THE SHAPES OF GALAXIES IN THE SOLOAN DIGITAL SKY SURVEY

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ABSTRACT

We estimate the distribution of apparent axis ratios $q$ for galaxies in the Sloan Digital Sky Survey Early Data Release. We divide the galaxies by profile type (de Vaucouleurs vs. exponential) as well as by color ($u^* - r^* \leq 2.22$ vs. $u^* - r^* > 2.22$). The axis ratios found by fitting models to the surface photometry are generally smaller than those found by taking the second moments of the surface brightness distribution. Using the axis ratios found from fitting models, we find that galaxies with de Vaucouleurs profiles have axis ratio distributions that are inconsistent, at the 99% confidence level, with their being a population of randomly oriented oblate spheroids. Red de Vaucouleurs galaxies are slightly rounder, on average, than blue de Vaucouleurs galaxies. By contrast, red galaxies with exponential profiles appear very much flatter, on average, than blue galaxies with exponential profiles. The red exponential galaxies are primarily disk galaxies seen nearly edge-on, with reddening due to the presence of dust, rather than to an intrinsically red stellar population.

Subject headings: galaxies: elliptical and lenticular, cD — galaxies: fundamental parameters — galaxies: photometry — galaxies: spiral

1. INTRODUCTION

Observationally based estimates of the three-dimensional shapes of galaxies arise as a diagnostic of the physics of galaxy formation and evolution. Galaxies can only be seen in projection against the sky; thus, astronomers can only attempt to deduce their three-dimensional properties from their two-dimensional, projected properties. Obviously, information about intrinsic shapes is lost in projection; for instance, using only the two-dimensional surface photometry of a given galaxy, it is impossible to determine its intrinsic three-dimensional shape.

Elliptical galaxies have isophotes that are well approximated as ellipses (hence the name “elliptical”). The shape of an ellipse is specified by its axis ratio $q$, with $0 \leq q \leq 1$. The three-dimensional isosurface of elliptical galaxies are generally modeled as ellipsoids. A stellar system whose isosurface are similar, concentric ellipsoids, without axis twisting, will have projected isophotes that are similar, concentric ellipses, without axis twisting (Contopoulos 1956; Stark 1977). The apparent axis ratio $q$ of the projected ellipses depends on the viewing angle and on the intrinsic axis ratios $\beta$ and $\gamma$ of the ellipsoid. Here, $\beta$ is the ratio of the intermediate-to-long axis, and $\gamma$ is the ratio of the short-to-long axis; thus, $0 \leq \gamma \leq \beta \leq 1$.

Beginning with Hubble (1926), many attempts have been made to deduce the distribution of intrinsic shapes of elliptical galaxies, given their distribution of apparent shapes. The early assumption, in the absence of evidence to the contrary, was that elliptical galaxies were oblate spheroids flattened by rotation (Sandage, Freeman, & Stokes 1970). If elliptical galaxies were all oblate spheroids ($\beta = 1$) or all prolate spheroids ($\beta = \gamma$), and if their orientations were random, then it would be possible to deconvolve their distribution of apparent axis ratios $f(q)$ to find their distribution of intrinsic axis ratios $N(\gamma)$. However, the pioneering work of Bertola & Capaccioli (1975) and Illingworth (1977) led astronomers to abandon the assumption that elliptical galaxies are necessarily oblate. The shapes of ellipticals have been reanalyzed with the assumption that they are intrinsically prolate or triaxial, rather than oblate (Binney 1978; Benacchio & Galleta 1980; Bingelli 1980; Binney & de Vaucouleurs 1981; Ryden 1996).

Statements about the intrinsic shapes of galaxies must be statistical in nature, since astronomers do not exactly know the distribution $f(q)$ of axis ratios for a given class of galaxy. In this paper, we will be examining the apparent axis ratios for galaxies in the Sloan Digital Sky Survey (SDSS; York et al. 2000). The set of axis ratios we analyze constitutes a finite sample drawn from a parent population $f(q)$. In this paper, we take into account the finite size of the sample in rejecting or accepting, at a known confidence level, two null hypotheses: that the galaxies are randomly oriented oblate spheroids or that they are randomly oriented prolate spheroids. To accomplish this, we make a kernel estimate $\hat{f}(q)$ of the distribution of axis ratios and mathematically invert $f(q)$ to find $N_c(\gamma)$ and $N_p(\gamma)$, the estimated distribution of intrinsic axis ratios for a population of oblate spheroids and a population of prolate spheroids, respectively.

