The VMB@CERN experiment

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Poster #34

on behalf of the VMB@CERN Collaboration

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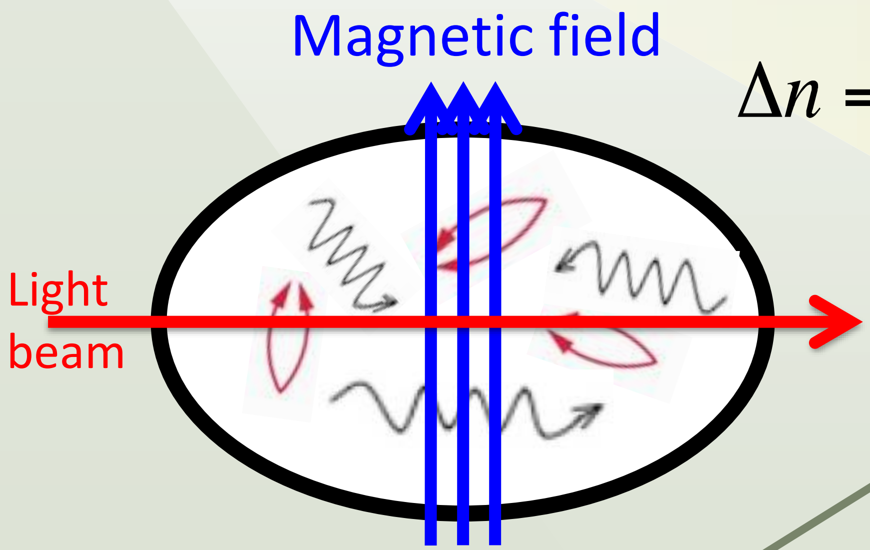
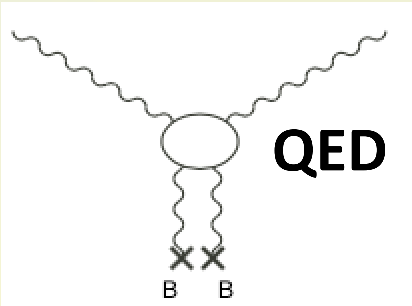
OPTICAL PROPERTIES OF QUANTUM VACUUM

Vacuum is structured and has properties that can be studied experimentally.



$$\Delta n = n_{\parallel} - n_{\perp}$$



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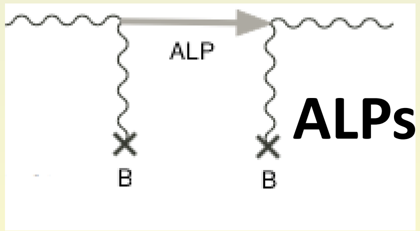
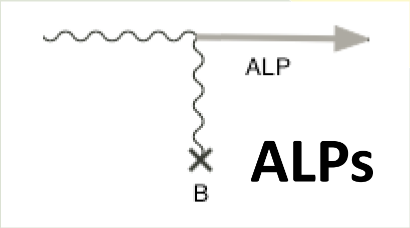
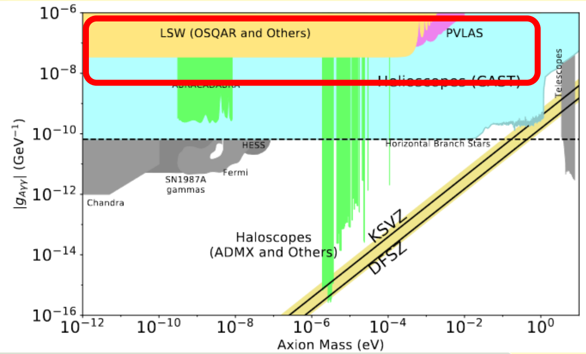


