Problem Set 1 - LV 141.246 QISS - 14.10.2011

1. **Energy Scales** As discussed in the lecture, you can convert energy into temperature, frequency and wavelength via the following relations

$$\begin{aligned} E &= k_B T \\ E &= hf \\ \lambda &= \frac{c}{f} \end{aligned}$$

Calculate the corresponding values for the following data

(a) Optical light (HeNe laser, red, 632.8nm)

(b) WLAN frequency (2.4 GHz)

(c) Ambient temperature (300 Kelvin)

(d) Ionization energy (He ionization energy 24.58eV)

Consider your results!

2. **MATLAB - Getting Started** MATLAB is very useful tool for dealing with numerical problems, especially handling vectors and matrices. It should be installed on your student computer. You can also purchase it for €13.90 from the ZID `http://www.sss.tuwien.ac.at/sss/mla/`

(a) Create a vector t with values (0, 0.1, 0.2, ... 10). Calculate $y = e^{t(3i-1/2)}$. Plot the real part of y versus t.

(b) Enter the following three matrices

$$A = \begin{pmatrix} 0 & i \\ i & 0 \end{pmatrix} \qquad B = \frac{1}{\sqrt{2}} \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & -i \\ 0 & i & 0 \end{pmatrix} \qquad C = \frac{1}{2} \begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{pmatrix}$$

.

Are these matrices hermitian (Hint: a matrix is hermitian if $H = H^\dagger$. Therefore calculate $H - H^\dagger$), are they unitary? Calculate trace and eigenvalues of these matrices.