Search for Sigma Hyperons in the Experiments with Polarized Target

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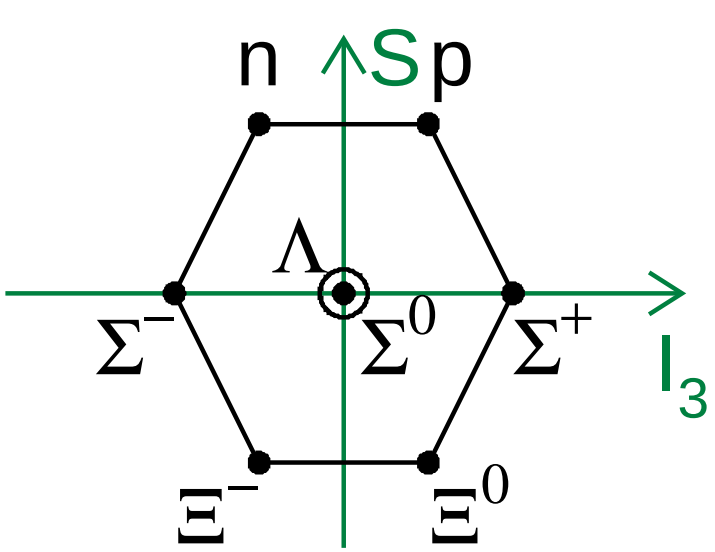
$$3 \otimes 3 \otimes 3 = 10_S \oplus 8_M \oplus 8_M \oplus 1_A$$

Octet



Decuplet

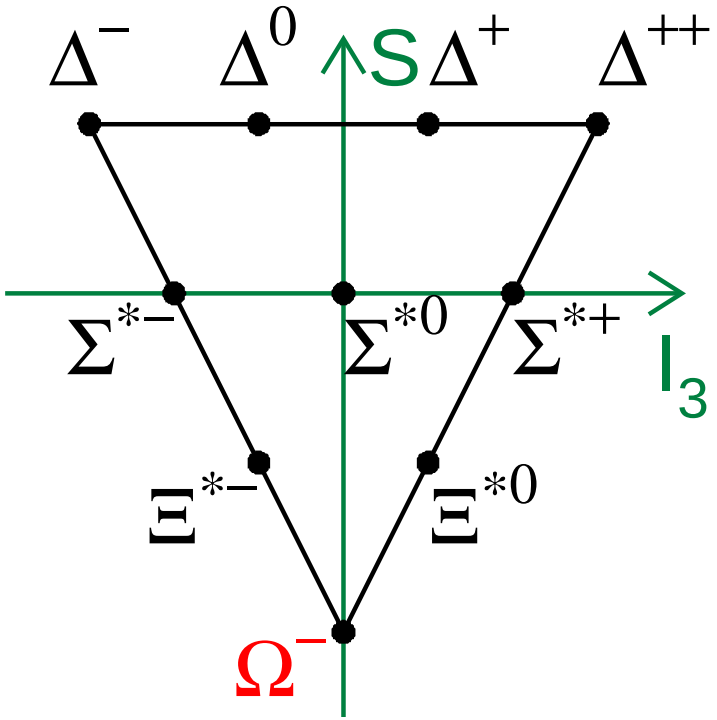


Table 1: Λ-hyperons used in the first fit of the data.

		J^P	Status	Mass	Width
singlet	$\Lambda(1405)$	$1/2^-$	****	$1405^{+1.3}_{-1.0}$	50.5 ± 2.0
$N(1535)$	$\Lambda(1670)$	$1/2^-$	****	$1660 - 1680$	$25 - 50$
$N(1650)$	$\Lambda(1800)$	$1/2^-$	***	$1720 - 1850$	$200 - 400$
singlet	$\Lambda(1520)$	$3/2^-$	****	1519.5 ± 1.0	15.6 ± 1.0
$N(1520)$	$\Lambda(1690)$	$3/2^-$	****	$1685 - 1695$	$50 - 70$
$N(1675)$	$\Lambda(1830)$	$5/2^-$	****	$1810 - 1830$	$60 - 110$
$N(2190)$	$\Lambda(2100)$	$7/2^-$	****	$2090 - 2110$	$100 - 250$
$N(1440)$	$\Lambda(1600)$	$1/2^+$	***	$1560 - 1700$	$50 - 250$
$N(1710)$	$\Lambda(1810)$	$1/2^+$	***	$1750 - 1850$	$50 - 250$
$N(1700)$	$\Lambda(1890)$	$3/2^+$	****	$1850 - 1910$	$60 - 200$
$N(1680)$	$\Lambda(1820)$	$5/2^+$	****	$1815 - 1825$	$70 - 90$
$N(2060)$	$\Lambda(2110)$	$5/2^+$	***	$2090 - 2140$	$150 - 250$

Table 2: Σ-Hyperons used in the first fit of the data.

