Search for metastable heavy charged particles with large ionization energy loss in pp collisions at root s=13 TeV using the ATLAS experiment

Aaboud, M., Aad, G., Abbott, B., Abbott, D. C., Abeloos, B., Abhayasinghe, D. K., ... & Banas, E. (2019). Search for heavy charged long-lived particles in the ATLAS detector in 36.1 fb− 1 of proton-proton collision data at s= 13 TeV. Physical Review D, 99(9), 092007. Accessed 23 Apr 2021.

Abstract

This paper presents a search for massive charged long-lived particles produced in pp collisions at √s=13 TeV at the LHC using the ATLAS experiment. The data set used corresponds to an integrated luminosity of 3.2 fb−1. Many extensions of the Standard Model predict the existence of massive charged long-lived particles, such as R-hadrons. These massive particles are expected to be produced with a velocity significantly below the speed of light, and therefore to have a specific ionization higher than any Standard Model particle of unit charge at high momenta. The Pixel subsystem of the ATLAS detector is used to measure the ionization energy loss of reconstructed charged particles and to search for such highly ionizing particles. The search presented here has much greater sensitivity than a similar search performed using the ATLAS detector in the √s=8 TeV data set, thanks to the increase in expected signal cross section due to the higher center-of-mass energy of collisions, to an upgraded detector with a new silicon layer close to the interaction point, and to analysis improvements. No significant deviation from Standard Model background expectations is observed, and lifetime-dependent upper limits on R-hadron production cross sections and masses are set. Gluino R-hadrons with lifetimes above 0.4 ns and decaying to $q\bar{q}$ plus a 100 GeV neutralino are excluded at the 95% confidence level, with lower mass limit ranging between 740 and 1590 GeV. In the case of stable R-hadrons the lower mass limit at the 95% confidence level is 1570 GeV..