ASTR232, Fall 2019
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Homework # 2

Problem 1a

What type of telescope was used for the SDSS, and what is its field of view?

Solution

SDSS used a 2.5 meter telescope at the Apache point Observatory.

Problem 1b

What are the effective (or average) wavelengths of the five photometric bands used in the SDSS, and what limiting magnitudes for point sources were achieved? What was the effective exposure time per filter in SDSS images?

Solution

The five photometric bands used in SDSS are u, g, r, i, and z. Their effective wavelengths and limiting magnitudes are tabulated below:

Table 1: SDSS Photometric Bands

	u	g	r	i	z
λ_{eff} $[\AA]$	3551	4686	6165	7481	8931
limiting mag	22.0	22.2	22.2	21.3	20.5

Additionally, the effective exposure time per filter was 54 seconds.

Problem 1c

How many spectra were obtained at once with the spectrographs, and what were the typical total integration (exposure) times for the spectra?

Solution

There are 640 spectra obtained at once and there are 3 exposures of 15 mins each, thus, 45 minutes total.

Problem 2b

- Write a brief but detailed description of the galaxy's appearance. Include anything you think might be relevant.
- Assign a full de Vaucouleurs classification to the galaxy. (Just do your best!)
- Estimate the diameter of the galaxy (in arcseconds) along its major axis.

Solution

- The galaxy is a reddish spiral galaxy with a small but prominent core. The spiral arms are large relative to the galaxy as a whole and are tightly bound.
- My classification of the galaxy is SAa.
- The approximate diameter of the galaxy is 50".

Problem 2c

- Record the r magnitude of the galaxy. This is supposed to correspond to the total flux of the object in the SDSS r band.
- Click on the spectrum and describe its appearance: does it only contain continuum emission (i.e., the integrated emission of many stars) or are there emission lines as well? If so, would you say they strong or weak? Compare the shape of the continuum to stellar spectra (see the "stellar spectra" supplementary file included with this assignment). Which stellar spectral type provides the closest match to the galaxy's spectrum? What is the galaxy's redshift (z at the bottom of the spectrum)?

Solution

- The r magnitude of the galaxy is 12.86.
- The spectrum of the galaxy is a continuum emmision with very weak emmision lines as no particular emission lines stand out and are all narrow. The stellar spectrum for an M0V star compares the most to this galaxy's spectrum.

Problem 2d

Solution

- Catalog name: NGC3895
- (l,b) = 137.0633,55.9515
- Classification: SB(rs)a
- Heliocentric radial velocity = 3159 km/s and z = 0.010537
- Hubble flow distance (Virgo + GA only) = 48.9 Mpc
- Rearranging the distance modulus to solve for M, we get

$$M = -5\log(\frac{d}{10}) + m \tag{1}$$

Plugging in the distance from NED and the r magnitude from SDSS, we get $\boxed{M = -20.59}$.

Next, we solve for the physical diameter. To do this, we use simple trigonometric rules and the small angle approximation to find that

$$\theta = \frac{\text{diameter}_{phys}}{\text{distance}} \tag{2}$$

Rearranging for diameter_{phys}, we get

$$\text{diameter}_{phys} = \theta \cdot \text{distance} \tag{3}$$

We turn our angular diameter in arcseconds into degrees and use the distance from NED to find that diameter_{phys} = 0.6792 Mpc = $\boxed{679.2 \text{ Kpc}}$

- ' *Revised Catalog of GALEX Ultravoilet Sources I. The All-Sky Survey: GUVcat_AIS* ' by Bianchi, Luciana et al., APJS, 230, 24B (2017). This paper conducts all sky surveys in the far-UV ($\lambda_{eff} \approx 1528\mathring{A}$) and near-UV ($\lambda_{eff} \approx 2310\mathring{A}$) bands. At the end of the surveys, 500 million source measurements were made and 100,000 UV spectra were obtained. NGC3895 was one of the objects that was observed and detected in the surveys and, thus, included in their catalog.

Table 2: Properties of Galaxies

	RA	DEC	catalog name	NED morph. classification	My classification	SDSS z	NED dist(Mpc)	SDSS r-mag	abs r-mag	ang. diamter(")	phys. diamter(Kpc)
1	177.2	59.4326	NGC3895	SB(rs)a	SAa	0.010537	48.9	12.86	-20.59	50	679.2
2	121.556	17.706	NGC2522	SOa	E6	0.0157	66.9	12.76	-21.37	80	14,867.9
3	170.663	37.765	NGC3652	Scd	SBb(s)	0.067	34.0	12.96	-19.679	160	15,112.3
4	175.07	17.72	NGC3801	SO?	SOA	0.0117	52.2	12.24	-21.348	150	21,751
5	208.532	60.67	NGC5370	SBOˆO(r)	SBa(r)	0.0102	48.1	12.94	-20.47	80	10,698
6	111.64	43.296	UGC03844	E?	E3	0.0105	45.5	12.94	-20.35	100	12,639.9

(1) NGC3895 is a small, red spiral galaxy with a small, bright core. The spiral arms are tightly bound and while there is no clear bar, its NED classification says it has a bar.

(2) NGC2522 is a red galaxy with a prominent core. It has a large ring structure, which makes it more of a spiral galaxy than an elliptical, hence the NED classification of SOa rather than an elliptical.

(3) NGC3652 is a blue galaxy with 2 spiral arms and a hint of a small bar structure, which is why i include B in my classification. The NED classification thinks the arms are less tightly bound than I do.

(4) NGC3801 is a red galaxy w a bright nucleus. There is no structure in the outer layer. My classification agrees with NED.

(5) NGC5370 has a red, barred core with a bluer outer ring. Classification fairly agreed, but I was unsure what the ˆ meant.

(6) UGC03844 has a bright red nucleus, which is the only real structure. Therefore, classfying was straight forward.