Phys 250 Quantum Optics, Homework #2

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Due Wed. Oct 14 at 6PM

Read the handout: *The Quantum Vacuum*, by P.W. Milonni, Sections 1.1-1.3, 1.8-1.10, 2.1-2.4 (the other sections are interesting too).

1. Derive (1.24) and (1.27)
2. Study the Harmonic Oscillator (section 2.2) and make sure you understand it in detail. Derive an explicit expression of the wave function, $\psi(q)$, of the ground state and the first three excited states and plot $|\psi(q)|^2$ for each.
3. Work through all the details in section 2.3.
4. Work out the expectation value of the position, $\langle q \rangle$, for an energy eigenstate of a harmonic oscillator, $|n\rangle$, as well as the states $\frac{1}{\sqrt{2}}(|n\rangle + e^{i\phi}|n+1\rangle)$ and $\frac{1}{\sqrt{2}}(|n\rangle + e^{i\phi}|n+2\rangle)$.

You may again hand in the homework in groups of 2 or 3.