

XXI SERBIAN ASTRONOMICAL
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The Edge-on Galaxies in the DESI survey: EGIDE project

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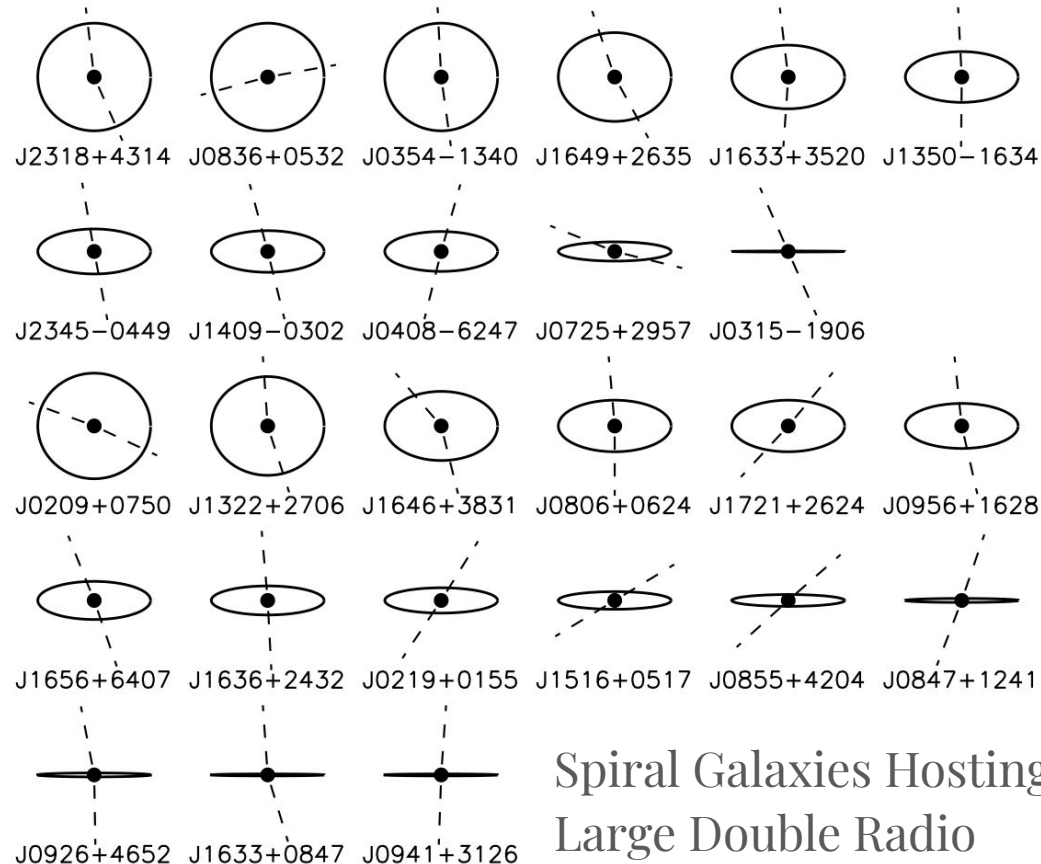
Russian Science Foundation №24-72-10084



Why do we need edge-on galaxies?

Many reasons:

- vertical matter distribution measurements
- enhanced line-of-sight, radial profiles and breaksable to study structures around, like polar rings (**Moiseev+2011**), galactic fountains, boxy bulges (**Marchuk+2022**), SDRAGNs (right)
- mutual orientation with cosmic web filaments (**Antipova+2025**)
- global disk instabilities, warps (**Reshetnikov+2025**)
- disk heating mechanisms
- probe dark matter halos within disk (**Zasov+2002**)



Spiral Galaxies Hosting
Large Double Radio
Sources (**Tate+2026**)

Previous samples of edge-on galaxies

Revised Flat Galaxy
Catalogue (**RFGC**)
Karachentsev et al. (1999)
~**4000** large galaxies

Catalog of Edge-on disc
Galaxies from SDSS (**EGIS**)
Bizyaev et al. 2014
~**5700** galaxies

2MASS-selected Flat Galaxy
Catalog (**2MFGC**)
Mosenkov et al. (2010)
~**200** galaxies

Edge-on Galaxies in the
Pan-STARRS survey (**EGIPS**)
Makarov et al. (2022)
~**16500** galaxies

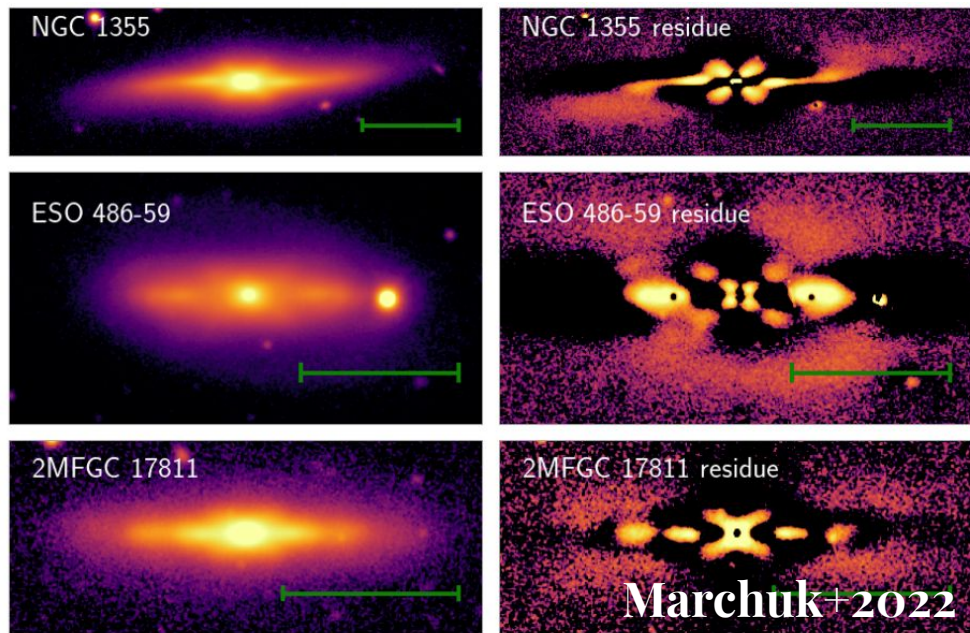
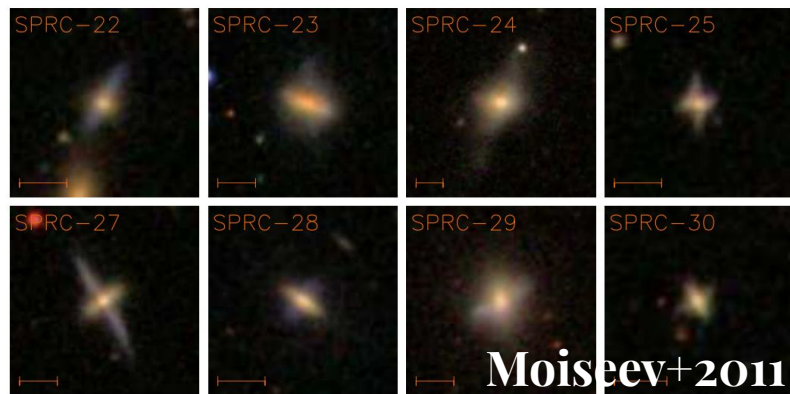


The Edge-on Galaxy Database

www.sao.ru/edgeon/catalogs.php

Why do we need more edge-ons?

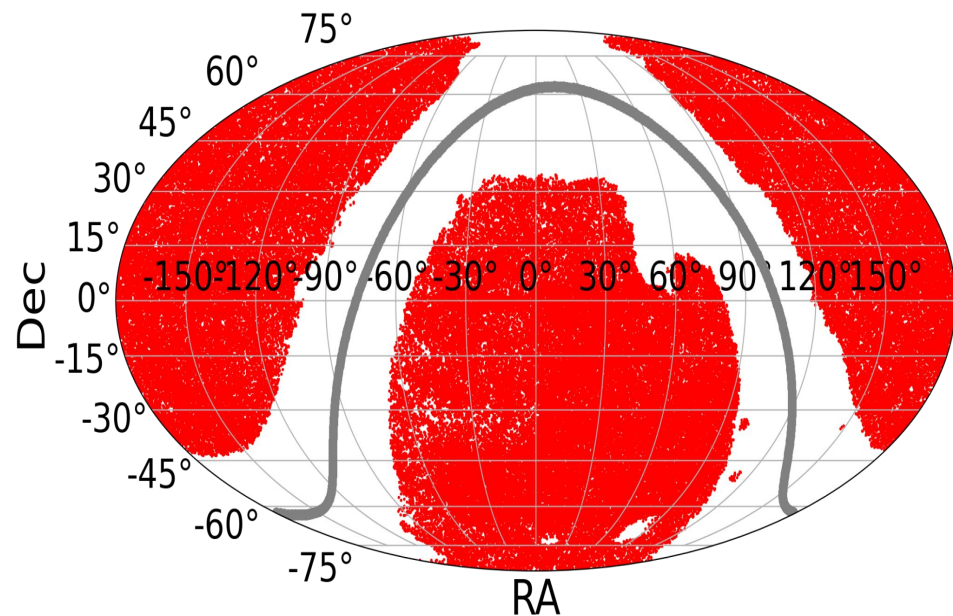
- for objects like polar ring galaxies (PRG) or boxy/peanut-shaped (B/PS) bulges we have **hundreds** of examples, need more
- cosmic web-related studies
- need bigger samples for statistical measurements because of many confounders
- secular evolution, ultra-thin galaxies, peculiar objects, etc.
- upcoming surveys like **Euclid/JWST/Roman/LSST** etc. will provide deeper data



How to find more: data & method

Data: DESI Legacy Imaging Surveys DR10

The **DESI Legacy Imaging Surveys** are designed to provide the essential imaging dataset for target selection of the Dark Energy Spectroscopic Instrument (**DESI**). It includes three individual telescopes: the Dark Energy Camera Legacy Survey (**DECaLS**), the Beijing-Arizona Sky Survey (**BASS**), and the Mayall z-band Legacy Survey (**MzLS**), plus the photometry at infrared wavelengths from the Wide-field Infrared Survey Explorer (**WISE**).

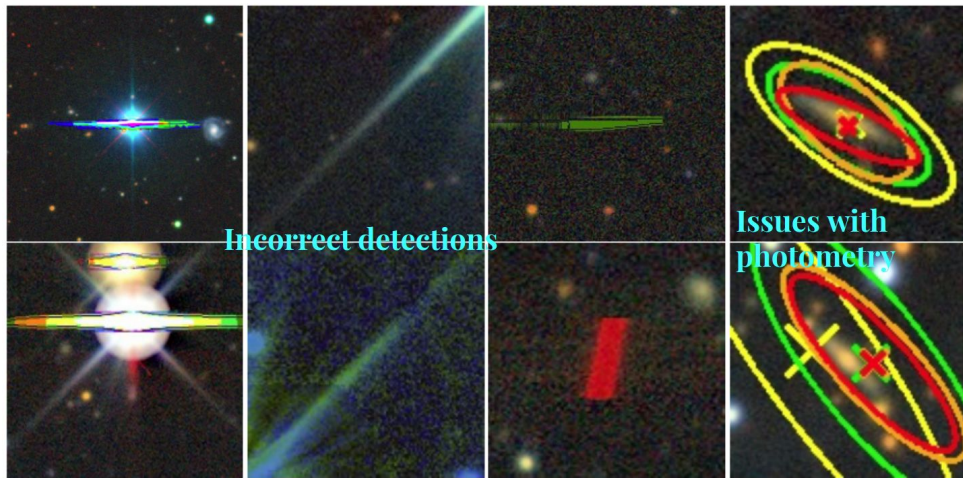


The two most notable changes in DR10:
1) inclusion of *i*-band observations;
2) extension of the southern ($\delta \leq 32.375^\circ$) part of the survey.

Four bands *griz*, pixel scale of 0.262 arcsec/pix, median PSF FWHM is 1.3-1.1 arcsec, depth of the images on average is 28.5-29 mag/arcsec² (*g*-band, 10 arcsec box).

