$\pi\Lambda\Sigma$ Coupling Extracted from Hyperonic Atoms

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Measurements of the atomic level widths in $\Sigma$-hyperonic atoms offer a good chance to determine the $f_{\pi\Lambda\Sigma}$ coupling constant. These widths are due to the $\Sigma N - \Lambda N$ conversion. In high atomic angular momentum states it is dominated by the the longest range interaction - the one pion exchange. We find a formula for for the lifetime in "upper" atomic levels. It has a form of the unitarity condition for loosely bound hyperons. Since the conversion happens on protons this formula involves the nuclear proton density distribution, the pion-nucleon and pion-hyperon coupling constants.

A joint analysis of the $\Sigma^- p \to \Lambda n$ cross sections and atomic widths allows to extract the constant $f^2_{\pi\Lambda\Sigma}/4\pi = 0.050 \pm 0.005$ (statistic) $\pm 0.004$ (systematic). The atomic data favour the value larger than values obtained from analyses of the scattering data alone.

The experimental upper width in Pb atom [1] offers the most accurate datum in the region of low energy $\Sigma$-hyperon physics. Older atomic data are less precise and lead to the sizable statistical error. The systematic error is due mostly to uncertainties of the proton density distribution at the nuclear periphery. Another source of the systematic uncertainty is due to the short ranged forces in the $\Sigma N - \Lambda N$ conversion. It is limited to a reasonable level by the low energy scattering data.

[1] R. J. Powers et al, Phys. Rev. C **47**, 1263 (1993).
[2] B.Loiseau and S.Wycech Phys. Rev. C **63**, 034003(2001).