a 90% confidence level.]
33800	0	BAGGETT	69B HBC	
62000	2	¹ EISELE	69B HBC	
10150	0	² COURANT	64 HBC	
1710	0	² NAUENBERG	64 HBC	
120	1	GALTIERI	62 EMUL	

¹ Effective denominator calculated by us.

² Effective denominator taken from EISELE 67.

$\Gamma(pe^+e^-)/\Gamma_{\text{total}}$ **Γ_8/Γ**

VALUE (units 10^{-6})	DOCUMENT ID	TECN	COMMENT
<7	¹ ANG	69B HBC	$K^- p$ at rest

¹ ANG 69B found three pe^+e^- events in agreement with $\gamma \rightarrow e^+e^-$ conversion from $\Sigma^+ \rightarrow p\gamma$. The limit given here is for neutral currents.

$\Gamma(p\mu^+\mu^-)/\Gamma_{\text{total}}$ **Γ_9/Γ**

A test for a $\Delta S = 1$ weak neutral current, but also allowed by higher-order electroweak interactions.

VALUE (units 10^{-8})	EVTS	DOCUMENT ID	TECN	COMMENT
1.09 ± 0.17	0.25k	¹ AAIJ	25D LHCB	pp at 7, 8, 13 TeV
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
1.08 ± 0.17	237	² AAIJ	25D LHCB	pp at 13 TeV
2.2 $\begin{smallmatrix} +0.9 & +1.5 \\ -0.8 & -1.1 \end{smallmatrix}$	10.2	³ AAIJ	18E LHCB	pp at 7, 8 TeV
8.6 $\begin{smallmatrix} +6.6 & \pm 5.5 \\ -5.4 & \end{smallmatrix}$	3	⁴ PARK	05 HYCP	p Cu, 800 GeV

¹ Combination of AAIJ 18E (Run 1) and AAIJ 25D (Run 2) results.
² Uses $B(\Sigma^+ \rightarrow p\pi^0) = (51.57 \pm 0.30) \times 10^{-2}$.
³ AAIJ 18E sees no structure in the dimuon mass distribution, contrary to PARK 05.
⁴ The masses of the three dimuons of PARK 05 are within 1 MeV of one another, perhaps indicating the existence of a new state P^0 with mass 214.3 ± 0.5 MeV. In that case, the decay is $\Sigma^+ \rightarrow pP^0$, $P^0 \rightarrow \mu^+\mu^-$, with a branching fraction of $(3.1^{+2.4}_{-1.9} \pm 1.5) \times 10^{-8}$.

$\Gamma(p\gamma_{\text{dark}})/\Gamma_{\text{total}}$ **Γ_{10}/Γ**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<3.2 × 10⁻⁵	90	¹ ABLIKIM	24AF BES3	$J/\psi, \psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$

¹ FCNC search for invisible massless particles (dark photons) using missing energy in Σ hyperon decays to a proton. For a QCD axion scenario, a competitive lower limit can be derived for the axial-vector part of the s - d flavor-violating axion-fermion effective decay constant $F_{sd}^A > 2.8 \times 10^7$ GeV.

$\Gamma(\Sigma^+ \rightarrow ne^+\nu_e)/\Gamma(\Sigma^- \rightarrow ne^-\bar{\nu}_e)$ **$\Gamma_6/\Gamma_3^{\Sigma^-}$**

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<0.009 OUR LIMIT	Our 90% CL limit, using $\Gamma(ne^+\nu_e)/\Gamma(n\pi^+)$ above.				

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

<0.019	90	0	EBENHOH	74 HBC	$K^- p$ at rest
<0.018	90	0	SECHI-ZORN	73 HBC	$K^- p$ at rest
<0.12	95	0	COLE	71 HBC	$K^- p$ at rest
<0.03	90	0	EISELE	69B HBC	See EBENHOH 74

$\Gamma(\Sigma^+ \rightarrow n\mu^+\nu_\mu)/\Gamma(\Sigma^- \rightarrow n\mu^-\bar{\nu}_\mu)$ **$\Gamma_7/\Gamma_4^{\Sigma^-}$**

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<0.12 OUR LIMIT	Our 90% CL limit, using $\Gamma(n\mu^+\nu_\mu)/\Gamma(n\pi^+)$ above.			