$\Delta n_{QED} = 3A_e B^2 = 4\times10^{-24}$ @ 1 T magnetic field

VACUUM MAGNETIC BIREFRINGENCE



Model independent search for 'light' DM



$$\Delta\tilde{n} = \Delta n_B + i\Delta\kappa_B$$

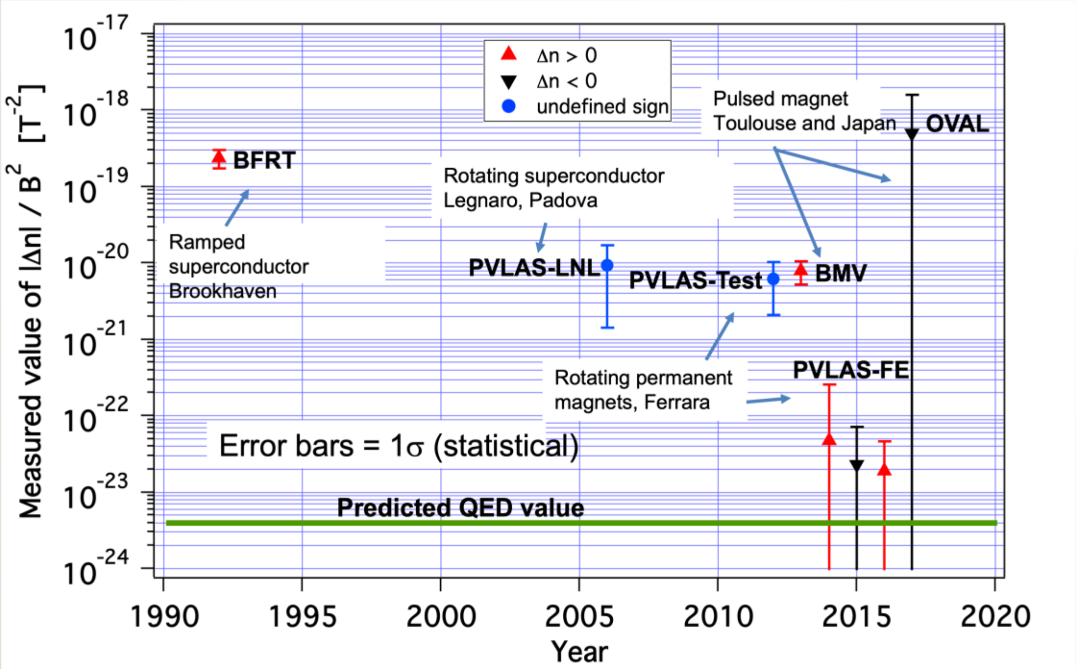
BIREFRINGENCE DICHROISM

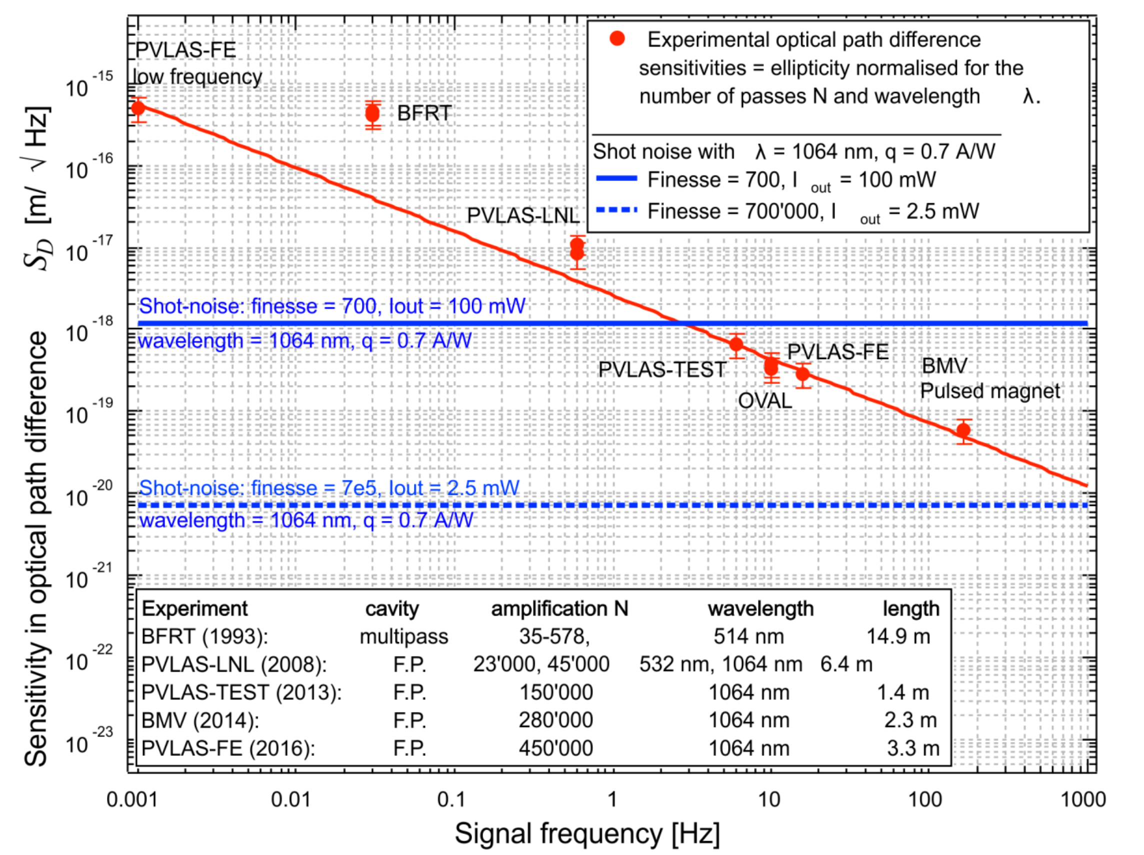
Experimental method:

