A matterless double-slit

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High Energy Quantum-Electrodynamics

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Overview

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- Brief history of the double-slit experiment
- The polarised vacuum and elastic, real, photon-photon scattering
- A matterless double-slit scenario
- Single-slit diffraction

The double-slit experiment

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- Double-slit effect first noted by Thomas Young (1804)

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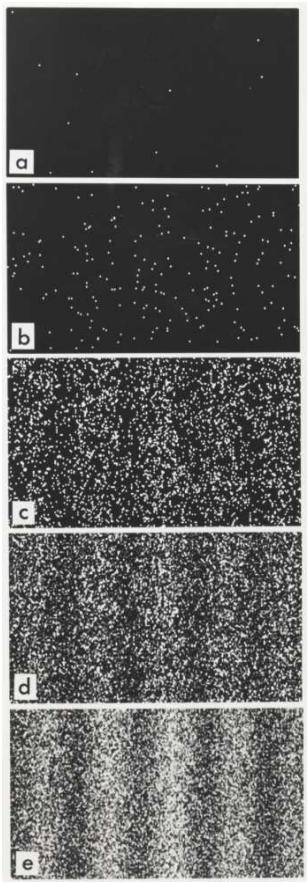

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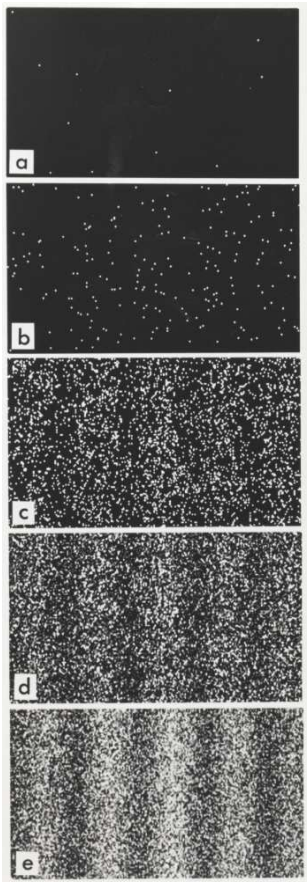

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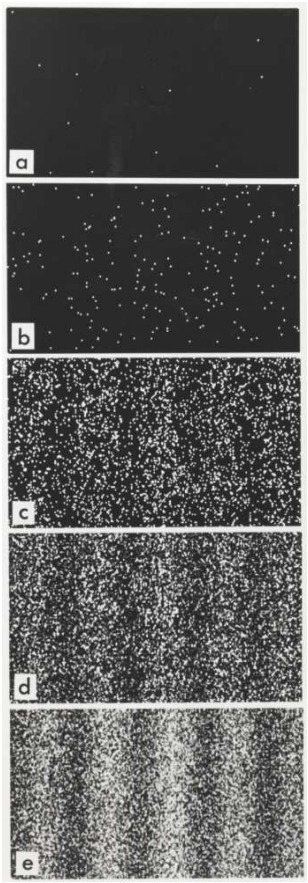

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- First "fundamental" massive particles (1961)
- Voted the "most beautiful experiment" by readers of Physics' World (2002)
- Recently performed with C_{60} fullerenes and biological molecules (1999, 2003)

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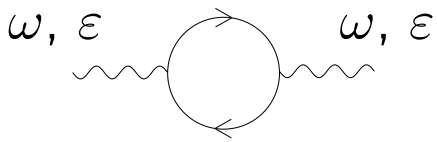
- 

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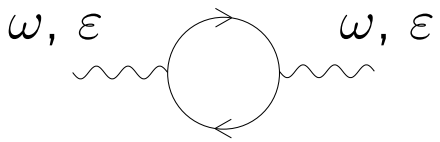
- 

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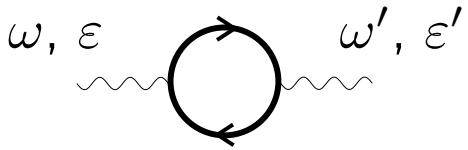
- 

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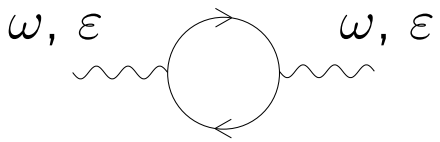
- 

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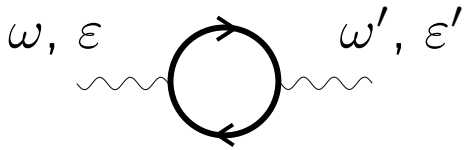
- 

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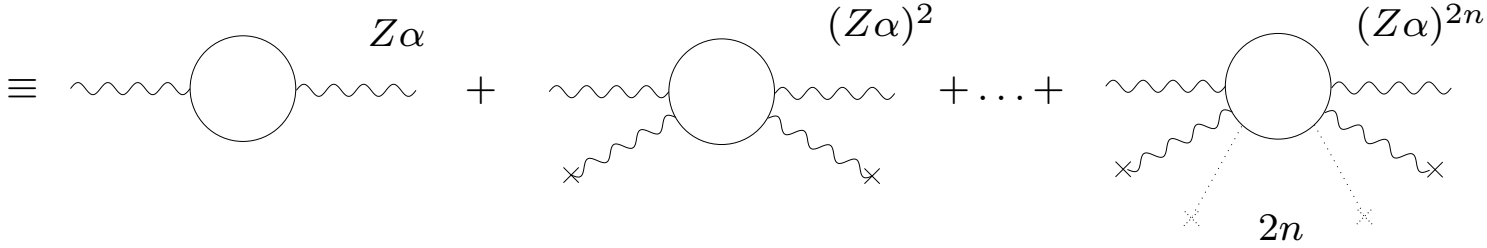