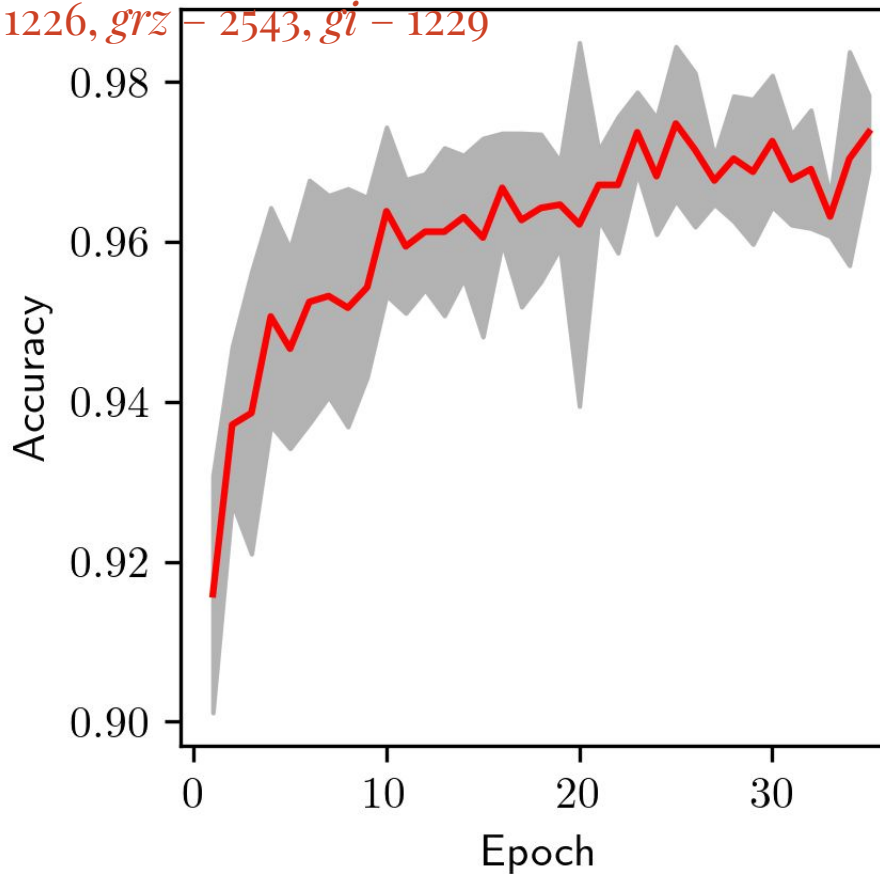
Method: Zoobot fine-tuning

- issue with stars with horizontal **CCD-leakage** (solution: classifier on 5000 examples)
- manual phase: from 192593 NN-selected objects we **removed** 43378 (~23%)
- **photometry** with **SExtractor** in *griz* (masking stars using information from Gaia)
- **extinction correction** using the SFD map



We tune 9 models ensemble tuned from zoobot `'convnext_nano'` model for each bands combination: training size *gri* -

1226, *grz* - 2543, *gi* - 1229



EGIDE: The Edge-on Galaxies in the DESI survey

In total we have **149,215** edge-on galaxies with SExtractor photometry in *griz* bands.

We additionally collect:

- **redshift** information: 98% from **REGALADE** (the Revised Galaxy List for the Advanced Detector Era, Tranin+2026 - 80 million up to 2000 Mpc = $z \leq 0.37 = cz \leq 111000$ km/s); we also collect and compare with **RCSEDv2**, **HyperLEDA**, **DESI DR1**
- **star formation rate** and other data from **CIGALE** fits from DESI DR1 (2025, for $\sim 20\%$)
- **total stellar masses** were estimated using calibration from **Ebrov+2025**:

$$\log(M_\star[M_\odot]) = 0.673 \times M_g - 1.108 \times M_r + 0.996.$$

Name	Reference	Size	a_r [arcsec]	Name	Reference	Size	a_r [arcsec]
RFGC	[97]	135	32.1	EGIS	[97]	2726	22.9
EGIPS	[73]	8294	22.6	HyperLEDA	[98]	60,838	16.0
DESI DR1	[98]	30,833	13.6	REGALADE	[99]	145,876	13.6
RCSEDv2:	[98]	30,163	16.0				
SDSS	[18]	17027	16.0	FAST	[100]	406	26.3
2DF	[101]	3869	14.3	2DFLENS	[102]	381	13.8
6DF	[103]	3067	22.1	HECTOSPEC	[104]	279	13.3
EBOSS	[18]	2392	14.8	CFA	[105]	125	19.2
LAMOST	[106]	1621	16.8	UZC	[107]	55	49.3

The Edge-on Galaxy Database

[Main](#) [Projects](#) [Catalogs](#) [About](#)

EGIDE - the Catalog of the Edge-on Galaxies In DESI Legacy Surveys

<https://www.sao.ru/edgeon/catalogs.php?cat=EGIDE>

12:11:04.33 +50:29:06.1 r=4.5

Examples

The request returns 373 objects.

EGIDE	g _{Petro}	r _{Petro}	i _{Petro}	z _{Petro}	Leda	b _T	cz _h	cz _{CMB}	z _{DESI}	RCSED2 Survey	z	REGALADE	z	
EGIDE J115826.1+504129	18.63	17.73	17.46									WISE J115826.20+504129.8	0.14522	
EGIDE J121046.8+461259	18.56	17.55	16.80									DESI J121046.81+461259.8	0.119786	
EGIDE J115022.3+500754	19.49	18.87	18.55									DESI J115022.39+500754.2	0.147195	
EGIDE J121324.4+545135	18.95	18.52	18.39	SDSSJ121324.49+545136.1	18.80							DESI J121324.49+545136.2	0.0770165	
EGIDE J122122.2+495816	19.11	18.26	17.58									DESI J122122.19+495816.9	0.16287	
EGIDE J120918.8+531130	19.04	18.07	17.40						0.19500(2)			WISEA J120918.96+531130.	0.195136	
EGIDE J120128.2+500934	19.04	18.65	18.34									DESI J120128.22+500934.6	0.0894221	
EGIDE J123811.9+503013	18.64	17.77	17.02									DESI J123811.93+503013.1	0.140083	
EGIDE J115551.8+481516	16.11	15.27	14.70	PGC037479	16.20	9693(5)	9900			25545	lamost	0.03235(1)	MCG+08-22-043	0.0323728
EGIDE J120929.5+531932	15.92	14.95	14.30	PGC038642	16.14	14752(5)	14928		0.04928(2)	26515	sdss	0.04921(1)	MCG+09-20-101	0.0491816
EGIDE J121223.5+533359	16.96	16.19	15.62	PGC038900	17.09	9742(4)	9917			26720	sdss	0.03250(1)	MCG+09-20-110	0.032531
EGIDE J121532.1+515447	16.17	15.60	15.32	UGC07272	16.33	4016(2)	4199		0.01341(0)	26950	sdss	0.01339(1)	PGC39203	0.0134535
EGIDE J121715.9+492949	16.58	15.88	15.36	UGC07318	16.95	10646(2)	10842		0.03547(0)	27087	sdss	0.03551(1)	UGC 7318	0.0355389
EGIDE J123219.9+530511	16.52	15.63	14.93	PGC041565	16.67	15622(5)	15793			28449	sdss	0.05211(2)	MCG+09-21-012	0.0520743
EGIDE J123307.9+503144	17.25	16.58	16.08	PGC041669	17.54	11800(5)	11984		0.03928(1)	28517	sdss	0.03936(2)	MCG+09-21-014	0.0393872
EGIDE J115357.8+531517	17.34	16.64	15.99	PGC091150	17.60	27762(7)	27943		0.09266(1)	55818	sdss	0.09261(2)	LEDA 91150	0.0925449
EGIDE J121415.6+504154	17.11	16.63	16.40	PGC091184	17.35	8698(4)	8888		0.02897(1)	55843	sdss	0.02902(1)	FGC 1389	0.0290585
EGIDE J122640.7+511404	16.97	16.30	16.07	PGC091199	17.46	9011(4)	9194			55856	sdss	0.03006(1)	LEDA 91199	0.0300958
EGIDE J123141.6+523539	17.36	16.68	16.16	PGC091204	17.66	13521(5)	13696		0.04511(0)	55859	sdss	0.04510(1)	LEDA 91204	0.045097
EGIDE J123156.2+523444	17.10	16.21	15.49	PGC091205	17.25	11373(7)	11548			55860	sdss	0.03794(2)	LEDA 91205	0.0379638
EGIDE J123610.8+484916	15.95	15.32	14.85	PGC091213	16.25	8632(4)	8824		0.02878(0)	55864	sdss	0.02880(1)	WISEA J123610.81+484916.	0.028842
EGIDE J120838.2+500218	17.53	16.70	16.07	PGC092939	17.79	15325(5)	15519		0.05119(1)	56438	sdss	0.05112(1)	LEDA 92939	0.0510869
EGIDE J121845.6+461437	17.92	17.14	16.51	PGC2277851	18.13	28128(9)	28339			401834	sdss	0.09382(3)	WISEA J121845.62+461436.	0.0937131
EGIDE J121750.1+462844	18.63	17.42	16.65	PGC2281910	18.72	47486(10)	47696			402448	eboss	0.15842(3)	WISEA J121750.08+462844.	0.158482

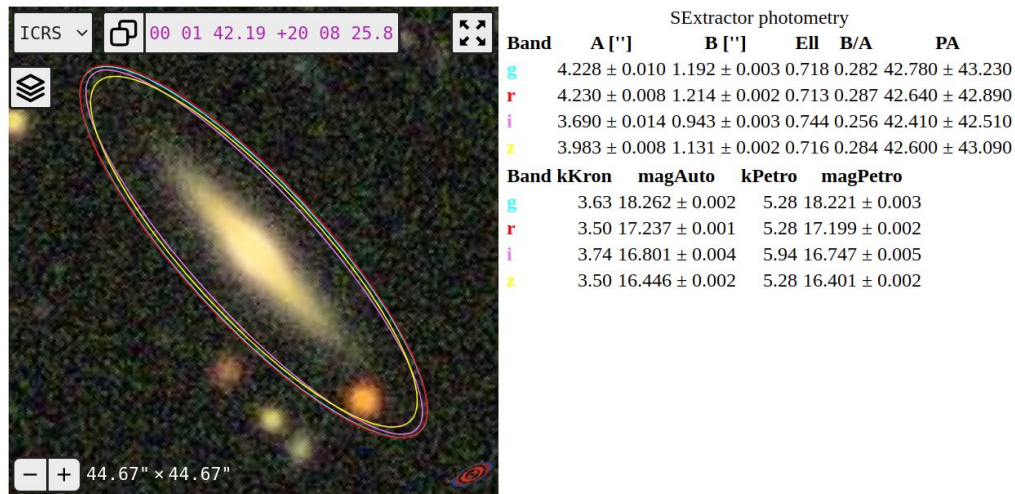
EGIDE: The Edge-on Galaxies in the DESI survey

```
egide='EGIDE J000142.1+200825'
```

Examples

The request returns a single object.

