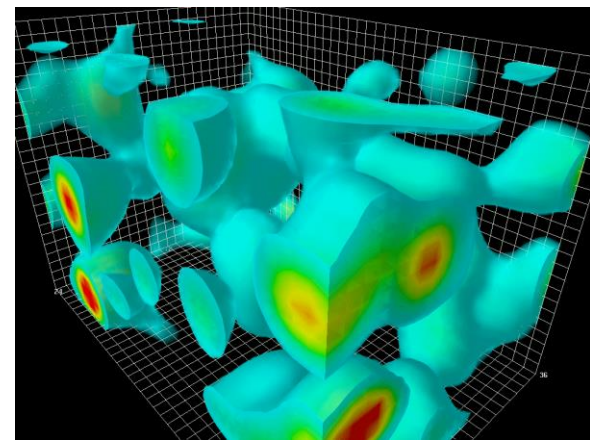


The DeLLight Project: Slowing down the light in vacuum with intense laser pulses

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Nonlinear interaction between EM-fields via e^-/e^+ pairs in QED vacuum

$$\mathbf{D} = \epsilon_0 \mathbf{E} + \mathbf{P}(\mathbf{E}, \mathbf{B}) = \epsilon(\mathbf{E}, \mathbf{B}) \cdot \mathbf{E}$$

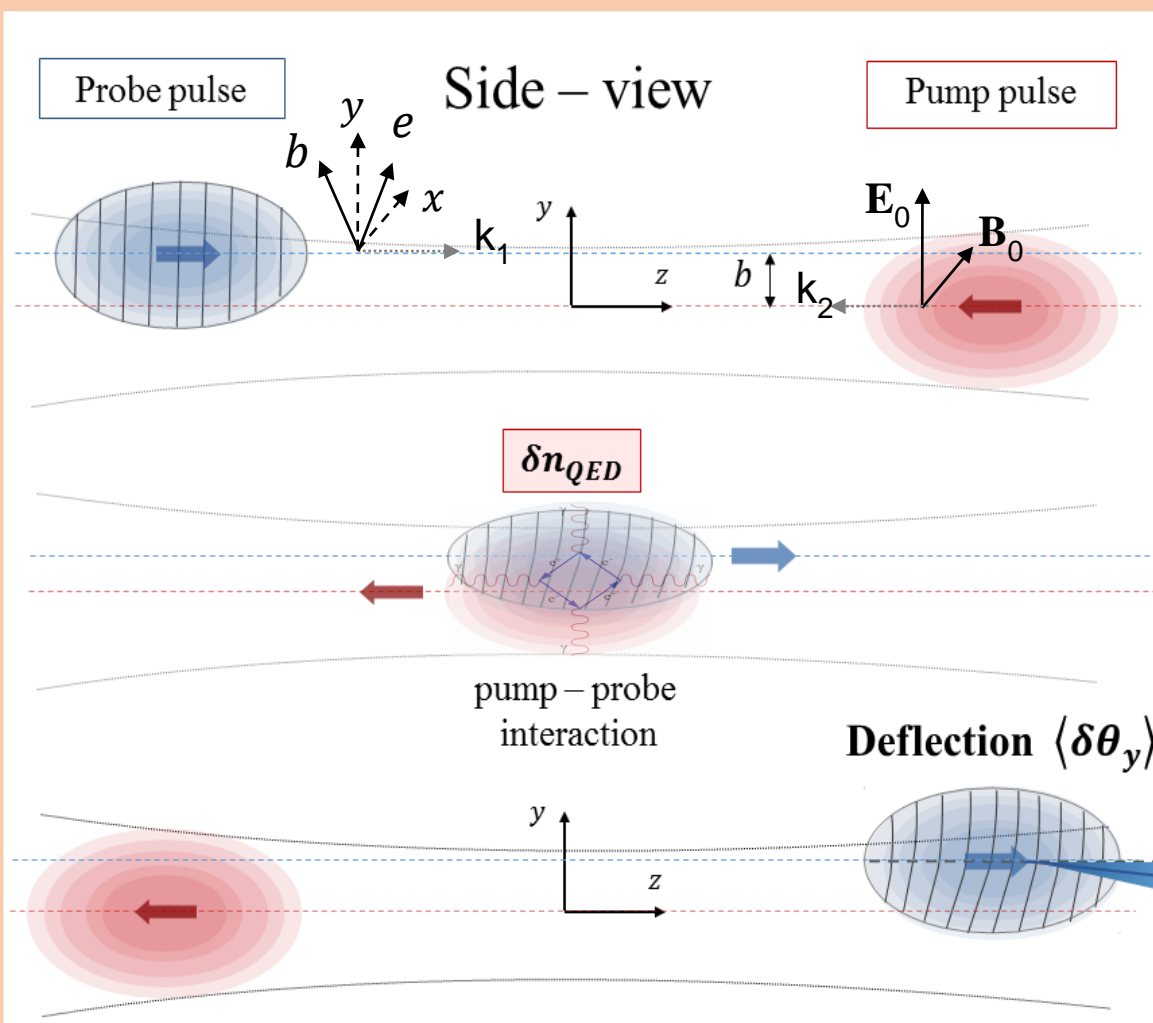
$$\mathbf{B} = \mu_0 \mathbf{H} + \mu_0 \mathbf{M}(\mathbf{E}, \mathbf{B}) = \mu(\mathbf{E}, \mathbf{B}) \cdot \mathbf{H}$$