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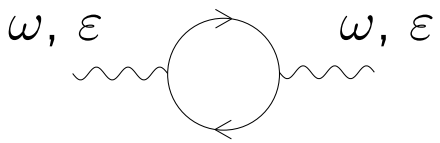
- 

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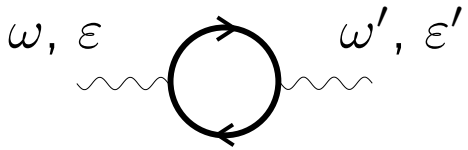
- 

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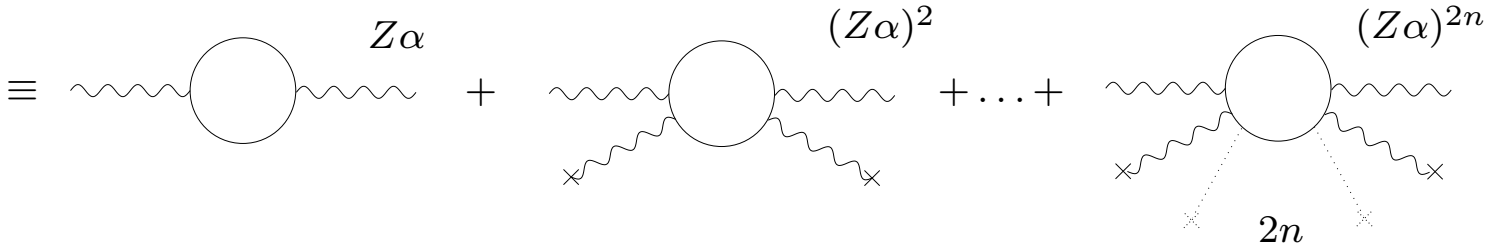
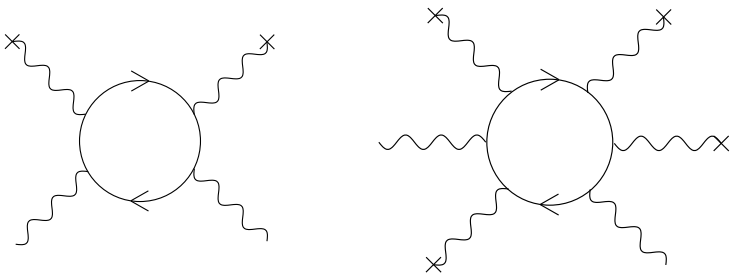


- 

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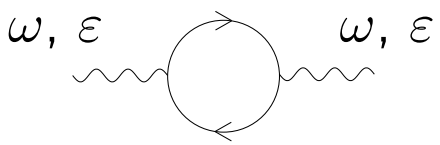
- 

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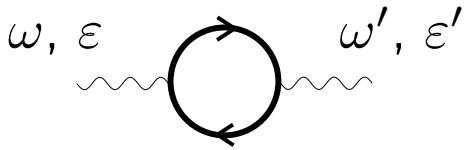
- 

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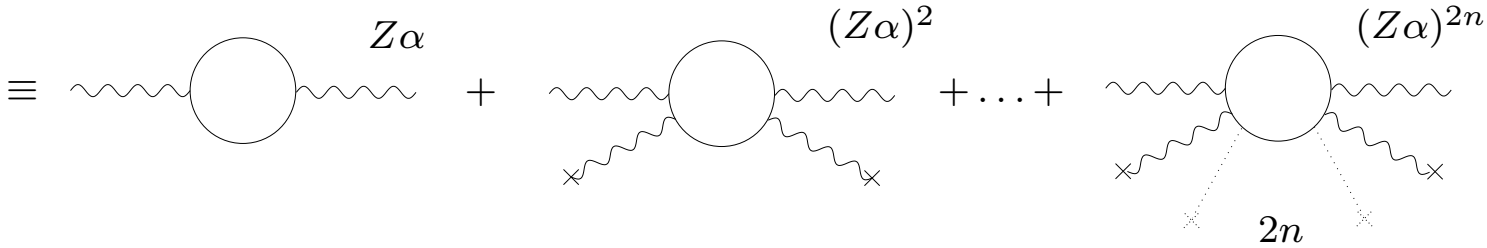
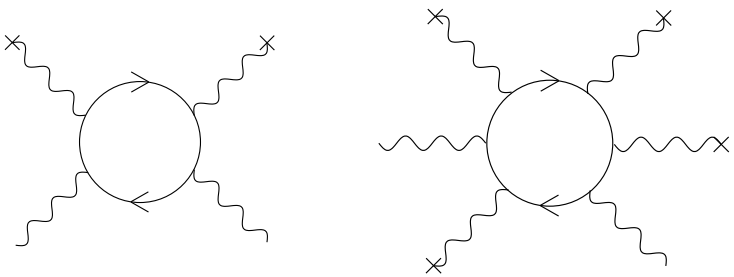


- 
Non-linear (and non-perturbative) coupling between free photons in an external field

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- Polarised vacuum as a Kerr-like medium

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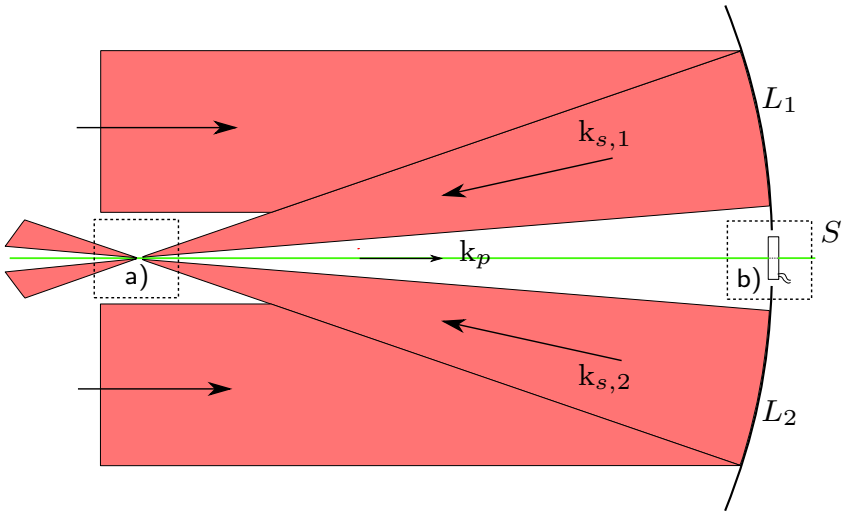