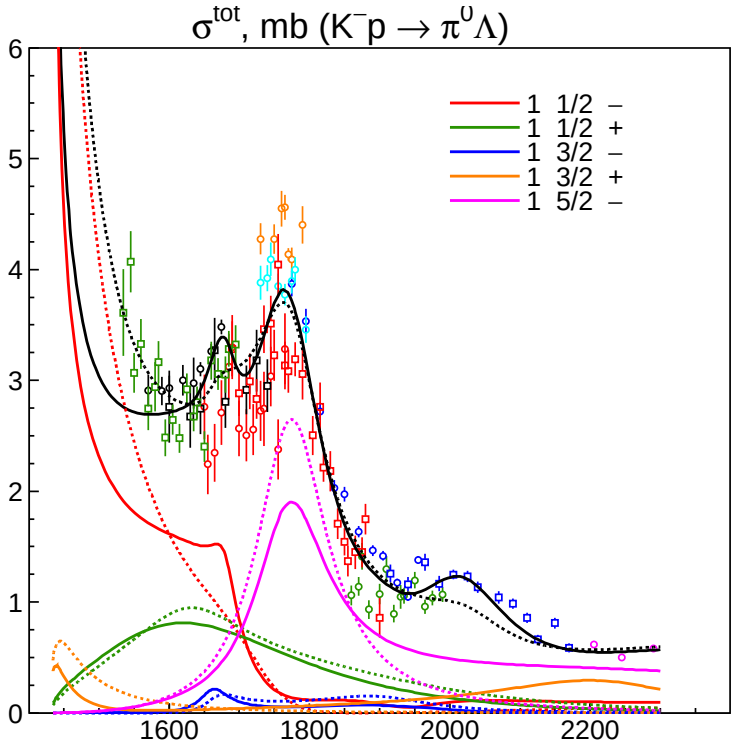
		J^P	Status	Mass	Width
$N(1440)$	$\Sigma(1660)$	$1/2^+$	***	$1630 - 1690$	$40 - 200$
$\Delta(1230)$	$\Sigma(1385)$	$3/2^+$	****	1382.80 ± 0.35	36.0 ± 0.7
$N(1680), \Delta(1905)$	$\Sigma(1915)$	$5/2^+$	****	$1900 - 1935$	$80 - 160$
$N(1990), \Delta(1950)$	$\Sigma(2030)$	$7/2^+$	****	$2025 - 2040$	$150 - 200$
$N(1520)$	$\Sigma(1670)$	$3/2^-$	****	$1665 - 1685$	$40 - 80$
$N(1535), \Delta(1620), N(1650)$	$\Sigma(1750)$	$1/2^-$	***	$1730 - 1800$	$60 - 160$
$N(1675)$	$\Sigma(1775)$	$5/2^-$	****	$1770 - 1780$	$105 - 135$
$N(1700), \Delta(1700)$	$\Sigma(1940)$	$3/2^-$	***	$1900 - 1950$	$150 - 300$

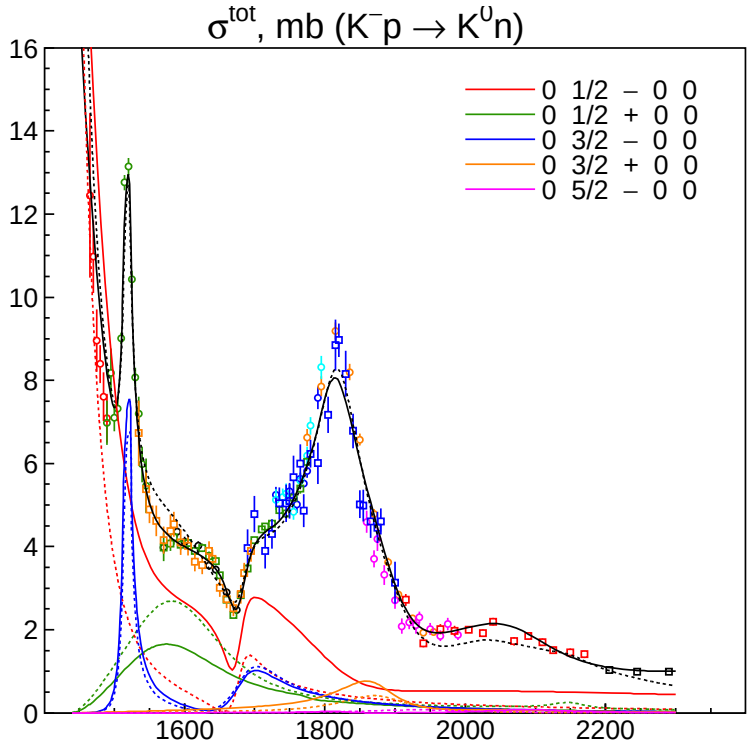
Many Σ states are missing.

