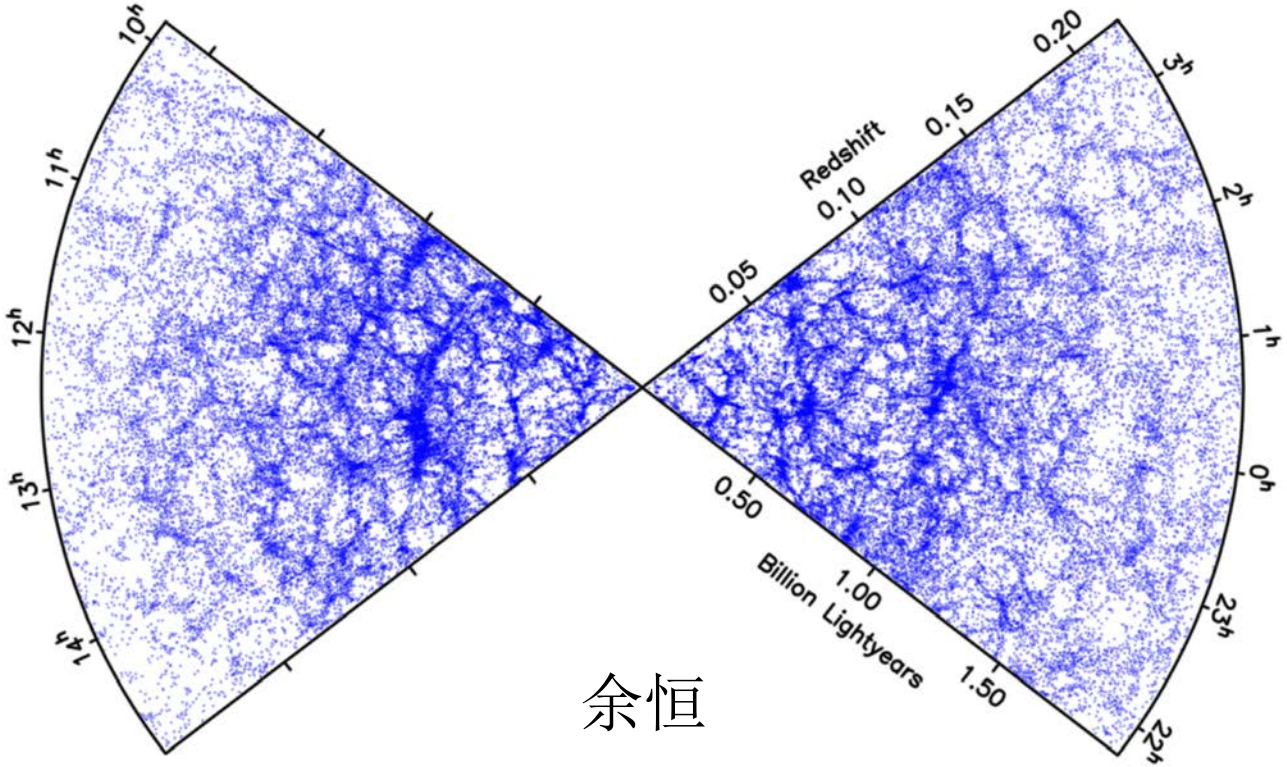
用Python搞定星表



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主要内容

- 基本星表读写
- 星表库查询
- 数据流过滤
- 星表合并
- 基本绘图

Name	RA(1950)	Dec(1950)	pm	angle	v_{rad}	Sp Type	m_v	B−V	U−B	R−I	π_{trig}	M_V
Sun						G2 V	-26.72	0.65	0.10			4.85
NN	00 00 06	-34 29.7	0.758	168.6		DC9	14.90	0.46	-0.44		75.2	14.28
GJ 1001	00 02 05	-40 57.8	1.618	154.5	-3	M3.5	12.84	1.63	1.30	1.23	104.2	12.93
NN	00 02 16	+34 22.8	0.776	83.0	+6.4 VAR	G2 V	6.11	0.62	0.09		29.8	4.56
NN	00 02 21	+22 59.5	0.380	91.5		G9 V	7.82	0.74	0.29	0.33		5.78
Gl 1	00 02 28	-37 36.2	6.097	112.5	22.9	M4 V	8.54	1.46	0.96	0.92	221.8	10.27
Gl 2	00 02 32	+45 30.6	0.894	100.5	0.1	dM2 e	9.93	1.49	1.18	0.85	87.0	9.63
NN	00 02 43	+48 12.0	0.009	305.5		G5	8.30					6.84
Gl 3	00 02 48	-68 06.2	0.582	190.7	41	K5 V	8.48	1.06	1.03	0.42	72.5	7.1
NN	00 02 54	-50 20.0	0.167	276.0		M5	11.95	1.50		+0.95t		10.31
Gl 4 A	00 03 02	+45 32.2	0.839	101.8	+0.0 SB	dK6 e	8.97	1.44	1.21	+0.71 J	87.0	8.67
Gl 4 B	00 03 02	+45 32.1	0.885	98.3	0.1	M0.5 V	9.02	1.45	1.20		87.0	8.72
