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Optics and magnetic fields for fundamental physics

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In recent years precision optics together with strong magnetic fields have become key ingredients for fundamental physics experiments searching, for example, for vacuum magnetic birefringence and for axions and/or axion-like particles. Vacuum magnetic birefringence (polarisation dependent refractive index) is a macroscopic non-linear electrodynamic effect in vacuum predicted as a consequence of the formulation of the Euler-Kockel-Heisenberg effective Lagrangian, first proposed in 1935, which takes into account electron-positron fluctuations. A direct laboratory observation of vacuum magnetic birefringence is still lacking today due to its minute value: $\Delta n = 4x10e\text{-}24$ @ B = 1T. Axions and axion-like particles are light neutral hypothetical bosons which could couple to two photons through the Primakoff effect. The existence of these hypothetical particles could solve the strong CP problem and are good dark matter candidates. I will describe some recent experimental results and proposals regarding these two areas of research. Key experimental ingredients in such researches are a Fabry-Perot interferometer, an intense magnetic field and a time-dependent effect.

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