# $\Sigma^0$

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

The spin and parity have not been measured directly. They are of course assumed to be the same as for the $\Sigma^+$ and $\Sigma^-$.

## $\Sigma^0$ MASS

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

| VALUE (MeV) | DOCUMENT ID |
|---|---|
| **1192.55±0.08 OUR FIT** | Error includes scale factor of 1.2. |

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

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **4.88±0.08 OUR FIT** | Error includes scale factor of 1.2. | | | | |
| **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 | |

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

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| **76.87±0.08 OUR FIT** | Error includes scale factor of 1.2. | | | | |
| **76.55±0.25 OUR AVERAGE** | | | | | |
| 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).

| VALUE ($10^{-20}$ s) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **7.4±0.7 OUR EVALUATION** | Using $\mu_{\Sigma\Lambda}$ (see the above note). | | | |
| $6.5^{+1.7}_{-1.1}$ | [1] DEVLIN | 86 | SPEC | Primakoff effect |
| 7.6±0.5±0.7 | [2] PETERSEN | 86 | SPEC | Primakoff effect |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 5.8±1.3 | [1] DYDAK | 77 | SPEC | See DEVLIN 86 |

[1] DEVLIN 86 is a recalculation of the results of DYDAK 77 removing a numerical approximation made in that work.
[2] 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.

| VALUE ($\mu_N$) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **1.61±0.08 OUR AVERAGE** | | | | |
| $1.72^{+0.17}_{-0.19}$ | [3] DEVLIN | 86 | SPEC | Primakoff effect |
| 1.59±0.05±0.07 | [4] PETERSEN | 86 | SPEC | Primakoff effect |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $1.82^{+0.25}_{-0.18}$ | [3] DYDAK | 77 | SPEC | See DEVLIN 86 |

[3] DEVLIN 86 is a recalculation of the results of DYDAK 77 removing a numerical approximation made in that work.
[4] 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

### $\Gamma(\Lambda\gamma\gamma)/\Gamma_{total}$ $\Gamma_2/\Gamma$

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

### $\Gamma(\Lambda e^+ e^-)/\Gamma_{total}$ $\Gamma_3/\Gamma$

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

## $\Sigma^0$ REFERENCES


| | | | | |
|---|---|---|---|---|
| DEVLIN | 86 | PR D34 1626 | +Petersen, Beretvas | (RUTG) |
| PETERSEN | 86 | PRL 57 949 | +Beretvas, Devlin, Luk+ | (RUTG, WISC, MICH, MINN) |
| DYDAK | 77 | NP B118 1 | +Navarria, Overseth, Steffen+ | (CERN, DORT, HEIDH) |
| COLAS | 75 | NP B91 253 | +Farwell, Ferrer, Six | (ORSAY) |
| DOSCH | 65 | PL 14 239 | +Engelmann, Filthuth, Hepp, Kluge+ | (HEID) |
| SCHMIDT | 65 | PR 140B 1328 | | (COLU) |
| BURNSTEIN | 64 | PRL 13 66 | +Day, Kehoe, Zorn, Snow | (UMD) |
| FEINBERG | 58 | PR 109 1019 | | (BNL) |