EGIDE J000142.1+200825



[PGC1617729](#)

pgc = 1617729

Celestial position

Designations

J000142.21+200826.2 2MASXJ00014221+2008262 PGC1617729
G107.34242-41.22071
SG313.08032+17.55223

[PA\[°\]](#) 40.0 [B_T\[mag\]](#) 18.61 ± 0.50

[D₂₅\["\]](#) 19.9 ± 4.8 [K_T\[mag\]](#) 13.85 ± 0.13

[R₂₅](#) 2.5 ± 0.2

For each galaxy we include

- photometry data: size, Kron and Petrosian magnitudes after correction, ellipse parameters from SExtractor
- redshift from REGALADE
- total stellar mass
- NN ensemble votes

When available:

- RCSEDv2 link ([Chilingarian+2016](#))
- HyperLEDA data ([Makarov+2014](#))
- DESI DR1 data ([DESI Collaboration+2025](#))

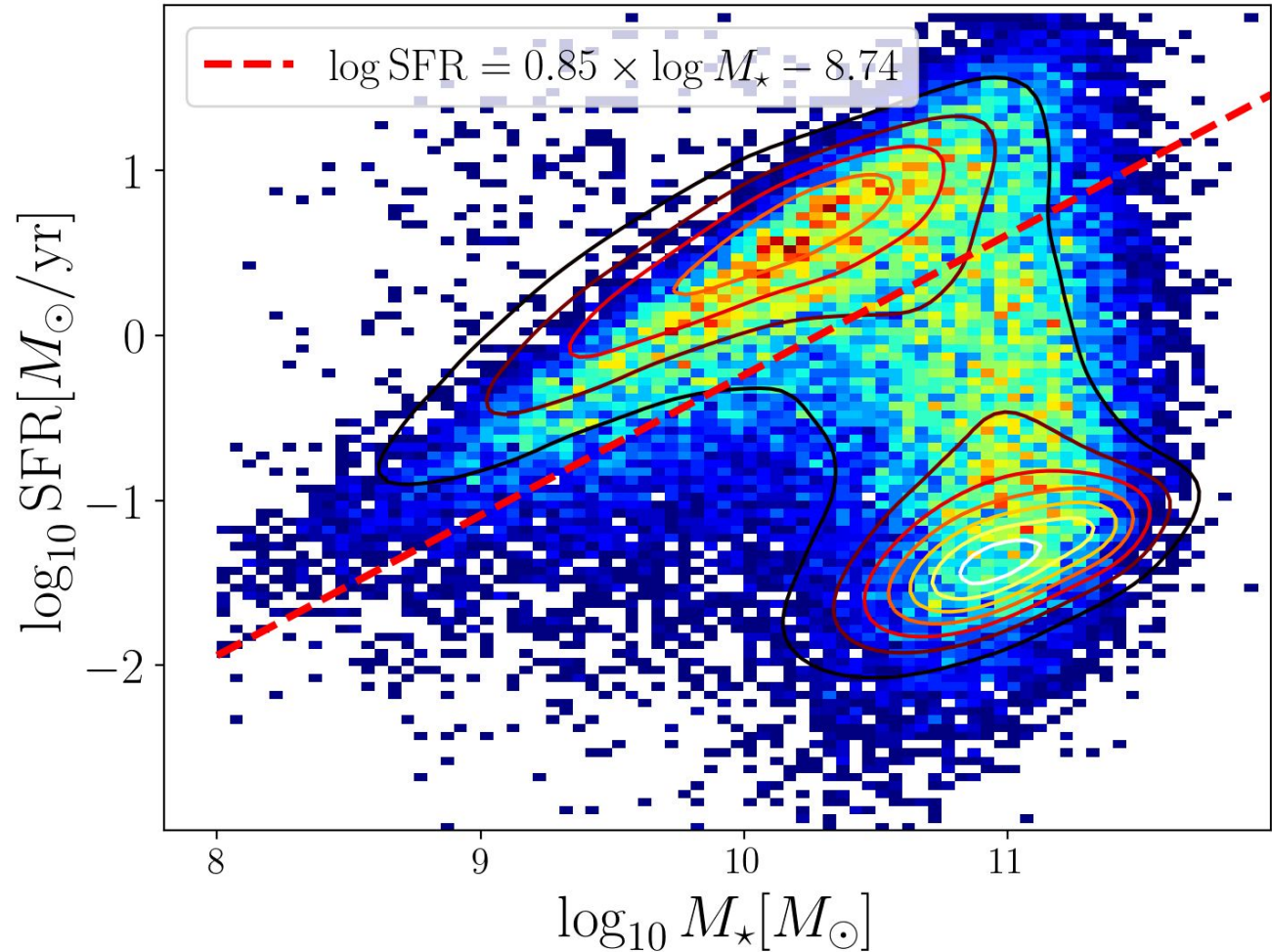
<https://www.sao.ru/edgeon/catalogs.php?cat=EGIDE>

Are EGIDE galaxies 'red' or 'blue'? SFMS perspective

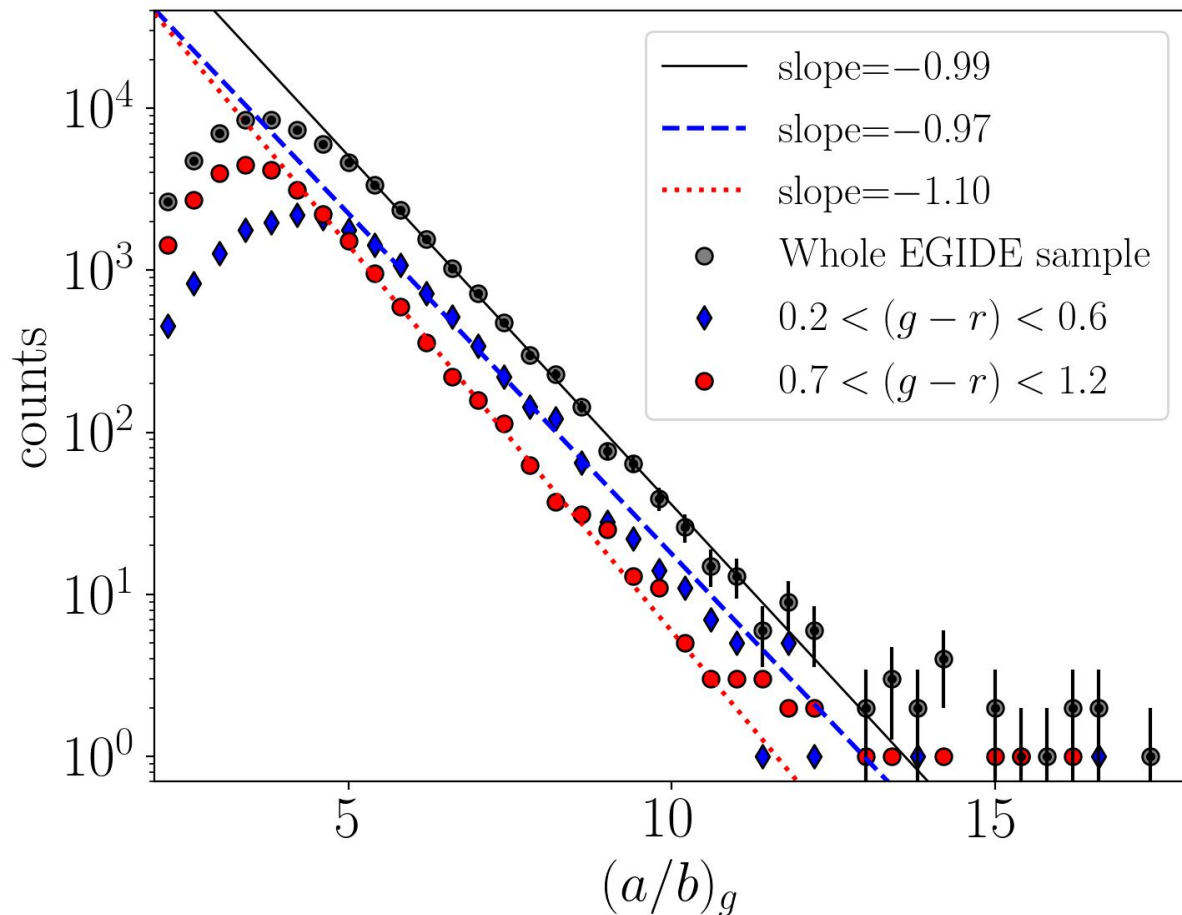
For the 20% of EGIDE sample in the intersection with DESI DR1 we see the same picture: star-forming main sequence (SFMS) and 'red cloud'.

Contours are for the DESI Early Data Release (EDR)
<https://data.desi.lbl.gov/doc/releases/edr/>

(galaxies selected in the same cz -volume)

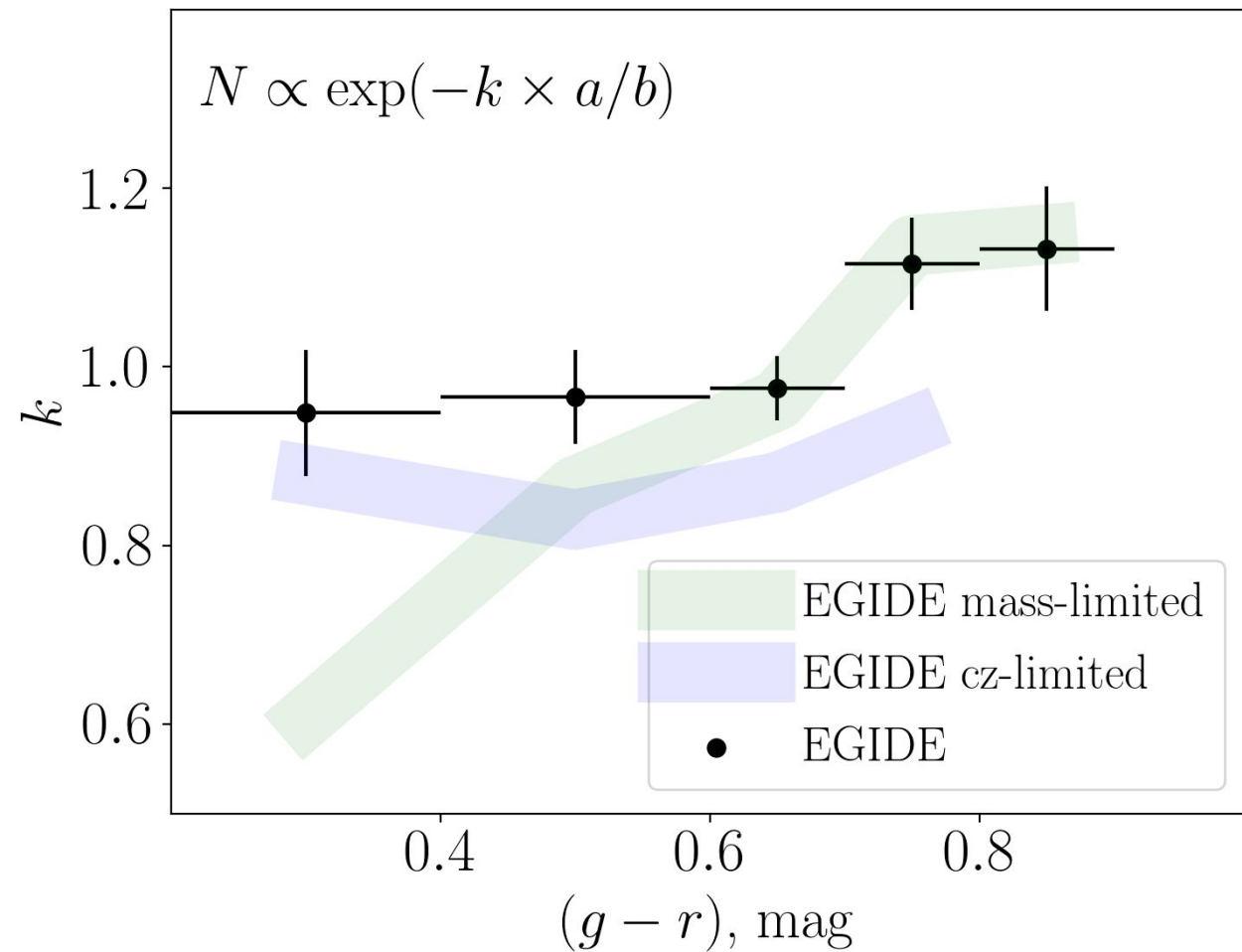


Scientific results I: count drop with a/b vs color



The number of the red galaxies drops with increasing a/b faster than for the blue galaxies.

