Contribution ID: **109** Type: **Poster presentation**

The SIDDHARTA-2 Experiment: Investigating the Strong Interaction with Kaonic Atoms

Tuesday 23 May 2023 17:50 (2h 10m)

The antikaon-nucleon interaction in the low-energy regime of QCD is, to this day, not fully understood and theoretical models need experimental constraints. Kaonic atoms are ideal candidates to study this regime of QCD including strangeness without the need for extrapolation to zero relative energy. The SIDDHARTA-2 experiment, located at the DAΦNE collider at LNF in Italy, can provide this input via X-ray spectroscopy of light kaonic atoms, in particular by measuring the $(2p \rightarrow 1s)$ transition in kaonic deuterium. In combination with the results for kaonic hydrogen obtained by SIDDHARTA, this will enable the extraction of the isospin-dependent antikaon-nucleon scattering lengths a_0 and a_1, which are crucial parameters for the theoretical descriptions. SIDDHARTA-2 performed its first periods of data acquisition in 2021 with a reduced setup, called SIDDHARTINO, and the full SIDDHARTA-2 setup in 2022. From these data, a new result for the $(3d \rightarrow 2p)$ transition in kaonic ^{4}He was extracted. Moreover, several transition energies in intermediate-mass kaonic atoms were measured for the first time. In preparation for the kaonic deuterium run, the setup was optimised via the implementation of a new SDD cooling system and additional veto detectors. The obtained results and optimisations of the apparatus are presented.

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Session Classification: Poster Session 2

Track Classification: spectroscopy of exotic atoms