

Pionic hydrogen and friends

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In the lightest exotic atoms –muonic and pionic hydrogen and deuterium - physical and technical problems are manifold interrelated. In pionic hydrogen the ground-state level shift and broadening give access to the pion-nucleon scattering lengths, for which the pionic deuterium level shift provides a mandatory constraint. Moreover, the determination of the level broadening in deuterium is the most precise method to quantify pion threshold production in proton-proton reactions. However, collisional processes during the atomic de-excitation cascade considerably complicate analyses of the X-ray line shapes in order to extract the hadronic effects. Therefore, in addition the purely electromagnetic twin system muonic hydrogen was studied. Results of these experiments performed at PSI by using a high-resolution crystal spectrometer are discussed in the context of recent theoretical efforts within the approach of chiral perturbation theory and atomic cascade calculations.

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