Gl 4.1A	00 03 38	+58 09.5	0.260	76.7	-11.6	G5 V	6.43c	+0.64c	+0.11c		46.5	4.77c
Gl 4.1B	00 03 38	+58 09.5	0.260	76.7	-16	dG8	7.20c	+0.78c	+0.33c		46.5	5.54c
NN	00 03 40	-66 07.5	0.593	160.6		M4	12.16	1.55		1.04		10.86
Gl 4.2A	00 03 44	-49 21.2	0.592	93.9	2.6	G1 IV	5.71	0.52	0.03	0.17	48.3	4.13
Gl 4.2B	00 03 44	-49 21.2	0.592	93.9			11.50				48.3	9.9*
Gl 5	00 04 01	+28 44.7	0.422	114.1	-5.5	K0 Ve	6.14	0.75	0.33		70.2	5.37
GJ 1002	00 04 13	-07 47.5	2.041	203.6	-42	M5-5.5	13.75	1.98	+1.60:	1.63	212.8	15.39
GJ 1003	00 04 46	+28 58.8	1.890	127.2		m	14.18	1.49	1.40	1.14	53.5	12.82

Centre de Données astronomiques de Strasbourg

Strasbourg astronomical Data Center

星表读写

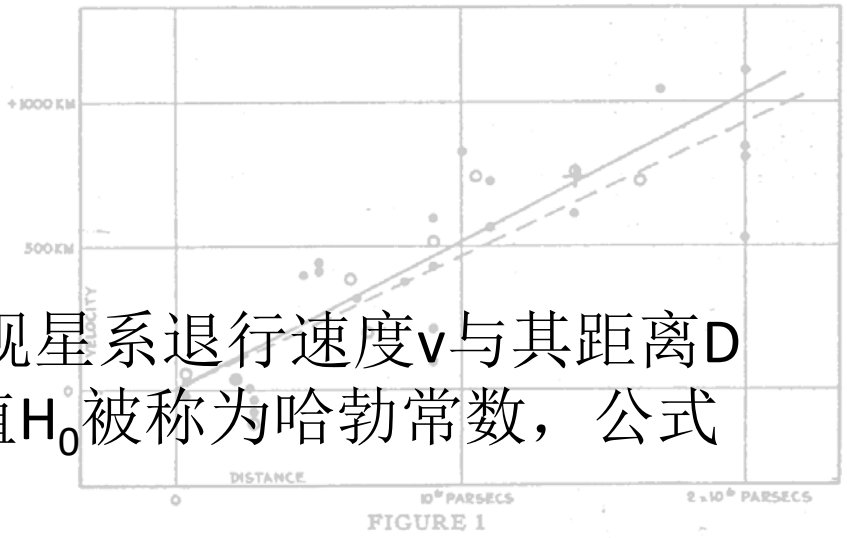


FIGURE 1

- 1929年美国天文学家哈勃发现星系退行速度v与其距离D成正比，即"哈勃定律"。比值H_0被称为哈勃常数，公式记为 $v = H_0D$ 。
- 1992年美国天文学家R.B.Tully等人系统测量了288个邻近星系的距离来确定银河系附近的物质分布。观测结果收录在CDS天文星表数据库中。可以利用其中的视向速度和距离来估计邻域的哈勃常数。
- 因为是期刊星表，对应的目录是J/ApJS/80/479 ：
  - http://cdsarc.u-strasbg.fr/viz-bin/Cat?J/ApJS/80/479
  - http://vizier.china-vo.org/ftp/cats/J_ApJS/80/479/