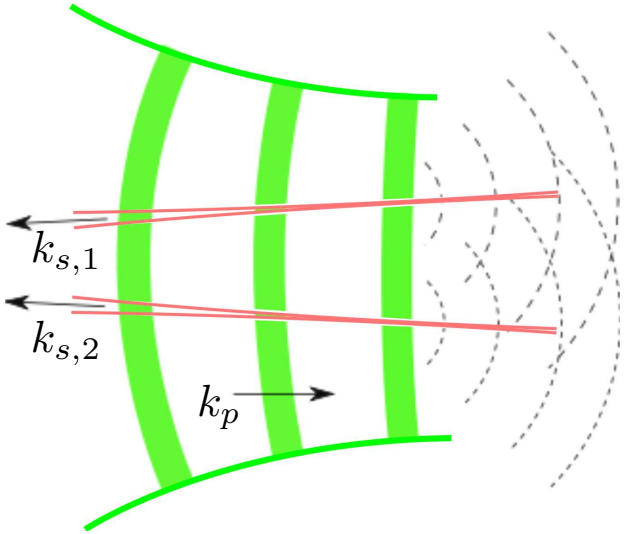

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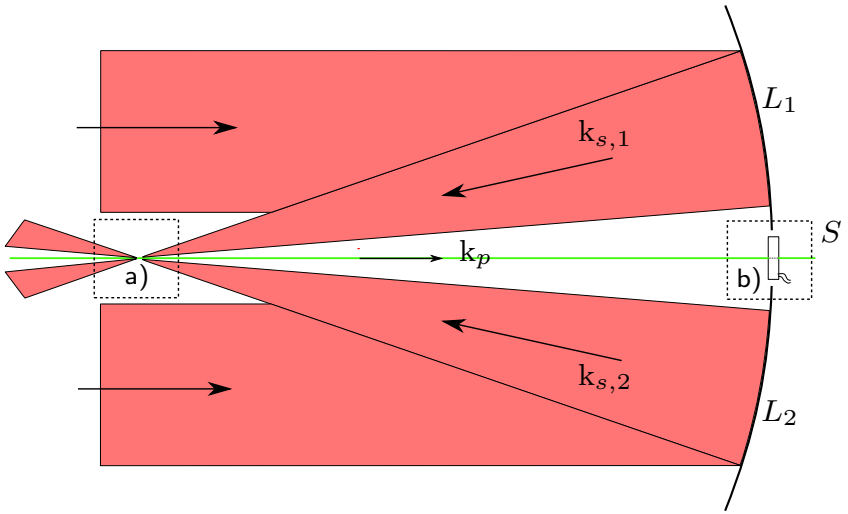

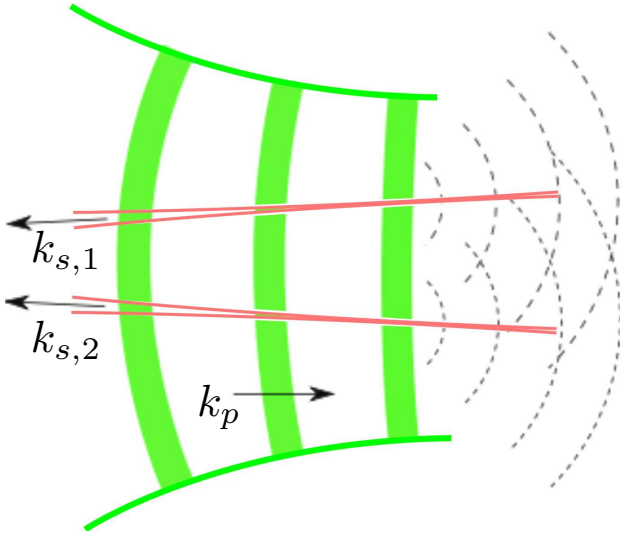

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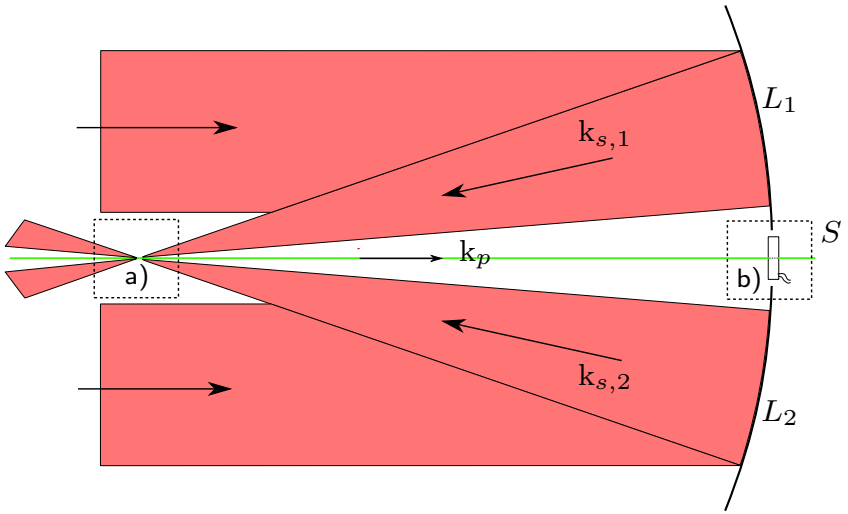