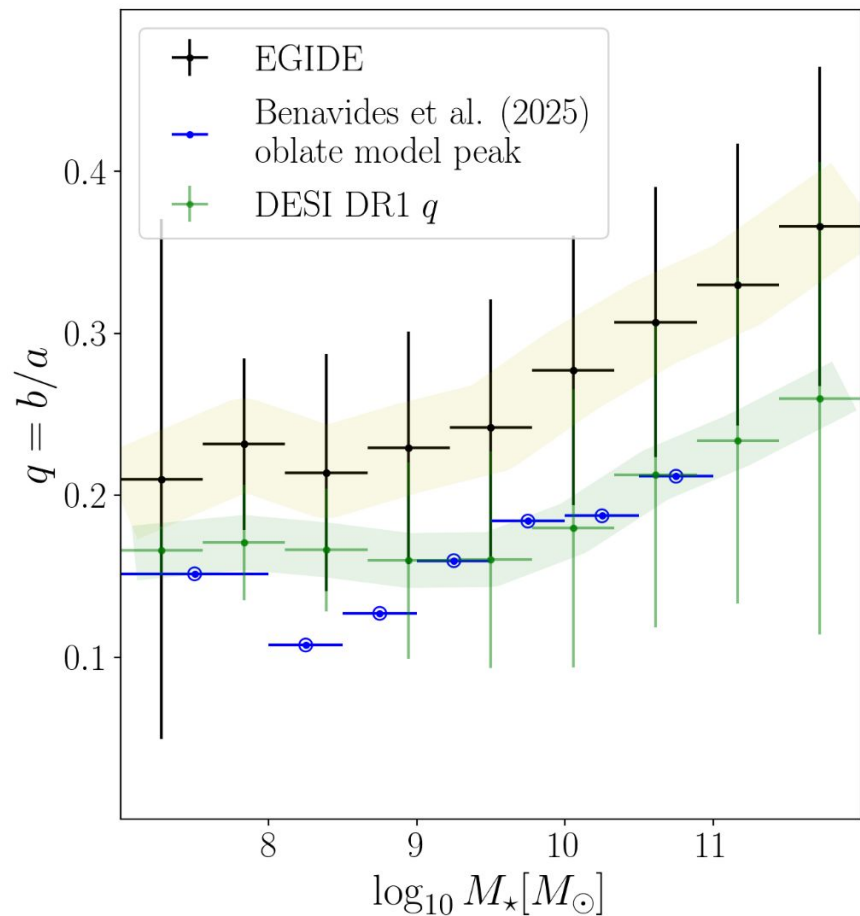
This is probably reflected in the fact that the early-type galaxies are systematically thicker than the late-type ones.



The number of the red galaxies drops with increasing a/b faster than for the blue galaxies.

This is probably reflected in the fact that the early-type galaxies are systematically thicker than the late-type ones.

Scientific results II: flattening vs stellar mass

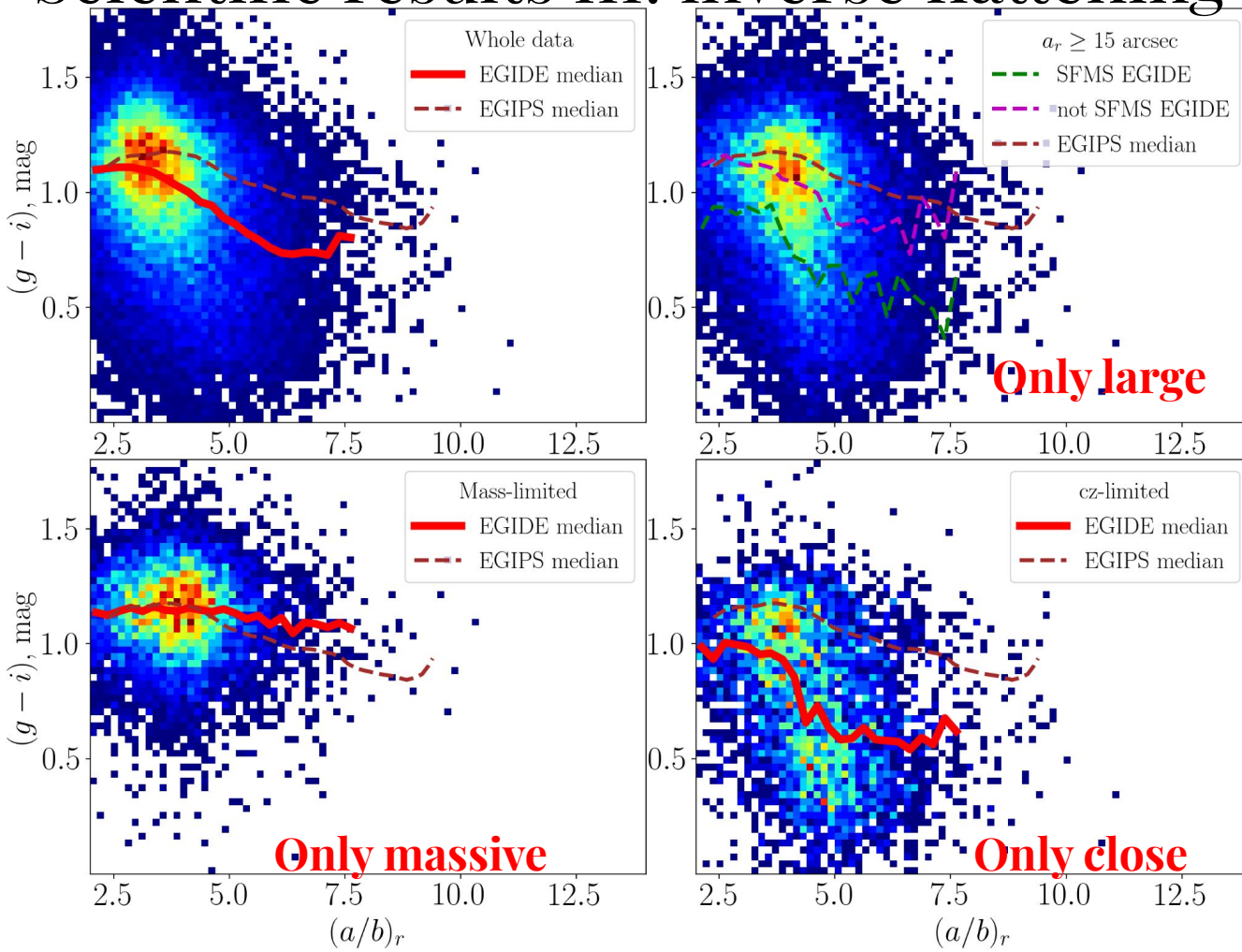


Increase of the relative thickness b/a (NB: not equal to h_z/h_R) for the high-mass end.

The same picture from the statistical models of figures of revolution (DESI DR1 – same, but q underestimated in models).

Curiously, two independent b/a datasets of $\sim 100,000$ s galaxies (statistical models and direct observations of edge-ons in EGIDE) produce nearly identical results.

Scientific results III: inverse flattening vs color



Despite the ten times larger sample size we observe in EGIDE exactly the same picture as was found for EGIPS: overdensity of galaxies represents thick ($a/b \sim 3-5$) and red $(g-i) \sim 1.2-1.3$ mag objects, while thinner galaxies with $a/b > 5$ are on average bluer by 0.2-0.4 mag.

Conclusions

We present the **EGIDE** (The Edge-on Galaxies in the DESI survey) project – catalogue of 149215 edge-on galaxies created using the public data of the DESI Legacy Imaging Survey DR10 images. The catalogue **covers more than half of the sky** and is constructed using a convolutional neural network, with subsequent manual supervision. We measure photometry, estimate stellar mass and collect redshift, star formation and other information. All of this is **publicly available** at the EGIDE site <https://www.sao.ru/edgeon/catalogs.php?cat=EGIDE>.

We also found that:

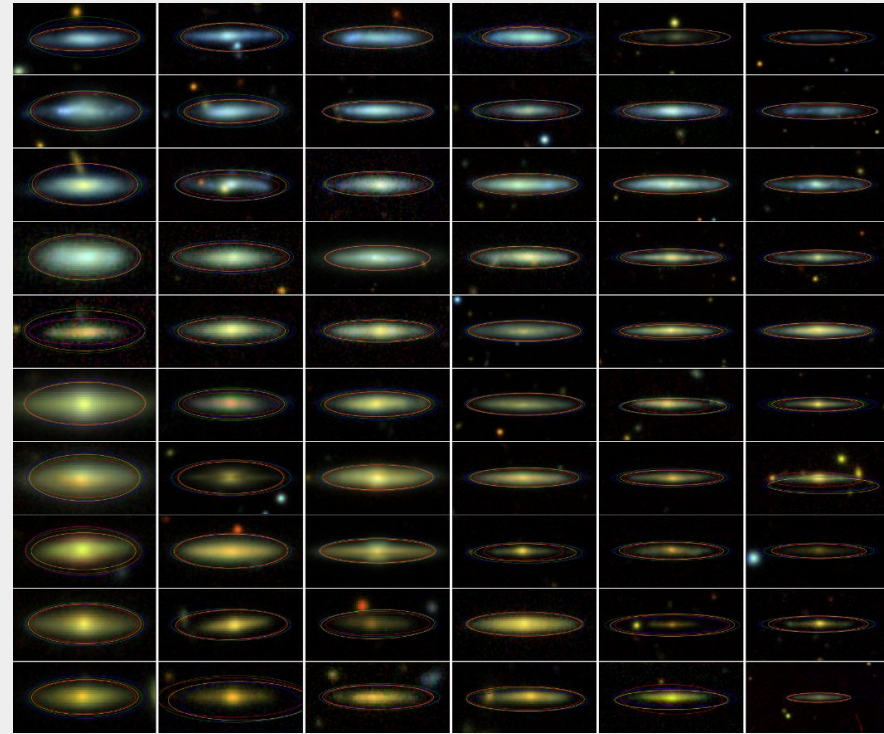
- sample is well **separated** into the red sequence and blue cloud populations
- number of red galaxies **drops** with increasing a/b faster than for the blue galaxies
- same trend of **increasing of the relative thickness** b/a for the high-mass end is detected from both the statistical models of figures of revolution and direct observations of edge-on galaxies in EGIDE **independently**
- galaxy **thickness varies with galaxy colour**: red sequence galaxies are thicker than blue cloud galaxies