The rest of the paper is organized as follows. In § 2, we describe the SDSS and the methods by which the apparent axis ratios of the galaxies are estimated. In § 3, we present a brief review of the nonparametric kernel estimators used in this paper. In §§ 4 and 5, we find the kernel estimate $\hat{f}(q)$ for galaxies with de Vaucouleurs luminosity profiles and for galaxies with exponential profiles and find the implications for their intrinsic shapes. In § 6, we discuss our results.

2. DATA

The SDSS is a digital photometric and spectroscopic survey that will, when completed, cover one-quarter of the celestial sphere in the north Galactic hemisphere and produce a smaller ($\sim 225$ deg$^2$) but much deeper survey in the south Galactic hemisphere. The photometric mosaic camera
(Gunn et al. 1998; see also Project Book § 4,1 “The Photometric Camera”) images the sky by scanning along great circles at the sidereal rate. The imaging data are produced simultaneously in five photometric bands (u′, g′, r′, i′, and z′; Fukugita et al. 1996) with effective wavelengths of 3543, 4770, 6231, 7625, and 9134 Å.

In 2001 June, the SDSS presented Early Data Release (EDR) to the general astronomical community, consisting of 462 deg² of imaging data in five bands. The data are acquired in three regions: along the celestial equator in the northern Galactic sky, along the celestial equator in the southern Galactic sky, and in a region overlapping the Space Infrared Telescope Facility First Look Survey. Galaxies in the EDR were analyzed with the SDSS photometric pipeline Photo (R. H. Lupton 2001, in preparation). This code fits two models to the two-dimensional image of each galaxy. One model has a de Vaucouleurs profile

$$I(r) = I_0 \exp\left(-\frac{r}{r_e}\right),$$

which is truncated beyond 7r_e to go smoothly to zero at 8r_e and with some softening within r_e/50. The second model has an exponential profile

$$I(r) = I_0 \exp\left(-1.68 r/r_e\right),$$

which is truncated beyond 3r_e to go smoothly to zero at 4r_e. Each model is assumed to have concentric isophotes with constant position angle $\phi$ and axis ratio $q$. Before the model is fitted to the data, the model is convolved with a double Gaussian fitted to the point-spread function (PSF). Assessing each model with a $\chi^2$ fit gives $r_e$, $q$, and $\phi$ for the best-fitting model, as well as $P(\text{dev})$ and $P(\text{exp})$, the likelihood associated with the best-fitting de Vaucouleurs and exponential models, respectively.

We use the model fits in the r band to divide the galaxies into two classes; the “de Vaucouleurs” galaxies are those with $P(\text{dev}) > P(\text{exp})$, and the “exponential” galaxies are those with $P(\text{exp}) > P(\text{dev})$. In our data analysis we chose the likelihood $P > 10^{-3}$ for a well-behaved distribution of galaxies and the spectroscopic redshift $z < 0.2$ to reduce the effects of gravitational lensing of foreground objects. In addition, we require that a fit using one of the galaxy models is better than a pure PSF fit. The spectroscopic sample of the EDR contains 13,092 de Vaucouleurs galaxies and 6081 exponential galaxies, based on these criteria. Although the classification in the SDSS is based purely on the surface brightness profile, it is generally true that galaxies classified as “elliptical” in the standard morphological schemes are better fitted by de Vaucouleurs profiles than by exponential profiles (Kormendy & Djorgovski 1989), while galaxies morphologically classified as “spiral” are better fitted by exponential profiles.

The SDSS photometric analysis also provides an independent measure of the axis ratio, one based on the second moments of the surface brightness distribution. The Stokes parameters $Q$ and $U$ are given in terms of the flux-weighted second moments as

$$Q \equiv \langle x^2 - y^2 \rangle,$$

$$U \equiv \langle xy \rangle.$$

If the isophotes of the galaxy are indeed concentric ellipses of constant position angle and axis ratio, then the axis ratio $q_{\text{Stokes}}$ is related to the values of $Q$ and $U$ by the relation

$$q_{\text{Stokes}} = \frac{\sqrt{Q^2 + U^2} - 1}{\sqrt{Q^2 + U^2} + 1}.$$

Unlike the axis ratios $q_{\text{model}}$ found by fitting models, the values of $q_{\text{Stokes}}$ do not attempt to correct for the effects of seeing.