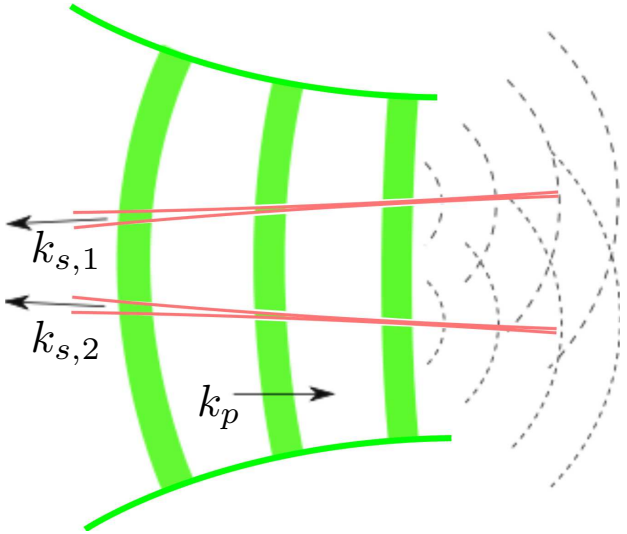

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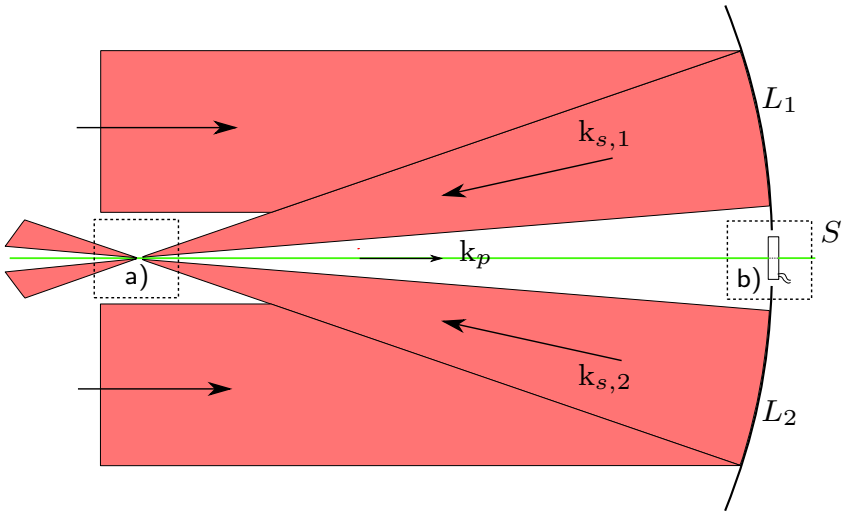

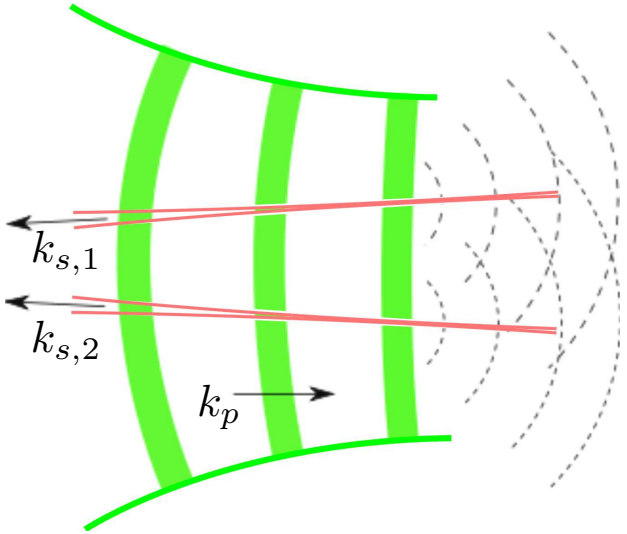

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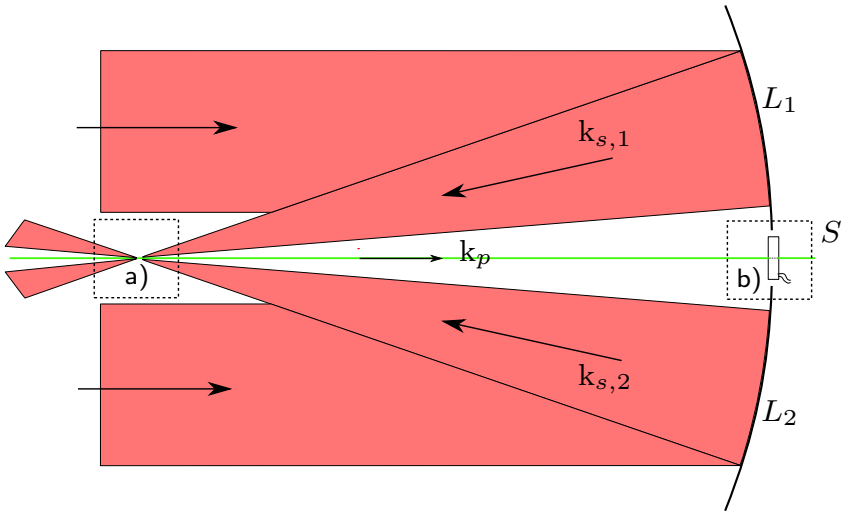