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

0.06 $\begin{smallmatrix} +0.045 \\ -0.03 \end{smallmatrix}$	2	EISELE	69B HBC	$K^- p$ at rest
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$$\frac{\Gamma(\Sigma^+ \rightarrow n\ell^+\nu)/\Gamma(\Sigma^- \rightarrow n\ell^-\bar{\nu}_\ell)}{\text{Test of } \Delta S = \Delta Q \text{ rule.}} \quad (\Gamma_6 + \Gamma_7)/(\Gamma_3^{\Sigma^-} + \Gamma_4^{\Sigma^-})$$

VALUE	EVTS	DOCUMENT ID	TECN
<0.043 OUR LIMIT			
Our 90% CL limit, using $[\Gamma(\Sigma^+ \rightarrow n\mu^+\nu_\mu) + \Gamma(\Sigma^+ \rightarrow ne^+\nu_e)]/\Gamma(\Sigma^+ \rightarrow n\pi^+)$.			

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

<0.08	1	NORTON	69	HBC
<0.034	0	BAGGETT	67	HBC

Σ^+ DECAY PARAMETERS

See the "Note on Baryon Decay Parameters" in the neutron Listings. A few early results have been omitted.

α_0 FOR $\Sigma^+ \rightarrow p\pi^0$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
-0.977 ± 0.009 OUR FIT				
-0.977 ± 0.009 OUR AVERAGE				
-0.975 ± 0.011 ± 0.002	1.07M	¹ ABLIKIM	25BT BES3	$J/\psi/\psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$
-0.945 ^{+0.055} _{-0.042}	1259	² LIPMAN	73 OSPK	$\pi^+ p \rightarrow \Sigma^+$
-0.940 ± 0.045	16k	BELLAMY	72 ASPK	$\pi^+ p \rightarrow \Sigma^+ K^+$
-0.98 ^{+0.05} _{-0.02}	1335	³ HARRIS	70 OSPK	$\pi^+ p \rightarrow \Sigma^+ K^+$
-0.999 ± 0.022	32k	BANGERTER	69 HBC	$K^- p$ 0.4 GeV/c

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

-0.998 ± 0.037 ± 0.009	93k	⁴ ABLIKIM	20X BES3	$J/\psi/\psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$
¹ ABLIKIM 25BT uses production through $e^+e \rightarrow J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$ and $e^+e \rightarrow \psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$, with 1016678 ± 1398 and 53293 ± 299 events, respectively.				
² Decay protons scattered off aluminum.				
³ Decay protons scattered off carbon.				
⁴ ABLIKIM 20X uses production through $e^+e \rightarrow J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$ and $e^+e \rightarrow \psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$, with 87,815 and 5,327 events, respectively. Note that the reported values of decay parameters α_0 of Σ^+ and $\bar{\alpha}_0$ of $\bar{\Sigma}^-$ are correlated.				

$\bar{\alpha}_0$ FOR $\bar{\Sigma}^- \rightarrow \bar{p}\pi^0$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.999 ± 0.011 ± 0.004	1.07M	¹ ABLIKIM	25BT BES3	$J/\psi/\psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.990 ± 0.037 ± 0.011	93k	² ABLIKIM	20X BES3	$J/\psi/\psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$
¹ ABLIKIM 25BT uses production through $e^+e \rightarrow J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$ and $e^+e \rightarrow \psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$, with 1016678 ± 1398 and 53293 ± 299 events, respectively.				
² ABLIKIM 20X uses production through $e^+e \rightarrow J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$ and $e^+e \rightarrow \psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$, with 87,815 and 5,327 events, respectively. Note that the reported values of decay parameters α_0 of Σ^+ and $\bar{\alpha}_0$ of $\bar{\Sigma}^-$ are correlated.				

$(\alpha_0 + \bar{\alpha}_0) / (\alpha_0 - \bar{\alpha}_0)$

Test of CP violation.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
-1.18 ± 0.83 ± 0.28	1.07M	¹ ABLIKIM	25BT BES3	$J/\psi/\psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$

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

0.4 ± 3.7 ± 1.0 93k ² ABLIKIM 20x BES3 $J/\psi/\psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$
¹ ABLIKIM 25BT uses production through $e^+e^- \rightarrow J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$ and $e^+e^- \rightarrow \psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$, with 1016678 ± 1398 and 53293 ± 299 events, respectively.
² ABLIKIM 20X uses production through $e^+e^- \rightarrow J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$ and $e^+e^- \rightarrow \psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$, with 87,815 and 5,327 events, respectively. Note that the reported values of decay parameters α_0 of Σ^+ and $\bar{\alpha}_0$ of $\bar{\Sigma}^-$ are correlated.

