Σ BARYONS
$(S = -1, I = 1)$

$\Sigma^+ = uus, \quad \Sigma^0 = uds, \quad \Sigma^- = dds$

NODE=BXXX025

Σ^+

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

NODE=S019

Mass $m = 1189.37 \pm 0.07$ MeV (S = 2.2)
NODE=S019M;DTYPE=M
Mean life $\tau = (0.8018 \pm 0.0026) \times 10^{-10}$ s
NODE=S019T;DTYPE=T
$c\tau = 2.404$ cm
NODE=S019CTA;DTYPE=C;OUR EVAL
$(\tau_{\Sigma^+} - \tau_{\overline{\Sigma}^-}) / \tau_{\Sigma^+} = -0.0006 \pm 0.0012$
NODE=S019DT;DTYPE=x
Magnetic moment $\mu = 2.458 \pm 0.010\ \mu_N$ (S = 2.1)
NODE=S019MM;DTYPE=m
$(\mu_{\Sigma^+} + \mu_{\overline{\Sigma}^-}) / \mu_{\Sigma^+} = 0.014 \pm 0.015$
NODE=S019MMD;DTYPE=i
$\Gamma(\overline{\Sigma}^+ \to n\ell^+\nu)/\Gamma(\Sigma^- \to n\ell^-\overline{\nu}_\ell) < 0.043$
NODE=S019R7;DTYPE=Y;OUR LIM; → UNCHECKED ← CLUMP=D

Decay parameters

$p\pi^0$ $\alpha_0 = -0.977 \pm 0.009$
NODE=S019A0;DTYPE=d;CLUMP=D
$\overline{p}\pi^0$ $\overline{\alpha}_0 = 0.999 \pm 0.012$
NODE=S019A1;DTYPE=d;CLUMP=D
$(\alpha_0 + \overline{\alpha}_0) / (\alpha_0 - \overline{\alpha}_0) = (-1.2 \pm 0.9) \times 10^{-2}$
NODE=S019A00;DTYPE=d;CLUMP=D
$(\alpha_0 - \overline{\alpha}_0)/2 = -0.9869 \pm 0.0019$
NODE=S019A04;DTYPE=d;CLUMP=D
$p\pi^0$ $\phi_0 = (36 \pm 34)^\circ$
NODE=S019F0;DTYPE=d;CLUMP=D
" $\gamma_0 = 0.16$ [a]
NODE=S019G0;DTYPE=d;CLUMP=D;OUR EVAL; → UNCHECKED ←
" $\Delta_0 = (187 \pm 6)^\circ$ [a]
NODE=S019D0;DTYPE=d;CLUMP=D;OUR EVAL; → UNCHECKED ←
$n\pi^+$ $\alpha_+ = (4.88 \pm 0.26) \times 10^{-2}$
NODE=S019A+;DTYPE=d;CLUMP=D
" $\phi_+ = (167 \pm 20)^\circ$ (S = 1.1)
NODE=S019F+;DTYPE=d;CLUMP=D
$\overline{\alpha}_-$ FOR $\overline{\Sigma}^- \to \overline{n}\pi^-$ $= (-5.7 \pm 0.5) \times 10^{-2}$
NODE=S019A01;DTYPE=d;CLUMP=D
$\overline{\alpha}_- / \overline{\alpha}_0 = (-5.7 \pm 0.6) \times 10^{-2}$
NODE=S019A02;DTYPE=d;CLUMP=D
$(\alpha_+ + \overline{\alpha}_-) / (\alpha_+ - \overline{\alpha}_-) = (-8 \pm 6) \times 10^{-2}$
NODE=S019A03;DTYPE=d;CLUMP=D
" $\gamma_+ = -0.97$ [a]
NODE=S019G+;DTYPE=d;CLUMP=D;OUR EVAL; → UNCHECKED ←
" $\Delta_+ = (-73^{+133}_{-10})^\circ$ [a]
NODE=S019D+;DTYPE=d;CLUMP=D;OUR EVAL; → UNCHECKED ←
$p\gamma$ $\alpha_\gamma = -0.69 \pm 0.05$
NODE=S019AG;DTYPE=d;CLUMP=D

