Init of numpy, sunpy, astropy, scidb and JSOC

In [1]:
```
import csv
import os
import numpy
import astropy
import sunpy
from sunpy.net import jsoc
from astropy.io import fits
from scidbpy import connect, SciDBQueryError, SciDBArray
sdb = connect('http://localhost:8080')
afl = sdb.afl
client = jsoc.JSOCClient()
```

Define JSOC Query

In [9]:
```
response = client.query(jsoc.Time('2014-01-01T00:00:00',
           '2014-01-01T01:00:00'), jsoc.Series('hmi.m_45s'),
            jsoc.Notify("simon.marcin@fhnw.ch"))
print response
```

```
         DATE          TELESCOP  INSTRUME  ... WAVELNTH     WAVEUNIT
-------------------- -------- ---------- ... -------- ---------------
2014-01-05T17:44:53Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:46:02Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:47:11Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:48:18Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:49:26Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:50:34Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:51:43Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:52:51Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:53:59Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:55:08Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
                 ...      ...        ... ...      ...             ...
2014-01-05T19:04:41Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T19:05:49Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:35:43Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:36:54Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:38:02Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:39:10Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:40:18Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:41:25Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
2014-01-05T17:42:33Z  SDO/HMI HMI_FRONT2 ...   6173.0 Invalid KeyLink
Length = 81 rows
```

Start download

In [ ]:
```
res = client.get(response)
```

```
Request JSOC_20151203_857 was submitted 1 seconds ago, it is not ready to
download.
Request JSOC_20151203_857 was submitted -9 seconds ago, it is not ready to
download.
Request JSOC_20151203_857 was submitted -20 seconds ago, it is not ready t
o download.
Request JSOC_20151203_857 was submitted -31 seconds ago, it is not ready t
o download.
Request JSOC_20151203_857 was submitted -42 seconds ago, it is not ready t
o download.
Request JSOC_20151203_857 was submitted -52 seconds ago, it is not ready t
o download.
Request JSOC_20151203_857 was exported at 2015.12.03_11:57:41_UT and is re
ady to download.
81 URLs found for download. Totalling 1226MB
```

Create 3D Array to store the images. x-axis, y-axis and time-axis.

In [2]:
```
sdb.query("CREATE ARRAY HMI_Cube <val:float>[x=0:4095,512,1, \
           y=0:4095,512,1, time=0:*,1,0]")
```

Validate the schema of the created array

In [25]:
```
hmi_cube = sdb.wrap_array("HMI_Cube")
print hmi_cube.datashape.schema
```

```
<val:float> [x=0:4095,512,1,y=0:4095,512,1,time=0:*,1,0]
```

In [ ]:
```
Get some basic fits information useing astropy.fits
```

In [22]:
```
hdulist = fits.open('hmi.m_45s.20140101_000045_TAI.2.magnetogram.fits')
hdulist.info()
```

```
Filename: /home/scidb/sunpy/data/hmi.m_45s.20140101_000045_TAI.2.magnetogr
am.fits
No.    Name         Type      Cards   Dimensions   Format
0    PRIMARY      PrimaryHDU       6   ()
1                 CompImageHDU    103   (4096, 4096)   int32
```

Process all fits file. The time dimension is broken down to an increasing integer. The file 'hmi_cube_import.csv' is a flat array representation of all fits file which gets imported to SciDB.

In [71]:
```
f = open('/home/scidb/p8/hmi_cube_import.csv','w')
count=0
for fn in os.listdir("./sunpy/data"):
    if fn.endswith("fits"):
        hdulist = fits.open('/home/scidb/sunpy/data/'+fn)
        hdulist[1].verify('fix')
        scidata = hdulist[1].data
        for x in xrange(0, 4095):
            for y in xrange(0, 4095):
                f.write('%d,%d,%d,%f\n' % (x,y,count,scidata[x][y]))
        print (fn+" done")
        count=count+1
f.close()
```

```
hmi.m_45s.20140101_000130_TAI.2.magnetogram.fits done
hmi.m_45s.20140101_004545_TAI.2.magnetogram.fits done
hmi.m_45s.20140101_003215_TAI.2.magnetogram.fits done
hmi.m_45s.20140101_003300_TAI.2.magnetogram.fits done
hmi.m_45s.20140101_003430_TAI.2.magnetogram.fits done
hmi.m_45s.20140101_005915_TAI.2.magnetogram.fits done
```

Import the flat data in parallel into the database. (run on direct on bash):

loadcsv.py -n 1 -a 'aFlat' -s ' [csvRow=0:*,500000,0]' -i *'./p8/hmi_cube_import.csv'* -A *'HMI_Cube'* -S *' [x=0:4095,512,1,y=0:4095,512,1,time=0:*,1,0]'*

Disconnect from SciDB.

In [3]:
```
sdb.reap()
```