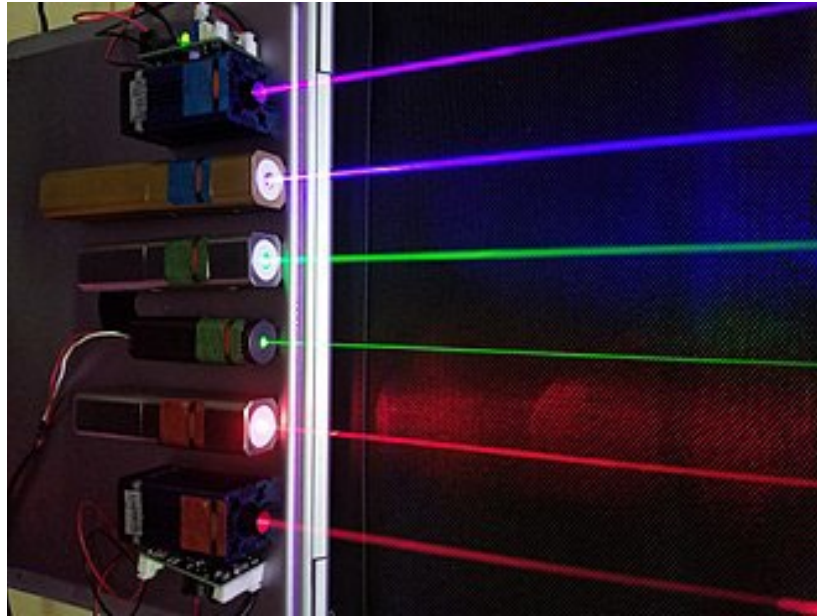# PC3130

Quantum Mechanics II
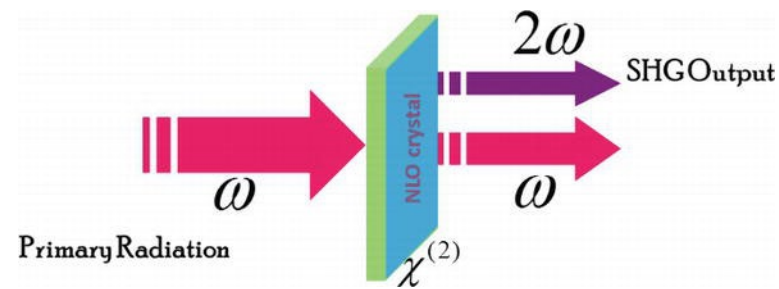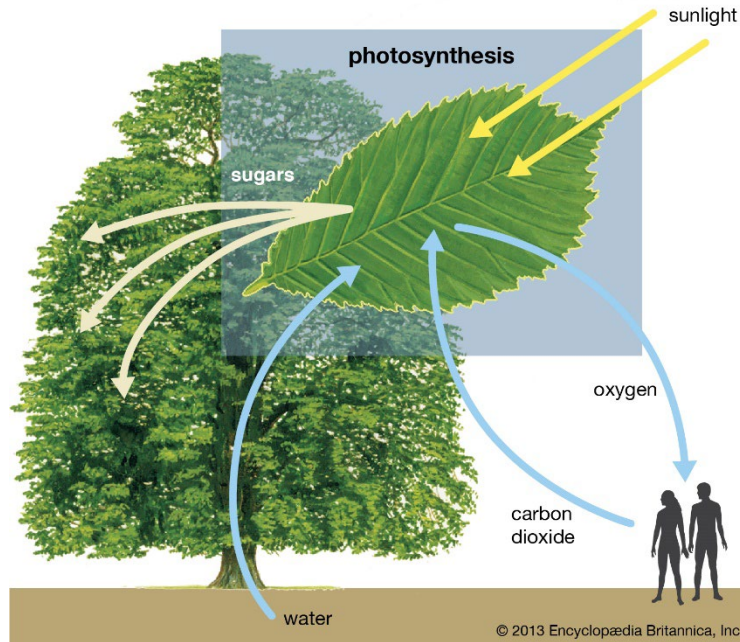
Time-Dependent Perturbation Theory