$(\alpha_0 - \bar{\alpha}_0)/2$

Average decay parameter assuming *CP* conservation.

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
-0.9869 ± 0.0011 ± 0.0016	1.07M	¹ ABLIKIM	25BT BES3	$J/\psi/\psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$
		¹ ABLIKIM 25BT		uses production through $e^+e^- \rightarrow J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$ and $e^+e^- \rightarrow \psi(2S) \rightarrow \Sigma^+ \bar{\Sigma}^-$, with 1016678 ± 1398 and 53293 ± 299 events, respectively.

ϕ_0 ANGLE FOR $\Sigma^+ \rightarrow p\pi^0$

($\tan \phi_0 = \beta/\gamma$)

VALUE (°)	EVTS	DOCUMENT ID	TECN	COMMENT
36 ± 34 OUR AVERAGE				
38.1 ^{+35.7} -37.1	1259	¹ LIPMAN	73 OSPK	$\pi^+ p \rightarrow \Sigma^+ K^+$
22 ± 90		² HARRIS	70 OSPK	$\pi^+ p \rightarrow \Sigma^+ K^+$

¹ Decay proton scattered off aluminum.

² Decay protons scattered off carbon.

α_+ / α_0

Older results have been omitted.

VALUE (units 10 ⁻²)	EVTS	DOCUMENT ID	TECN	COMMENT
-4.99 ± 0.27 OUR FIT				
-5.0 ± 0.4 OUR AVERAGE				
-4.90 ± 0.32 ± 0.21	754k	¹ ABLIKIM	23BN BES3	$J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$
-7.3 ± 2.1	23k	MARRAFFINO 80	HBC	$K^- p$ 0.42–0.5 GeV/c
		¹ ABLIKIM 23BN		uses production through $e^+e^- \rightarrow J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$ with 10G J/ψ events.

α_+ FOR $\Sigma^+ \rightarrow n\pi^+$

VALUE (units 10 ⁻²)	EVTS	DOCUMENT ID	TECN	COMMENT
4.88 ± 0.26 OUR FIT				
4.9 ± 0.4 OUR AVERAGE				Error includes scale factor of 1.2.
4.81 ± 0.31 ± 0.19	754k	¹ ABLIKIM	23BN BES3	$J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$
3.7 ± 4.9	4101	BERLEY	70B HBC	
6.9 ± 1.7	35k	BANGERTER 69	HBC	$K^- p$ 0.4 GeV/c

¹ ABLIKIM 23BN uses production through $e^+e^- \rightarrow J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$ with 10G J/ψ events.

ϕ_+ ANGLE FOR $\Sigma^+ \rightarrow n\pi^+$

($\tan \phi_+ = \beta/\gamma$)

VALUE (°)	EVTS	DOCUMENT ID	TECN	COMMENT
167 ± 20 OUR AVERAGE				Error includes scale factor of 1.1.
184 ± 24	1054	¹ BERLEY	70B HBC	
143 ± 29	560	BANGERTER 69B	HBC	$K^- p$ 0.4 GeV/c

¹ Changed from 176 to 184° to agree with our sign convention.

$\bar{\alpha}_-$ FOR $\bar{\Sigma}^- \rightarrow \bar{\pi}\pi^-$

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
$-5.65 \pm 0.47 \pm 0.22$	1.1M	¹ ABLIKIM	23BN BES3	$J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$
¹ ABLIKIM 23BN uses production through $e^+e^- \rightarrow J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$ with 10G J/ψ events.				