星表内容

```
11-1    Virgo       130 92 26 15.6 1016
11-0+1  U  8036       1  1    16.8  893
11+2                 18  2    12.9  750
11+2    N  4713           1    10.9
11+2    N  4808           1    14.8
……
```

Bytes	Format	Units	Label	Explanations
1- 7	A7	---	Group	Group identification
9- 18	A10	---	Gal	Galaxy identification
20- 22	I3	---	Memb	Group members
24- 25	I2	---	Ngal	Number of total galaxies
27- 28	I2	---	Ngal2	Number of galaxies with distance
30- 33	F4.1	Mpc	Dist	Distance
35- 38	I4	km/s	Vel	Velocity
40	A1	---	note	Note

参考代码：读取格式化星表

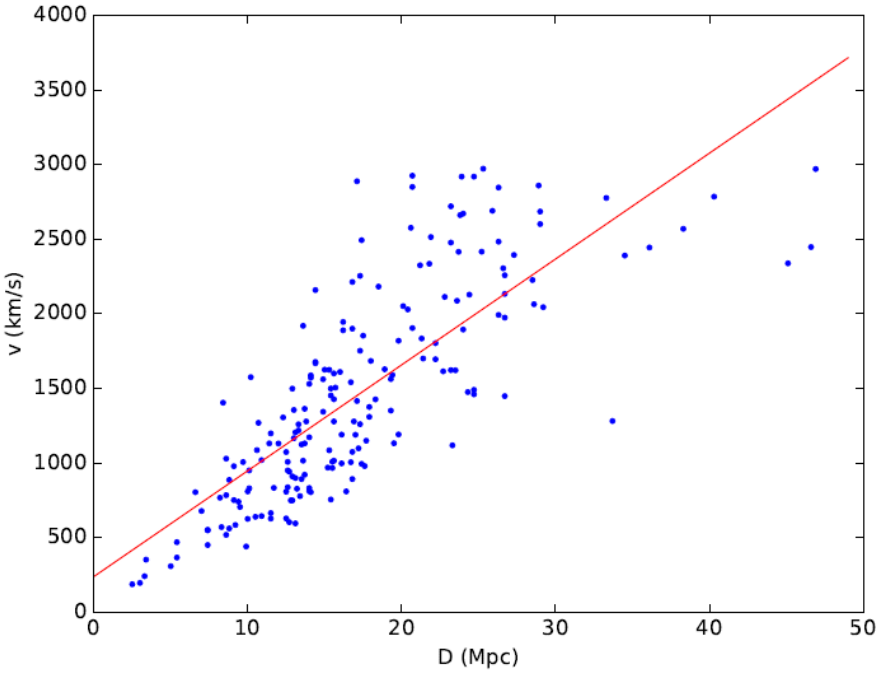
```
H_set = []
lines = open("table1.dat").readlines()
f = open('galaxies.dat','w')
for line in lines:
    if len(line.strip()) > 35:
        d = float(line[29:33])
        v = float(line[34:38])
        output = " ".join(map(str,[v,d]))
        #output = str(v).ljust(8)+str(d).ljust(8)
        f.write(output+'\n')
f.close()
```

参考代码： 读取数据并拟合

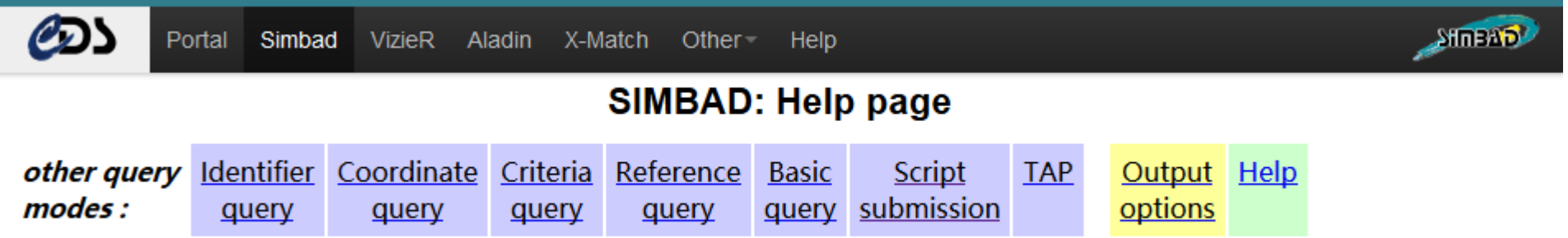
```
import numpy as np
data = np.loadtxt('galaxies.dat')
D = data[:,0]
v = data[:,1]
H = np.polyfit(D, v, 1)
print("Hubble constant is :",H)
```

