A cool investigation into antiproton beam dynamics

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A new paper published in *Nuclear Instruments and Methods in Physics A* will help scientists provide higher quality antiproton beams to experiments at CERN and antimatter facilities across the world. "Non-Gaussian beam dynamics in low energy antiproton storage rings" (J. Resta-López et.al) presents simulation studies undertaken to investigate the effects of beam heating phenomena present in antimatter decelerators.

Currently most, if not all, antimatter experiments rely on low energy antiproton beams as a means to study the fundamental properties of antimatter. As a result, particle "accelerators" are used in a more unusual way to reduce the energy of, and slow down anti-particles. Once such "decelerator" is currently undergoing construction at the Antimatter Factory at CERN and is due for completion later this year. The Extra Low Energy Antiproton Decelerator (ELENA) ring will provide several experiments with higher intensity and lower energy beams than they have had before – speeding up the process of obtaining answers to fundamental questions about the universe. However, during the deceleration and storage process the beam experiences heating effects, causing the beam to "blow up" in phase space and if unmonitored and ignored, become unusable.

Using ELENA as a case study, the paper investigates how cooling instruments such as the electron cooler can counteract these negative effects, and what this will mean for the shape and characteristics of the beam when it reaches the experiments. The paper presents several

methods for simulating the beam evolution under these conflicting forces, eventually suggesting the best model and showing the distribution of the beam after the deceleration and cooling process.

The paper marks an important step towards understanding how to best control and manipulate some of the more mysterious matter in the universe.

More information: J. Resta-López et al. Non-Gaussian beam dynamics in low energy antiproton storage rings, *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* (2016). DOI: 10.1016/j.nima.2016.08.003

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