# Search for photon oscillations into massive particles

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Extensions of the Standard Model commonly involve light fields very weakly coupled to ordinary matter, hence difficult to detect. A famous example of such a field is the axion, a light, pseudoscalar, neutral and spinless particle which was proposed 30 years ago to solve the strong CP problem [1]. The most popular strategy to detect the axion uses its coupling to a two-photon vertex and consists of converting an axion into a photon of same energy in an intense magnetic field [2]. Despite a constant experimental effort, no axion has been detected yet. The experimental results, along with astrophysical and cosmological arguments, have nevertheless put stringent bounds on the axion mass and on its coupling to two photons.

Triggered by some unexpected experimental results [3], several "light shining through the wall" experiments were built last year, among which our "boson project" was able to improve the existing limits from previous purely laboratory searches [4]. After describing the experimental set-up and presenting our results, I will stress how such optical precision experiments are a unique and powerful tool to explore low energy physics beyond the Standard Model [5]. This point will be further illustrated by the case of paraphoton, a massive relative of ordinary photon weakly coupled to it, which properties are constrained by our recent experimental data.

Finally, I shall briefly sketch some possible future experiments that would yield valuable information on physics beyond standard model.

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[1] R.D. Peccei and H. Quinn, Phys. Rev. Lett. **38**, 1440 (1977); S. Weinberg, *ibid.* **40**, 223 (1977); F. Wilczek, *ibid.* **40**, 279 (1977).

[2] P. Sikivie, Phys. Rev. Lett. **51**, 1415 (1983); **52**, 695(E) (1984).

[3] E. Zavattini *et al.*, Phys. Rev. Lett. **96**, 110406 (2006); Phys. Rev. Lett. **99**, 129901(E) (2007).

[4] C. Robilliard *et al.*, Phys. Rev. Lett. **99**, 190403 (2007).

[5] M. Ahlers *et al.*, Phys. Rev. D **76**, 115005 (2007); H. Gies *et al.*, Phys. Rev. D **77**, 025016 (2008).