

IL CIELO COME LABORATORIO

MORFOLOGIA DELLE GALASSIE DI HCG07

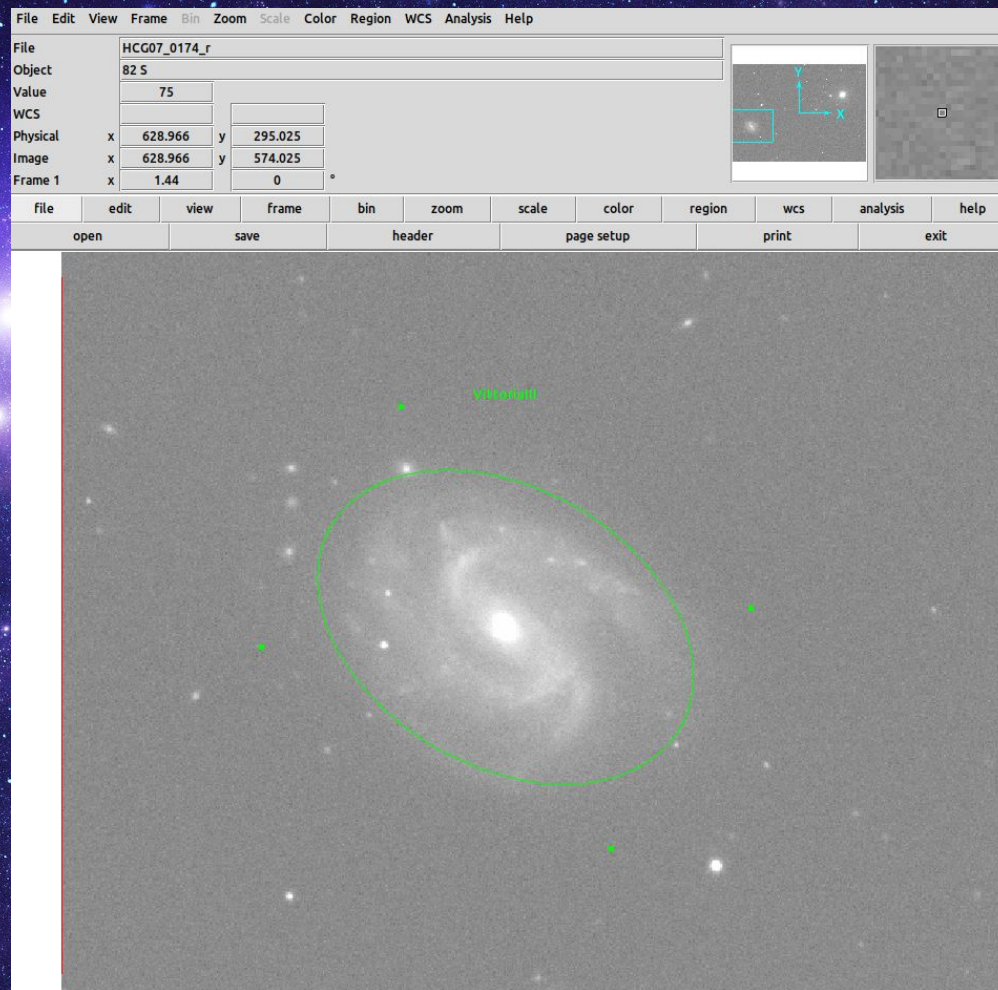
Scopo dell'esperienza

Determinare il rapporto B/T tra l'intensità totale del bulge e l'intensità totale delle galassie, per poi stimare il tipo morfologico delle 4 differenti galassie nell'Hickson Compact Group 7



Come Procedere

1. Riproduzione isofote (IRAF)
2. Calcolo intensità superficiale (IRAF)
3. Grafico della brillantezza (matplotlib, python)
4. Determinazione del rapporto B/T (python)



I R A F

Image Reduction and Analysis Facility

PACKAGE = isophote

TASK = geompar

```

(x0      =      294.) initial isophote center X
(y0      =      537.) initial isophote center Y
(ellip0  =        0.3) initial ellipticity
(pa0     =     -30.) initial position angle (degrees)
(sma0    =     133.) initial semi-major axis lenght
(minsma  =        0.1) minimum semi-major axis lenght
(maxsma  =      INDEF) maximum semi-major axis lenght
(step    =        0.1) sma step between successive ellipses
(linear  =        no) linear sma step ?
(maxrit  =      INDEF) maximum sma lenght for iterative mode
(recente=        yes) allows finding routine to re-center x0-y0 ?
(xylearn=        yes) updates pset with new x0-y0 ?
(physica=        yes) physical coordinate system ?
(mode    =        al)