The Edge-on Galaxies in the DESI survey: EGIDE project

XXI КОНФЕРЕНЦИЈА
АСТРОНОМА СРБИЈЕ

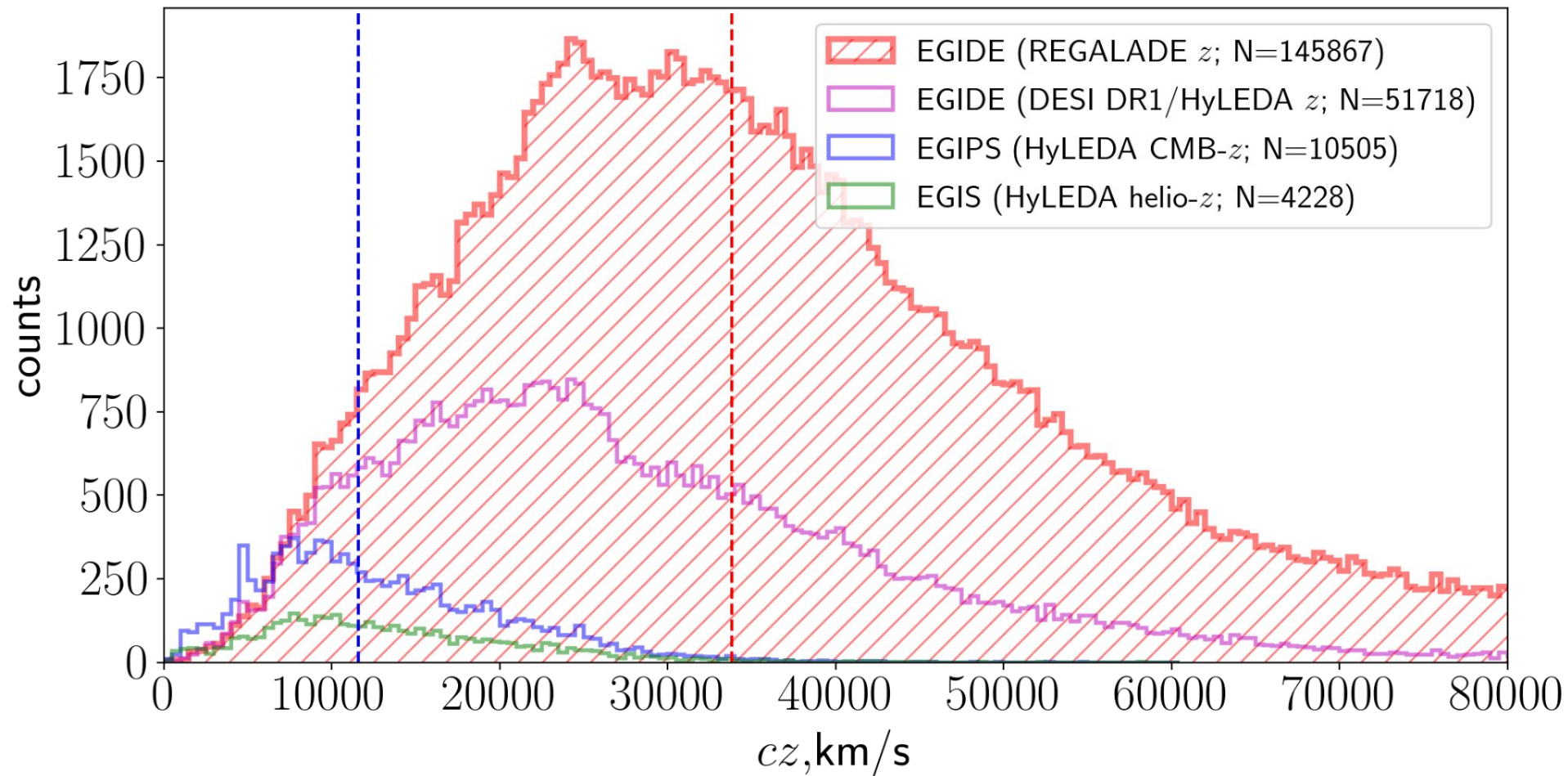
**Thank you for
your attention!
Q&A?**

EGIDE galaxies: $(g-i)$ vs a/b



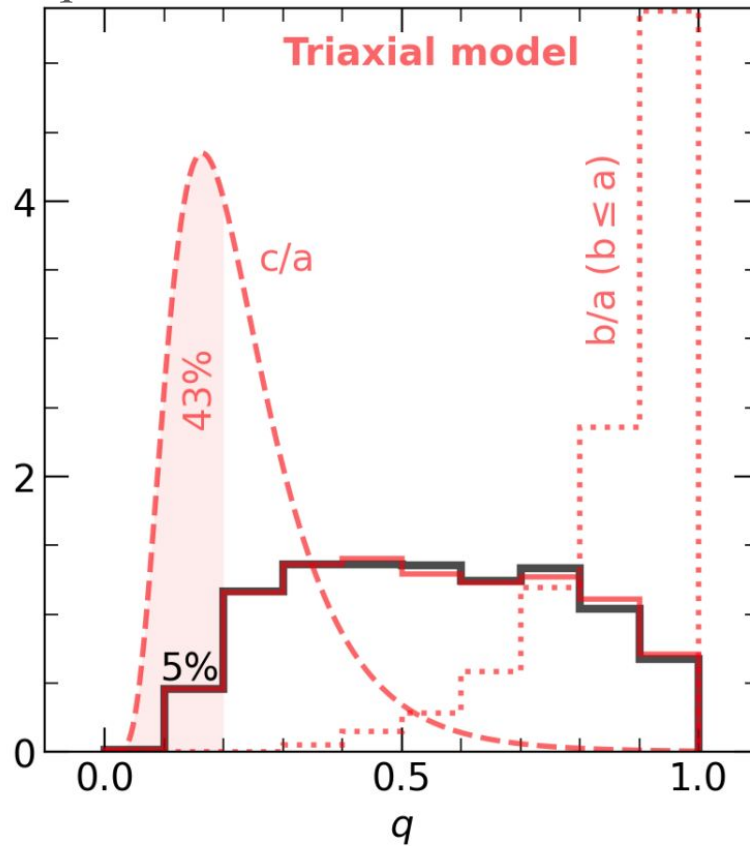
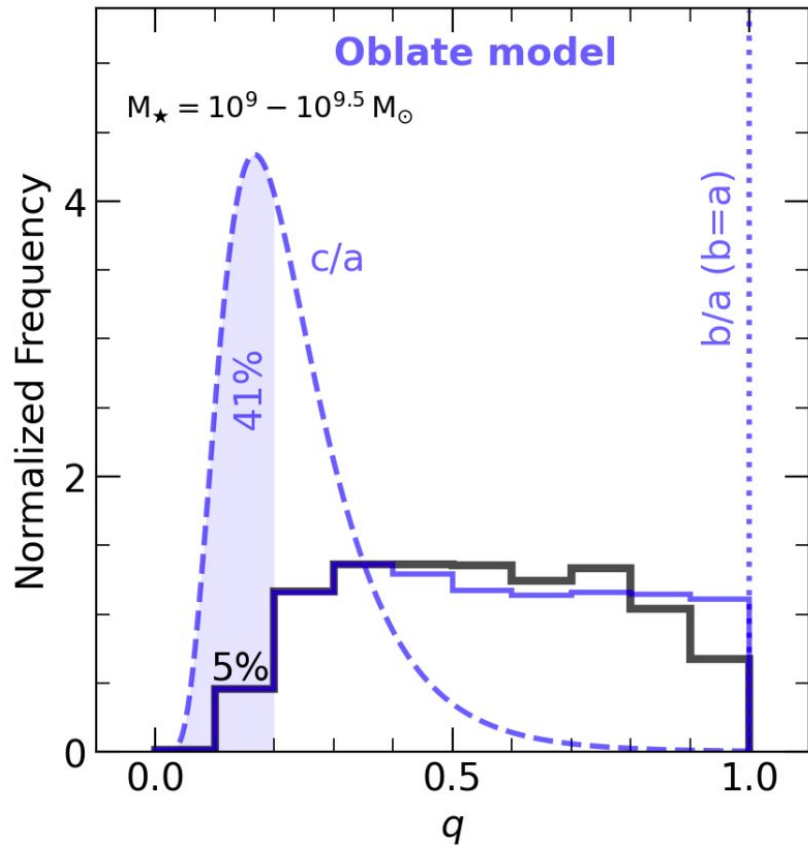
**Russian Science Foundation grant
№24-72-10084 (PI: Marchuk, A.)**

Redshift distribution

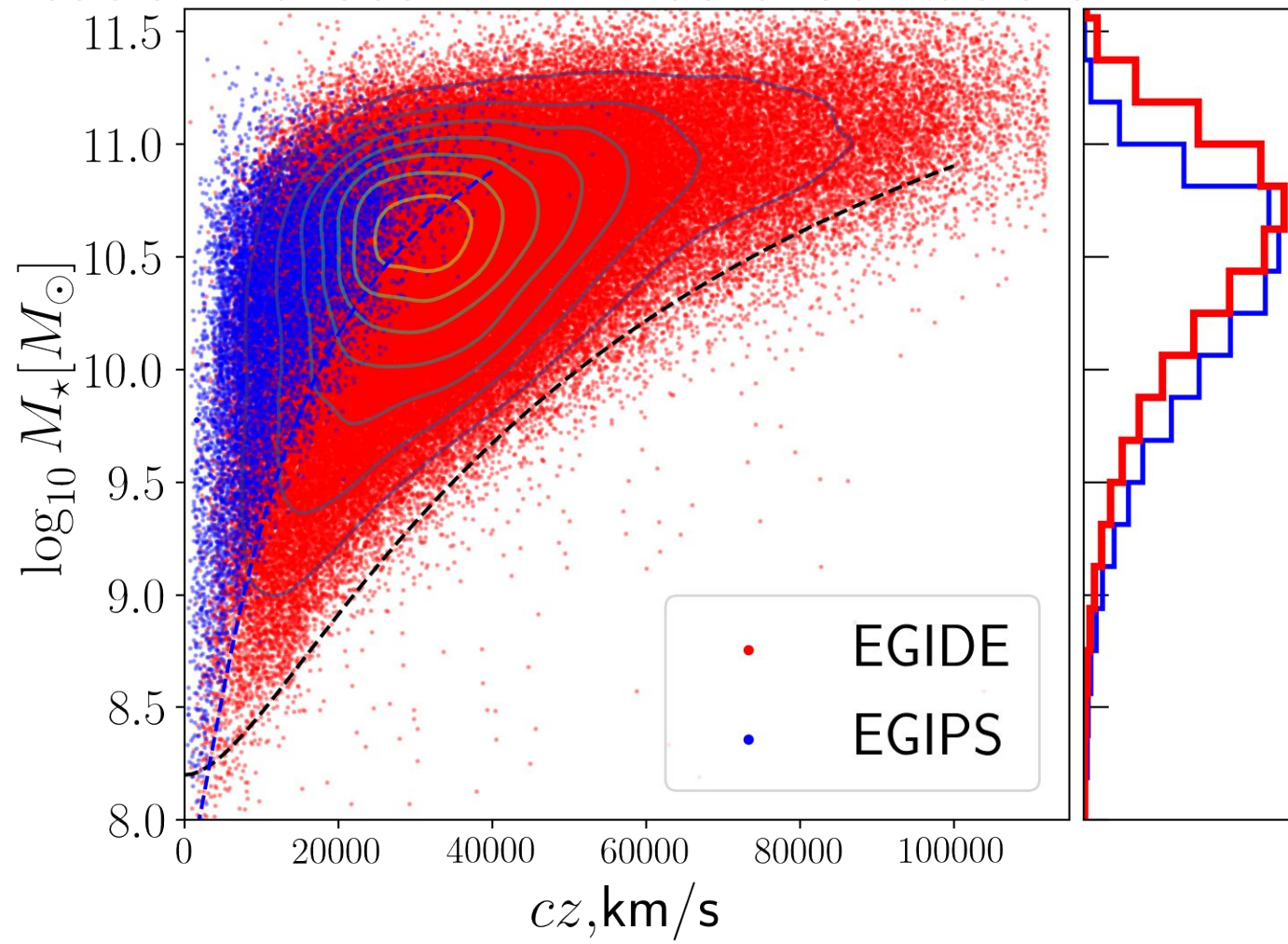


Scientific results II: flattening vs stellar mass

Statistical models from **J.Benavides et al. (2025)**: they explore prolate or oblate figures of revolution to match the observed $q=b/a$ distribution in mass bins

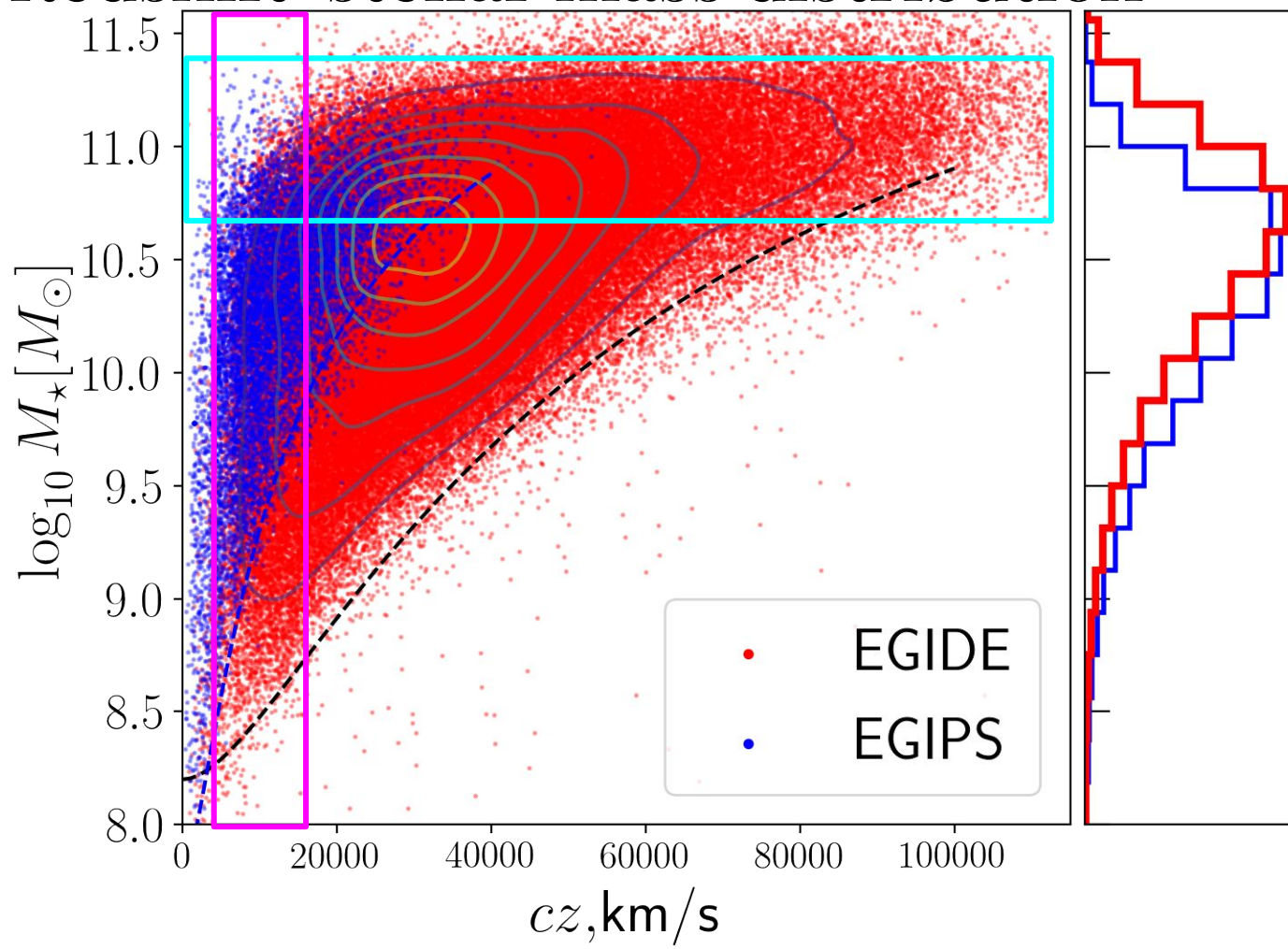


Redshift-stellar mass distribution



Galaxies in EGIDE are more massive and significantly more distant compared to EGIPS data.

