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Production of a 6 keV antihydrogen beam in the GBAR experiment

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The upgrade of the antiproton decelerator, the Extra Low ENergy Antiproton (ELENA) ring started its operation at CERN in the Fall of 2021 and opened a new era for antihydrogen research. The Gravitational Behaviour of Antihydrogen at Rest (GBAR) collaboration has since started taking data and aims to directly test the Weak Equivalence Principle with a free fall of ultracold antihydrogen $\overline{\mathrm{H}}$ in Earth's gravitational field. The main principle is to first produce an antihydrogen ion $\overline{\mathrm{H}}^{+}$ and sympathetically cool it with Be^{+} in a Paul trap to μK temperature. The excess positron is then photodetached using a $1640\,\mathrm{nm}$ laser and the now neutral antiatom experiences a classical free fall. By measuring the time of flight and the annihilation position of the $\overline{\mathrm{H}}$ we want to measure its acceleration with a precision of 1% in a first phase. During the production of the $\overline{\mathrm{H}}^{+}$, $\overline{\mathrm{H}}$ atoms, with a fraction in the 2S state, will be produced which can be used to measure the Lamb shift. I will present the production of $6\,\mathrm{keV}$ $\overline{\mathrm{H}}$, a milestone for the experiment, as well as the status and future prospects of GBAR [GBAR, EPJC 83, 1004 (2023)].

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