```

I R A F

Image Reduction and Analysis Facility

PACKAGE = isophote

TASK = ellipse

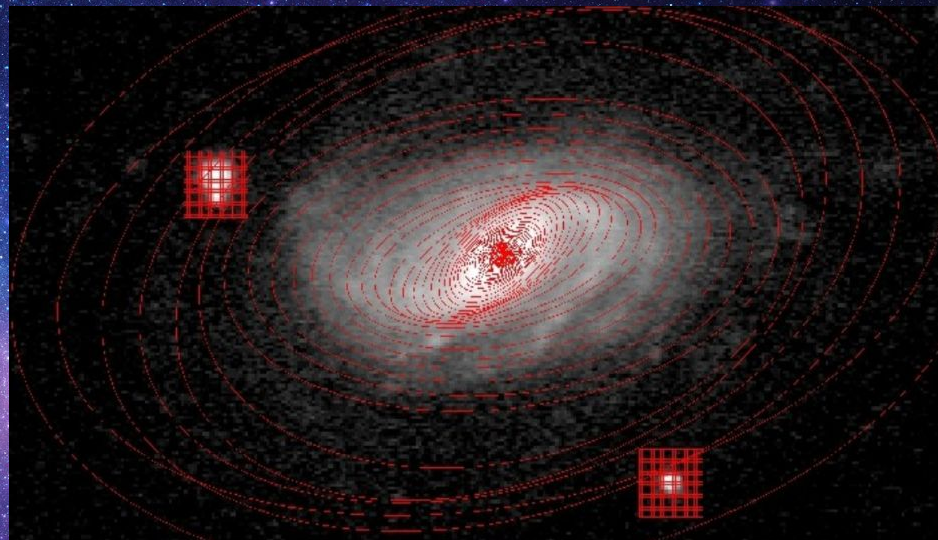
```

input    =      HCG07_0174_r  input image name
output   =      VittoriaIII  output table name
(dqf     =      .clh) data quality file name or extension
(inellip=        ) table with input ellipses for no-fit mode
(geompar=        ) geometric parameters (pset)
(control=        ) algorithm control parameters (pset)
(sample  =        ) sampling control parameters (pset)
(magpar  =        ) magnitude scale parameters (pset)
(interac=        yes) interactive ?
(device  =      red) graphics output device
(icomman=        ) image cursor
(gcomman=        ) graphics cursor
(masksz  =      20) pixel square mask size ('m' cursor key)
(region  =        no) region masking mode ?
(memory  =        yes) memory-intensive (versus disk-intensive) ?
(verbose =        yes) list summary at STDOUT ?
(mode    =        al)

