First Direct Observations of Gear-Changing In A Collider

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In this work we perform the first ever demonstration of gear-changing in a real-world collider. Gear-changing refers to a collision scheme where each ring of a collider stores a different harmonic number of bunches. These bunches are kept synchronized using different velocities. Such a system has been theorized, but has now been demonstrated using the Double ElectroStatic Ion Ring ExpEriment (DESIREE) in Stockholm Sweden. The experiment was able to demonstrate a gear-changing system, with both four on three bunches and five on four bunches. We determined a measurable parameter that shows a gear-changing system out to $37500$ turns of the slow beam. We also developed new insights into how to control this type of system, opening up new possibilities for research.