$\bar{\alpha}_- / \bar{\alpha}_0$

VALUE (units 10^{-2})	DOCUMENT ID	TECN	COMMENT
$-5.71 \pm 0.53 \pm 0.32$	ABLIKIM	23BN BES3	$J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$

$(\alpha_+ + \bar{\alpha}_-) / (\alpha_+ - \bar{\alpha}_-)$

VALUE (units 10^{-2})	DOCUMENT ID	TECN	COMMENT
$-8.0 \pm 5.2 \pm 2.8$	ABLIKIM	23BN BES3	$J/\psi \rightarrow \Sigma^+ \bar{\Sigma}^-$

α_γ FOR $\Sigma^+ \rightarrow p\gamma$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
-0.69 ± 0.05 OUR AVERAGE				
$-0.652 \pm 0.056 \pm 0.020$	2.5k	¹ ABLIKIM	23Y BES3	$e^+e^- \rightarrow J/\psi \rightarrow \Sigma \bar{\Sigma}$
$-0.720 \pm 0.086 \pm 0.045$	35k	² FOUCHER	92 SPEC	$\Sigma^+ 375 \text{ GeV}$
$-0.86 \pm 0.13 \pm 0.04$	190	KOBAYASHI	87 CNTR	$\pi^+ p \rightarrow \Sigma^+ K^+$
$-0.53 \begin{smallmatrix} +0.38 \\ -0.36 \end{smallmatrix}$	46	MANZ	80 HBC	$K^- p \rightarrow \Sigma^+ \pi^-$
$-1.03 \begin{smallmatrix} +0.52 \\ -0.42 \end{smallmatrix}$	61	GERSHWIN	69B HBC	$K^- p \rightarrow \Sigma^+ \pi^-$

¹ This value is quoted by ABLIKIM 23Y for the simultaneous fit to $\Sigma \rightarrow p\gamma$ and $\bar{\Sigma} \rightarrow \bar{p}\gamma$ assuming no CP violation. Individual values are given as -0.587 ± 0.082 and 0.710 ± 0.076 , respectively.

² See TIMM 95 for a detailed description of the analysis.

Σ^+ REFERENCES

We have omitted some papers that have been superseded by later experiments. See our earlier editions.

AAIJ	25D	PRL 135 051801	R. Aaij <i>et al.</i>	(LHCb Collab.)
ABLIKIM	25BT	PRL 135 141804	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	24AF	PL B852 138614	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	23AA	PR D107 072010	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	23BN	PRL 131 191802	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	23Y	PRL 130 211901	M. Ablikim <i>et al.</i>	(BESIII Collab.)
ABLIKIM	20X	PRL 125 052004	M. Ablikim <i>et al.</i>	(BESIII Collab.)
AAIJ	18E	PRL 120 221803	R. Aaij <i>et al.</i>	(LHCb Collab.)
PARK	05	PRL 94 021801	H.K. Park <i>et al.</i>	(FNAL HyperCP Collab.)
BARBOSA	00	PR D61 031101	R.F. Barbosa <i>et al.</i>	(FNAL E761 Collab.)
TIMM	95	PR D51 4638	S. Timm <i>et al.</i>	(FNAL E761 Collab.)
MORELOS	93	PRL 71 3417	A. Morelos <i>et al.</i>	(FNAL E761 Collab.)
FOUCHER	92	PRL 68 3004	M. Foucher <i>et al.</i>	(FNAL E761 Collab.)
HESSEY	89	ZPHY C42 175	N.P. Hessey <i>et al.</i>	(BNL-811 Collab.)
KOBAYASHI	87	PRL 59 868	M. Kobayashi <i>et al.</i>	(KYOT)
WILKINSON	87	PRL 58 855	C.A. Wilkinson <i>et al.</i>	(WISC, MICH, RUTG+)
BIAGI	85	ZPHY C28 495	S.F. Biagi <i>et al.</i>	(CERN WA62 Collab.)
ANKENBRA...	83	PRL 51 863	C.M. Ankenbrandt <i>et al.</i>	(FNAL, IOWA, ISU+)
MANZ	80	PL 96B 217	A. Manz <i>et al.</i>	(MPIM, VAND)
MARRAFFINO	80	PR D21 2501	J. Marraffino <i>et al.</i>	(VAND, MPIM)
NOWAK	78	NP B139 61	R.J. Nowak <i>et al.</i>	(LOUC, BELG, DURH+)
CONFORTO	76	NP B105 189	B. Conforto <i>et al.</i>	(RHEL, LOIC)
EBENHOH	74	ZPHY 266 367	H. Ebenhoh <i>et al.</i>	(HEIDT)
EBENHOH	73	ZPHY 264 413	W. Ebenhoh <i>et al.</i>	(HEIDT)
LIPMAN	73	PL 43B 89	N.H. Lipman <i>et al.</i>	(RHEL, SUSS, LOWC)

