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Search for Axion Quark Nuggets at the LHC

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Axion Quark Nuggets (AQNs) [1] have been suggested to solve the Dark Matter (DM) and the missing Antimatter problem in the universe, and have been proposed as an explanation of various observations [2-4]. Their size is in the μm range, and their density is equal to the nuclear density with an expected flux of about $1/\text{km}^2/\text{year}$. For the typical velocity of DM constituents (250 km/s), the solar system bodies act as highly performing gravitational lenses, including the inner Earth and the Moon towards the Earth; Here we assume that DM streams or clusters are impinging, e.g., on the Earth, as was worked out for DM axions and WIMPs [5-6]. Interestingly, in the LHC beam, unforeseen beam losses are possibly triggered by Unidentified Falling Objects (UFOs), which are believed to consist of dust particles with a size in the μm range and a density several orders of magnitude lower than AQNs. It has been suggested [7] that streaming DM constituents incident on the Earth should result in jet-like structures (“hairs”) exiting the Earth. Such ideas open novel directions in the search for DM. We suggest a new analysis of the UFO results at the LHC, assuming that they are eventually, at least partly, due to AQNs, while other potential signatures are being investigated. Specifically, a re-analysis of the existing data from the 4000 LHC beam monitors is proposed, arguing that dust and AQNs should behave differently. The feasibility of this idea has been presented within the Roadmap of DM models for Run 3 at CERN.

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