```

maximum greylevel to be displayed: 10000

#	# Semi- # major # axis #(pixel)	Isophote mean intensity	Ellipticity	Position Angle (degree)	Grad. rel. error	Data	Flag	Iter.	Stop code
133.00	1124.60(	5.06)	0.255(0.011)	51.10(1.40)	0.090	715	0	2000	2
146.30	1122.01(	3.68)	0.290(0.010)	61.10(1.16)	0.111	766	0	31	0
160.93	1119.94(	4.13)	0.306(0.033)	61.10(3.65)	0.442	832	0	29	0
177.02	1119.65(	6.21)	0.375(0.018)	56.52(1.75)	0.157	863	0	12	0
194.73	1117.91(	4.95)	0.312(0.036)	62.26(3.95)	0.308	1002	0	41	0
214.20	1131.09(	74.08)	0.641(0.030)	46.39(2.17)	0.314	752	0	10	0
235.62	1117.09(	3.48)	0.422(0.035)	49.78(3.05)	0.292	1100	0	10	0
259.18	1116.40(	3.38)	0.259(0.074)	42.99(9.49)	INDEF	1388	0	10	0
120.91	1126.92(	4.09)	0.216(0.010)	56.52(1.53)	0.130	668	0	13	0
109.92	1132.33(	4.84)	0.262(0.009)	62.29(1.11)	0.088	588	0	64	0
99.92	1137.39(	6.00)	0.254(0.009)	66.72(1.22)	0.077	538	0	10	0
90.84	1142.81(	8.41)	0.225(0.012)	66.72(1.77)	0.091	499	0	2000	2
82.58	1148.28(	12.09)	0.195(0.018)	58.65(2.93)	0.129	463	0	10	0
75.08	1152.79(	8.72)	0.285(0.014)	29.83(1.65)	0.115	395	0	10	0
68.25	1159.19(	7.82)	0.373(0.020)	34.06(1.93)	0.168	334	0	10	0
62.05	1172.88(	11.24)	0.672(0.020)	46.69(1.39)	0.337	206	0	11	0
56.40	1177.73(	9.58)	0.664(0.009)	49.78(0.62)	0.196	190	0	10	0
51.28	1182.67(	8.77)	0.657(0.008)	51.57(0.60)	0.199	175	0	10	0
46.62	1185.71(	7.82)	0.644(0.011)	52.32(0.79)	0.189	163	0	10	0
42.38	1188.93(	8.18)	0.636(0.016)	51.13(1.16)	0.252	150	0	10	0
38.53	1187.81(	7.12)	0.587(0.029)	51.13(2.13)	0.437	147	0	2000	2
35.02	1189.30(	6.80)	0.550(0.015)	52.07(1.14)	0.214	141	0	10	0
31.84	1189.12(	6.25)	0.499(0.018)	50.73(1.45)	0.258	137	0	2000	2
28.94	1188.92(	6.37)	0.436(0.020)	51.86(1.72)	0.238	133	0	2000	2
26.31	1192.80(	6.07)	0.426(0.016)	47.19(1.40)	0.293	122	0	10	0
23.92	1194.62(	6.15)	0.385(0.015)	44.39(1.38)	0.274	116	0	10	0
21.75	1199.98(	5.91)	0.357(0.013)	44.24(1.27)	0.202	108	0	10	0
19.77	1205.86(	4.46)	0.365(0.015)	45.09(1.45)	0.134	97	0	10	0
17.97	1211.34(	5.50)	0.348(0.017)	47.21(1.72)	0.114	90	0	36	0
16.34	1216.22(	5.17)	0.320(0.015)	44.88(1.61)	0.119	84	0	10	0
14.85	1222.39(	6.34)	0.295(0.018)	45.52(2.04)	0.127	78	0	10	0
13.50	1229.17(	6.41)	0.257(0.015)	46.90(1.99)	0.106	73	0	10	0
12.28	1238.03(	6.68)	0.231(0.014)	43.50(1.94)	0.097	67	0	10	0
11.16	1249.24(	7.09)	0.221(0.015)	38.13(2.19)	0.095	62	0	10	0
10.14	1266.43(	6.45)	0.244(0.012)	33.60(1.65)	0.082	55	0	10	0
9.22	1289.09(	8.42)	0.252(0.011)	34.05(1.39)	0.068	50	0	10	0
8.38	1316.71(	10.22)	0.254(0.010)	34.14(1.26)	0.071	45	0	10	0
7.62	1353.35(	13.81)	0.253(0.011)	35.78(1.41)	0.072	41	0	10	0
6.93	1396.44(	17.86)	0.251(0.012)	36.68(1.63)	0.083	38	0	10	0
6.30	1439.72(	22.24)	0.239(0.014)	36.96(1.97)	0.099	35	0	10	0
5.73	1489.20(	27.00)	0.231(0.015)	37.52(2.16)	0.114	32	0	10	0
5.21	1546.00(	34.26)	0.231(0.017)	38.61(2.41)	0.140	29	0	10	0
4.73	1597.68(	40.88)	0.219(0.020)	39.37(2.87)	0.179	26	0	10	0



```

1 import numpy as np
2 import matplotlib.pyplot as plt
3 from scipy import special
4 from astropy.convolution import Gaussian1DKernel
5
6
7 # brightness profile functions
8
9 def bdev(Ie, re, r):
10     return Ie * np.exp(-7.67 * ((r/re)**0.25-1))
11
12 def bexp(Ie, re, r):
13     return 5.36 * Ie * np.exp(-1.68 * (r/re))
14
15 def bser(Ie, re, n, r):
16     bn = 1.9992 * n - 0.3271
17     return Ie * np.exp(-bn * ((r/re)**(1/n)-1))
18
19 def disc(I0, h, r):
20     return I0 * np.exp(-r/h)
21
22 def psf(I0, fwhm, r):
23     sig = fwhm / np.sqrt(8 * np.log(2))
24     return I0 * np.exp(-0.5*(r/sig)**2.)
25
26 def fbdev(Ie, re):
27     return 22.66 * Ie * re**2
28
29 def fbexp(Ie, re):
30     return 11.93 * Ie * re**2
31
32 def fbser(Ie, re, n):
33     bn = 1.9992 * n - 0.3271
34     Kn = 2 * np.pi * n * np.exp(bn) * 2*(special.gammainc(2*n, bn)*special.gamma(2*n))/ (bn)**(2*n)
35     return Kn * Ie * re**2
36
37 def fdisc(I0, h):
38     return 2 * np.pi * I0 * h**2
39
40 def fpsf(I0, fwhm):
41     sig = fwhm / np.sqrt(8 * np.log(2))
42     return 0.5 * np.sqrt(2 * np.pi) * I0 * sig
43
44 # -----
45

