Our goal in this notebook is to calculate the hyperfine splitting for $^{87}Sr^{+}$. This will be given by

$$E_{\text{hfs}} = \frac{1}{2}AC + BC(C+1),$$

where C is given by

$$C = F(F+1) - J(J+1) - I(I+1).$$

First, we will store the values of A and B given by Safronova's paper. Both of these values are in MHz

In [1]:
```
AP=-35.3
BP=88.68
```

In [2]:
```
def hyperfine_split(F,J=3.00/2,I=9.00/2):
    C=F*(F+1)-J*(J+1)-I*(I+1)
    #print "C=",C,"I=",I,"F=",F,"A=",AP,"B=",BP
    return (1.0/2)*AP*C+BP*C*(C+1)
```

In [3]:
```
AP=-35.3
BP=88.68

print "F=3 gives", hyperfine_split(3),"MHz"
print "F=4 gives", hyperfine_split(4),"MHz"
print "F=5 gives", hyperfine_split(5),"MHz"
print "F=6 gives", hyperfine_split(6),"MHz"
```

```
F=3 gives 22971.135 MHz
F=4 gives 5803.375 MHz
F=5 gives 306.075 MHz
F=6 gives 17120.835 MHz
```

Now, we look at the S state. $A = 1000$ MHz, $B = 0$ MHz while $J = \frac{1}{2}$ and I is still $\frac{9}{2}$.

In [4]:
```
AP=1000
BP=0

print "F=4 gives", hyperfine_split(4,J=1.0/2)
print "F=5 gives", hyperfine_split(5,J=1.0/2)
```

```
F=4 gives -2750.0
F=5 gives 2250.0
```

The difference between these is clearly 5 GHz.

In [5]:
```
#A version table.
#This notebook does not use anything else from the qutip package.
from qutip.ipynbtools import version_table
version_table()
```

```
/home/jlarchibald/anaconda/lib/python2.7/site-packages/IPython/parallel.py:13:
ShimWarning: The `IPython.parallel` package has been deprecated. You should imp
ort from ipyparallel instead.
  "You should import from ipyparallel instead.", ShimWarning)
```

Out[5]:

Software	Version
Cython	0.22.1
SciPy	0.15.1
QuTiP	3.1.0
Python	2.7.10 |Anaconda 2.3.0 (64-bit)| (default, Oct 19 2015, 18:04:42) [GCC 4.4.7 20120313 (Red Hat 4.4.7-1)]
IPython	4.0.0
OS	posix [linux2]
Numpy	1.9.2
matplotlib	1.4.3
Mon Nov 23 22:59:56 2015 CST	