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Theory of transversal light forces in semiconductors

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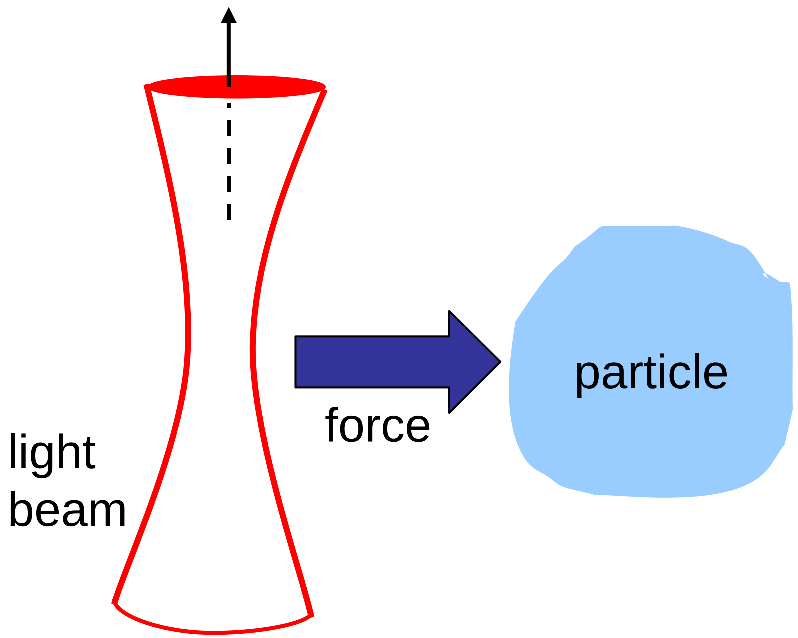
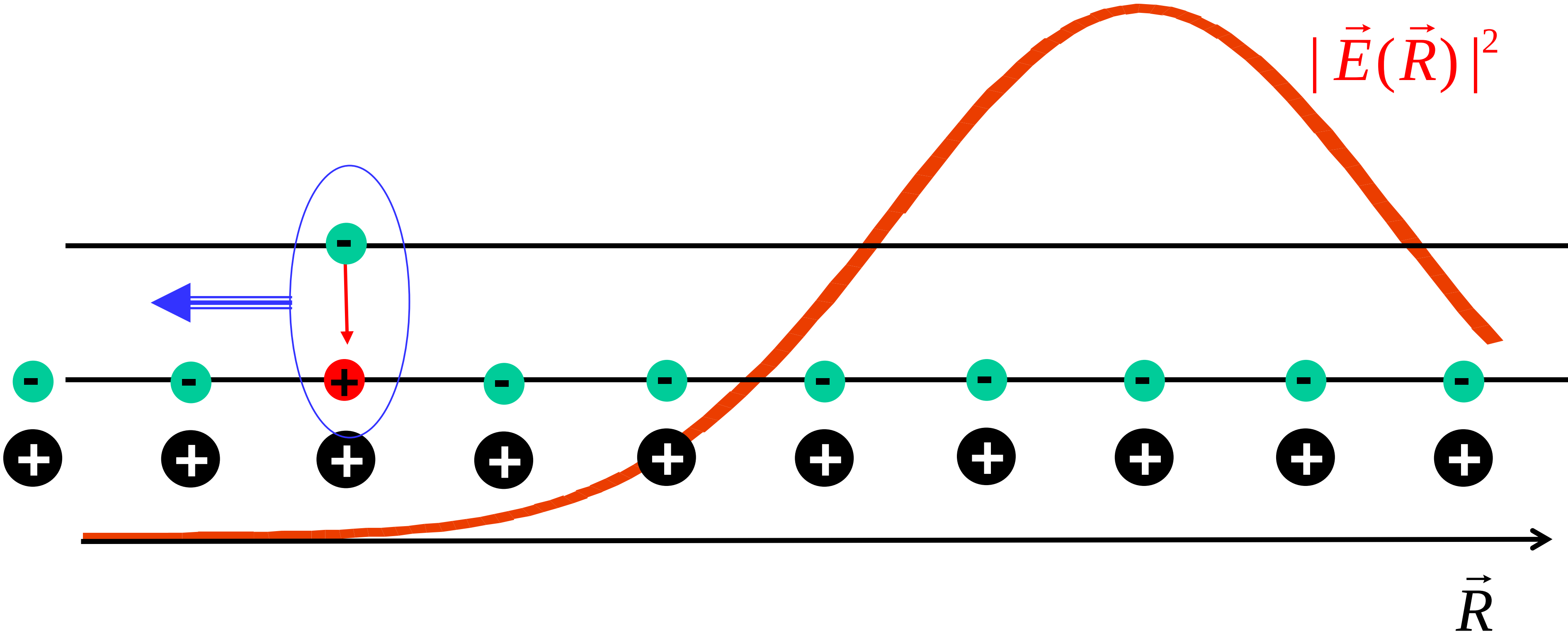
Light forces and optical tweezers