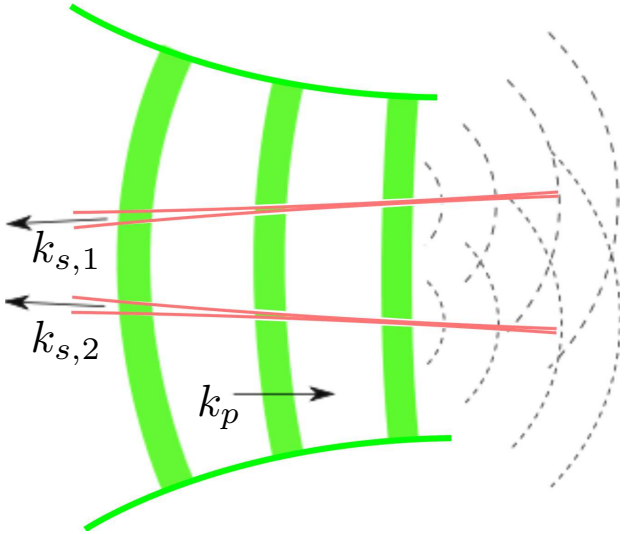

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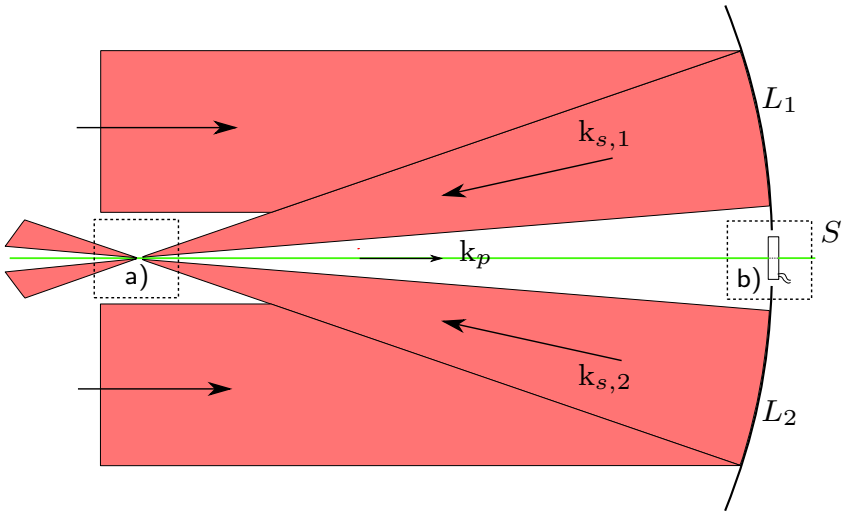

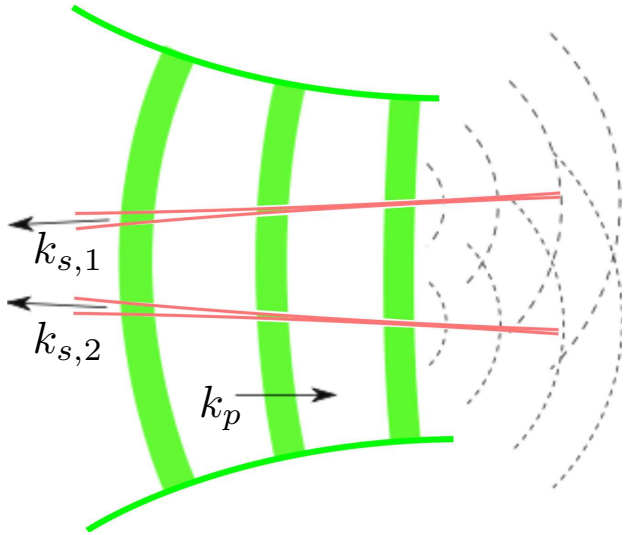

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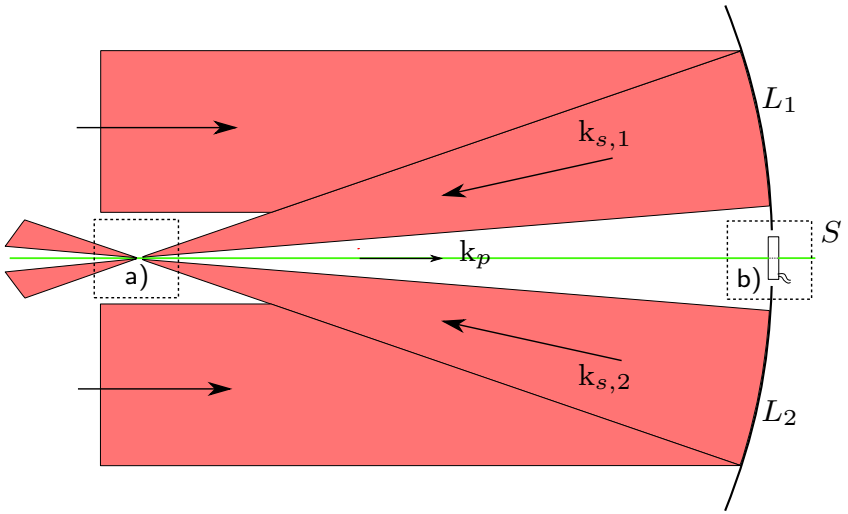