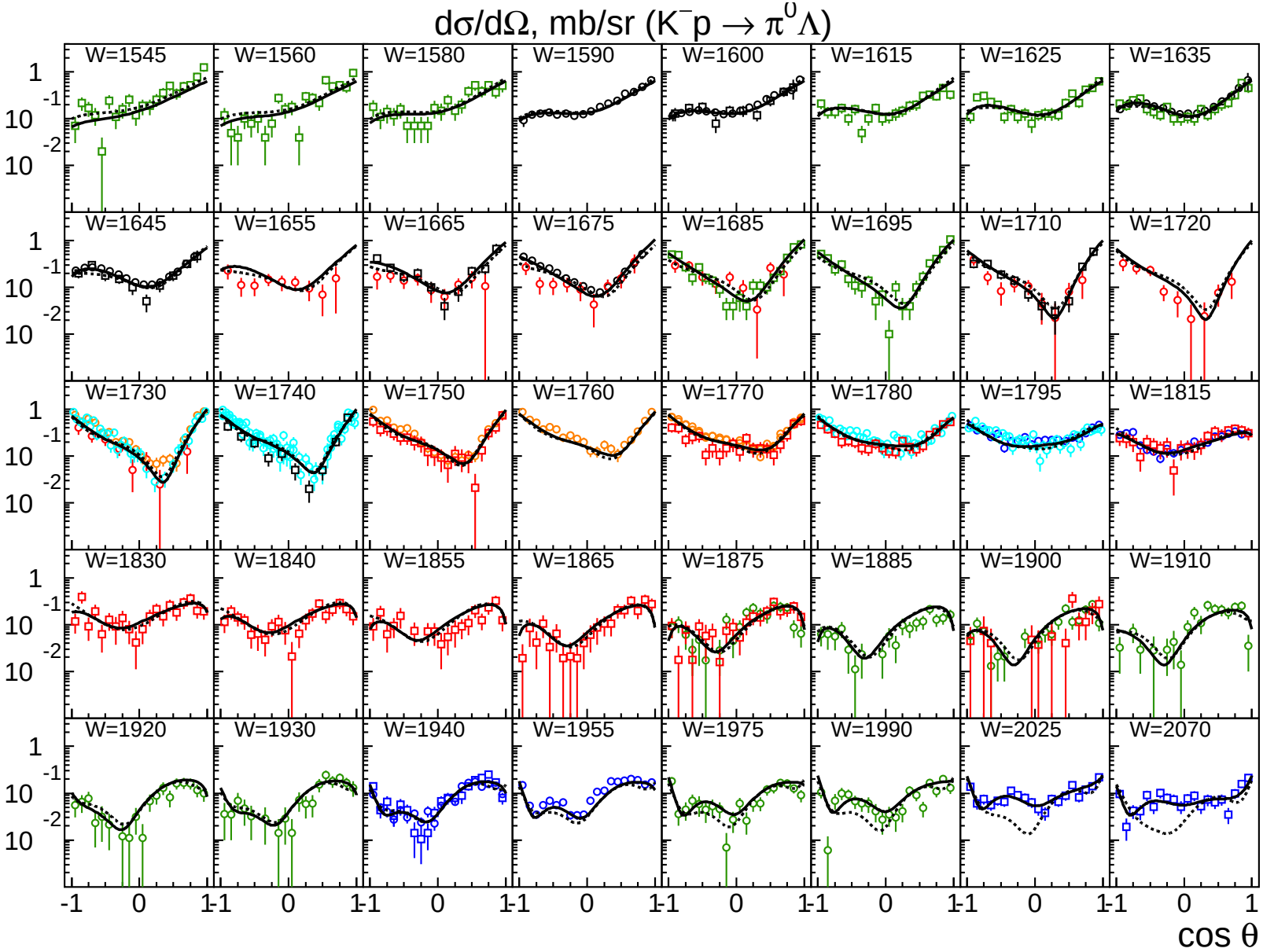
Table 3: Σ-Hyperons Observed states

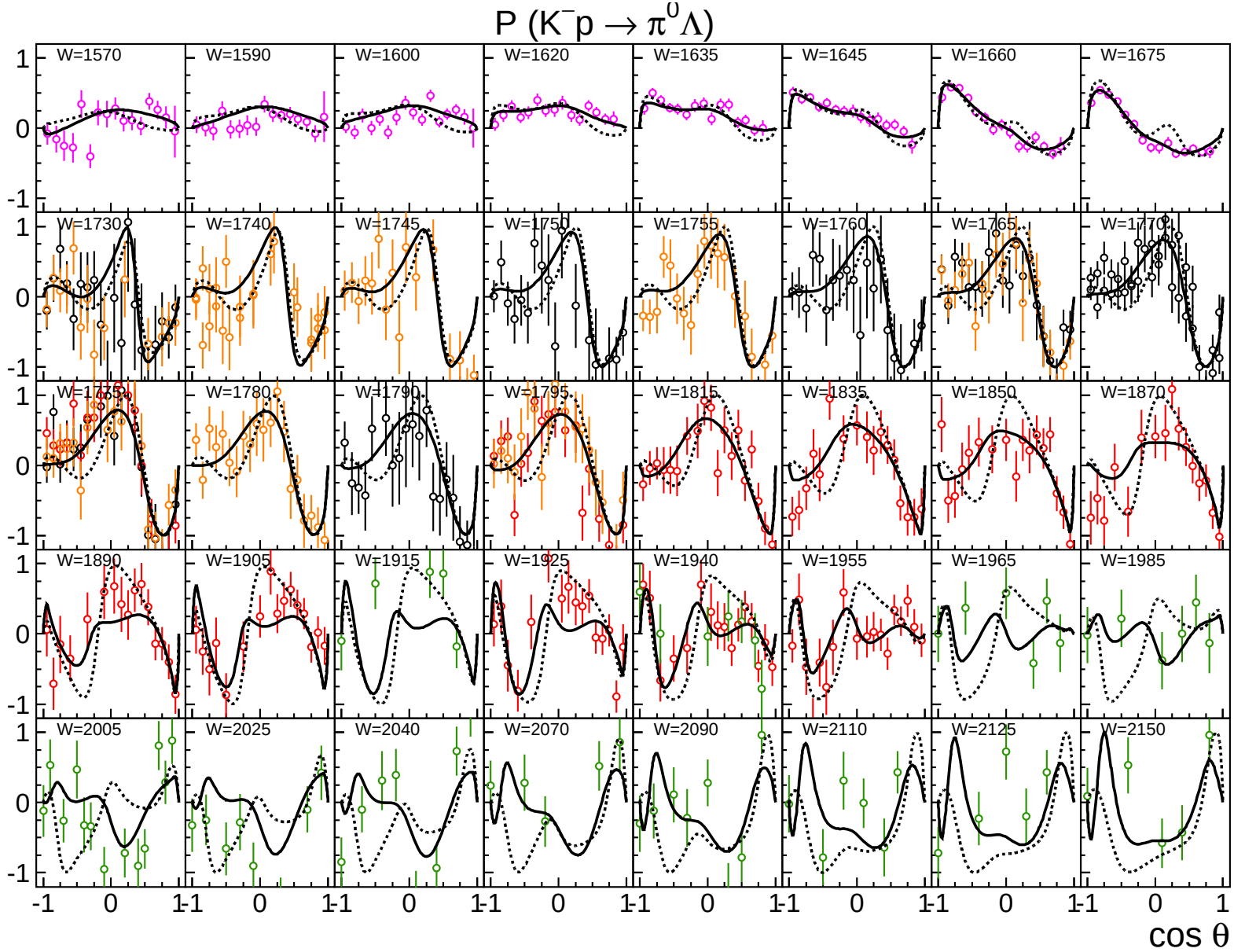
J^P		Known state	BG	ANL/Osaka
$1/2^+$	$N(1440)$	$\Sigma(1660)$		
$3/2^+$	$\Delta(1230)$	$\Sigma(1385)$		
$5/2^+$	$N(1680), \Delta(1905)$	$\Sigma(1915)$		
$7/2^+$	$N(1990), \Delta(1950)$	$\Sigma(2030)$		
$3/2^-$	$N(1520)$	$\Sigma(1670)$		$\Sigma(1580)$
$1/2^-$	$N(1535), \Delta(1620), N(1650)$	$\Sigma(1750)$	$\Sigma(1620)$	
			$\Sigma(1900)$	
$5/2^-$	$N(1675)$	$\Sigma(1775)$		
$3/2^-$	$N(1700), \Delta(1700)$	$\Sigma(1910)$	$\Sigma(2010)$	
$1/2^-$	$N(1895)$		$\Sigma(2120)$	

