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Theoretical Optics

(V: 4 SWS=48h, Ü: 1 SWS =16h)

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| | 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 | |