## **EPS-HEP2023** conference



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## Impact of accelerator physics on van der Meer luminosity calibrations at the LHC

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The uncertainties affecting the integrated absolute luminosity recorded by the experimental detectors in pp collisions during LHC Run 2 lie in the 1-2% range. They typically fall into three categories: van-der-Meer (vdM) calibration biases, instrumental non-linearities that affect the transfer of the vdM calibration to the high-luminosity physics regime, and long-term stability of the luminometers. In a recent update by the AT-LAS Collaboration, the vdM-calibration uncertainty in pp collisions at sqrt(s) = 13 TeV, which slightly dominates the other two categories, reached an absolute accuracy better than 1%, a performance unmatched at any hadron collider since the CERN ISR. Controlling systematic uncertainties to such a level requires an indepth understanding of multiple beam-instrumentation or accelerator-physics effects. The most challenging problems arise (i) from non-linear correlations in the transverse-density distributions of the colliding bunches (also known as non-factorization), and (ii) from separation-dependent, beam—beam-induced distortions of the beam orbits and of the bunch shapes. A broad overview of the above issues and of their mitigation will be illustrated by studies selected from recently released luminosity-performance results.

## **Collaboration / Activity**

ATLAS

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