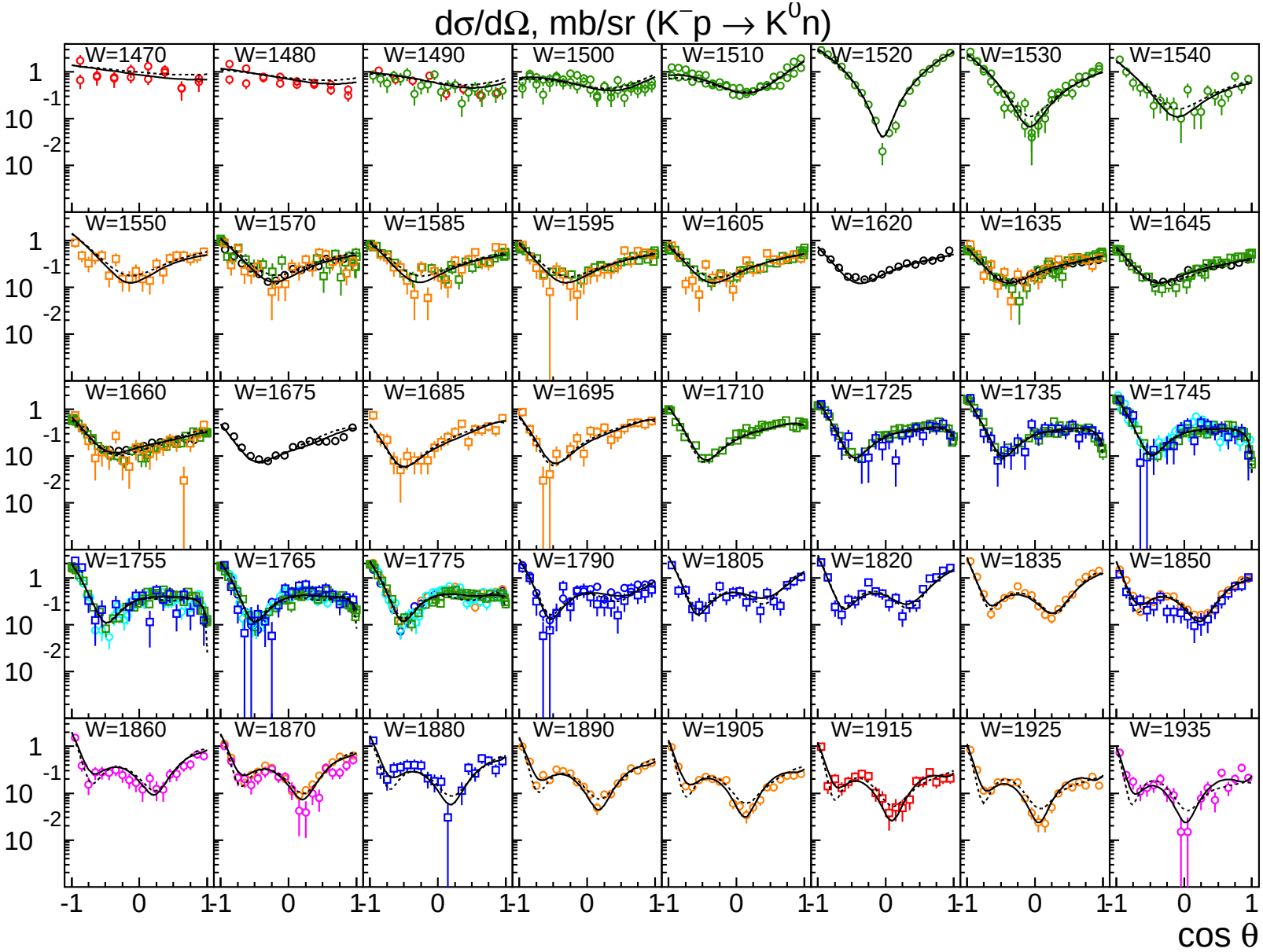
The total cross section for the $K^- p \to K^0 n$ and $K^- p \to \pi^0 \Lambda$

