example-energy-levels

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1 QuTiP example: Energy-levels of a quantum systems as a function of a single parameter

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For more information about QuTiP see http://qutip.org

In [1]: %pylab inline

Populating the interactive namespace from numpy and matplotlib

In [2]: from qutip import *

1.1 Energy spectrum of three coupled qubits

In [3]:
```python
def compute(w1list, w2, w3, g12, g13):

    # Pre-compute operators for the hamiltonian
    sz1 = tensor(sigmaz(), qeye(2), qeye(2))
    sx1 = tensor(sigmax(), qeye(2), qeye(2))

    sz2 = tensor(qeye(2), sigmaz(), qeye(2))
    sx2 = tensor(qeye(2), sigmax(), qeye(2))

    sz3 = tensor(qeye(2), qeye(2), sigmaz())
    sx3 = tensor(qeye(2), qeye(2), sigmax())

    idx = 0
    evals_mat = zeros((len(w1list),2*2*2))
    for w1 in w1list:

        # evaluate the Hamiltonian
        H = w1 * sz1 + w2 * sz2 + w3 * sz3 + g12 * sx1 * sx2 + g13 * sx1 * sx3

        # find the energy eigenvalues of the composite system
        evals, ekets = H.eigenstates()

        evals_mat[idx,:] = real(evals)

        idx += 1

    return evals_mat
```

In [4]:
```python
w1  = 1.0 * 2 * pi   # atom 1 frequency: sweep this one
w2  = 0.9 * 2 * pi   # atom 2 frequency
```

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```
        w3  = 1.1 * 2 * pi    # atom 3 frequency
        g12 = 0.05 * 2 * pi    # atom1-atom2 coupling strength
        g13 = 0.05 * 2 * pi    # atom1-atom3 coupling strength

        w1list = linspace(0.75, 1.25, 50) * 2 * pi # atom 1 frequency range
```
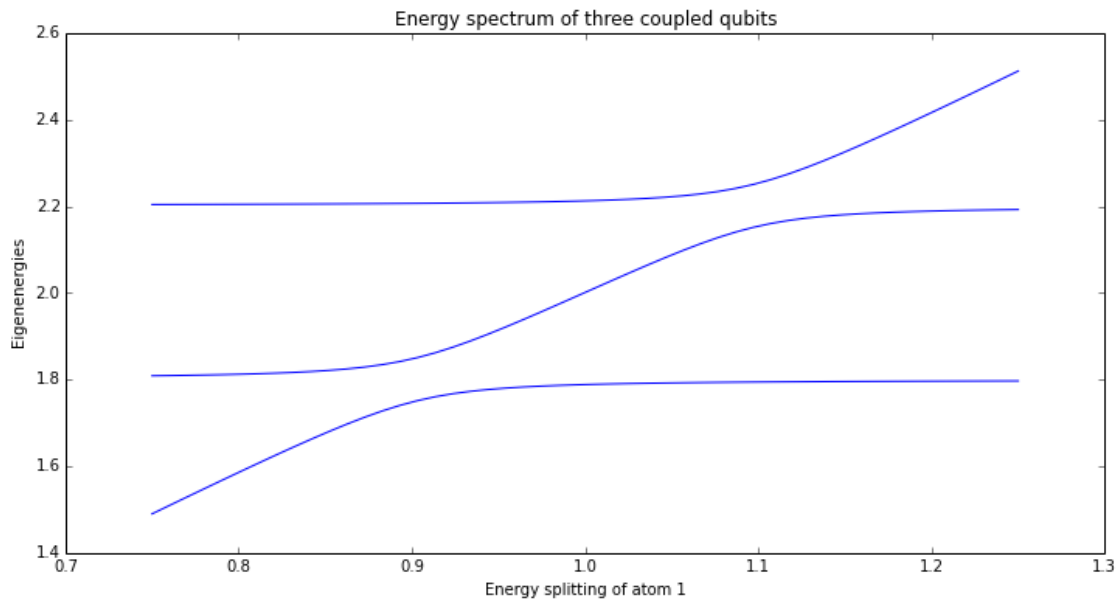
In [5]: `evals_mat = compute(w1list, w2, w3, g12, g13)`

In [6]: `figure(figsize=(12,6))`

```
        for n in [1,2,3]:
            plot(w1list / (2*pi), (evals_mat[:,n]-evals_mat[:,0]) / (2*pi), 'b')

        xlabel('Energy splitting of atom 1')
        ylabel('Eigenenergies')
        title('Energy spectrum of three coupled qubits');
```


1.2 Versions

In [7]: `from qutip.ipynbtools import version_table`

`version_table()`

Out[7]: `<IPython.core.display.HTML at 0x7fc288b682b0>`