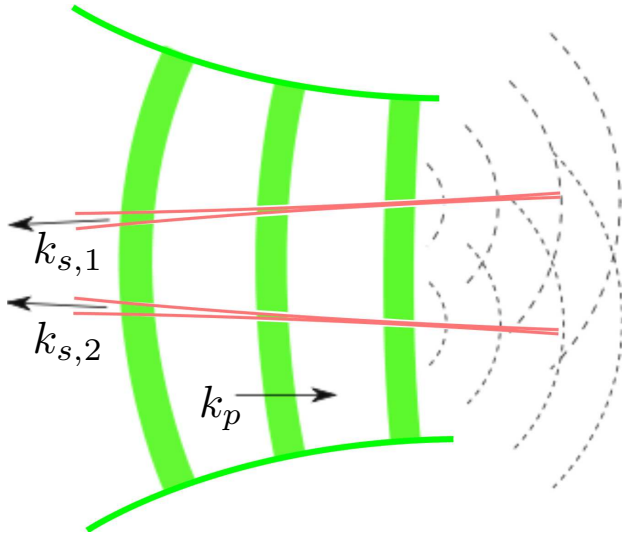

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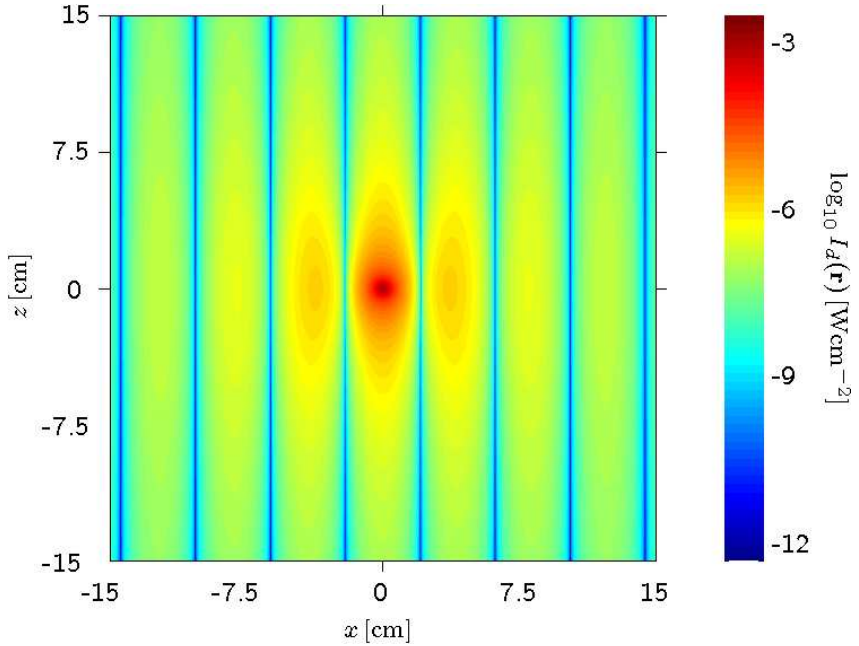

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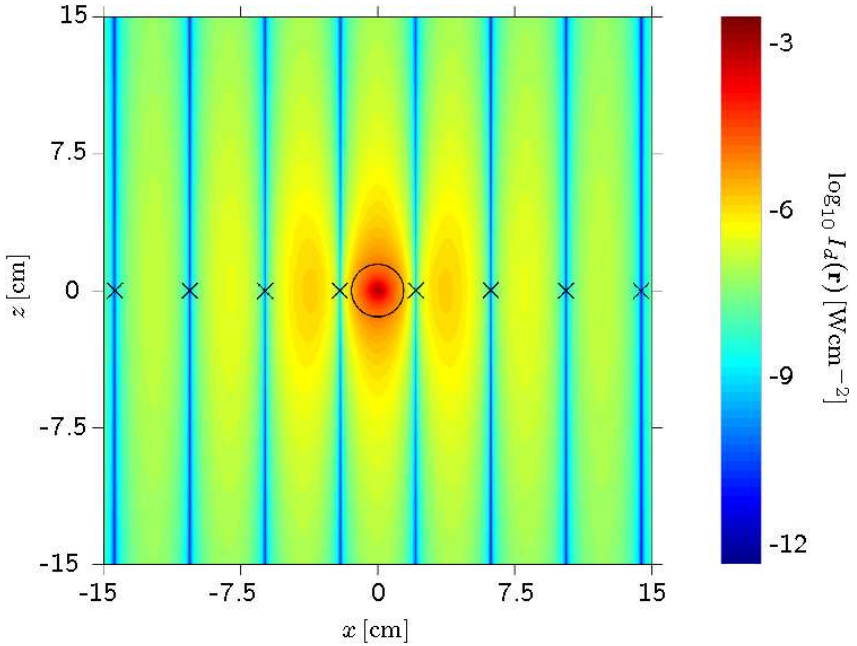

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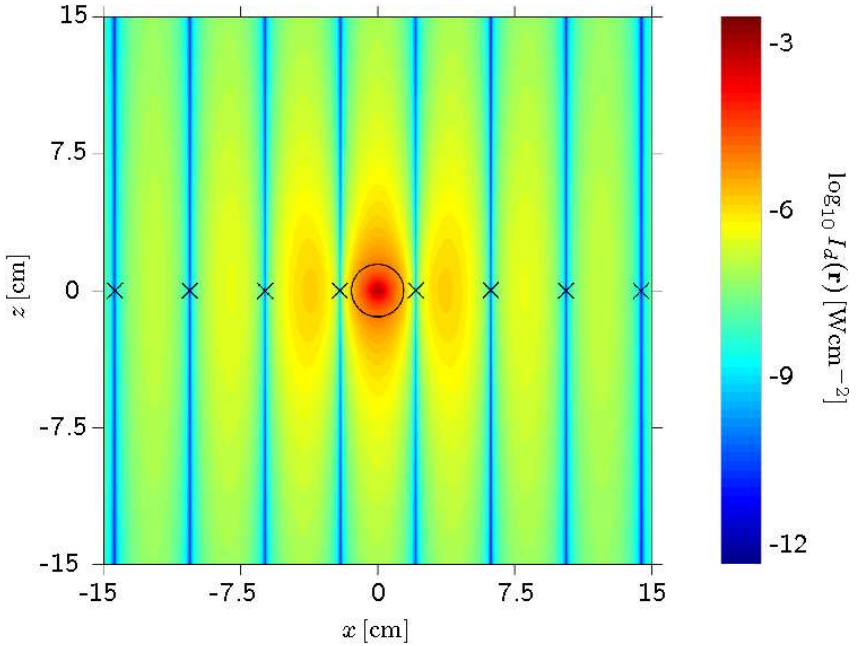