Σ^+ DECAY MODES		Fraction (Γ_i/Γ)	Scale factor/ Confidence level	p (MeV/c)	
$p\pi^0$		(51.47±0.30) %		189	NODE=S019220;DESIG=1
$n\pi^+$		(48.43±0.30) %		185	DESIG=2
$p\gamma$		(1.04±0.06) $\times 10^{-3}$	S=2.4	225	DESIG=5
$n\pi^+\gamma$	[b]	(4.5 ±0.5) $\times 10^{-4}$		185	DESIG=3
$\Lambda e^+\nu_e$		(2.3 ±0.4) $\times 10^{-5}$		71	DESIG=4
$\Delta S = \Delta Q$ (SQ) violating modes or $\Delta S = 1$ weak neutral current ($S1$) modes					NODE=S019;CLUMP=A
$ne^+\nu_e$	SQ	< 5 $\times 10^{-6}$	CL=90%	224	DESIG=7;OUR LIM;→ UNCHECKED ←
$n\mu^+\nu_\mu$	SQ	< 3.0 $\times 10^{-5}$	CL=90%	202	DESIG=6;OUR LIM;→ UNCHECKED ←
pe^+e^-	$S1$	< 7 $\times 10^{-6}$		225	DESIG=8
$p\mu^+\mu^-$	$S1$	(1.09±0.17) $\times 10^{-8}$		121	DESIG=9
$p\gamma_{dark}$		< 3.2 $\times 10^{-5}$	CL=90%	–	DESIG=195

Σ^0

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

NODE=S021

Mass $m = 1192.642 \pm 0.024$ MeV
NODE=S021M;DTYPE=M
$m_{\Sigma^-} - m_{\Sigma^0} = 4.807 \pm 0.035$ MeV (S = 1.1)
NODE=S021D1;DTYPE=D
$m_{\Sigma^0} - m_\Lambda = 76.959 \pm 0.023$ MeV
NODE=S021DL;DTYPE=D
Mean life $\tau = (7.4 \pm 0.7) \times 10^{-20}$ s
NODE=S021T;DTYPE=T;OUR EVAL; → UNCHECKED ←
$c\tau = 2.22 \times 10^{-11}$ m
NODE=S021CTA;DTYPE=C;OUR EVAL
Transition magnetic moment $|\mu_{\Sigma\Lambda}| = 1.61 \pm 0.08\ \mu_N$
NODE=S021MM;DTYPE=m
Magnetic moment $\mu = (-1.7 \pm 2.8) \times 10^{-3}$
NODE=S021A00;DTYPE=m
Magnetic moment $\mu = (2.1 \pm 3.0) \times 10^{-3}$
NODE=S021A01;DTYPE=m
Magnetic moment $\mu = (0.4 \pm 3.2) \times 10^{-3}$
NODE=S021A02;DTYPE=m

Σ^0 DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)	
$\Lambda\gamma$	100 %		74	NODE=S021225;DESIG=1;OUR EVAL; → UNCHECKED ←
$\Lambda\gamma\gamma$	$<$ 3 %	90%	74	DESIG=3
$\Lambda e^+ e^-$	[c] 5×10^{-3}		74	DESIG=2;OUR EVAL;→ UNCHECKED ←

Σ^-

$I(J^P) = 1(\frac{1}{2}^+)$ NODE=S020

Mass $m = 1197.449 \pm 0.029$ MeV (S = 1.1) NODE=S020M;DTYPE=M
$m_{\Sigma^-} - m_{\Sigma^+} = 8.08 \pm 0.08$ MeV (S = 1.9) NODE=S020D;DTYPE=D
$m_{\Sigma^-} - m_{\Lambda} = 81.766 \pm 0.029$ MeV (S = 1.1) NODE=S020DL;DTYPE=D
Mean life $\tau = (1.479 \pm 0.011) \times 10^{-10}$ s (S = 1.3) NODE=S020T;DTYPE=T
$c\tau = 4.434$ cm NODE=S020CTA;DTYPE=C;OUR EVAL
Magnetic moment $\mu = -1.160 \pm 0.025\ \mu_N$ (S = 1.7) NODE=S020MM;DTYPE=m
Σ^- charge radius = 0.78 ± 0.10 fm NODE=S020CR;DTYPE=x