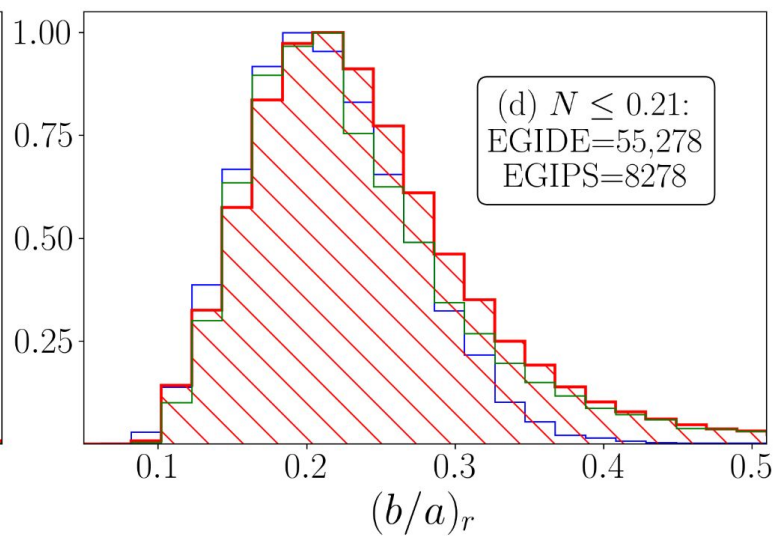
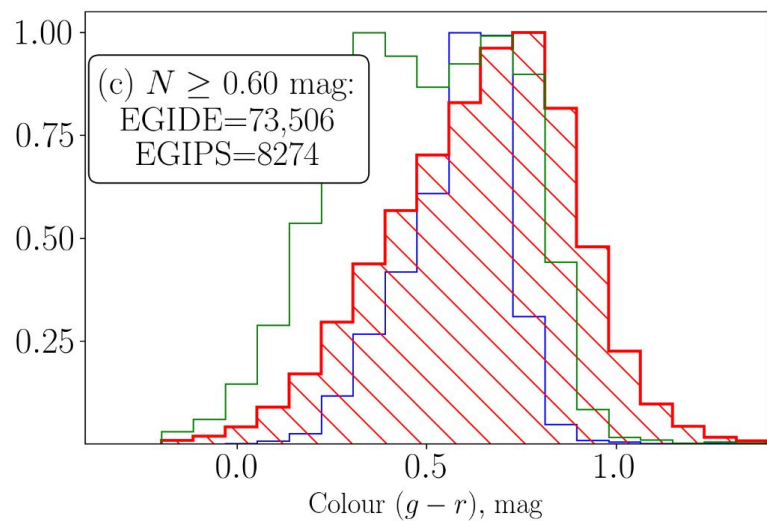
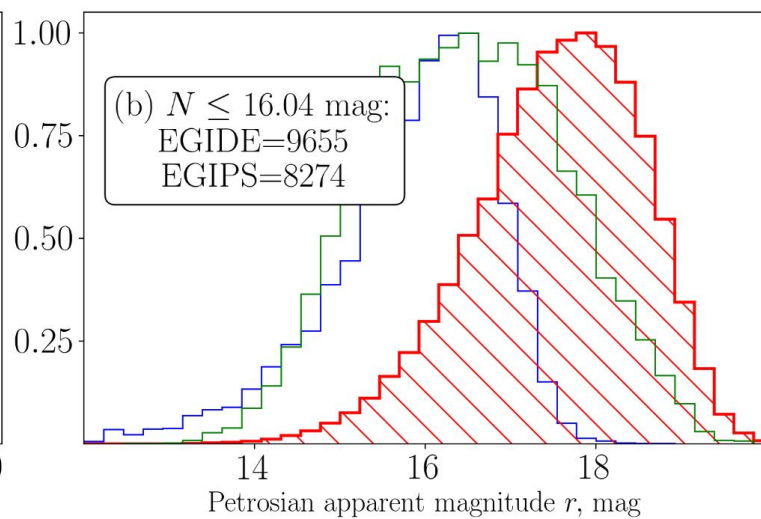
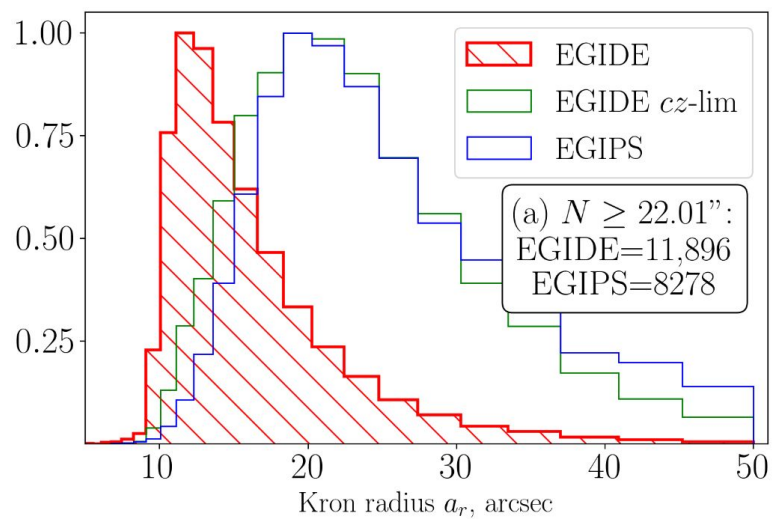
Redshift-stellar mass distribution



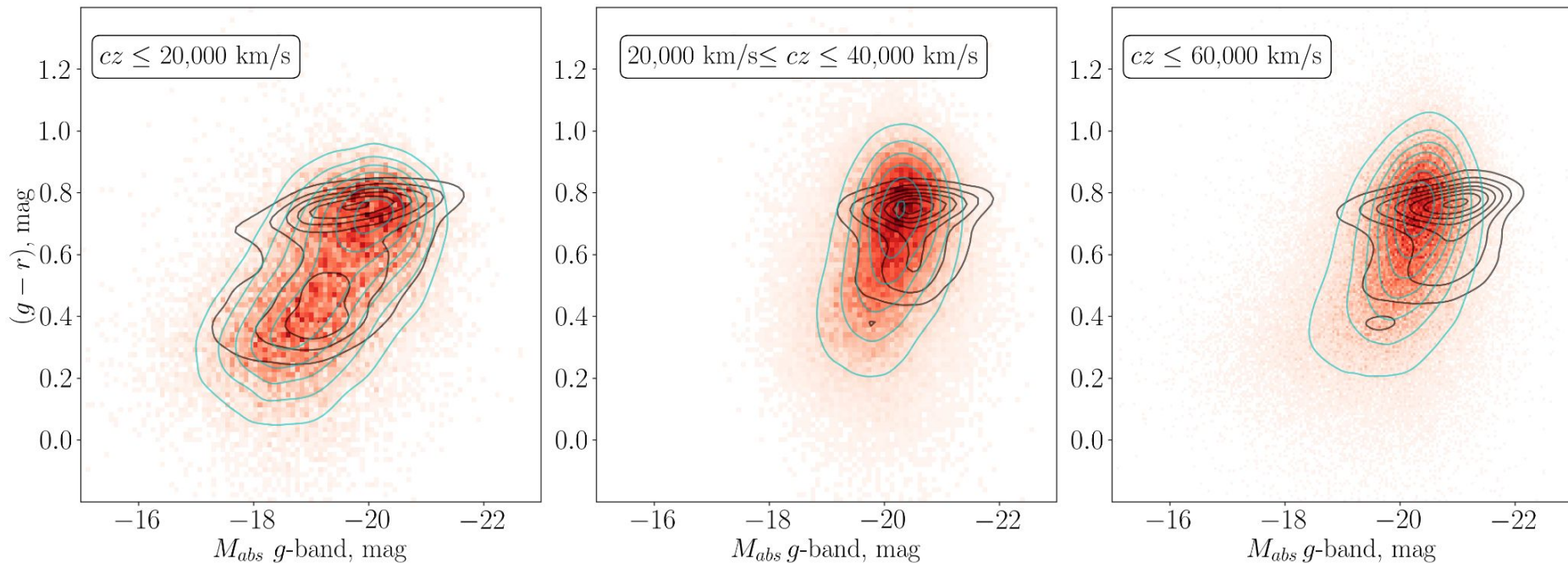
Galaxies in EGIDE are more massive and significantly more distant compared to EGIPS data.

Additional subsamples:

