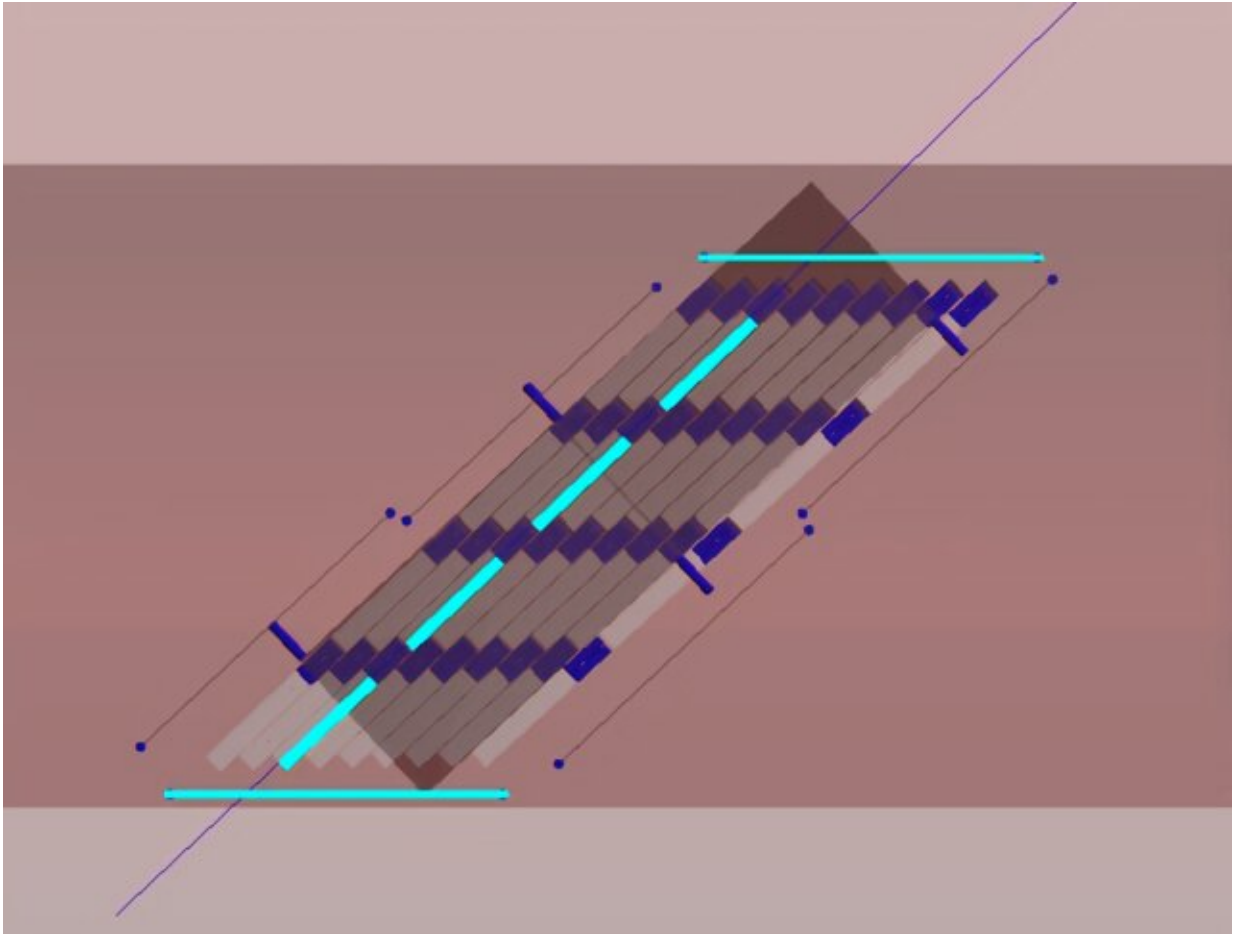


# Chasing particles with tiny electric charges

July 15 2020, by Ana Lopes

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Computer simulation of the proposed milliQan detector. The light blue represents the flash of light that would be produced in the detector by the passage of a millicharged particle. Credit: The milliQan collaboration

All known elementary particles have electric charges that are integer

multiples of a third of the electron charge. But some theories predict the existence of "millicharged" elementary particles that would have a charge much smaller than the electron charge and could account for the elusive dark matter that fills the universe. An international team of researchers has now reported the first search at the Large Hadron Collider (LHC)—and more generally at any hadron collider—for elementary particles with charges smaller than a tenth of the electron charge.

Many previous studies have tried and failed to find millicharged particles, both directly, at collider and non-collider experiments, and indirectly, using astronomical observations. But millicharged particles with masses between about 1 billion electron volts (GeV) and 100 GeV remain largely unexplored owing to the lack of sensitivity of current detectors to such particles.

This is where a proposed detector called milliQan could make a difference. The detector would be sensitive to 1–100 GeV millicharged particles produced in proton–proton collisions at the LHC, through the flash of light created in its interior by the passage of such a particle. The detector has yet to be approved, and if approved then built, but a demonstrator detector that is a mere 1% of the full detector and was installed at the LHC in 2017 and gathered data in 2018 has now delivered promising results.

The data taken by the milliQan demonstrator rule out the existence of millicharged particles with masses between 20 and 4700 MeV for charges varying between 0.006 and 0.3 times the electron charge, depending on the mass. The results are consistent with those previously obtained by other experiments and represent a hadron collider's first venture into the territory of particles with a charge smaller than 0.1 times the electron charge.

"We are very pleased by these results from the demonstrator. It has certainly achieved the original goal of providing feedback on our design and giving us experience with its operation, but to demonstrate that with only a 1% prototype we were already able to place new constraints on the properties of millicharged particles was a nice bonus. We are now quite confident that the full-scale milliQan detector will perform as expected, and we look forward to securing the funding to make this happen," says Chris Hill, co-spokesperson of the milliQan collaboration.

**More information:** Ball et al., Search for millicharged particles in proton-proton collisions at  $s\sqrt{=13}$  TeV. arXiv:2005.06518 [hep-ex]. [arxiv.org/abs/2005.06518](https://arxiv.org/abs/2005.06518)

Provided by CERN

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