For the galaxies in the SDSS EDR, the value of $q_{\text{Stokes}}$ is generally larger than $q_{\text{model}}$, as shown in Figure 1. To investigate the origin of this difference, we used the elliptical isophote fitting routine in Imaging and Reduction Analysis Facility (IRAF) to plot $q$ versus $r/r_e$ for a subset of galaxies in the sample. Figure 2 shows the result for just four of the de Vaucouleurs galaxies examined. The horizontal dashed lines indicate $q_{\text{Stokes}} \pm \sigma$ in $q_{\text{Stokes}}$; the horizontal dotted lines indicate $q_{\text{model}} \pm \sigma$ in $q_{\text{model}}$. For these four galaxies, as for most galaxies in the SDSS, $q_{\text{Stokes}}$ is greater than $q_{\text{model}}$. As is also typical, $q(r)$ found by fitting individual isophotes decreases as a function of radius; most elliptical galaxies are rounder in their central regions than in their outer regions (Ryden, Forbes, & Terlevich 2001). The values of $q_{\text{Stokes}}$, based on the luminosity-weighted second moments, are primarily indicating the axis ratio of the central regions of each galaxy, where the surface brightness is highest. The values of $q_{\text{model}}$, by contrast, are more strongly influenced by the axis ratio in the outer regions. Since in this paper we are not primarily interested in the central regions of the galaxies, we will adopt $q_{\text{model}}$ as our primary measure of the axis ratio.

![Fig. 1.—Axis ratio $q_{\text{Stokes}}$ vs. axis ratio $q_{\text{model}}$ for the galaxies studied](image-url)
The distribution of galaxies in the SDSS EDR is strongly bimodal in the $g^* - r^*$ versus $u^* - g^*$ color-color diagram (Strateva et al. 2001). The optimal color separation between the two peaks is at $u^* - r^* = 2.22$. The detection of a local minimum indicates that the two peaks correspond roughly to early-type (E and S0) and late-type (Sa, Sb, Sc, and Irr) galaxies. The late-type galaxies are the bluer group, reflecting their more recent star formation activity. The color criterion of Strateva et al. (2001) provides another means of dividing our data set. In addition to distinguishing between de Vaucouleurs and exponential galaxies, we can also distinguish between red ($u^* - r^* > 2.22$) and blue ($u^* - r^* \leq 2.22$) galaxies. Not surprisingly, the de Vaucouleurs galaxies are predominantly red, and the exponential galaxies are predominantly blue. Of the 13,092 de Vaucouleurs galaxies, 10,898 are red, but only 2194 are blue. Of the 6081 exponential galaxies, 4697 are blue, while 1384 are red.

3. METHOD

We use a standard nonparametric kernel technique to estimate the distribution of intrinsic axis ratios. General reviews of kernel estimators are given by Silverman (1986) and Scott (1992); applications to astronomical data are given by Vio et al. (1994), Tremblay & Merritt (1995), and Ryden (1996). Here, we give a brief overview, adopting the notation of Ryden (1996). Given a sample of axis ratios for $N$ galaxies, $q_1, q_2, \ldots, q_N$, the kernel estimate of the frequency distribution $f(q)$ is

$$\hat{f}(q) = \frac{1}{Nh} \sum_{i=1}^{N} K\left(\frac{q - q_i}{h}\right),$$

where $K(x)$ is the kernel function, normalized so that

$$\int_{-\infty}^{\infty} K(x) dx = 1,$$

and $h$ is the kernel width, which determines the balance between smoothing and noise in the estimated distribution. One way of choosing $h$ is to use the value that minimizes the expected value of the integrated mean square error between the true $f$ and the estimated $\hat{f}$ (Tremblay & Merritt 1995). We follow Silverman (1986) in using the formula

$$h = 0.9 A N^{-0.2},$$

with $A = \min\{\sigma, Q_4/1.34\}$, where $\sigma$ is the standard deviation of the data and $Q_4$ is the interquartile range. This formula for $h$ minimizes the expected value of the mean square error for samples that are not strongly skewed (Silverman 1986; Vio et al. 1994). We choose a Gaussian kernel to ensure that $f$ is smooth and differentiable.