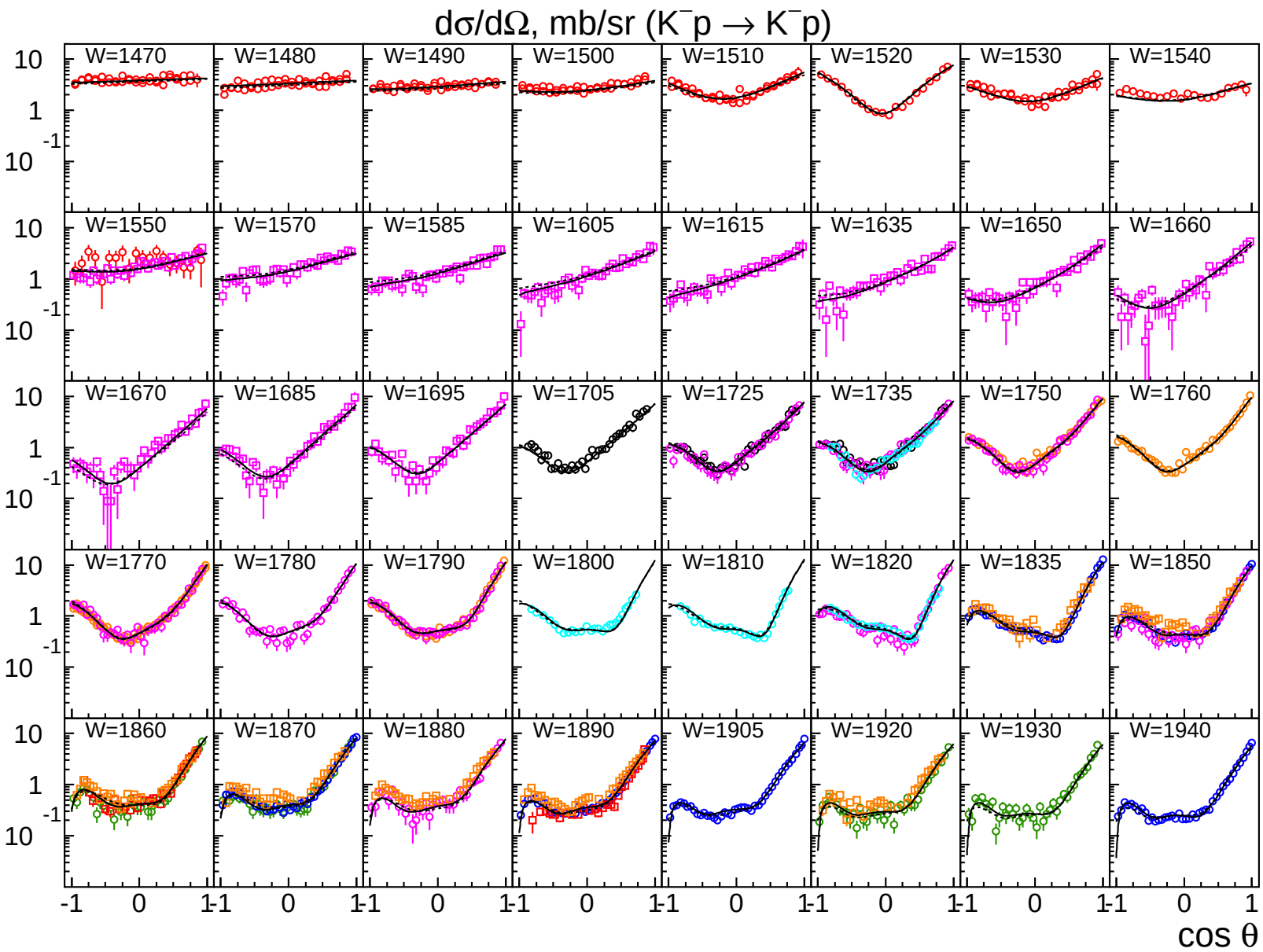




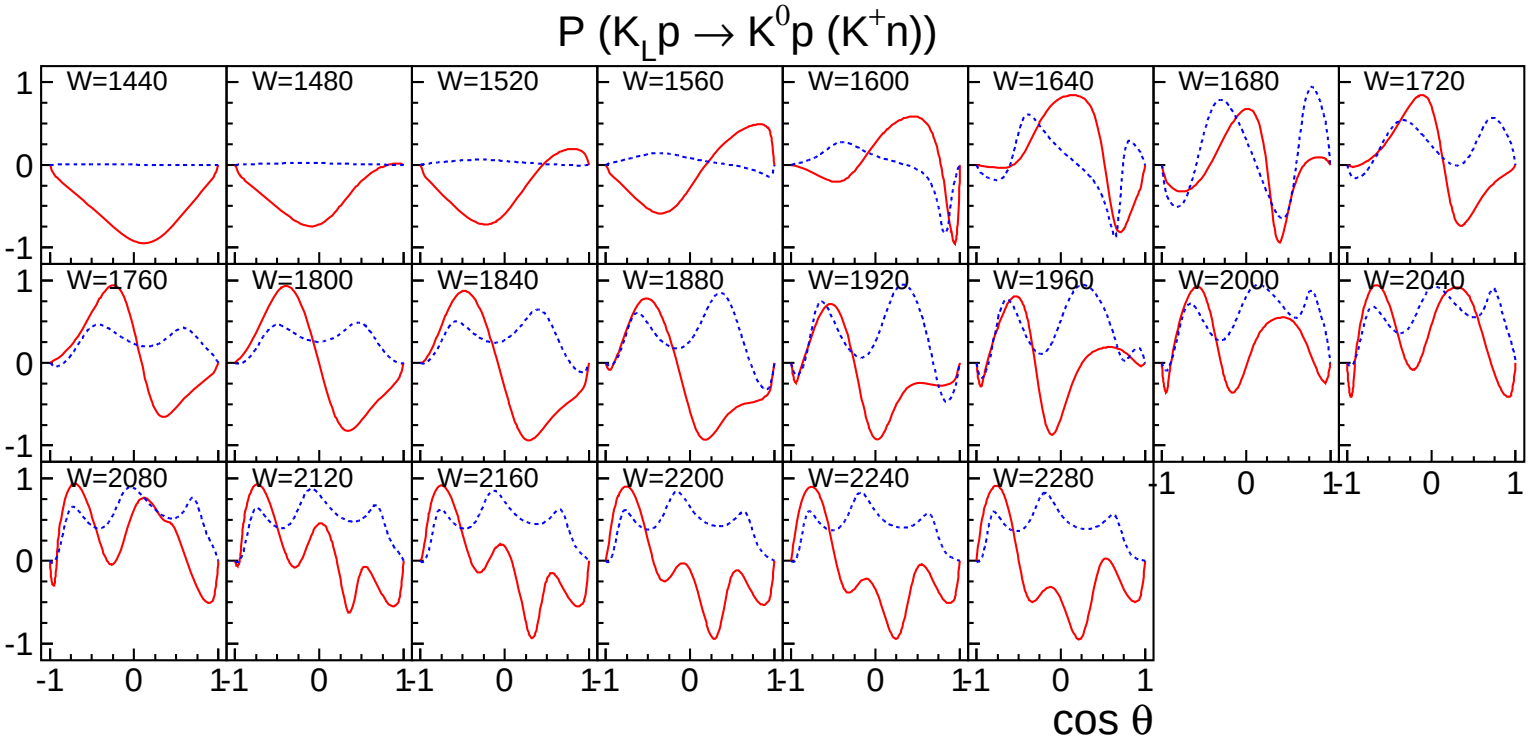

dσ/dΩ, mb/sr (K⁻p → π⁰Λ)
W=1545
W=1560
W=1580
W=1590
W=1600
W=1615
W=1625
W=1635
W=1645
W=1655
W=1665
W=1675
W=1685
W=1695
W=1710
W=1720
W=1730
W=1740
W=1750
W=1760
W=1770
W=1780
W=1795
W=1815
W=1830
W=1840
W=1855
W=1865
W=1875
W=1885
W=1900
W=1910
W=1920
W=1930
W=1940
W=1955
W=1975
W=1990
W=2025
W=2070
cos θ


P (K⁻p → π⁰Λ)
W=1570
W=1590
W=1600
W=1620
W=1635
W=1645
W=1660
W=1675
W=1730
W=1740
W=1745
W=1750
W=1755
W=1760
W=1765
W=1770
W=1775
W=1780
W=1790
W=1795
W=1815
W=1835
W=1850
W=1870
W=1890
W=1905
W=1915
W=1925
W=1940
W=1955
W=1965
W=1985
W=2005
W=2025
W=2040
W=2070
W=2090
W=2110
W=2125
W=2150
1
0
-1
cos θ