```

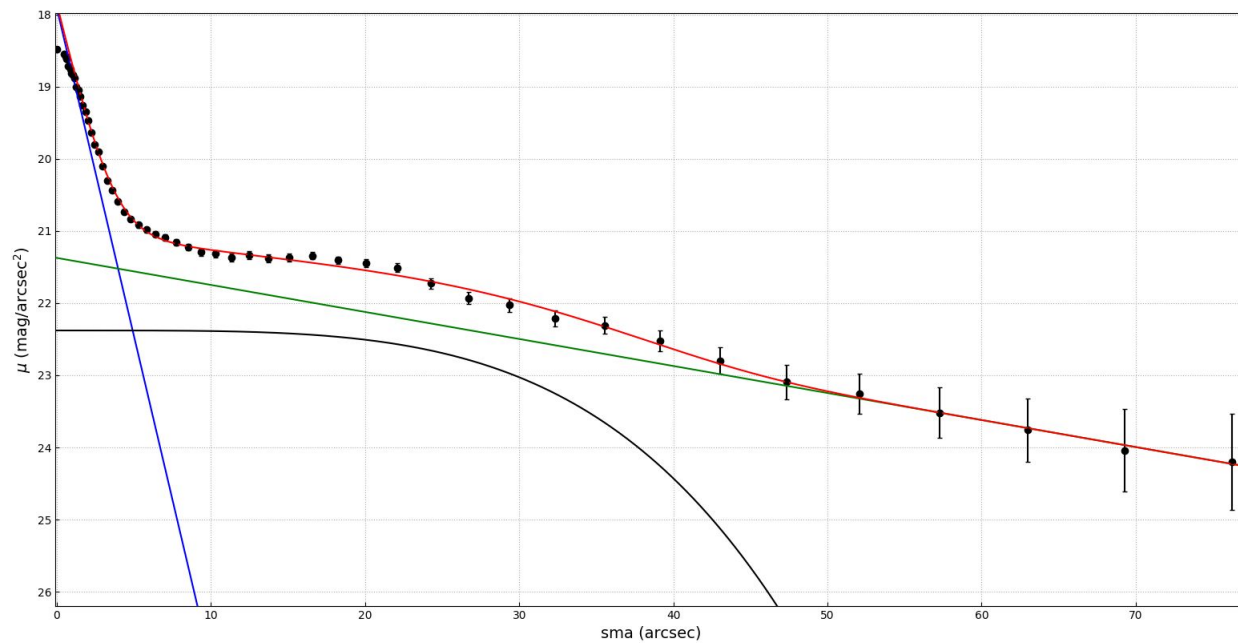
```

49 f = open('sma_int', 'r')
50 data = np.genfromtxt(f)
51 sma = data[:,0]
52 intsup = data[:,1]
53 err = data[:,2]
54
55
56 # costanti fotometriche (DA MODIFICARE)
57 m0 = 23.959
58 dm0 = 0.001
59 k = 0.168
60 dk = 0.
61 X = 1.1897
62 #oklessgo
63
64 # costante di calibrazione ed errore
65 cal = m0 - k * X
66 dcal = dm0 + dk * X
67
68
69 # brillantezza calibrata ed errore
70 mu = -2.5*np.log10(intsup) + cal
71 dmu = 1.0857 * err + dcal
72
73
74
75 # Parametri di scala delle funzioni (DA MODIFICARE)
76 # (le lunghezze sono espresse in arcsec)
77
78 # bulge
79 Ie = 41.
80 re = 2.
81 n = 1
82
83 # barra
84 Ib = 3
85 rb = 22
86 nb = 0.25
87
88 # disco
89 I0 = 9
90 h = 29