$$\mathbf{P} = \xi \epsilon_0^2 [2(E^2 - c^2 B^2) \mathbf{E} + 7c^2 (\mathbf{E} \cdot \mathbf{B}) \mathbf{B}]$$

$$\mathbf{M} = -\xi \epsilon_0^2 c^2 [2(E^2 - c^2 B^2) \mathbf{B} - 7(\mathbf{E} \cdot \mathbf{B}) \mathbf{E}]$$

$$\xi^{-1} = \frac{45 m_e^4 c^5}{4 \alpha^2 \hbar^3} \cong 3 \times 10^{29} \text{ J/m}^3$$

→ optical nonlinearity in vacuum



Pump specifications (LASERIX)

Energy ≈ 2.5 Joules
 Duration ≈ 50 fs
 Waist @ focus $\approx 5 \mu\text{m}$
 $\Rightarrow I_{\text{pump}} \sim 2 \times 10^{20} \text{ W/cm}^2$

$$\delta n_{QED} \sim 3 \times 10^{-13}$$

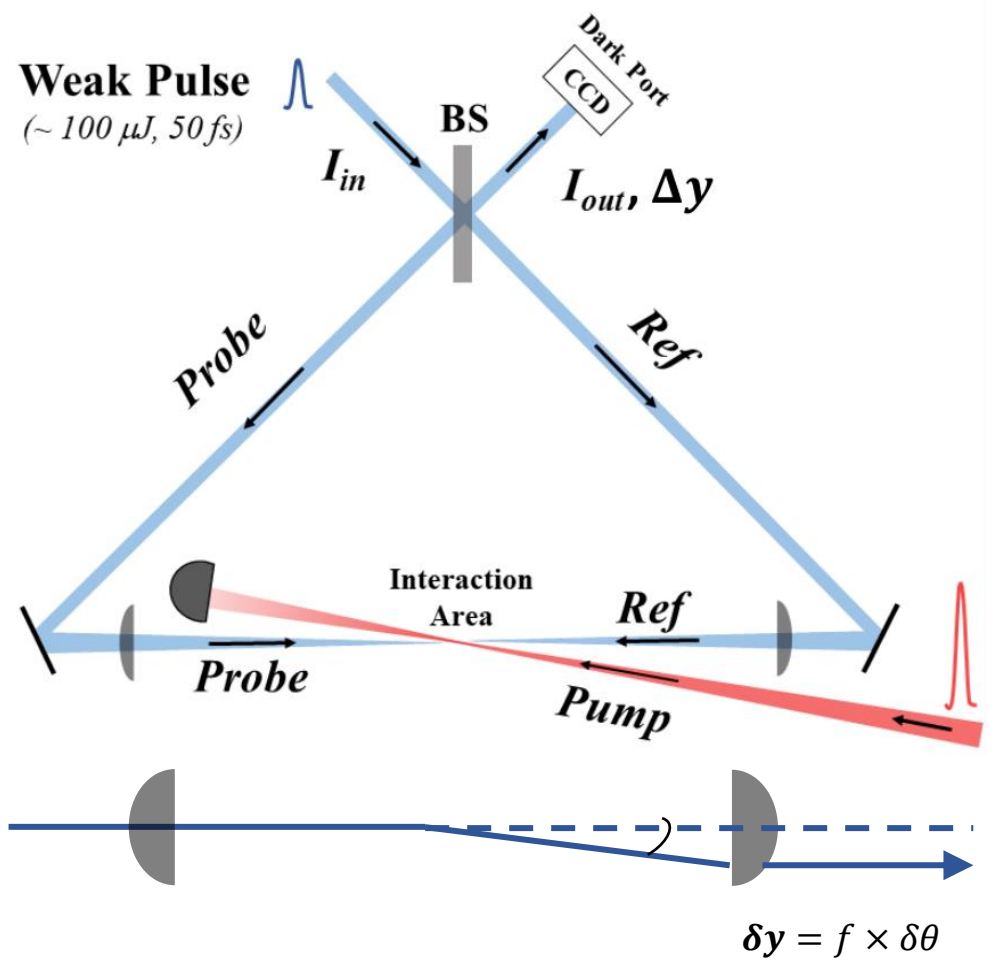
$$\langle \delta\theta_y \rangle \sim 0.13 \text{ prad}$$

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Amplification by a Sagnac interferometer



$$\Delta y = 2.7 \text{ nm} \times \frac{E(\text{Joule}) \times f(\text{m})}{(w_0^2 + W_0^2 (\mu\text{m}))^{3/2} \times \sqrt{\mathcal{F}/10^{-5}}}$$

$$\Delta y \sim 15 \text{ pm}$$

Spatial resolution $\sigma_y = 15 \text{ nm}$
 ON-OFF @ 5 Hz
 1 sigma sensitivity within
 ~ 4 days with LASERIX