Decay parameters

CLUMP=D

$n\pi^-$	$\alpha_- = -0.068 \pm 0.008$	NODE=S020A-;DTYPE=d;CLUMP=D
"	$\phi_- = (10 \pm 15)^\circ$	NODE=S020F-;DTYPE=d;CLUMP=D
"	$\gamma_- = 0.98$ [a]	NODE=S020G-;DTYPE=d;CLUMP=D;OUR EVAL;→ UNCHECKED ←
"	$\Delta_- = (249^{+12}_{-120})^\circ$ [a]	NODE=S020D-;DTYPE=d;CLUMP=D;OUR EVAL;→ UNCHECKED ←
$ne^-\overline{\nu}_e$	$g_A/g_V = 0.340 \pm 0.017$ [d]	NODE=S020AV2;DTYPE=d;CLUMP=D
"	$f_2(0)/f_1(0) = 0.97 \pm 0.14$	NODE=S020F2;DTYPE=d;CLUMP=D
"	$D = 0.11 \pm 0.10$	NODE=S020TC;DTYPE=d;CLUMP=D
$\Lambda e^-\overline{\nu}_e$	$g_V/g_A = 0.01 \pm 0.10$ [d] (S = 1.5)	NODE=S020AV;DTYPE=d;CLUMP=D
"	$g_{WM}/g_A = 2.4 \pm 1.7$ [d]	NODE=S020WM;DTYPE=d;CLUMP=D

Σ^- DECAY MODES		Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)	
$n\pi^-$		(99.848±0.005) %		193	NODE=S020230;DESIG=1
$n\pi^-\gamma$	[b]	(4.6 ±0.6) $\times 10^{-4}$		193	DESIG=2
$ne^-\overline{\nu}_e$		(1.017±0.034) $\times 10^{-3}$		230	DESIG=4
$n\mu^-\overline{\nu}_\mu$		(4.5 ±0.4) $\times 10^{-4}$		210	DESIG=3
$\Lambda e^-\overline{\nu}_e$		(5.73 ±0.27) $\times 10^{-5}$		79	DESIG=5
$\Sigma^+ X$		$<$ 1.2 $\times 10^{-4}$	90%	–	DESIG=193
Lepton number (L) violating modes					NODE=S020;CLUMP=L
pe^-e^-	L	$<$ 6.7 $\times 10^{-5}$	90%	231	DESIG=192

$\Sigma(1385)\ 3/2^+$

$I(J^P) = 1(\frac{3}{2}^+)$ NODE=B043

$\Sigma(1385)^+$ mass $m = 1382.83 \pm 0.34$ MeV (S = 1.9) NODE=B043M+;DTYPE=M
$\Sigma(1385)^0$ mass $m = 1383.8 \pm 0.9$ MeV (S = 1.3) NODE=B043M0;DTYPE=M
$\Sigma(1385)^-$ mass $m = 1387.2 \pm 0.5$ MeV (S = 2.2) NODE=B043M-;DTYPE=M
$\Sigma(1385)^+$ full width $\Gamma = 36.2 \pm 0.7$ MeV NODE=B043W+;DTYPE=G
$\Sigma(1385)^0$ full width $\Gamma = 44 \pm 8$ MeV (S = 2.0) NODE=B043W0;DTYPE=G
$\Sigma(1385)^-$ full width $\Gamma = 39.4 \pm 2.1$ MeV (S = 1.7) NODE=B043W-;DTYPE=G
Below $\overline{K}N$ threshold

Σ(1385) DECAY MODES	Fraction (Γ_i/Γ)	Confidence level	p (MeV/c)	
$\Lambda\pi$	(87.0 ±1.5) %		208	NODE=B043235;DESIG=1;OUR EST
$\Sigma\pi$	(11.7 ±1.5) %		129	DESIG=2;OUR EST
$\Lambda\gamma$	($1.25^{+0.13}_{-0.12}$) %		241	DESIG=3
$\Sigma^+\gamma$	(7.0 ±1.7) $\times 10^{-3}$		180	DESIG=6
$\Sigma^-\gamma$	< 2.4 $\times 10^{-4}$	90%	173	DESIG=5