- numpy.loadtxt(fname, dtype=<type 'float'>, comments='#', delimiter=None, converters=None, skiprows=0, usecols=None)

参考代码：绘图




```
import pylab as pl
x = np.arange(50)
pl.figure()
pl.plot(D,v,'.b')
pl.plot(x,H[0]*x+H[1],'r-')
pl.xlabel('D (Mpc)')
pl.ylabel('v (km/s)')
pl.show()
#pl.savefig('hubble.pdf')
```



Simbad的批量查询

- 法国斯特拉斯堡天文数据中心(CDS)的天文数据证认测量和记录系统Simbad提供了强大的天体数据查询平台。提供包括名称、编号、座标、测光、红移、参考文献等丰富的数据。
- 单个天体可以使用查询页面；当查询目标较多或者需要定制输出格式时，可以提交脚本来批量查询。
- http://simbad.u-strasbg.fr/simbad/sim-fscript

查询结果

```
::script::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

echo My first Simbad script
format object form1 "%IDLIST(1) : %COO(d;C) : %otype : %RV(Z (B))"
set radius 5s
echodata test1
query coo 83.633212d 22.014460d
query id Abell1689

::console::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

C.D.S.  -  SIMBAD4 rel 1.5.6  -  2016.06.23CEST08:01:33
My first Simbad script
total execution time: 0.223 secs
simbatch done

::data::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

test1
M   1 : 083.63308+22.01450 : SNR ~ : ~ (~                  )
V* CM Tau : 083.63307625+22.01449328 : Pulsar ~ : ~ (~                  )
Trimble 28 : 083.6337+22.0156 : Star ~ : ~ (~                  )
2MASS J05343217+2200560 : 083.63408+22.01556 : Star ~ : ~ (~                  )
ACO  1689 : 197.8925-01.3656 : ClG ~ : 0.1842 (2013ApJ...767...15R)
```

星表内容

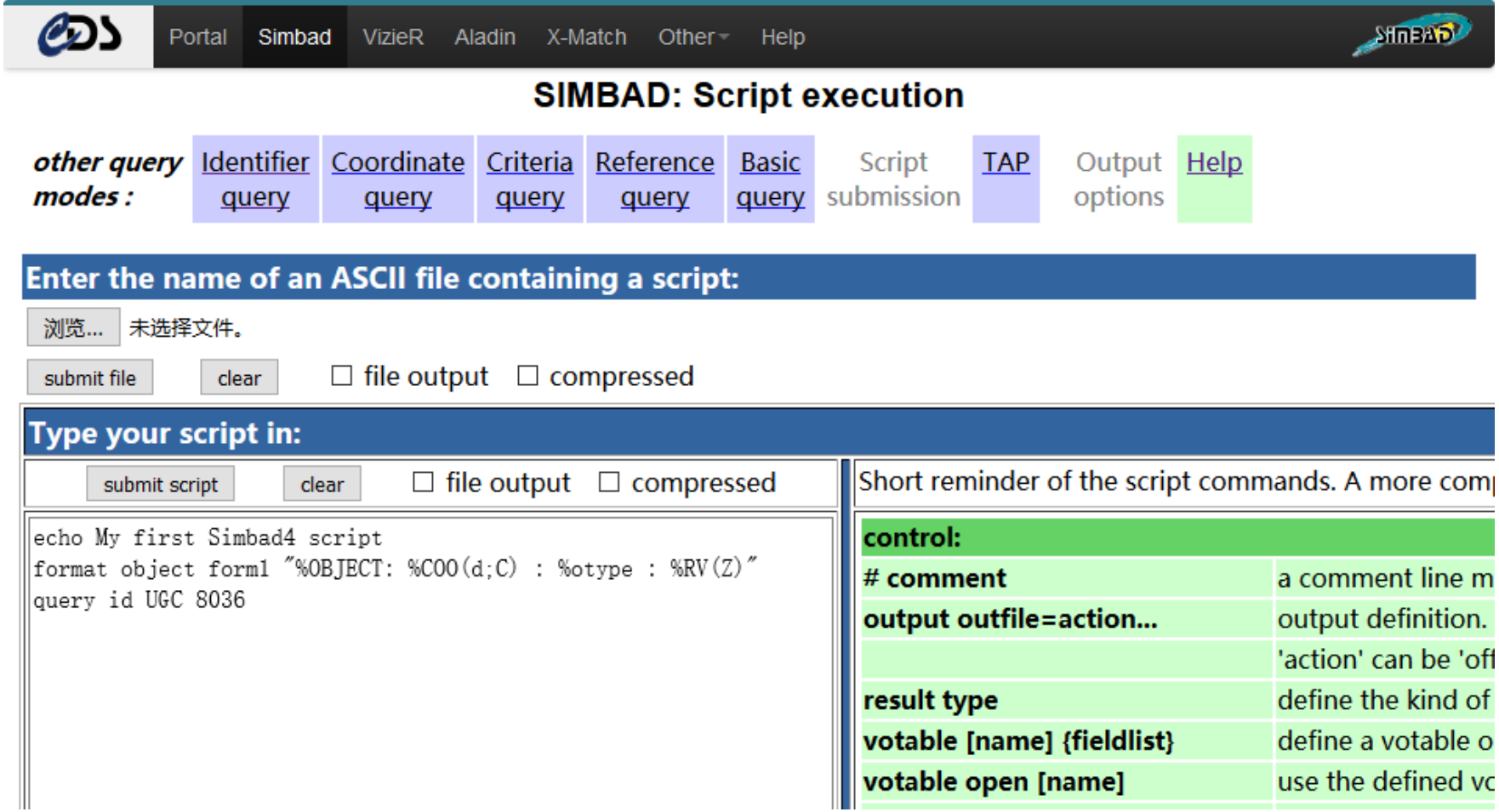
```
11-1    Virgo       130 92 26 15.6 1016
11-0+1  U  8036       1  1    16.8  893
11+2                 18  2    12.9  750
11+2    N  4713           1    10.9
11+2    N  4808           1    14.8
……
```