- Perturb with an external B field
- Probe with a (polarised) light beam
- Detect changes in the polarisation state

Key ingredients:

- High magnetic field — **Effect α B^2**
- Long optical path — **Optical cavity**
- High sensitivity polarimeter — **Modulation of the signal**





Need to increase the signal!

LHC dipole magnet $B^2 L \approx 1200\ T^2\ m$

PVLAS permanent magnets $B^2 L \approx 10\ T^2\ m$

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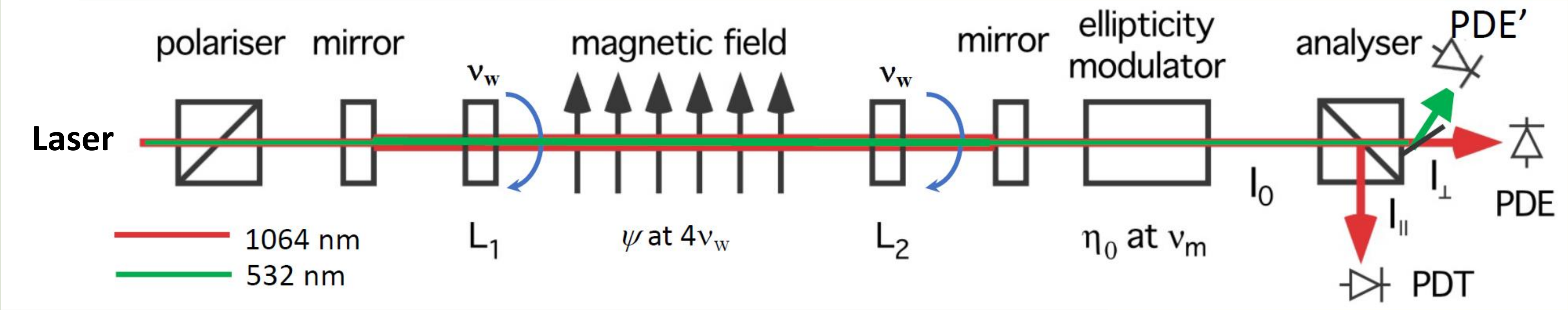
Magnetic field in superconducting magnets cannot be modulated (fast enough).

Rotate polarization instead of magnet!

LoI submitted to CERN: CERN-SPSC-2018-036/SPSC-I-249



We use two co-rotating half waveplates inside the optical cavity:

- Polarisation rotates inside the magnetic field but is fixed on the mirrors (no mirror birefringence signal).
- Maximum finesse ≈ 800 - 3000 (depending on the losses of the waveplates).
- Auxiliary green laser beam @ 532 nm allows real-time control of systematics of the individual waveplates.