

Interferometry of light propagation in pulsed fields

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with H.Gies
(TPI Jena)

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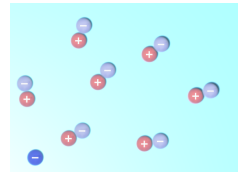
- 1 Introduction
- 2 GWIs
- 3 Pulsed high fields
- 4 Discovery potential
- 5 Conclusion

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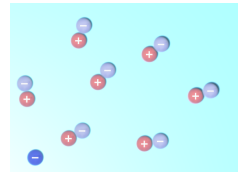
NL QED and beyond

- polarization of the vacuum leads to modified dispersion relation [Heisenberg/Euler 36]



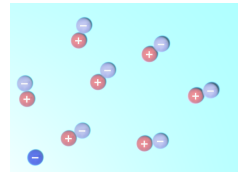
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- in QED: $v_{\parallel/\perp} = 1 - \frac{(14)_{\parallel}, (8)_{\perp}}{45} \frac{\alpha^2}{m^4} B_e^2 \sin^2 \theta$



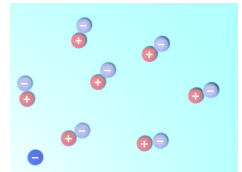
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- similar: **effective coupling** to MCPs and axions?
- **large mass** / **small coupling** renders the effect tiny



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very sensitive instruments

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interferometers (GWIs) **do**
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- [Boer/Van Holten 02, Zavattini/Calloni 08]
- use of **pulsed** magnets is
advantageous



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GWs in general

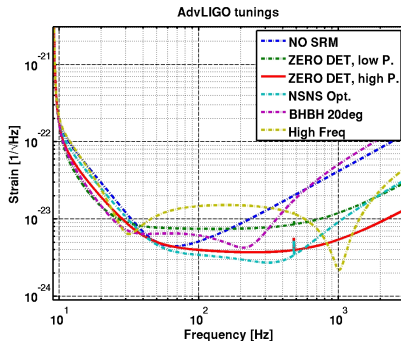
- measure the relative change of armlength (strain)
 $h(t) = \frac{\Delta L}{L}$ due to an incoming GW



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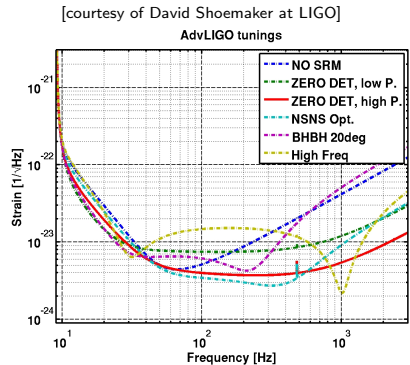
- measure the relative change of armlength (strain)

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 due to an incoming GW
- the sensitivity is strongly frequency dependent (low f : seismic, high f : shot noise)
- generically most sensitive at $\mathcal{O}(10^2)$ Hz



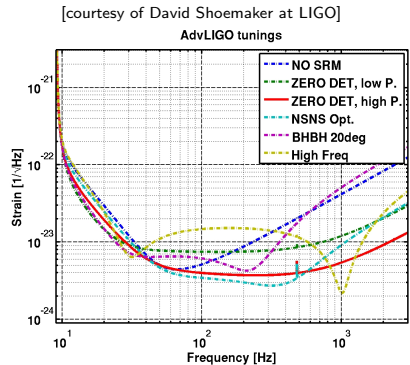
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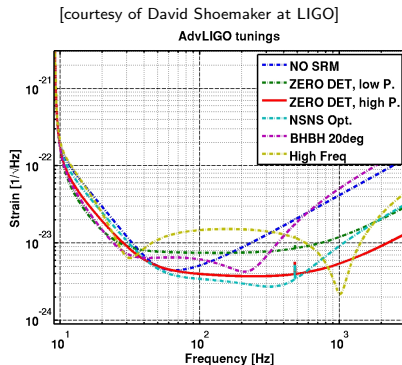
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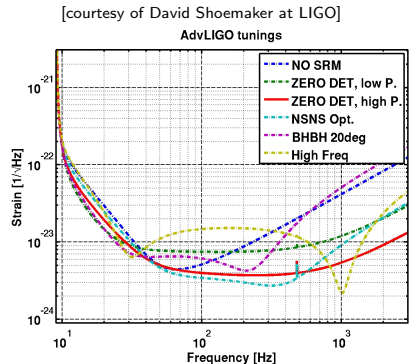
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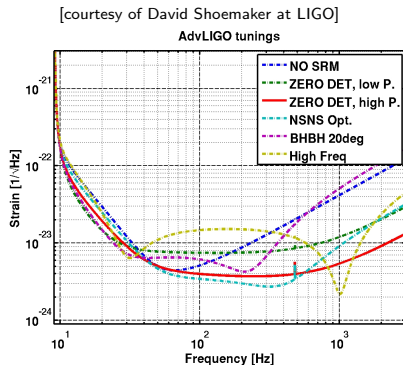
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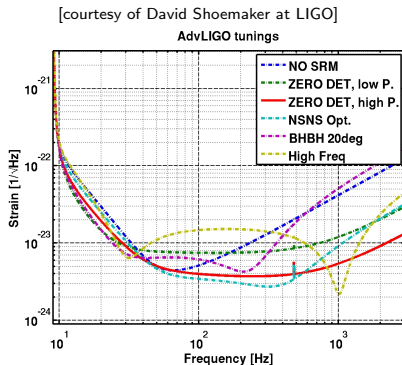
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- (no polarimetry)
- strong magnetic fields at $\mathcal{O}(10\text{ms})$?