Bytes	Format	Units	Label	Explanations
1- 7	A7	---	Group	Group identification (1)
9- 18	A10	---	Gal	Galaxy identification (2)

(2) Entries are identified, in order of priority, by a NGC number (preceded by N), or by an UGC number (preceded by U), or by a name constructed from equatorial coordinates.

参考代码—生成脚本

```
lines = open('table1.dat').readlines()
n=len(lines)
dict_gal = dict()
script = """
format object form1 "%OBJECT: %COO(d;C): %otype: %RV(V)"
"""
for i in range(0,n):
    id = lines[i][8:16]
    id = id.replace("U ","UGC")
    id = id.replace("N ","NGC").strip()
    if "GC" in id:
        dict_gal[id] = lines[i][29:34]
        script = script +"query id "+id+"\n"
```



- http://simbad.u-strasbg.fr/simbad/sim-script?submit=submit+script&script=echo+My+first+Simbad4+script++++++++++++++++++++++++++++++++++%0D%0Aformat+object+form1+%22%25OBJECT%3A+%25COO%28d%3BC%29+%3A+%25otype+%3A+%25RV%28Z%29%22++++%0D%0Aquery+id+UGC+8036++

参考代码—网站交互

```
import urllib.parse , urllib.request
url='http://simbad.u-strasbg.fr/simbad/sim-script?submit=submit+script&script='+urllib.parse.quote_plus(script)
page = urllib.request.urlopen(url)
data = page.read()
page.close()
print(data)

result = open('simba_output.dat','w')
result.writelines(data.decode("utf8"))
result.close()
```

查询结果

```
::script::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

format object form1 "%OBJECT: %COO(d;C): %otype: %RV(V)"
query id UGC 8036
query id NGC 4713
... There are more lines

::console::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

C.D.S.  -  SIMBAD4 rel 1.5.6  -  2016.06.24CEST03:42:32
total execution time: 2.824 secs
simbatch done

::data::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

UGC 8036: 193.702867+19.178347: GinCl ~: 913
NGC 4713: 192.491225+05.311425: GinGroup ~: 647
```

