



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

COURANT 63 and ALFF 65, using  $\Sigma^0 \rightarrow \Lambda e^+ e^-$  decays (Dalitz decays), determined the  $\Sigma^0$  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  $\Sigma^0$  mean life and  $\Sigma^0 \rightarrow \Lambda$  transition magnetic moment come (see below), strongly support  $J = 1/2$ .

### $\Sigma^0$ MASS

The fit uses  $\Sigma^+$ ,  $\Sigma^0$ ,  $\Sigma^-$ , and  $\Lambda$  mass and mass-difference measurements.

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1192.642 ± 0.024</b>				<b>OUR FIT</b>

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

1192.65 ± 0.020 ± 0.014	3327	<sup>1</sup> WANG	97	SPEC	$\Sigma^0 \rightarrow \Lambda \gamma \rightarrow$ $(p\pi^-)(e^+ e^-)$
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<sup>1</sup> This WANG 97 result is redundant with the  $\Sigma^0$ - $\Lambda$  mass-difference measurement below.

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

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>4.807 ± 0.035</b>				<b>OUR FIT</b> 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 $\Lambda$ mass
4.75 ± 0.1	18	BURNSTEIN	64	HBC	

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

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>76.959 ± 0.023</b>				<b>OUR FIT</b>

<b>76.966 ± 0.020 ± 0.013</b>	3327	WANG	97	SPEC	$\Sigma^0 \rightarrow \Lambda \gamma \rightarrow$ $(p\pi^-)(e^+ e^-)$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

76.23 ± 0.55	109	COLAS	75	HLBC	$\Sigma^0 \rightarrow \Lambda \gamma$
76.63 ± 0.28	208	SCHMIDT	65	HBC	See note with $\Lambda$ mass

## $\Sigma^0$ 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  $\Sigma^0$ - $\Lambda$  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).

<u>VALUE (<math>10^{-20}</math> s)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>7.4±0.7 OUR EVALUATION</b>	Using $\mu_{\Sigma\Lambda}$ (see the above note).		
6.5 <sup>+1.7</sup> <sub>-1.1</sub>	<sup>2</sup> DEVLIN	86	SPEC Primakoff effect
7.6±0.5±0.7	<sup>3</sup> PETERSEN	86	SPEC Primakoff effect
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
5.8±1.3	<sup>2</sup> DYDAK	77	SPEC See DEVLIN 86
<sup>2</sup> DEVLIN 86 is a recalculation of the results of DYDAK 77 removing a numerical approximation made in that work.			
<sup>3</sup> An additional uncertainty of the Primakoff formalism is estimated to be < 5%.			

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

See the note in the  $\Sigma^0$  mean-life section above. Also, see the "Note on Baryon Magnetic Moments" in the  $\Lambda$  Listings.

<u>VALUE (<math>\mu_N</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1.61±0.08 OUR AVERAGE</b>			
1.72 <sup>+0.17</sup> <sub>-0.19</sub>	<sup>4</sup> DEVLIN	86	SPEC Primakoff effect
1.59±0.05±0.07	<sup>5</sup> PETERSEN	86	SPEC Primakoff effect
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1.82 <sup>+0.25</sup> <sub>-0.18</sub>	<sup>4</sup> DYDAK	77	SPEC See DEVLIN 86
<sup>4</sup> DEVLIN 86 is a recalculation of the results of DYDAK 77 removing a numerical approximation made in that work.			
<sup>5</sup> An additional uncertainty of the Primakoff formalism is estimated to be < 2.5%.			

## $\Sigma^0$ DECAY MODES

Mode	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level
$\Gamma_1$ $\Lambda\gamma$	100 %	
$\Gamma_2$ $\Lambda\gamma\gamma$	< 3 %	90%
$\Gamma_3$ $\Lambda e^+ e^-$	[a] $5 \times 10^{-3}$	

[a] A theoretical value using QED.

## $\Sigma^0$ BRANCHING RATIOS

$\Gamma(\Lambda\gamma\gamma)/\Gamma_{\text{total}}$		$\Gamma_2/\Gamma$	
<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
<0.03	90	COLAS	75 HLBC

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

$\Gamma_3/\Gamma$

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

<i>VALUE</i>	<i>DOCUMENT ID</i>	<i>COMMENT</i>
<b>0.00545</b>	FEINBERG 58	Theoretical QED calculation

### $\Sigma^0$ REFERENCES

WANG	97	PR D56 2544	M.H.L.S. Wang <i>et al.</i>	(BNL-E766 Collab.)
DEVLIN	86	PR D34 1626	T. Devlin, P.C. Petersen, A. Beretvas	(RUTG)
PETERSEN	86	PRL 57 949	P.C. Petersen <i>et al.</i>	(RUTG, WISC, MICH+)
DYDAK	77	NP B118 1	F. Dydak <i>et al.</i>	(CERN, DORT, HEIDH)
COLAS	75	NP B91 253	J. Colas <i>et al.</i>	(ORSAY)
ALFF	65	PR 137 B1105	C. Alff <i>et al.</i>	(COLU, RUTG, BNL) P
DOSCH	65	PL 14 239	H.C. Dosch <i>et al.</i>	(HEID)
SCHMIDT	65	PR 140B 1328	P. Schmidt	(COLU)
BURNSTEIN	64	PRL 13 66	R.A. Burnstein <i>et al.</i>	(UMD)
COURANT	63	PRL 10 409	H. Courant <i>et al.</i>	(CERN, UMD) P
FEINBERG	58	PR 109 1019	G. Feinberg	(BNL)