To obtain physically reasonable results, with $\hat{f} = 0$ for $q < 0$ and $q > 1$, we apply reflective boundary conditions (Silverman 1986; Ryden 1996). In practice, this means replacing the simple Gaussian kernel with the kernel

$$K_{red} = K\left(\frac{q - q_i}{h}\right) + K\left(\frac{q + q_i}{h}\right) + K\left(\frac{2 - q - q_i}{h}\right).$$

Use of this kernel assures the correct normalization, $\int_{0}^{\infty} f(q) dq = 1$. If we suppose that the $N$ galaxies in our sample are randomly oriented oblate spheroids, then the estimated frequency of intrinsic axis ratios, $N_0(\gamma)$, can be found by the mathematical inversion

$$N_0(\gamma) = \frac{2\gamma \sqrt{1 - \gamma^2}}{\pi} \int_{0}^{\gamma} \frac{d}{dq} \left(\frac{q^2}{\gamma^2 - q^2}\right) dq,$$  

Similarly, if the galaxies are assumed to be randomly oriented prolate spheroids, then the estimated frequency of intrinsic axis ratios, $N_p(\gamma)$, is given by

$$N_p(\gamma) = \frac{2\sqrt{1 - \gamma^2}}{\gamma \pi} \int_{0}^{\gamma} \frac{d}{dq} \left(\frac{q^2}{\gamma^2 - q^2}\right) dq.$$  

If the oblate hypothesis is incorrect, then the inversion of equation (10) may result in $N_0$, which is negative for some values of $\gamma$. Similarly, if the prolate hypothesis is incorrect, $N_p$, from equation (11), may be negative.

To exclude the oblate or prolate hypothesis at some statistical confidence level, we must take into account the errors in $f$ both from the finite sample size and from the errors in measuring $q$ for individual galaxies. The error due to finite sampling can be estimated by bootstrap resampling of the original data set. Randomly taking $N$ data points, with replacement, from the original data set, a new estimator $f$ is created from the bootstrapped data and is then inverted to find new estimates of $N_0$ and $N_p$. After creating a large number of bootstrap estimates for $f$, $N_0$, and $N_p$, error intervals can be placed on the original kernel estimates. In this paper, we performed 300 bootstrap resamplings of each data set. An additional source of error in $f$, $N_0$, and $N_p$ is the error that is inevitably present in the measured values of the apparent axis ratio. The SDSS EDR galaxies have an error $\sigma_i$ associated with the axis ratio $q_i$ of each galaxy. To
model the effect of errors, we replace the kernel width \(h\) given by equation (8) with a broader width
\[
H' = \sqrt{h^2 + \sigma_i^2}.
\] (12)

4. GALAXIES WITH DE VAUCOULEURS PROFILES

We can now apply the mathematical apparatus described in §3 to our four subsamples of galaxies: red de Vaucouleurs galaxies, blue de Vaucouleurs galaxies, red exponential galaxies, and blue exponential galaxies. Unfortunately, given the desirability of large \(N\) in determining \(f(q)\), not all the galaxies in the SDSS EDR are sufficiently well resolved for their axis ratios to be reliably determined. A plot of \(q_{\text{model}}\) versus \(r_e\), measured in units of the PSF width (PSFW) as shown in Figure 3, reveals that the galaxies with \(q_{\text{model}} = 1\) are mainly galaxies whose effective radius is not much larger than the PSFW (typically, \(r_e \approx 2\)PSFW). For instance, Figure 4 shows the estimated distribution \(f(q_{\text{model}})\) for all the red de Vaucouleurs galaxies \((N = 10,898)\). In addition to the main peak at \(q_{\text{model}} \approx 0.80\), there is a secondary peak at \(q_{\text{model}} = 1\). To eliminate these spurious round, poorly resolved galaxies, we retain in our samples only those galaxies with \(r_e > 2\)PSFW. After this purge of too-small galaxies, there are \(N = 5,659\) galaxies in the red de Vaucouleurs subsample, \(N = 1784\) galaxies in the blue de Vaucouleurs subsample, \(N = 815\) galaxies in the red exponential subsample, and \(N = 2,263\) galaxies in the blue exponential subsample.

