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Axion Quark Nuggets and Matter-Antimatter asymmetry as two sides of the same coin: theory, observations and future experimental searches

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In this talk I want to discuss the (unorthodox) scenario when the baryogenesis is replaced by a charge segregation process in which the global baryon number of the Universe remains zero. In this, the so-called axion quark nugget (AQN) dark matter model the unobserved antibaryons come to comprise the dark matter in the form of dense nuggets. In this framework, both types of matter (dark and visible) have the same QCD origin, form at the same QCD epoch, and both proportional to one and the same fundamental dimensional parameter of the system, which explains how the two, naively distinct, problems could be intimately related, and could be solved simultaneously within the same framework. I specifically focus on several recent papers written with AMO (Atomic-Molecular-Optic), Nuclear physics and Astro-physics people to apply these generic ideas to several recent proposals: 1. on broadband strategy in the axion searches; 2. on daily modulations and amplifications generated by the AQN dark matter and how they can be studied; 3. on recently detected by Telescope Array the Mysterious Burst Events which are very distinct from conventional cosmic air showers.

The talk is based on several recent papers including:

1. D. Budker, V. V. Flambaum, X. Liang and A. Zhitnitsky, "Axion Quark Nuggets and how a Global Network can discover them," *Phys. Rev. D* 101 no.4, 043012 (2020) [arXiv:1909.09475 [hep-ph]].
2. A. Zhitnitsky, "The Mysterious Bursts observed by Telescope Array and Axion Quark Nuggets," *Journal of physics G: Nuclear and Particle Physics* (2021) [arXiv:2008.04325 [hep-ph]]

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