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Advanced Kaonic Atom Measurements at the DAΦNE Collider: The SIDDHARTA-2 Experiment and Beyond

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Kaonic atoms are exotic atoms formed when a negatively charged kaon (K^-) is stopped in a target and captured by the atomic system, replacing the electron in a highly excited level. The captured K^- initiates an electromagnetic cascade down to the innermost levels of the atom. As the innermost levels are approached, the strong interaction between the kaon and nucleons induces energy shifts and broadening of the atomic levels. The SIDDHARTA collaboration measures these energy shifts and widths using high-precision x-ray spectroscopy and compares them with the purely electromagnetic values calculated with quantum electrodynamics (QED). X-ray spectroscopy on kaonic atoms provides a direct measurement of the effects of the strong kaon-nucleon interaction at low energies, making it a crucial data source for the development of theoretical models. These models are used to derive: Kaon-Nucleon (KN) interaction at threshold, KNN interaction at threshold, nuclear density distributions, possible existence of kaon condensates, kaon mass, kaonic atoms cascade models and the E2 nuclear resonance effects.\\
In 2009, the SIDDHARTA experiment achieved the most precise measurement of the 2p $\rightarrow$ 1s transition in kaonic hydrogen (KH), extracting the shift and width of the 1s level due to the strong kaon-nucleus interaction. The upcoming SIDDHARTA-2 experiment aims to perform the first-ever measurement of the 2p $\rightarrow$ 1s transition in kaonic deuterium (KD), providing the energy shift and width of the 1s level due to the strong kaon-nucleus interaction. These shift and width parameters in KD and KH allow for the first experimental determination of the isospin-dependent antikaon-nucleon scattering lengths, which are fundamental constraints for theoretical models aiming to describe the strong interaction.\\
Kaonic atoms measurements are still today a valid source of investigation for strong physics in the strangeness sector. Despite the recent measurements at DAFNE and JPARC on KHe and KH, knowledge of kaonic atoms still predominantly dates back to the 1970s, with many of these old measurements suffering from large uncertainties and incompatibilities. Additionally, several kaonic atom measurements are yet to be performed. The SIDDHARTA collaboration is planning a new series of measurements beyond the SIDDHARTA-2 experiment: for example the revisiting K^- mass, the first measurement of unmeasured kaonic atoms, the measurement of the nuclear resonance effects in kaonic atoms and so on. Goals, perspectives, setups, and technologies involved in these proposed measurements will be outlined.

Is this abstract from experiment?

Yes

Name of experiment and experimental site

SIDDHARTA-2 https://siddharta2.lnf.infn.it/

Is the speaker for that presentation defined?

Yes

Details

It is me.

Internet talk

Yes

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