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Theoretical Optics

(V: 4 SWS=48h, Ü: 1 SWS =16h)

	64
1. The laws of radiation in a cavity	10
1.1 Spectra of light	
1.2 Kirchhoff law, balance of radiation	
1.3 Derivation of Stefan-Boltzmann and Wien's displacement law (thermodynamical processes)	
1.4 Thermal radiation and derivation of Rayleigh-Jeans and Wien formula	
1.5 Unification of Planck's radiation formula, derivation by entropy, quantization	
2. Electromagnetic waves	15
2.1 Flux of fields, Gauß integral theorem, sources of fields	
2.2 Charge distribution in large distance, multipole expansion	
2.3 Stokes' integral theorem, induction law, electrical displacement current	
2.4 Maxwell equations	
2.5 Solution in vacuum	
2.6 Properties of waves (phase-, group velocity)	
2.7 Energy transport, Poyntingvector	
2.8 General solutions of Maxwell equations in terms of retarded potentials (dipole radiation)	
2.9 Calculus with nabla operators	
2.10 Boundary conditions, polarization	
2.11 Reflection and transmission at planar interfaces, Fresnel's formulae	
2.12 Metal optics, waves and reflexion at metal surfaces	
2.13 Dielectrics, dispersion, electrical conducting solids	
3. Interference and diffraction	5
3.1 Optical lattices, double slit	
3.2 Kirchhoff's diffraction theory	
3.3 Fraunhofer and Fresnel diffraction	
4. Introduction into quantum theory	15
4.1 Philosophy of measurement	
4.2 Observables and operators, uncertainty	
4.3 Second quantization, harmonic oscillator in number states	
4.4 Time evolution of mean values, Ehrenfest theorem	
4.5 Quantization of electromagnetic field	
4.6 Coherent states, chaotic light	
4.7 Coherence properties (Mach-Zehnder, Hanbury Brown-Twiss Interferometry)	
5. Single-mode quantum optics	10
5.1 Squeezed states (vacuum, phase, amplitude)	
5.2 Phase distribution, Observation of non-classical light	
5.3 Interaction of photons with atoms	
5.4 Selection rules	
6. Quantum information	9
6.1 Entangled states	
6.2 Bell's inequalities	
6.3 Quantum computing and quantum logic	
6.4 Quantum cryptography	
6.5 Quantum teleportation	