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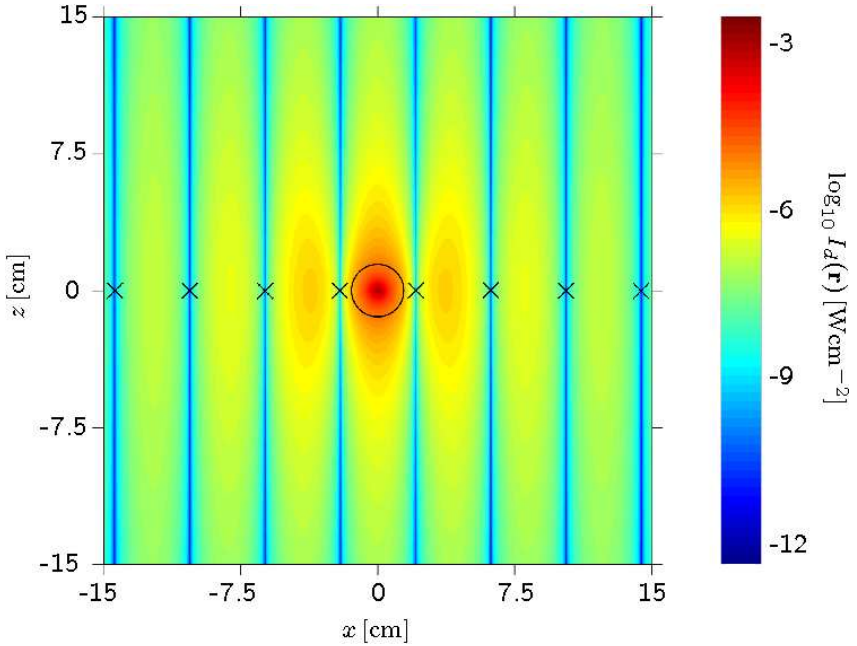

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- $\langle I_s \rangle = 2.5 \times 10^{24}$ Wcm^{-2}, $\langle I_p \rangle = 7.7 \times 10^{15}$ Wcm^{-2}, ~ 4 diffracted photons per shot

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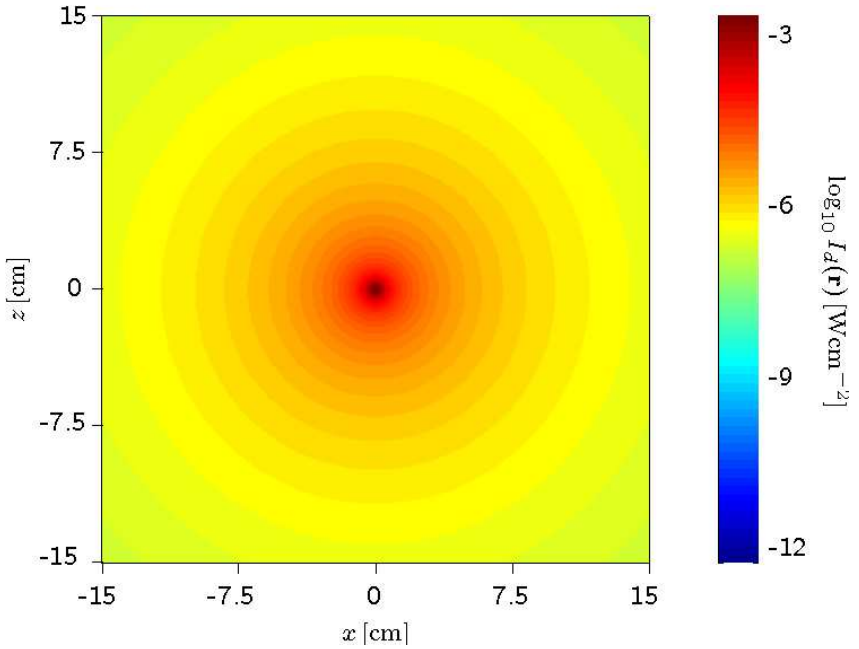

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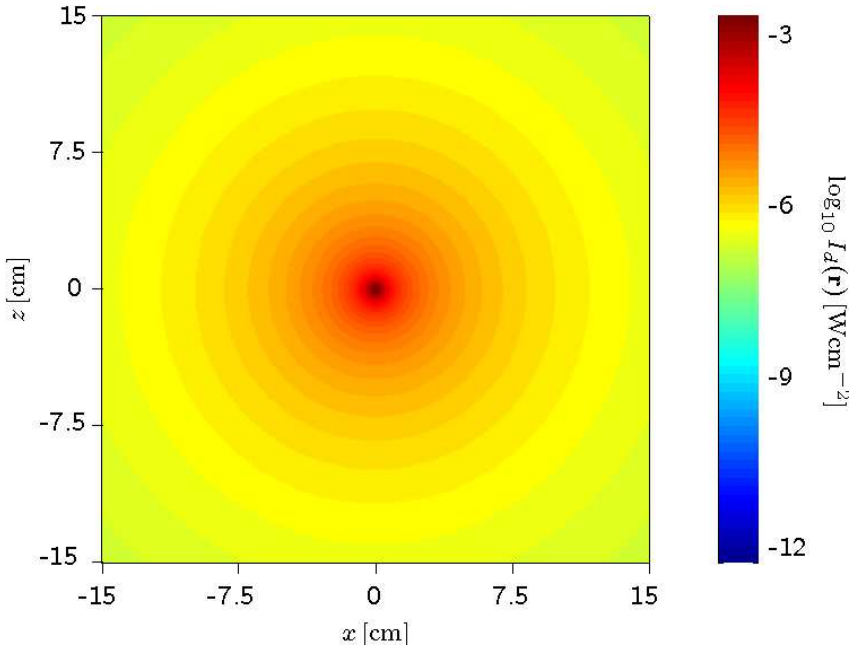