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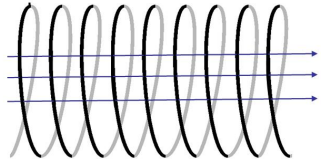
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High magnetic fields



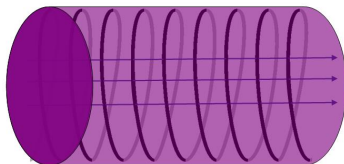
High magnetic fields

- modern high field laboratories aim at 100T in solenoids [Wosnitza et al. 06]



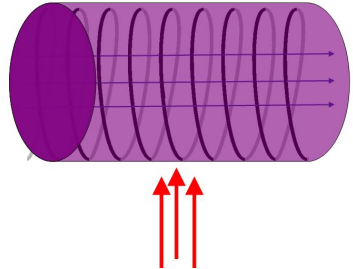
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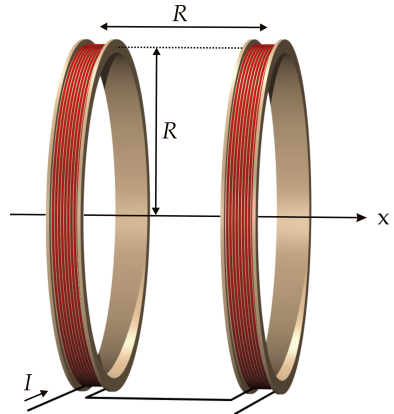
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- asks for Helmholtz coils (aim: 60T)



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- Ask for a SNR of $\mathcal{O}(1)$ at
AdvLIGO (under construction) and GEO600(operational)

Results: Nonlinear QED

- $N = 2700$ pulses at
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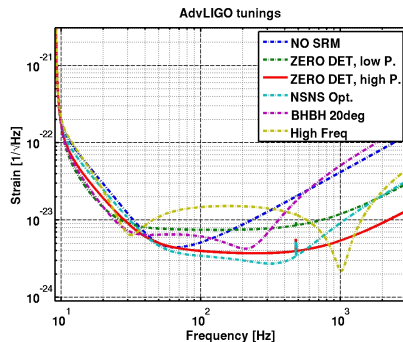
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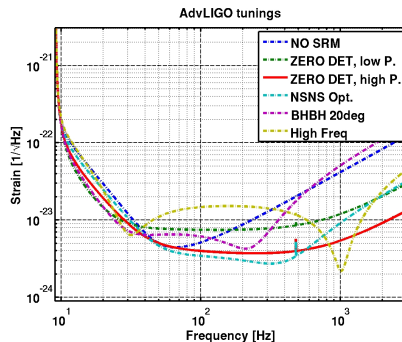
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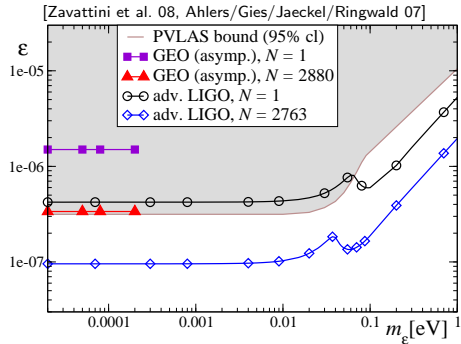
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- what about hypothetical particles?



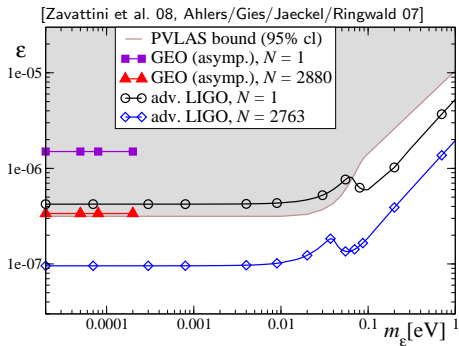
MCPs at AdvLIGO and GEO600

- coil separation of $\mathcal{O}(1\text{cm})$ constrains masses to $m_\epsilon \gtrsim 2 \times 10^{-5} \text{eV}$



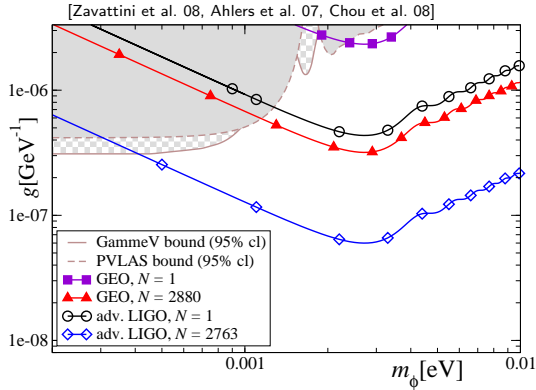
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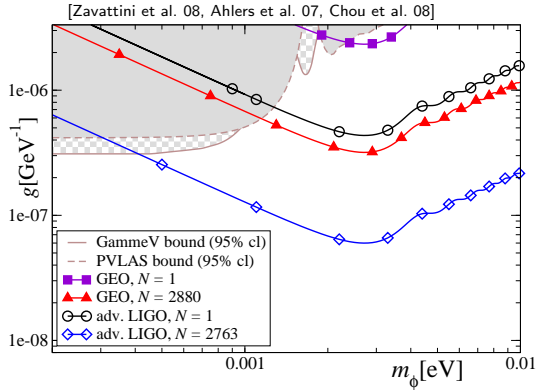
ALPs at AdvLIGO and GEO600

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- In both cases:
astrophysical energy loss considerations



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- “kill two birds with one stone ?” B.D. and Holger Gies (to be published in EPL)

thank you for your attention!