Some motivation

Lasers

**Light-matter interaction
(linear and non-linear)**
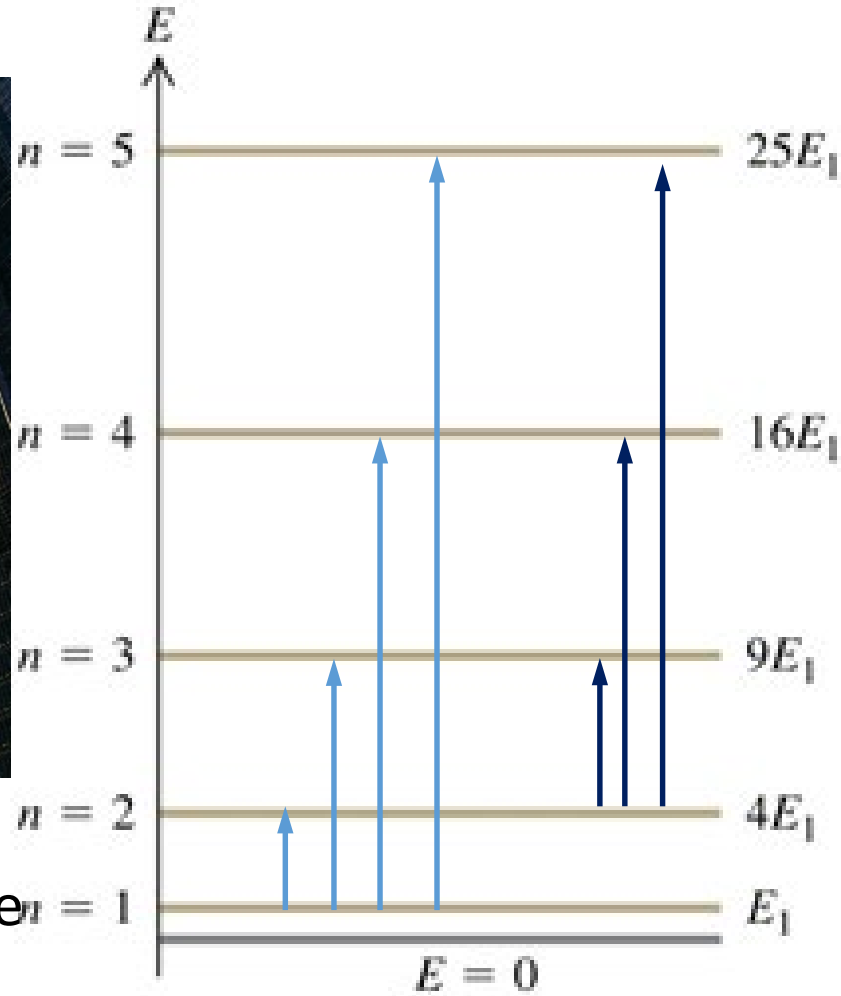

sunlight

photosynthesis

sugars

oxygen

carbon
dioxide

water

© 2013 Encyclopædia Britannica, Inc.

Samsung
SUHDTV 4K

2ω SHG Output

Primary Radiation

ω ω

NLO crystal

$\chi^{(2)}$

NANOCO

Optical Absorption

Shanghai Tower

118th floor observation deck

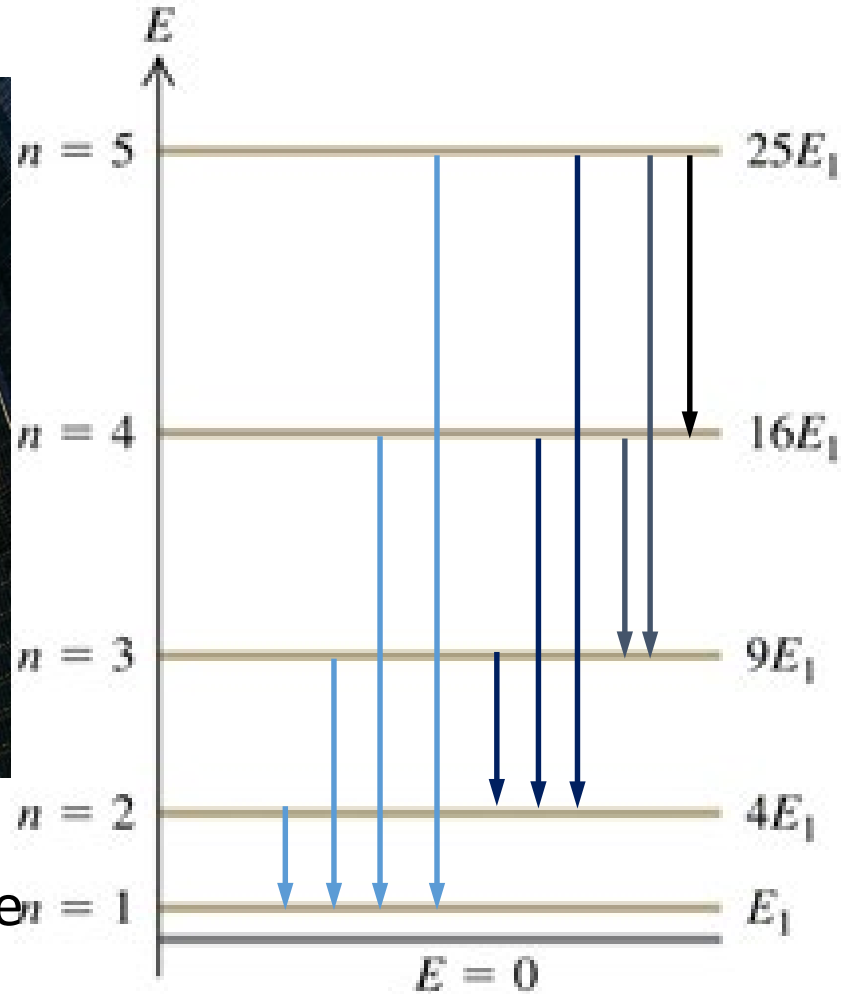Ground state

Particle in an infinite square well

- The electron in the ground state can be excited to any of the excited states. When this happens, the system absorbs a photon of energy equal to the energy difference between the two states.

- *Only* photons with energies corresponding to these transitions ($hf = E_n - E_1, n = 2, 3, \ldots$) can be absorbed.

- If the electron is initially in an excited state n = m, the system can absorb photons with energy $hf = E_n - E_m, n > m$. Only photons of these energies can be absorbed.

Optical Emission

Shanghai Tower

118th floor observation deck

Ground state

- The electron in any of the excited states can decay to the ground state or an excited state of lower energy. When this happens, the system emits a photon of energy equal to the energy difference between the two states.

- *Only* photons with energies corresponding to these transitions ($hf = E_n - E_m, n > m$) can be emitted.

Optical anisotropy in black phosphorus

Ref: Nanoscale, 8, 483 (2016), 2D Materials 2, 044014 (2015)