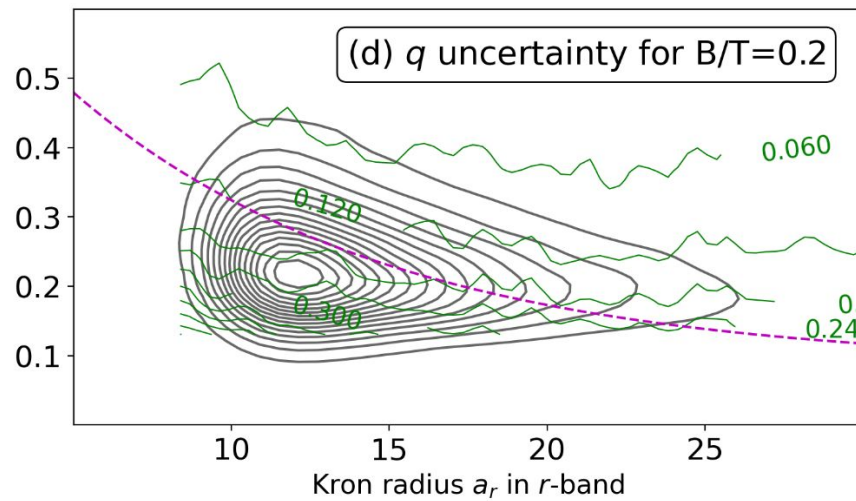
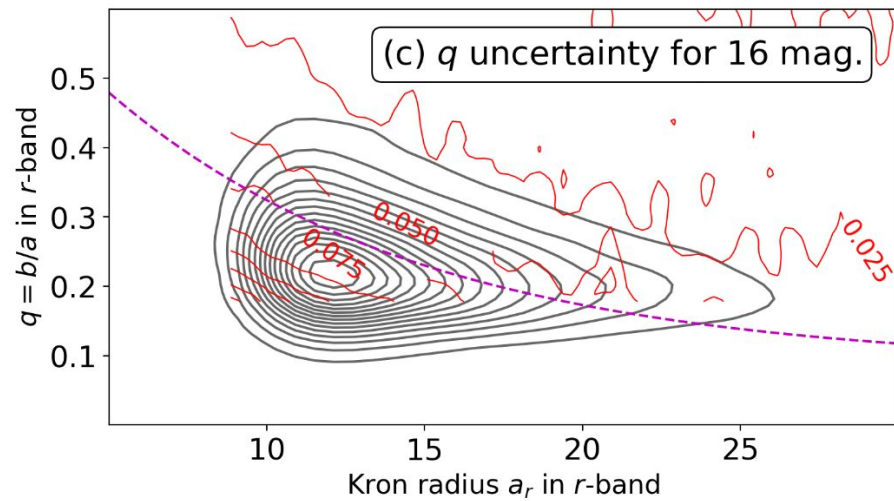
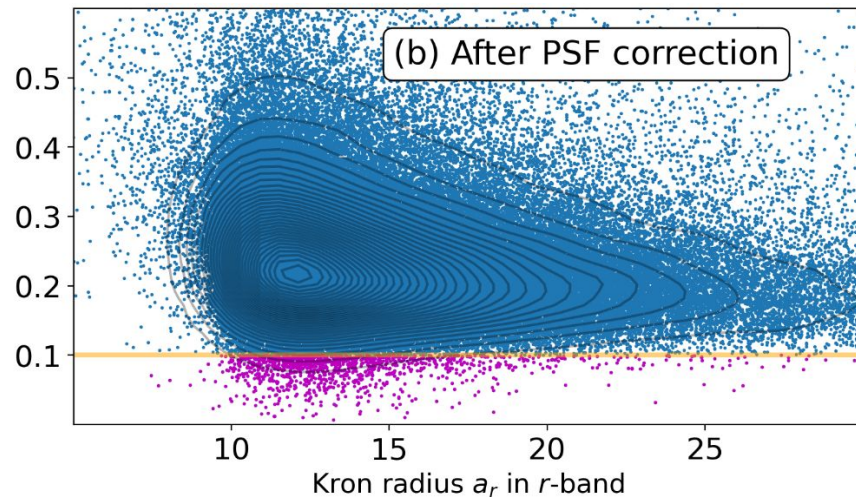
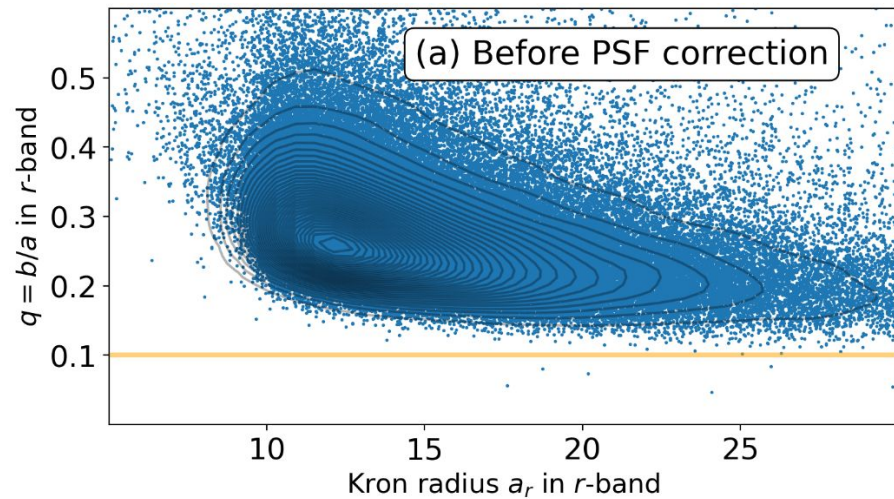
- **volume-limited** ($5000 \text{ km/s} < cz < 15000 \text{ km/s}$)
- **mass-limited** ($\log M = 10.7 \div 11.4$ M_{sun})



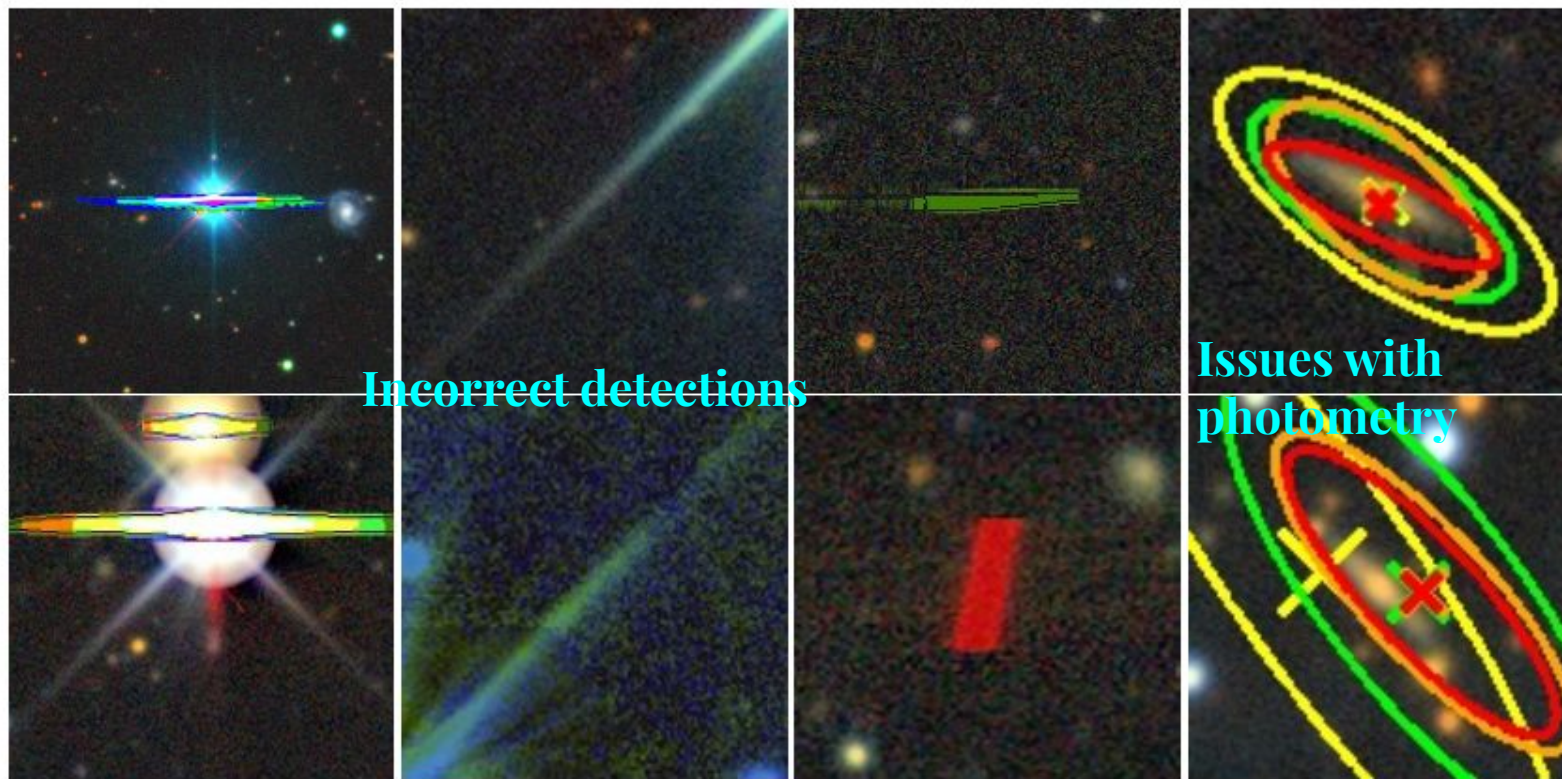
Are EGIDE galaxies `red` or `blue`? CMD perspective



Black contours: SDSS DR7

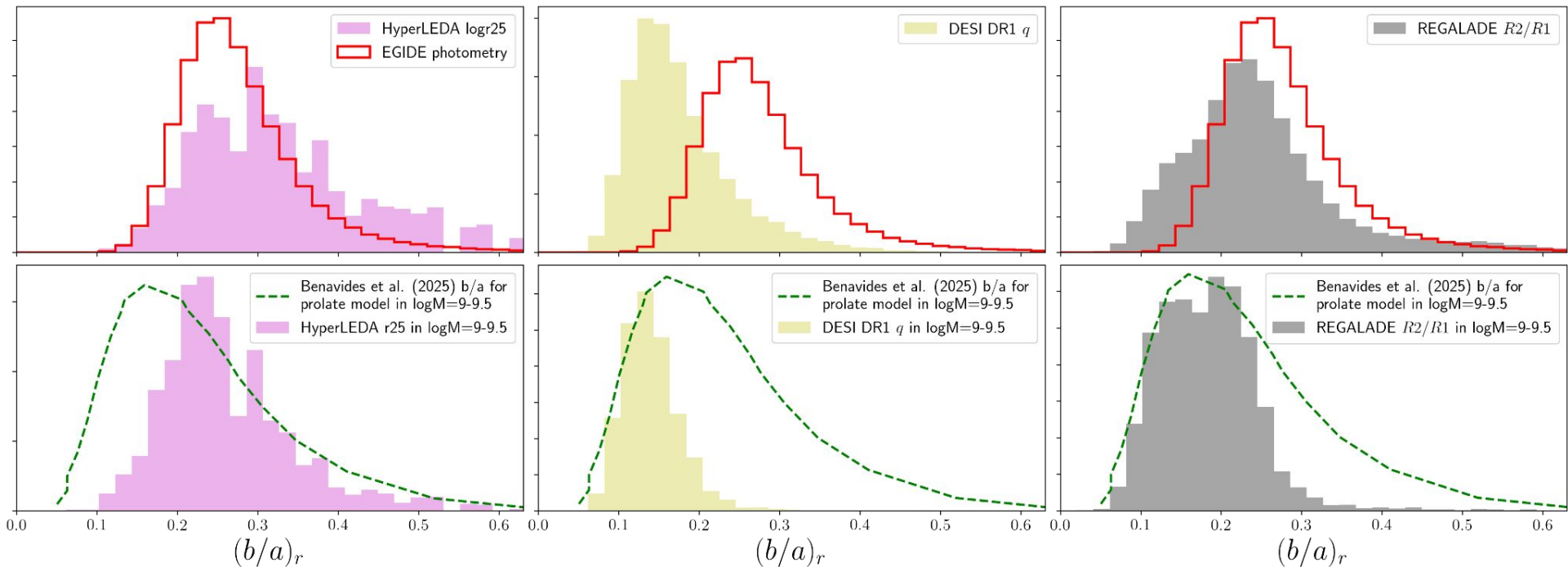


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- manual phase: from 192593 NN-selected objects we **removed** 43378 (~23%)
- **photometry** with **SExtractor** in *griz* (masking stars using information from Gaia)
- **extinction correction** using the SFD map (Schlafly & Finkbeiner 2011)



How flat are EGIDE galaxies?