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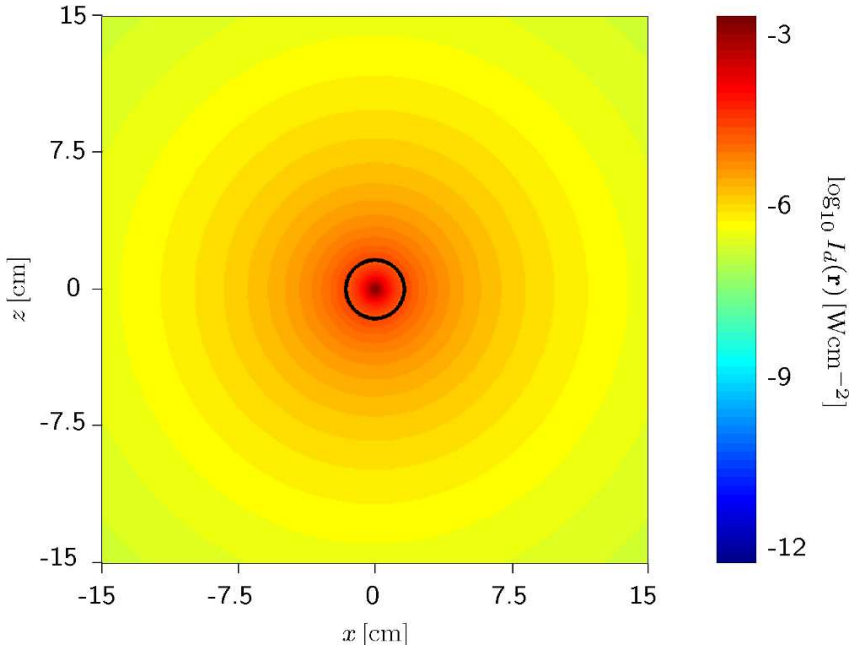

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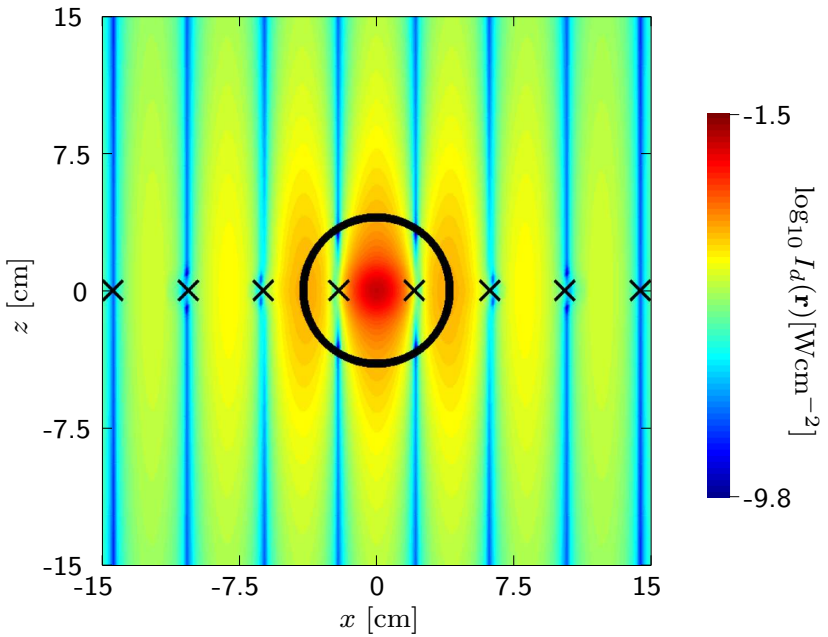
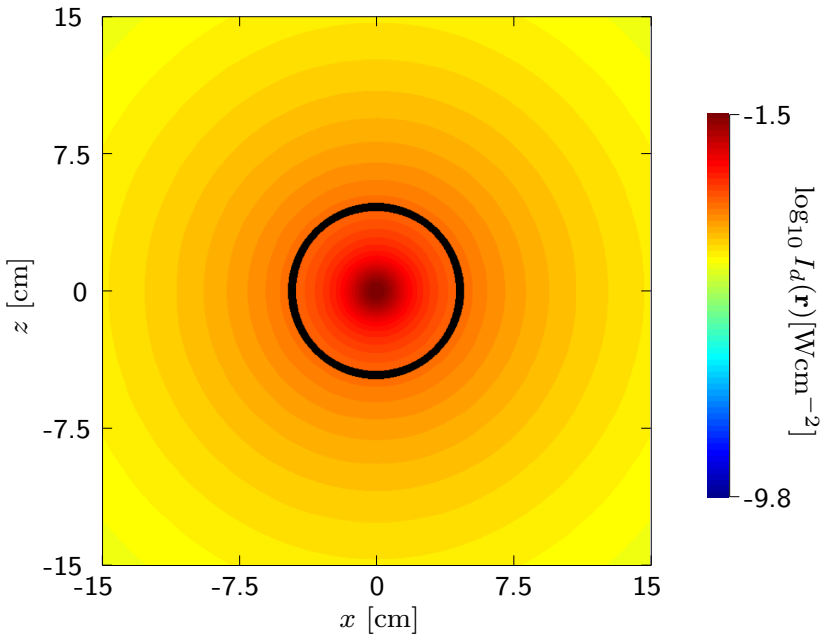
Strong laser [Wcm^{-2}]	Probe laser [Wcm^{-2}]	$\langle N_d \rangle$	$\langle N_s \rangle$
10^{24}	10^{16}	0.5	5
5×10^{24}	10^{16}	12	120
10^{25}	10^{17}	500	5100

$$w_{p,0} = 100\ \mu\mathrm{m}$$





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- This can be used to design a "matterless double-slit" experiment

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Thank you for your attention