PDG	73	RMP 45 S1	T.A. Lasinski <i>et al.</i>	(LBL, BRAN, CERN+)
SECHI-ZORN	73	PR D8 12	B. Sechi-Zorn, G.A. Snow	(UMD)
BELLAMY	72	PL 39B 299	E.H. Bellamy <i>et al.</i>	(LOWC, RHEL, SUSS)
BOHM	72	NP B48 1	G. Bohm <i>et al.</i>	(BERL, KIDR, BRUX, IASD+)
Also		IIHE-73.2 Nov	G. Bohm	(BERL, KIDR, BRUX, IASD, DUUC+)
COLE	71	PR D4 631	J. Cole <i>et al.</i>	(STON, COLU)
TOVEE	71	NP B33 493	D.N. Tovee <i>et al.</i>	(LOUC, KIDR, BERL+)
BERLEY	70B	PR D1 2015	D. Berley <i>et al.</i>	(BNL, MASA, YALE)
EISELE	70	ZPHY 238 372	F. Eisele <i>et al.</i>	(HEID)
HARRIS	70	PRL 24 165	F. Harris <i>et al.</i>	(MICH, WISC)
PDG	70	RMP 42 87	A. Barbaro-Galtieri <i>et al.</i>	(LRL, BRAN+)
ANG	69B	ZPHY 228 151	G. Ang <i>et al.</i>	(HEID)
BAGGETT	69B	Thesis MDDP-TR-973	N.V. Baggett	(UMD)
BALTAY	69	PRL 22 615	C. Baltay <i>et al.</i>	(COLU, STON)
BANGERTER	69	Thesis UCRL 19244	R.O. Bangerter	(LRL)
BANGERTER	69B	PR 187 1821	R.O. Bangerter <i>et al.</i>	(LRL)
BARLOUTAUD	69	NP B14 153	R. Barloutaud <i>et al.</i>	(SACL, CERN, HEID)
EISELE	69	ZPHY 221 1	F. Eisele <i>et al.</i>	(HEID)
Also		PRL 13 291	W. Willis <i>et al.</i>	(BNL, CERN, HEID, UMD)
EISELE	69B	ZPHY 221 401	F. Eisele <i>et al.</i>	(HEID)
GERSHWIN	69B	PR 188 2077	L.K. Gershwin <i>et al.</i>	(LRL)
Also		Thesis UCRL 19246	L.K. Gershwin	(LRL)
NORTON	69	Thesis Nevis 175	H. Norton	(COLU)
BAGGETT	67	PRL 19 1458	N. Baggett <i>et al.</i>	(UMD)
Also		Vienna Abs. 374	N.V. Baggett, B. Kehoe	(UMD)
Also		Private Comm.	N.V. Baggett	(UMD)
BARASH	67	PRL 19 181	N. Barash <i>et al.</i>	(UMD)
EISELE	67	ZPHY 205 409	F. Eisele <i>et al.</i>	(HEID)
HYMAN	67	PL 25B 376	L.G. Hyman <i>et al.</i>	(ANL, CMU, NWES)
PDG	67	RMP 39 1	A.H. Rosenfeld <i>et al.</i>	(LRL, CERN, YALE)
CHANG	66	PR 151 1081	C.Y. Chang	(COLU)
Also		Thesis Nevis 145	C.Y. Chang	(COLU)
BAZIN	65	PRL 14 154	M. Bazin <i>et al.</i>	(PRIN, COLU)
BAZIN	65B	PR 140 B1358	M. Bazin <i>et al.</i>	(PRIN, RUTG, COLU)
SCHMIDT	65	PR 140 B1328	P. Schmidt	(COLU)
BHOWMIK	64	NP 53 22	B. Bhowmik <i>et al.</i>	(DELH)
COURANT	64	PR 136 B1791	H. Courant <i>et al.</i>	(CERN, HEID, UMD+)
NAUENBERG	64	PRL 12 679	U. Nauenberg <i>et al.</i>	(COLU, RUTG, PRIN)
BARKAS	63	PRL 11 26	W.H. Barkas, J.N. Dyer, H.H. Heckman	(LRL)
Also		Thesis UCRL 9450	J.N. Dyer	(LRL)
GALTIERI	62	PRL 9 26	A. Barbaro-Galtieri <i>et al.</i>	(LRL)
HUMPHREY	62	PR 127 1305	W.E. Humphrey, R.R. Ross	(LRL)