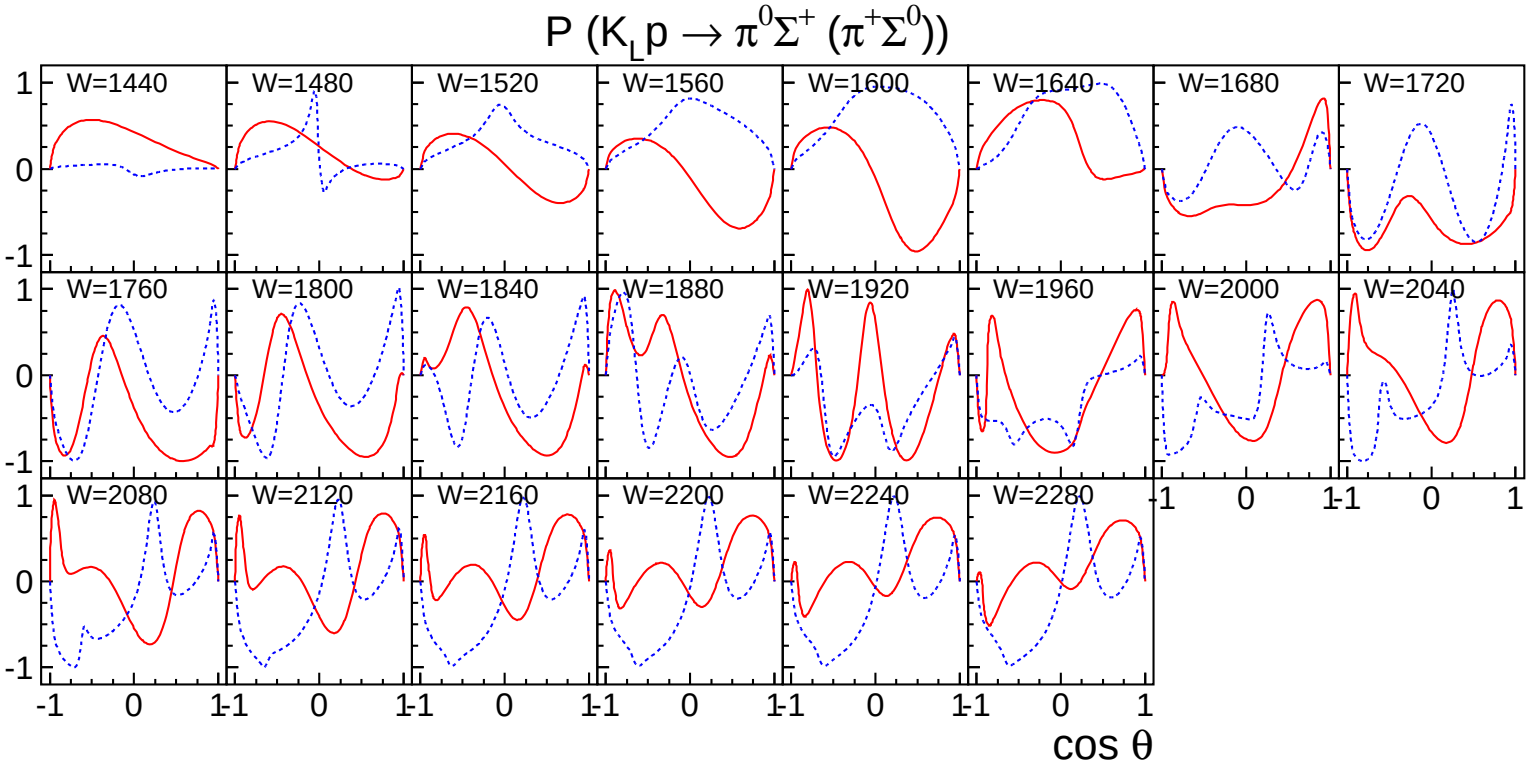

dσ/dΩ, mb/sr (K⁻p → K⁰n)
W=1470
W=1480
W=1490
W=1500
W=1510
W=1520
W=1530
W=1540
W=1550
W=1570
W=1585
W=1595
W=1605
W=1620
W=1635
W=1645
W=1660
W=1675
W=1685
W=1695
W=1710
W=1725
W=1735
W=1745
W=1755
W=1765
W=1775
W=1790
W=1805
W=1820
W=1835
W=1850
W=1860
W=1870
W=1880
W=1890
W=1905
W=1915
W=1925
W=1935
1
10⁻¹
10⁻²
-1
0
1
cos θ


dσ/dΩ, mb/sr (K⁻p → K⁻p)
W=1470
W=1480
W=1490
W=1500
W=1510
W=1520
W=1530
W=1540
W=1550
W=1570
W=1585
W=1605
W=1615
W=1635
W=1650
W=1660
W=1670
W=1685
W=1695
W=1705
W=1725
W=1735
W=1750
W=1760
W=1770
W=1780
W=1790
W=1800
W=1810
W=1820
W=1835
W=1850
W=1860
W=1870
W=1880
W=1890
W=1905
W=1920
W=1930
W=1940
10
1
-1
10
-1
0
1
cos θ

Prediction for the recoil asymmetry $K_L p \to K^0 p(K^+ n)$



Prediction for the recoil asymmetry $K_L p \to \pi^0\Sigma^+(\pi^+\Sigma^0)$



SUMMARY

- **The planned $K_L p$ experiment provides a unique possibility to study the spectrum and properties of Σ hyperons.**
- **It is very important to perform the full amplitude decomposition of the observables measured in the Kp collision reactions: therefore the data from polarized target are important for the determination of the spectrum and properties of Σ hyperons.**