Σ^0

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

COURANT 63 and ALFF-STEINBERGER 65, using $\Sigma^0 \to \Lambda e^+ e^-$ decays (Dalitz decays), determined the Σ^0 parity to be positive, given that $J = 1/2$ and that certain very reasonable assumptions about form factors are true. The results of experiments involving the Primakoff effect, from which the Σ^0 mean life and $\Sigma^0 \to \Lambda$ transition magnetic moment come (see below), strongly support $J = 1/2$.

Σ^0 MASS

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

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1192.642±0.024 OUR FIT					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1192.65 ±0.020±0.014	3327	[1] WANG	97	SPEC	$\Sigma^0 \to \Lambda\gamma \to (p\pi^-)(e^+e^-)$

[1] This WANG 97 result is redundant with the Σ^0-Λ mass-difference measurement below.

$m_{\Sigma^-} - m_{\Sigma^0}$

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
4.807±0.035 OUR FIT Error includes scale factor of 1.1.					
4.86 ±0.08 OUR AVERAGE Error includes scale factor of 1.2.					
4.87 ±0.12	37	DOSCH	65	HBC	
5.01 ±0.12	12	SCHMIDT	65	HBC	See note with Λ mass
4.75 ±0.1	18	BURNSTEIN	64	HBC	

$m_{\Sigma^0} - m_{\Lambda}$

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
76.959±0.023 OUR FIT					
76.966±0.020±0.013	3327	WANG	97	SPEC	$\Sigma^0 \to \Lambda\gamma \to (p\pi^-)(e^+e^-)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
76.23 ±0.55	109	COLAS	75	HLBC	$\Sigma^0 \to \Lambda\gamma$
76.63 ±0.28	208	SCHMIDT	65	HBC	See note with Λ mass

Σ^0 MEAN LIFE

These lifetimes are deduced from measurements of the cross sections for the Primakoff process $\Lambda \rightarrow \Sigma^0$ in nuclear Coulomb fields. An alternative expression of the same information is the Σ^0-Λ transition magnetic moment given in the following section. The relation is $(\mu_{\Sigma\Lambda}/\mu_N)^2\ \tau = 1.92951 \times 10^{-19}$ s (see DEVLIN 86).

VALUE (10^{-20} s)	*DOCUMENT ID*		*TECN*	*COMMENT*
7.4±0.7 OUR EVALUATION	Using $\mu_{\Sigma\Lambda}$ (see the above note).			
$6.5^{+1.7}_{-1.1}$	[2] DEVLIN	86	SPEC	Primakoff effect
$7.6\pm0.5\pm0.7$	[3] PETERSEN	86	SPEC	Primakoff effect
• • • We do not use the following data for averages, fits, limits, etc. • • •				
5.8 ± 1.3	[2] DYDAK	77	SPEC	See DEVLIN 86

[2] DEVLIN 86 is a recalculation of the results of DYDAK 77 removing a numerical approximation made in that work.
[3] An additional uncertainty of the Primakoff formalism is estimated to be < 5%.

$\left|\mu(\Sigma^0 \rightarrow \Lambda)\right|$ TRANSITION MAGNETIC MOMENT

See the note in the Σ^0 mean-life section above. Also, see the "Note on Baryon Magnetic Moments" in the Λ Listings.

VALUE (μ_N)	*DOCUMENT ID*		*TECN*	*COMMENT*
1.61±0.08 OUR AVERAGE				
$1.72^{+0.17}_{-0.19}$	[4] DEVLIN	86	SPEC	Primakoff effect
$1.59\pm0.05\pm0.07$	[5] PETERSEN	86	SPEC	Primakoff effect
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$1.82^{+0.25}_{-0.18}$	[4] DYDAK	77	SPEC	See DEVLIN 86

[4] DEVLIN 86 is a recalculation of the results of DYDAK 77 removing a numerical approximation made in that work.
[5] An additional uncertainty of the Primakoff formalism is estimated to be < 2.5%.

Σ^0 DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\Lambda\gamma$	100 %	
Γ_2	$\Lambda\gamma\gamma$	< 3 %	90%
Γ_3	$\Lambda e^+ e^-$	[a] 5×10^{-3}	

[a] A theoretical value using QED.

Σ^0 BRANCHING RATIOS

$\Gamma(\Lambda\gamma\gamma)/\Gamma_{\text{total}}$ Γ_2/Γ

VALUE	*CL%*	*DOCUMENT ID*		*TECN*
<0.03	90	COLAS	75	HLBC

$\Gamma(\Lambda e^+ e^-)/\Gamma_{\text{total}}$ Γ_3/Γ

See COURANT 63 and ALFF-STEINBERGER 65 for measurements of the invariant-mass spectrum of the Dalitz pairs.

VALUE	*DOCUMENT ID*		*COMMENT*
0.00545	FEINBERG	58	Theoretical QED calculation

Σ^0 REFERENCES

WANG	97	PR D56 2544	M.H.L.S. Wang *et al.*	(BNL-E766 Collab.)
DEVLIN	86	PR D34 1626	T. Devlin, P.C. Petersen, A. Beretvas	(RUTG)
PETERSEN	86	PRL 57 949	P.C. Petersen *et al.*	(RUTG, WISC, MICH+)
DYDAK	77	NP B118 1	F. Dydak *et al.*	(CERN, DORT, HEIDH)
COLAS	75	NP B91 253	J. Colas *et al.*	(ORSAY)
ALFF-...	65	PR 137B 1105	C. Alff-Steinberger *et al.*	(COLU, RUTG+) P
DOSCH	65	PL 14 239	H.C. Dosch *et al.*	(HEID)
SCHMIDT	65	PR 140B 1328	P. Schmidt	(COLU)
BURNSTEIN	64	PRL 13 66	R.A. Burnstein *et al.*	(UMD)
COURANT	63	PRL 10 409	H. Courant *et al.*	(CERN, UMD) P
FEINBERG	58	PR 109 1019	G. Feinberg	(BNL)