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Overview on Strong Interaction from Kaonic Atoms

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Collaboration

Abstract content

Less than a decade after the first observation of X-rays from kaonic atoms, strong interaction level shifts and widths were measured directly, in addition to transition yields that indirectly provide informaion on level widths. Experiments between the mid-1970s and mid-1980s provided good quality data for 24 nuclear species from Li to U, that serve up to now as the data-base for studies of low energy K^- interaction with nuclei. Puzzles with early results on kaonic atoms of hydrogen and He were resolved by new precision experiments at KEK and Frascati between 1997 and 2007.
Early optical model analyses indicated departure of potentials from the geometry of charge distribution of nuclei, thus leading to density-dependent phenomenological interaction models that produced good fits to the data. Conflicting results were obtained from attempts to relate experiments to more fundamental K^- -nucleon interaction.
As early as in 1971 it was suggetsed that sub-threshold energies were relevant for kaonic atoms, but only since 2011 a self- consistent sub-threshold kinematics model has been applied systematically in analyses of kaonic atom data. In the last 10 years several chiral models for the K^-N interaction provided K^-N scattering amplitudes based on fits to low energy K^-N data including the latest results for kaonic hydrogen from the SIDDHARTA collaboration. Potentials based on such amplitudes within the sub-threshold kinematics model could not fit the kaonic atom data, unless an additional phenomenological term was included, interpreted as representing multi-nucleon processes. Seven mixed chiral-phenomenological models produced almost equally good fits to the data although different models predicted widely different behavior for the K^-N amplitudes below threshold.
Very recently it was shown that one could distinguish between different models by comparing predictions to experimental values of single-nucleon absorption fractions at threshold. Only two out of seven models tested were able to fit both kaonic atom data and absorption fractions. This way long-standing ambiguities regarding the K^- - nucleus potentials are now resolved, with consequences for possible binding of K^- mesons in nuclei and possible K^- condensation in astrophysical scenarios.

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