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# Constraints on the cosmic ray cluster physics from a very deep observation of the Perseus cluster with MAGIC

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Galaxy clusters are the largest and most massive gravitationally bound structures known in the Universe. Cosmic-ray hadrons (CR) accelerated at structure formation shocks and injected by galaxies, are confined in galaxy clusters where they accumulate for cosmological times. The presence of diffuse synchrotron radio emission in several clusters proves the existence of high-energy electrons, and magnetic fields, but a direct proof of CR acceleration is missing. However CRs must interact with the intra-cluster medium (ICM) inducing a diffuse gamma-ray emission. The Perseus cluster, a nearby cool-core cluster, has been identified among the best candidates to detect such emission. We present here the results of a very deep observation of the Perseus cluster with the MAGIC telescopes, accumulating about 300 hours of data from 2009 to 2015. No evidence of large-scale VHE gamma-ray emission from CR-ICM interactions has been detected. The flux upper limit above 1 TeV allows us to put stringent constraints on the cluster CR physics, in particular on the CR-to-thermal pressure, on the CR acceleration efficiency at formation shocks, and on the magnetic field of the central cluster region.

## Collaboration

MAGIC

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