```

bulge - barra - disco - totale

utilizzo del filtro r



```
ccl@labas15:~$ cd Desktop/GAL_MORPH
ccl@labas15:~/Desktop/GAL_MORPH$ python3 profilo_di_brillanza.py
m_bulge= 15.532
m_bar   = 13.732
m_disc  = 12.066
m_tot   = 11.818
B/T     = 0.033
```

$$\Delta m = -2.5 \log(B/T)$$

Numerical Hubble stage

Hubble stage <i>T</i>	−6	−5	−4	−3	−2	−1	0	1	2	3	4	5	6	7	8	9	10	11
de Vaucouleurs class ^[16]	cE	E	E ⁺	S0 [−]	S0 ⁰	S0 ⁺	S0/a	Sa	Sab	Sb	Sbc	Sc	Scd	Sd	Sdm	Sm	Im	
approximate Hubble class ^[19]	E			S0			S0/a	Sa	Sa-b	Sb	Sb-c	Sc			Sc-Irr	Irr I		

Le galassie



← Vittorialis



Annamaria IV →

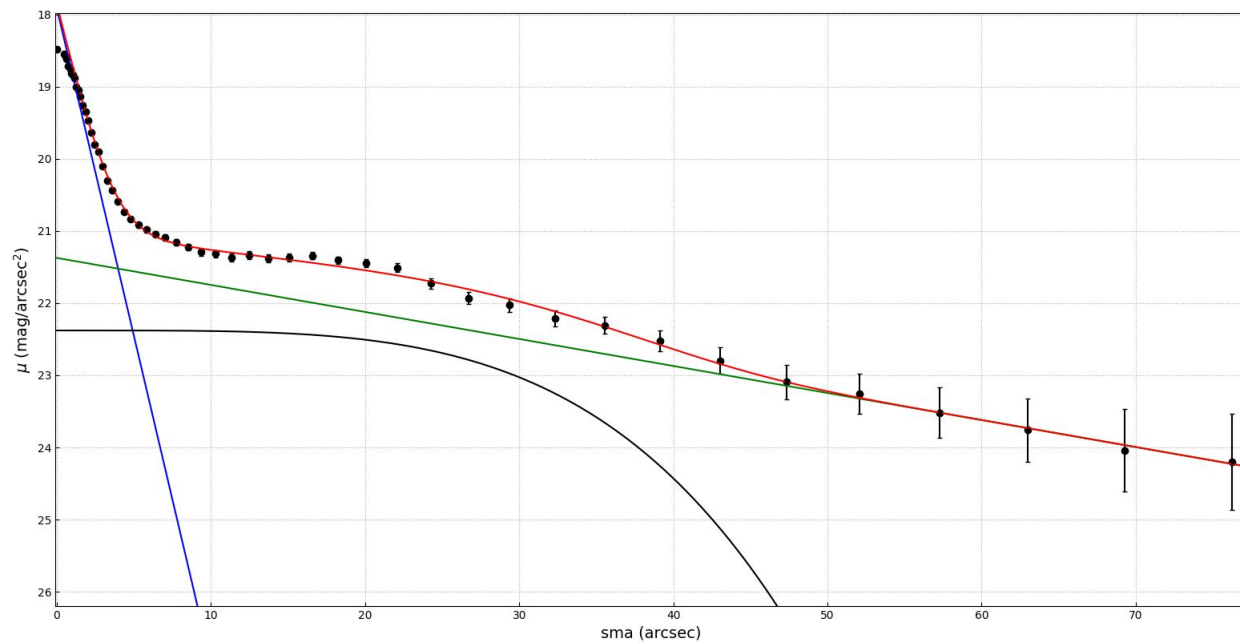


← Mariangelis



Paolis →

Vittoria III - NGC 201



Bulge

le	41
----	----

re	2
----	---

n	1
---	---

Barra

lb	3
----	---

rb	22
----	----

nb	0.25
----	------

Disco

lo	9
----	---

h	29
---	----

Vittoria III - NGC 201

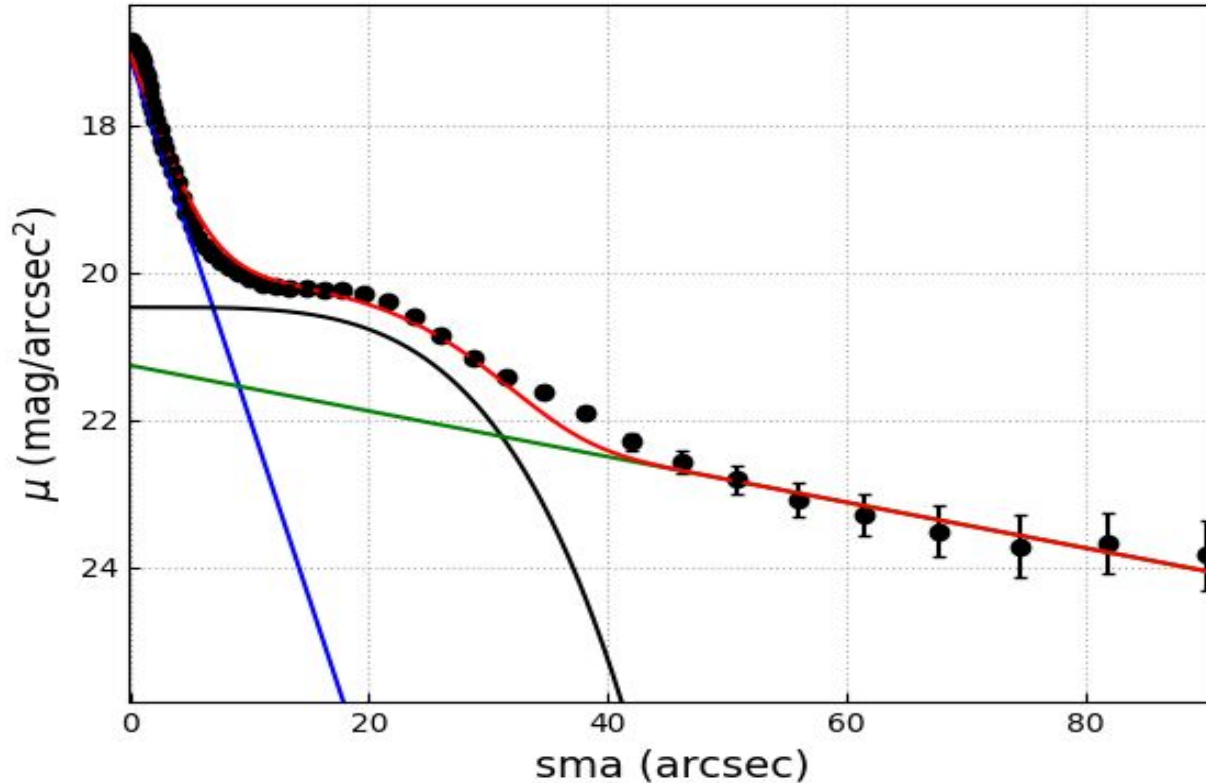


Magnitudini	
m_{bulge}	15.532
m_{barra}	13.732
m_{disco}	12.066
m_{tot}	11.818
B/T	0.033

