Contribution ID: **66** Type: **parallel**

Constraint on transient variations of fine-structure constants with optical atomic clocks

Tuesday 13 September 2016 16:10 (30 minutes)

One of possible scenarios predicts that the dark matter (DM) may have a form of stable topological defects [1]. For nonzero DM coupling to standard-model particles, the encounter with such object would effectively result in temporary variation of fundamental constants. Recently it was proposed by Derevianko and Pospelov [2] that the networks of correlated atomic clocks may be used for such searches. For the class of optical clocks [3-7] such measurements are mostly sensitive to the variations of the fine-structure constant since the electronic transitions are used. We present first experimental constraint on the coupling of transient DM coupling to standard-model particles obtained with optical atomic clocks. In our measurement [8] we used two non-separated strontium optical lattice clocks [9,10]. In contrast to the approach given in Ref. [2] we do not measure a phase difference between the clocks but the common signal in the readouts. Furthermore the sensitivity of our method does not scale with the distance between the sensors hence can applied to both distant and non-separated sensors. Our constraint already reaches the capability of a constellation of GPS atomic clocks [2] and substantially exceeds previous laboratory and astrophysical limits [11].

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Summary

Primary author: WCISLO, Piotr (Nicolaus Copernicus University in Torun)

Co-authors: Dr CYGAN, Agata (Nicolaus Copernicus University in Torun); Prof. LISAK, Daniel (Nicolaus Copernicus University in Torun); Dr BOBER, Marcin (Nicolaus Copernicus University in Torun); Dr ZAWADA, Michal (Nicolaus Copernicus University in Torun); Dr MORZYNSKI, Piotr (Nicolaus Copernicus University in Torun); Prof. CIURYLO, Roman (Nicolaus Copernicus University in Torun)

Presenter: WCISLO, Piotr (Nicolaus Copernicus University in Torun)

Session Classification: [VC-E] Varying constants –laboratory experiments