Σ(1660) 1/2+

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

NODE=B079

Re(pole position) = 1585 ± 20 MeV
NODE=B079RE;DTYPE=i

-2Im(pole position) = 290^{+140}_{-40} MeV
NODE=B079IM;DTYPE=i

Mass m = 1640 to 1680 (≈ 1660) MeV
NODE=B079M;DTYPE=M;OUR EST;
→ UNCHECKED ←

Full width Γ = 100 to 300 (≈ 200) MeV
NODE=B079W;DTYPE=G;OUR EST;
→ UNCHECKED ←

Σ(1660) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)	
$N\overline{K}$	0.05 to 0.15 (≈ 0.10)	405	NODE=B079215;DESIG=1
$\Lambda\pi$	(35 ±12) %	440	DESIG=3
$\Sigma\pi$	(37 ±10) %	387	DESIG=2
$\Sigma\sigma$	(20 ± 8) %	–	DESIG=5
$\Lambda(1405)\pi$	(4.0 ± 2.0) %	199	DESIG=6

Σ(1670) 3/2−

$I(J^P) = 1(\frac{3}{2}^-)$

NODE=B044

Mass m = 1665 to 1685 (≈ 1675) MeV
NODE=B044M;DTYPE=M;OUR EST;
→ UNCHECKED ←

Full width Γ = 40 to 100 (≈ 70) MeV
NODE=B044W;DTYPE=G;OUR EST;
→ UNCHECKED ←

Σ(1670) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)	
$N\overline{K}$	0.06 to 0.12	419	NODE=B044215;DESIG=1
$\Lambda\pi$	5–15 %	452	DESIG=2;OUR EST
$\Sigma\pi$	30–60 %	398	DESIG=3;OUR EST
$\Sigma\sigma$	(7.0 ±3.0) %	–	DESIG=62

Σ(1750) 1/2−

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

NODE=B057

Mass m = 1700 to 1800 (≈ 1750) MeV
NODE=B057M;DTYPE=M;OUR EST;
→ UNCHECKED ←

Full width Γ = 100 to 200 (≈ 150) MeV
NODE=B057W;DTYPE=G;OUR EST;
→ UNCHECKED ←

Σ(1750) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)	
$N\overline{K}$	0.06 to 0.12	486	NODE=B057215;DESIG=1
$\Lambda\pi$	(14 ±5) %	507	DESIG=3
$\Sigma\pi$	(16 ±4) %	456	DESIG=4
$\Sigma\eta$	15–55 %	98	DESIG=2;OUR EST
$\Sigma(1385)\pi$, D-wave	< 1 %	305	DESIG=5
$\Lambda(1520)\pi$	(2.0 ±1.0) %	175	DESIG=6
$N\overline{K}^*(892)$, S=1/2	(8 ±4) %	†	DESIG=7

Σ(1775) 5/2−

$I(J^P) = 1(\frac{5}{2}^-)$

NODE=B045

Mass m = 1770 to 1780 (≈ 1775) MeV
NODE=B045M;DTYPE=M;OUR EST;
→ UNCHECKED ←

Full width Γ = 105 to 135 (≈ 120) MeV
NODE=B045W;DTYPE=G;OUR EST;
→ UNCHECKED ←

Σ(1775) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)	
$N\overline{K}$	37–43%	508	NODE=B045215;DESIG=1;OUR EST
$\Lambda\pi$	14–20%	525	DESIG=2;OUR EST
$\Sigma\pi$	2–5%	475	DESIG=5;OUR EST
$\Sigma(1385)\pi$	8–12%	327	DESIG=4;OUR EST
$\Lambda(1520)\pi$, P-wave	17–23%	202	DESIG=3;OUR EST

Σ(1910) 3/2⁻

$I(J^P) = 1(\frac{3}{2}^-)$

NODE=B098

was Σ(1940)

Mass m = 1870 to 1950 (≈ 1910) MeV
Full width Γ = 150 to 300 (≈ 220) MeV

NODE=B098M;DTYPE=M;OUR EST; → UNCHECKED ←
NODE=B098W;DTYPE=G;OUR EST; → UNCHECKED ←

Σ(1910) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)	
$N\overline{K}$	0.01 to 0.05 (≈ 0.02)	615	NODE=B098215;DESIG=1
$\Lambda\pi$	(6 ± 4) %	619	DESIG=2
$\Sigma\pi$	(86 ±21) %	574	DESIG=3
$\Sigma(1385)\pi$	seen	439	DESIG=8;OUR EST
$\Lambda(1520)\pi$	seen	329	DESIG=181;OUR EST
$\Delta(1232)\overline{K}$	(3.0 ± 1.0) %	377	DESIG=182
$N\overline{K}^*(892)$	seen	273	DESIG=9;OUR EST
$N\overline{K}^*(892)$, S=1/2 , D-wave	(1.0 ± 1.0) %	273	DESIG=185