$$\Delta m = -2.5 \log(B/T) = 3.70$$

classe: SBbc

AnnamariaIV - NGC 192



Bulge

le	90
re	2.37
n	1

Barra

lb	17.4
rb	17.8
nb	0.25

Disco

l0	10
h	35

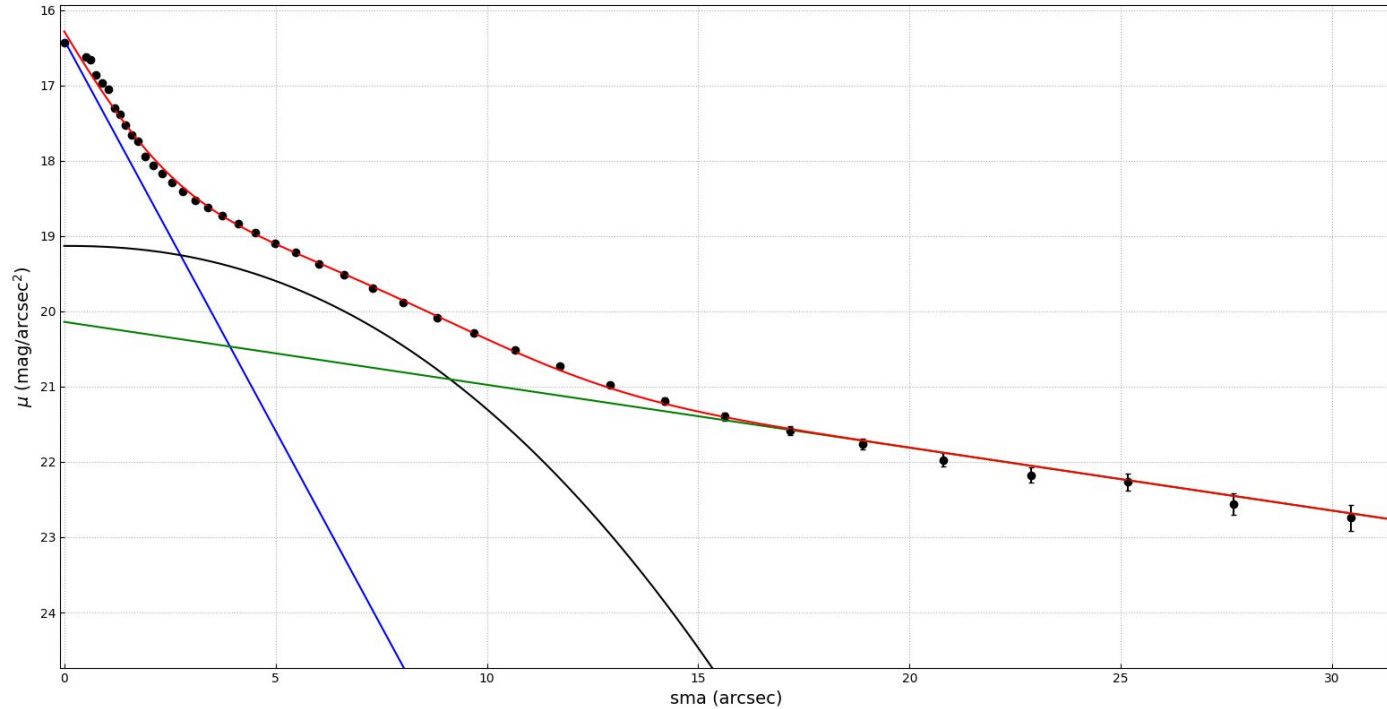
AnnamariaIV - NGC 192



$\Delta m = -2.5 \log(B/T) = 2.37$
classe: SBab

Magnitudini	
m_{bulge}	13.342
m_{barra}	12.284
m_{disco}	11.543
m_{tot}	10.970
B/T	0.113