参考代码—数据提取

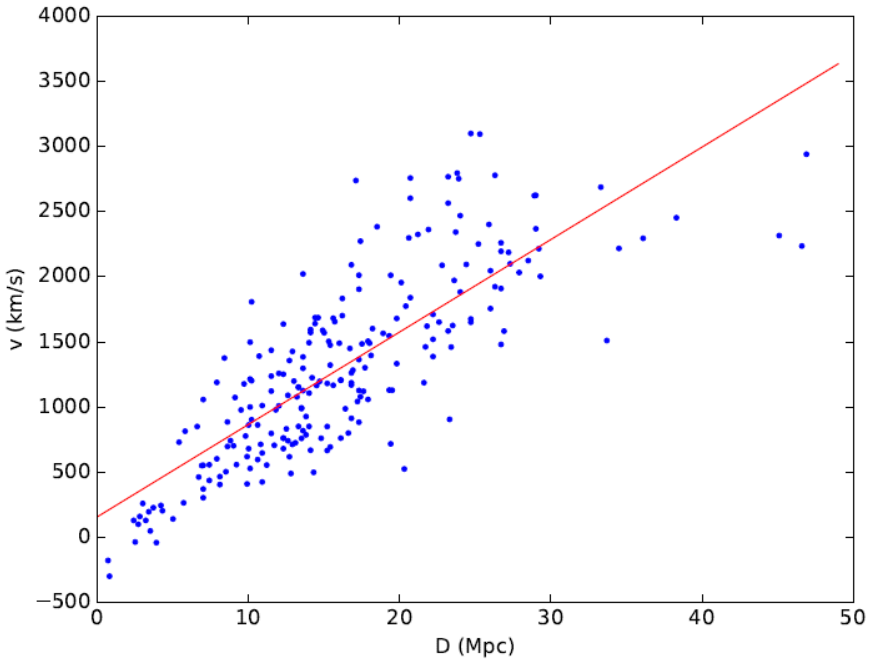
```
sig = 0
lines = open('simba_output.dat').readlines()
f = open('hubble_upd.dat','w')
for line in lines:
    if sig ==1:
        data = line.strip().split(":")
        if len(data) == 4:
            id = data[0].strip()
            #print(id,data[-1],dict_gal[id])#
            f.write("\t".join([id,dict_gal[id],data[-1]])+"\n")

    if line[:8] == "::data::":
        sig = 1
f.close()
```

参考代码：绘图

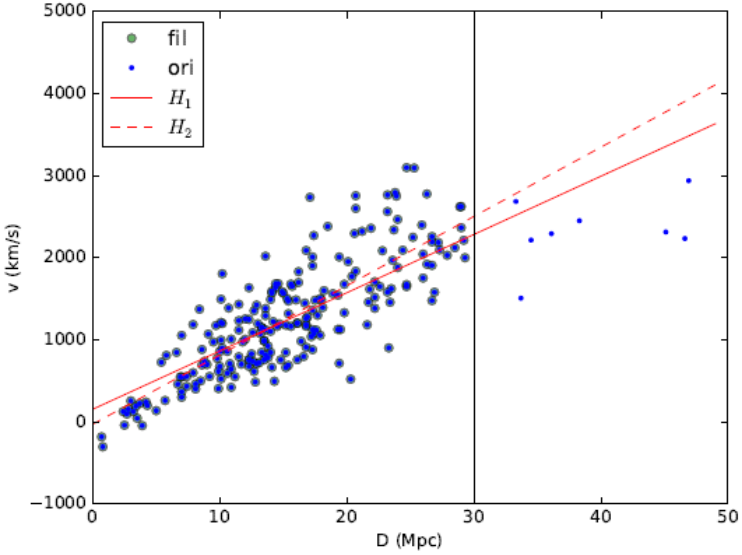
```
import numpy as np
data = np.loadtxt('hubble_upd.dat',usecols=[1,2],delimiter="\t")
H = np.polyfit(data[:,0], data[:,1], 1)
print("Hubble constant is :",H)
```

```
import pylab as pl
x = np.arange(50)
pl.figure()
pl.plot(data[:,0], data[:,1],'.b')
pl.plot(x,H[0]*x+H[1],'r-')
pl.xlabel('D (Mpc)')
pl.ylabel('v (km/s)')
pl.savefig('hubble_upd.pdf')
```