- Transversal light force (light gradient force) verified for atoms, molecules, bacteria, dielectric spheres *etc.*

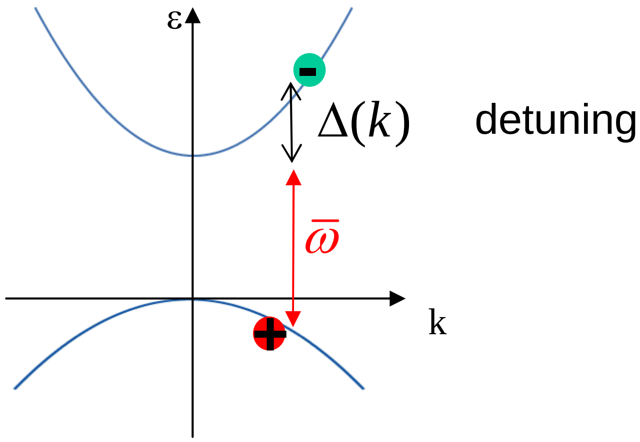
- Example: controlled transport of gaseous Bose-Einstein condensate over 44 cm (Ketterle group, PRL 88, 020401 (2002))

Semiconductor: Electronic Excitation Moving



Transversal Force on Electrons and Holes

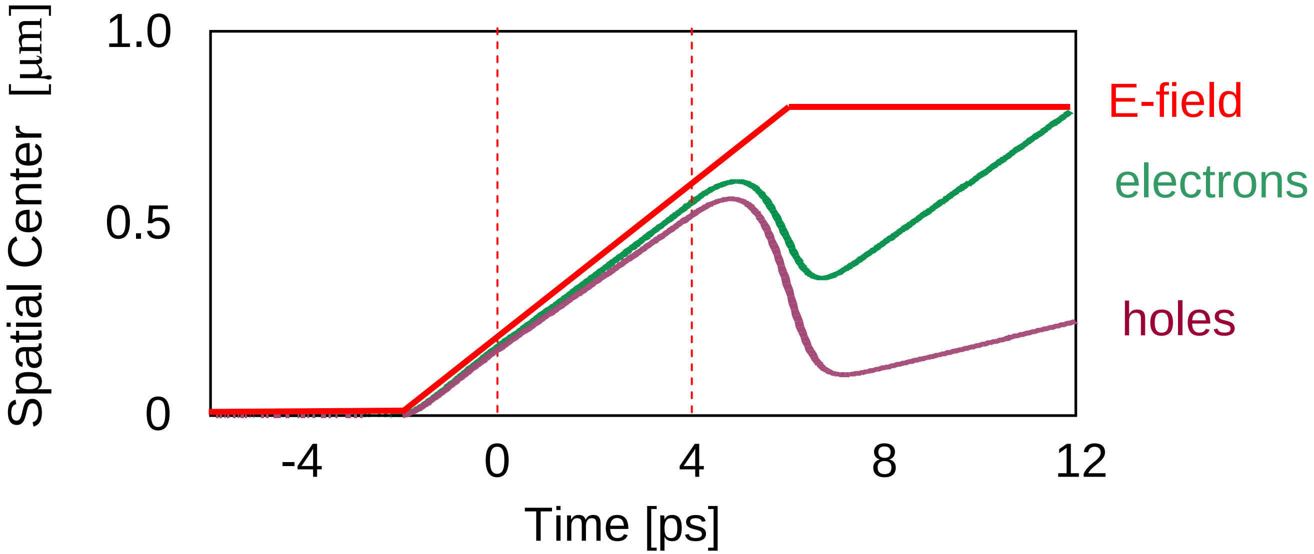
$$\vec{F}_{transv}\left(\vec{R}\right) = -\hbar\nabla_{\vec{R}}\left(\left|\vec{\mu}\cdot\vec{E}\left(\vec{R}\right)\right|^2\right)\frac{\Delta\left(\vec{K}\right)}{\gamma^2+\Delta\left(\vec{K}\right)^2}$$



- Same structural form as for atoms
- Different sign than for atoms
- Practically, restricted to **repulsive force** (since E-field needs to be red detuned, Δ(K)>0)

Lindberg, Binder, J. Phys. C 15, 1119 (2003)

Spatial center of carrier density distribution



- Spatial displacement after E-field gone
- Non-zero velocities after E-field gone

Binder, Lindberg, J. Phys. C 18, 729 (2006)