The estimated distribution \(f(q_{\text{model}})\) for the edited subsample of red de Vaucouleurs galaxies (excluding galaxies with \(r_e < 2\)PSFW) is shown as the solid line in the top panel of Figure 5. Note that the secondary peak at \(q_{\text{model}} = 1\) has disappeared. The dashed lines to either side of the solid line are the 80% confidence intervals, estimated by bootstrap resampling, while the dotted lines are the 98% confidence interval. The estimated distribution \(\mathcal{N}_p(\gamma)\) of intrinsic axis ratios, given the oblate hypothesis, is shown in the middle panel of Figure 5. The 98% confidence interval drops below zero for \(\gamma > 0.91\); thus, the oblate hypothesis for this subsample of galaxies can be rejected at the 99% (one-sided) confidence interval. To produce as few nearly circular galaxies as are seen, there would have to be a negative number of nearly spherical oblate galaxies. The estimated distribution \(\mathcal{N}_p(\gamma)\), given the prolate hypothesis, is shown in the bottom panel of Figure 5. The best estimate for \(\mathcal{N}_p\), shown as the solid line, is positive everywhere. Thus, the surface photometry of the red de Vaucouleurs galaxies is consistent with their being a population of randomly oriented prolate spheroids. If they are all prolate, then their average intrinsic axis ratio is
\[
\langle\gamma\rangle_p = \int_0^1 \gamma \mathcal{N}_p(\gamma) d\gamma = 0.608.
\] (13)

Although the shape distribution for red de Vaucouleurs galaxies is consistent with the prolate hypothesis, it does not require prolateness. The galaxies could also be triaxial and produce the same distribution of apparent shapes.

Plots of \(f\), \(\mathcal{N}_p\), and \(\mathcal{N}_p\) are given in Figure 6 for the 1784 blue de Vaucouleurs galaxies. Just as for the red de Vaucouleurs galaxies, the oblate hypothesis can be rejected at the 99% confidence level because of the scarcity of nearly circular galaxies in projection. The prolate hypothesis, however, cannot be rejected at the 90% confidence level for this sample; see the bottom panel of Figure 6. If the blue de Vaucouleurs galaxies are prolate, then \(\mathcal{N}_p\) yields an average intrinsic axis ratio \(\langle\gamma\rangle_p = 0.592\), only slightly smaller than that for red de Vaucouleurs galaxies. As measured by the Kolmogorov-Smirnov (K-S) test, however, the distribution of \(q\) for blue de Vaucouleurs galaxies is significantly different from that for red de Vaucouleurs. The K-S probability from comparing the two samples is \(P_{KS} = 3 \times 10^{-3}\); i.e., the two samples are different at the 99.7% confidence level.
5. GALAXIES WITH EXPONENTIAL PROFILES

Unlike galaxies with de Vaucouleurs profiles, which are generally smooth ellipticals, galaxies with exponential profiles are generally spiral galaxies, containing nonaxisymmetric structures such as spiral arms and bars. Given such a large amount of substructure present in spiral galaxies, attempting to characterize their shape by a single axis ratio $q$ is a gross oversimplification. Nevertheless, as long as it is not overanalyzed, the distribution $f(q)$ contains useful information about the overall shape of exponential galaxies.

For instance, Figure 7 shows the estimated value of $f(q_{\text{model}})$ for the 815 red exponential galaxies. The peak in $f$ is at $q_{\text{model}} \approx 0.27$, and relatively few red exponential galaxies have $q_{\text{model}} > 0.6$. The large apparent flattening of the galaxies in the red exponential subsample is a sign that they are not a population of randomly oriented disks. Instead, the sample preferentially contains edge-on (or nearly edge-on) disks. The red color of galaxies in this

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Fig. 5.—Top left: Distribution of apparent axis ratios for a subsample of 5659 red de Vaucouleurs galaxies with $r_c > 2$ PSFW. Top right: Distribution of intrinsic axis ratios for the same subsample, assuming the galaxies are randomly oriented oblate objects. Bottom: Distribution of intrinsic axis ratios, assuming the galaxies are randomly oriented prolate objects. The kernel width is $h = 0.03$. The solid line in each panel is the best fit, the dashed lines give the 80% error interval, and the dotted lines give the 98% error interval.
subsample is not the intrinsic color of the stars but is rather the result of internal reddening by dust in the galaxy’s disk. For a typical edge-on spiral galaxy such as NGC 4594, the maximum reddening $E(B-V)$ is 0.4 (Knapen et al. 1991). Then, the corresponding reddening in the $u-r$ color will be $\sim 1$, using the transformation $E(u-r) = [A_u/E(B-V) - A_r/E(B-V)] E(B-V)$, with $A_u/E(B-V) = 5.155$, and $A_r/E(B-V) = 2.751$ (Stoughton et al. 2002).