参考代码—筛选数据

```
data2 = data[data[:,0]<30]
H2 = np.polyfit(data2[:,0], data2[:,1], 1)
print("Local Hubble constant is :", H2)
pl.figure()
pl.plot(data2[:,0], data2[:,1],'og',alpha=0.6,label="fil")
pl.plot(data[:,0], data[:,1],'.b',label="ori")
pl.plot(x,H[0]*x+H[1],'r-',label="$H_1$")
pl.plot(x,H2[0]*x+H2[1],'r--',label="$H_2$")
pl.axvline(x=30,color='k')
pl.xlabel('D (Mpc)')
pl.ylabel('v (km/s)')
pl.legend(loc=2,numpoints=1)
pl.savefig('hubble_upd2.pdf')
```



谢谢！

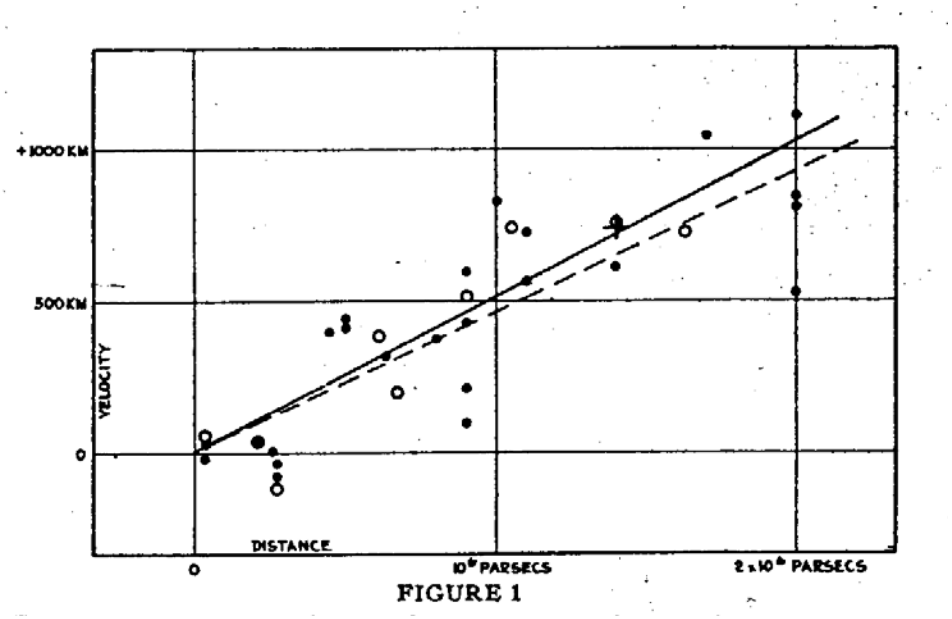
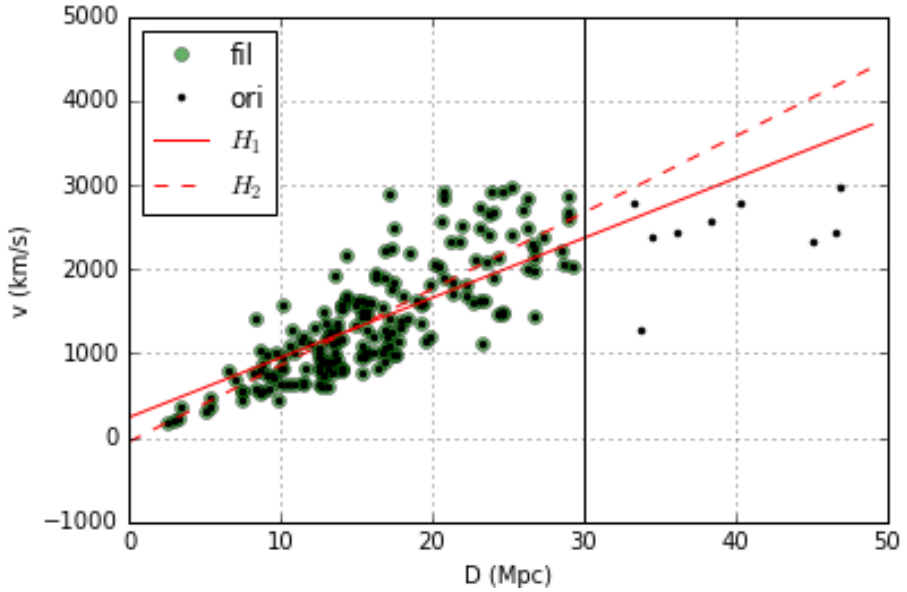


FIGURE 1

1929



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