Mariangelall - NGC 196



Bulge

le	165
re	1.75
n	1

Barra

lb	40
rb	5.7
nb	0.45

Disco

l0	28
h	13

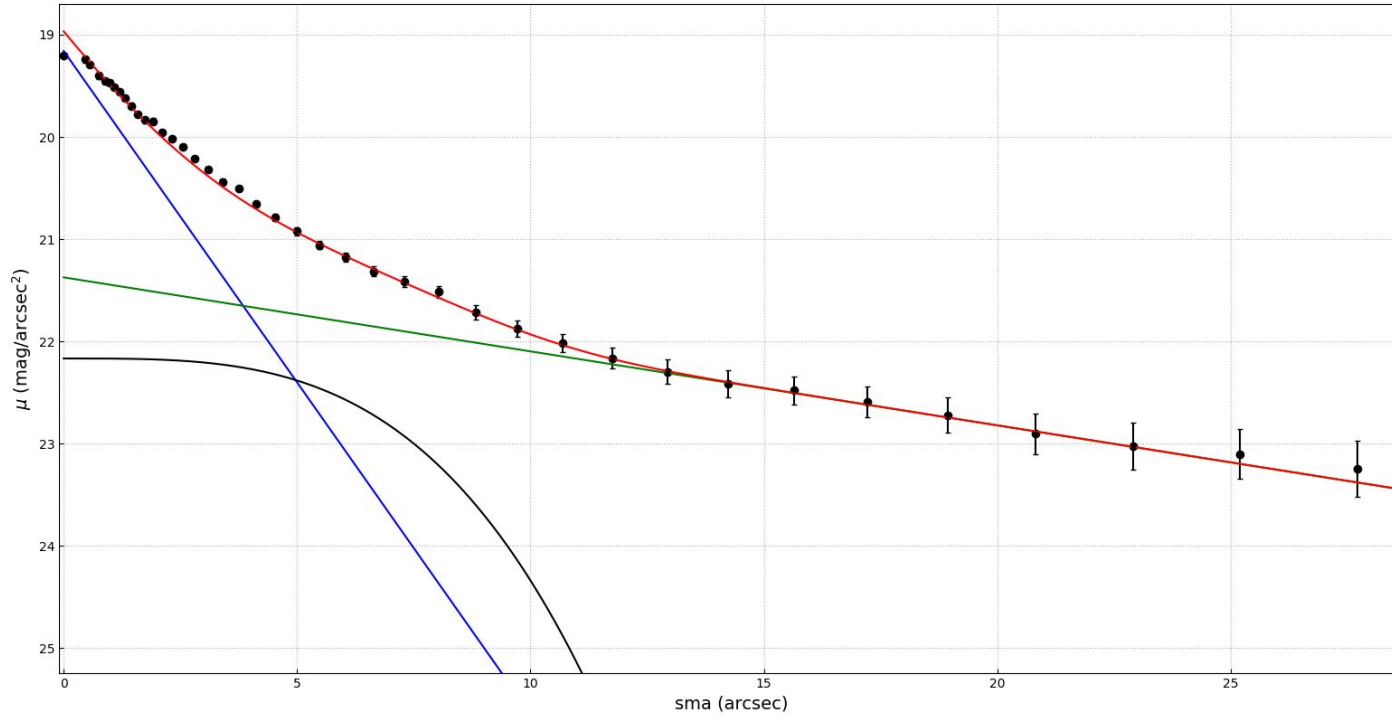
Mariangelall - NGC 196



$\Delta m = -2.5 \log(B/T) = 2.23$
classe: SBab

Magnitudini	
m_{bulge}	14.310
m_{barra}	13.637
m_{disco}	12.576
m_{tot}	12.080
B/T	0.128

Paolali - NGC 197



Bulge

le	13
----	----

re	2.8
----	-----

n	1
---	---

Barra

lb	3.3
----	-----

rb	5.5
----	-----

nb	0.3
----	-----

Disco

lo	9
----	---

h	15
---	----

Paolani - NGC 197



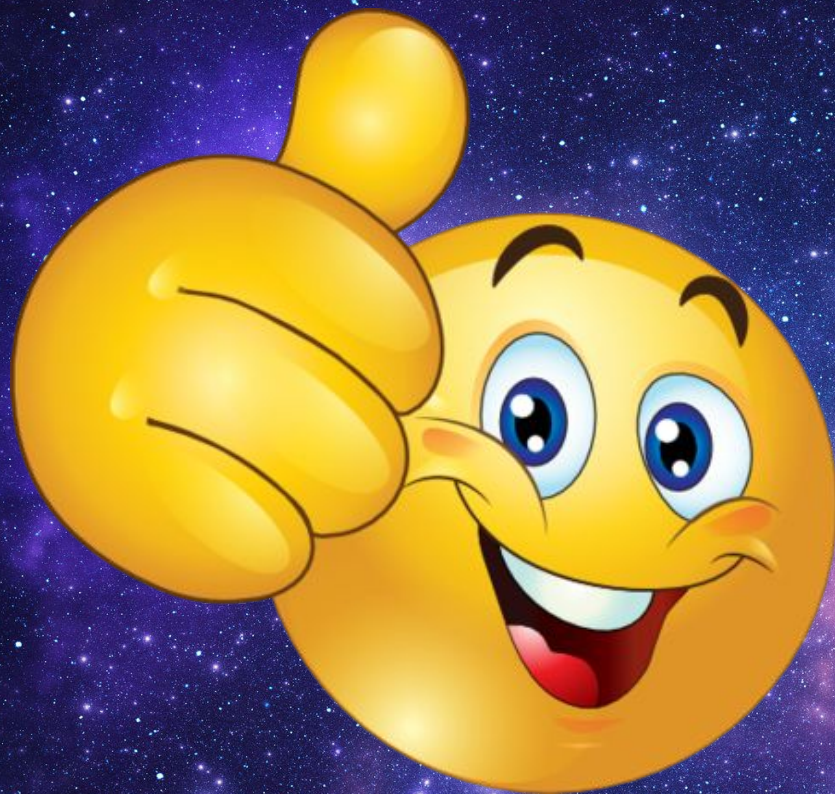
$$\Delta m = -2.5 \log(B/T) = 2.70$$

classe: SBb

Magnitudini	
m_{bulge}	16.048
m_{barra}	16.577
m_{disco}	13.498
m_{tot}	13.342
B/T	0.083

Conclusioni

- ★ **Vittoriall → galassia di tipo SBbc → galassia a spirale barrata con bulge ridotto**
- ★ **AnnamarialV → galassia di tipo SBab → galassia a spirale barrata con bulge medio**
- ★ **Mariangelall → galassia di tipo SBab → galassia a spirale barrata con bulge medio**
NB: classificata lenticolare
- ★ **Paolall → galassia di tipo SBb → galassia a spirale barrata con bulge intermedio**



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