By contrast, Figure 8 shows the estimated value of $f(q_{\text{model}})$ for the 2263 blue exponential galaxies. The apparent shapes of blue exponential galaxies are very different from the apparent shapes of red exponential galaxies; a K-S test comparing the two populations yields $P_{\text{KS}} = 5 \times 10^{-95}$. The scarcity of exponential galaxies with $q \geq 0.9$ is an indication that the exponential galaxies are not perfectly axisymmetric disks. Indeed, visual inspection of the SDSS images reveals that most of the exponential galaxies contain readily visible nonaxisymmetric structure in the form of spiral arms, bars, or tidal distortions.

6. DISCUSSION

The galaxies in the SDSS EDR with de Vaucouleurs profiles have a distribution of apparent shapes that is incompatible (at the 99% confidence level) with their being randomly oriented oblate spheroids. This is consistent with the result found by Lambas, Maddox, & Loveday (1992) for a sample...
of 2135 elliptical galaxies with shapes estimated from survey plates of the APM Bright Galaxy Survey. When the SDSS survey is complete, it will provide a sample of galaxies \( \times 20 \) times larger than the SDSS EDR. This increase in sample size will enable us to determine more accurately the distribution of apparent axis ratios \( f(q) \). The kernel width \( h \) will be decreased by a factor \( \sim 0.2 \approx 0.55 \). The error intervals, which are essentially determined by the \( N^{1/2} \) fluctuations in bins of width \( h \), will be reduced by a factor \( \sim 0.4 \approx 0.30 \). Although a simple increase in the sample size will not enable us to determine the true distribution of intrinsic shapes, it will enable us to make stronger statistical statements about our rejection or acceptance of the prolate or oblate hypothesis.

The blue de Vaucouleurs galaxies, with a mean axis ratio of \( \langle q_{\text{model}} \rangle = 0.639 \), are only slightly flatter in shape than the red de Vaucouleurs galaxies, with \( \langle q_{\text{model}} \rangle = 0.652 \). Thus, if the color of the blue de Vaucouleurs galaxies is the result, at least in part, of recent star formation, then we can conclude that the overall shape of the galaxies is not strongly affected by star formation. Although elliptical galaxies with old stellar populations tend to be rounder than those with young stellar populations (Ryden et al. 2001), this difference is only large at small radii \( (r \lesssim r_e/8) \), while the values of \( q_{\text{model}} \) used in this paper emphasize the axis ratio at much larger radii \( (r \gtrsim r_e) \).

The galaxies with exponential profiles have, by contrast, shapes that are strongly dependent on color, with the red exponential galaxies consisting predominantly of dust-reddened edge-on (or nearly edge-on) disks. A significant number of galaxies in the SDSS EDR appear to be edge-on late-type galaxies with exponential profiles rather than early-type galaxies with de Vaucouleurs profiles. The number of red exponential galaxies \( (N = 815) \) is 14.4% of the number of red de Vaucouleurs galaxies \( (N = 5659) \). Thus, if we attempted to select out elliptical galaxies purely on the basis of color, we would have been faced with a significant contamination by reddened disks. Spectroscopy or accurate surface photometry is required to distinguish between elliptical galaxies and disk galaxies. This analysis agrees very well with the result of Schade et al. (1999) and carries substantially more statistical weight.

In summary, galaxies with de Vaucouleurs profile have an axis ratio distribution consistent, at a high confidence level, with their being randomly oriented prolate spheroids (although it is also consistent with their being triaxial systems). Galaxies with exponential profiles have an axis ratio distribution that is dependent on color, suggesting that red exponential galaxies are nearly edge-on systems reddened by dust. Since a fair number of red galaxies in the SDSS EDR are nearly edge-on exponential disks, it is dangerous to select elliptical galaxies purely on the basis of color.

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\(^3\) The SDSS Web site is http://www.sdss.org/.
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