Σ(1915) 5/2⁺

$I(J^P) = 1(\frac{5}{2}^+)$

NODE=B046

Mass m = 1900 to 1935 (≈ 1915) MeV
Full width Γ = 80 to 160 (≈ 120) MeV

NODE=B046M;DTYPE=M;OUR EST; → UNCHECKED ←
NODE=B046W;DTYPE=G;OUR EST; → UNCHECKED ←

Σ(1915) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)	
$N\overline{K}$	0.05 to 0.15	618	NODE=B046215;DESIG=1
$\Lambda\pi$	(6.0 ±2.0) %	623	DESIG=2
$\Sigma\pi$	(10.0 ±2.0) %	577	DESIG=3
$\Sigma(1385)\pi$, P-wave	(2.0 ±2.0) %	443	DESIG=4
$\Sigma(1385)\pi$, F-wave	(4.0 ±2.0) %	443	DESIG=5
$\Lambda(1520)\pi$, D-wave	(8.0 ±2.0) %	334	DESIG=190
$N\overline{K}^*(892)$, S=1/2, F-wave	(5.0 ±3.0) %	282	DESIG=183
$N\overline{K}^*(892)$, S=3/2, F-wave	(5.0 ±2.0) %	282	DESIG=185
$\Delta\overline{K}$, P-wave	(16 ±5) %	383	DESIG=188
$\Delta\overline{K}$, F-wave	(5.0 ±3.0) %	383	DESIG=189

Σ(2030) 7/2⁺

$I(J^P) = 1(\frac{7}{2}^+)$

NODE=B047

Mass m = 2025 to 2040 (≈ 2030) MeV
Full width Γ = 150 to 200 (≈ 180) MeV

NODE=B047M;DTYPE=M;OUR EST; → UNCHECKED ←
NODE=B047W;DTYPE=G;OUR EST; → UNCHECKED ←

Σ(2030) DECAY MODES	Fraction (Γ_i/Γ)	p (MeV/c)	
$N\overline{K}$	17–23 %	702	NODE=B047215;DESIG=1;OUR EST
$\Lambda\pi$	17–23 %	700	DESIG=2;OUR EST
$\Sigma\pi$	5–10 %	657	DESIG=3;OUR EST
ΞK	<2 %	422	DESIG=4;OUR EST
$\Sigma(1385)\pi$	5–15 %	532	DESIG=10;OUR EST
$\Sigma(1385)\pi$, F-wave	(1.0±1.0) %	532	DESIG=21
$\Lambda(1520)\pi$	10–20 %	431	DESIG=181;OUR EST
$\Delta(1232)\overline{K}$	10–20 %	498	DESIG=182;OUR EST
$\Delta(1232)\overline{K}$, F-wave	(15 ±5) %	498	DESIG=8
$\Delta(1232)\overline{K}$, H-wave	(1.0±1.0) %	498	DESIG=9
$N\overline{K}^*(892)$, S=3/2, F-wave	(14 ±8) %	439	DESIG=12

NOTES

[*a*] The decay parameters γ and Δ are calculated from α and ϕ using LINKAGE=SBE

$$\gamma = \sqrt{1-\alpha^2}\,\cos\phi\,, \qquad \tan\Delta = -\frac{1}{\alpha}\,\sqrt{1-\alpha^2}\,\sin\phi\,.$$

See the "Note on Baryon Decay Parameters" in the neutron Particle Listings.

[*b*] See the Listings for the pion momentum range used in this measurement. LINKAGE=SD

[*c*] A theoretical value using QED. LINKAGE=SU

[*d*] The parameters g_A, g_V, and g_{WM} for semileptonic modes are defined by $\overline{B}_f[\gamma_\lambda(g_V + g_A\gamma_5) + i(g_{WM}/m_{B_i})\,\sigma_{\lambda\nu}\,q^\nu]B_i$, and ϕ_{AV} is defined by $g_A/g_V = |g_A/g_V|e^{i\phi_{AV}}$. See the "Note on Baryon Decay Parameters" in the neutron Particle Listings. LINKAGE=SBD