Upper row: our photometry vs other

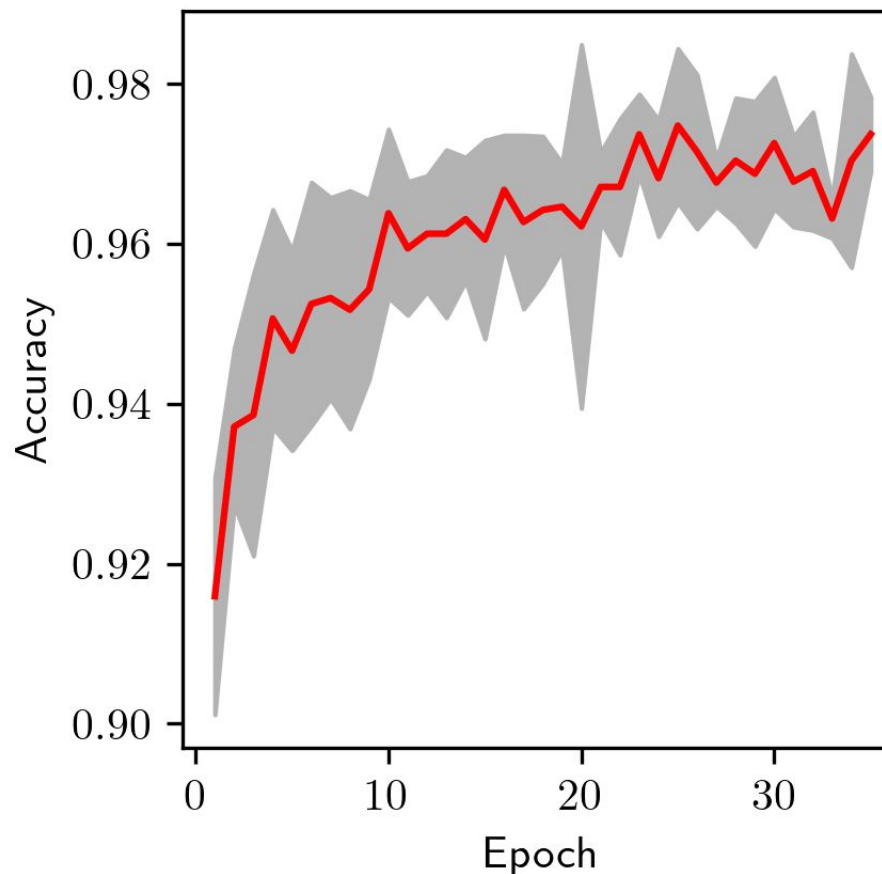


Bottom row: statistical model vs other
in certain mass bin $\log M = 9 \div 9.5$

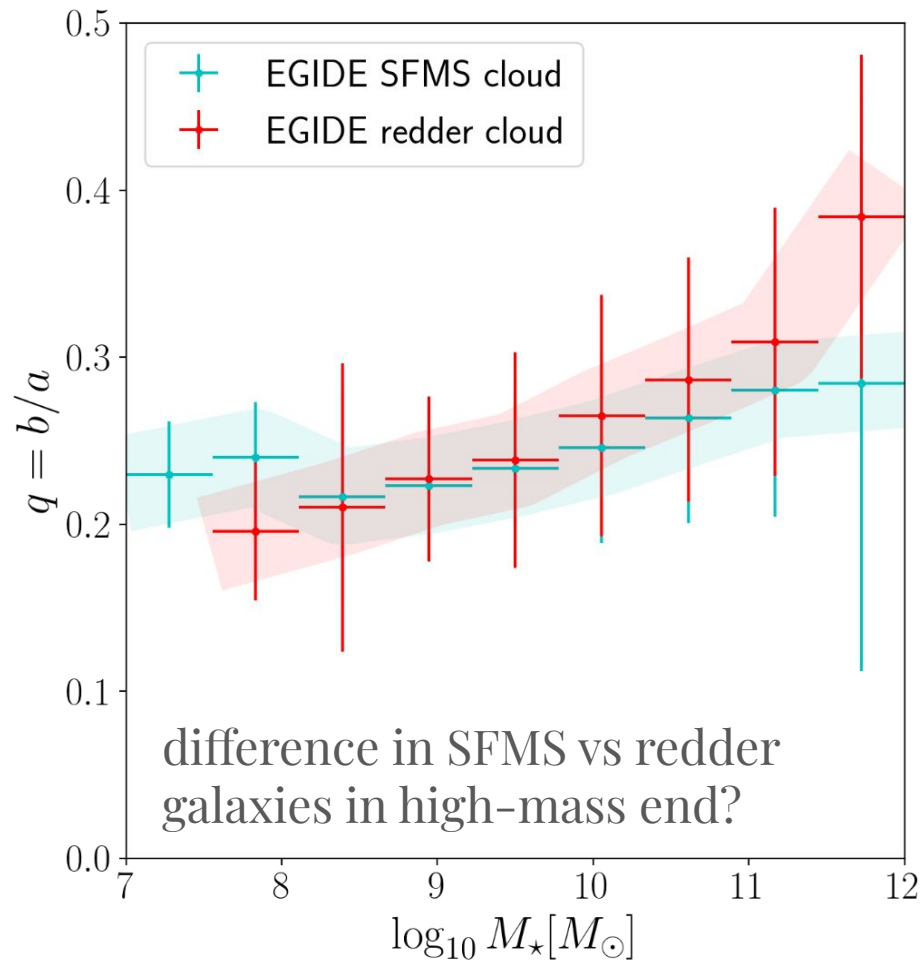
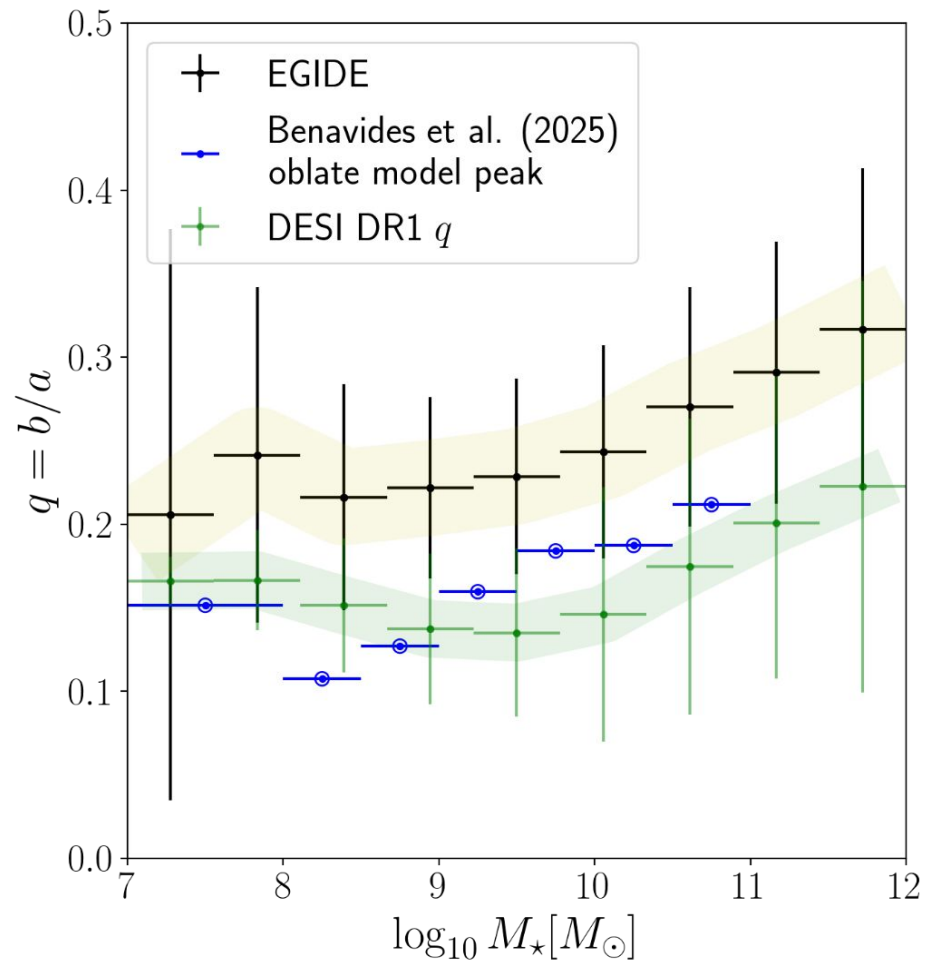
Method: Zoobot fine-tuning

We tune 9 models ensemble for each bands combination: training size $gri = 1226$, $grz = 2543$, $gi = 1229$

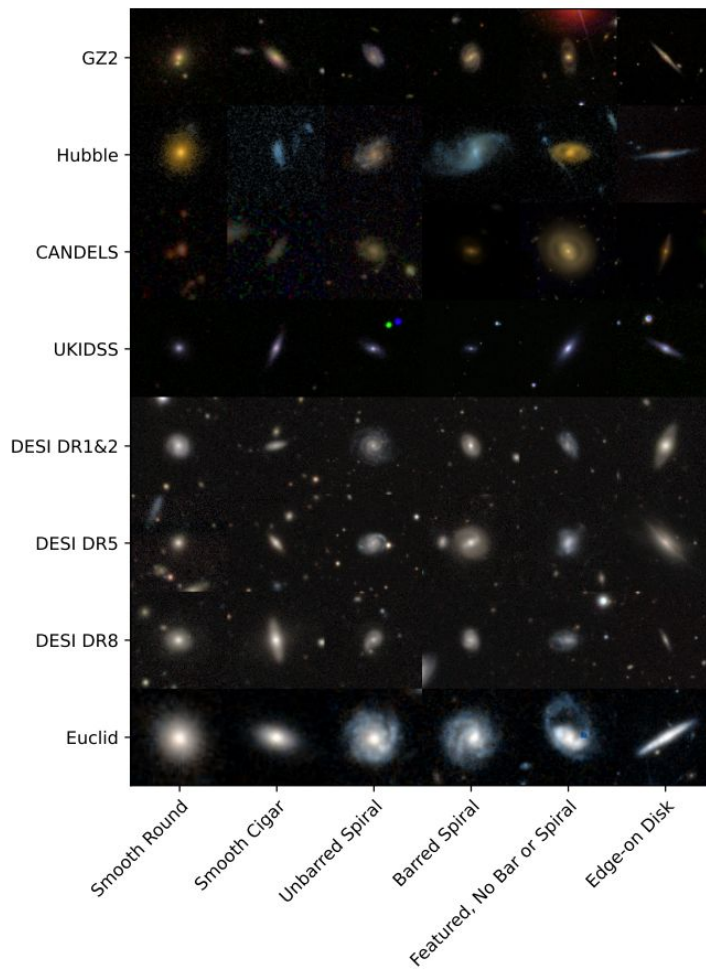
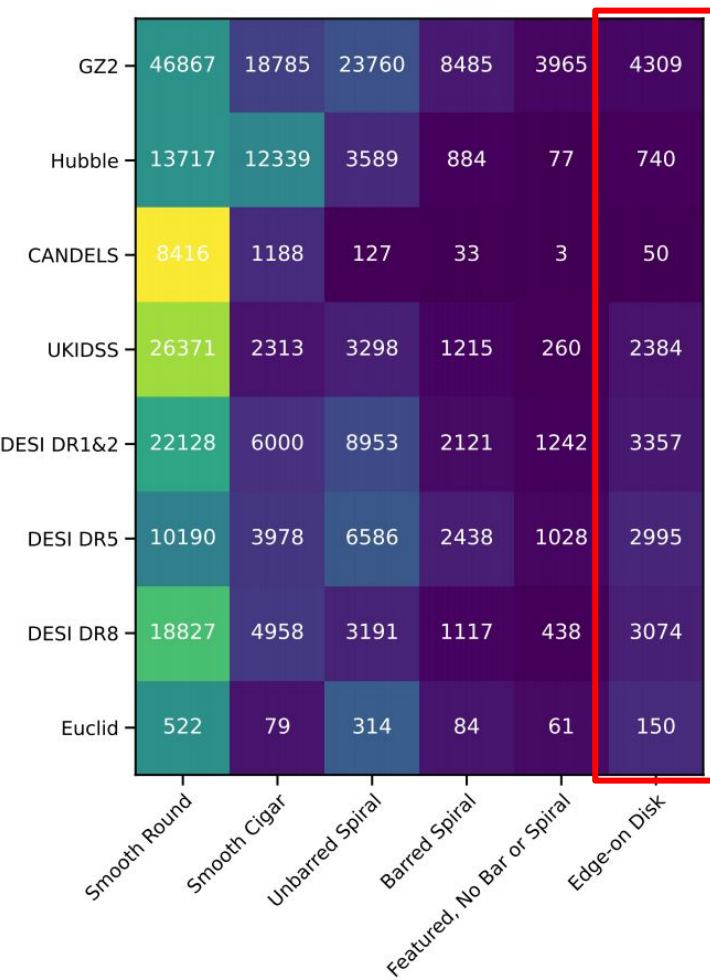
Architecture	Parameters	Test loss	Finetune	HF 🤖
ConvNeXT-Pico	9.1M	19.33	Yes	Link
ConvNeXT-Nano	15.6M	19.23	Yes	Link
ConvNeXT-Tiny	44.6M	19.08	Yes	Link
ConvNeXT-Small	58.5M	19.06	Yes	Link
ConvNeXT-Base	88.6M	19.05	Yes	Link
ConvNeXT-Large	197.8M	19.09	Yes	Link
MaxViT-Tiny	29.1M	19.22	Yes	Link
MaxViT-Small	64.9M	19.20	Yes	Link
MaxViT-Base	124.5	19.09	Yes	Link
Max-ViT-Large	211.8M	19.18	Yes	Link
EfficientNetB0	5.33M	19.48	Yes	WIP
EfficientNetV2-S	48.3M	19.33	Yes	WIP
ResNet18	11.7M	19.83	Yes	Link
ResNet50	25.6M	19.43	Yes	Link
ResNet101	44.5M	19.37	Yes	Link



Scientific results II: flattening vs stellar mass



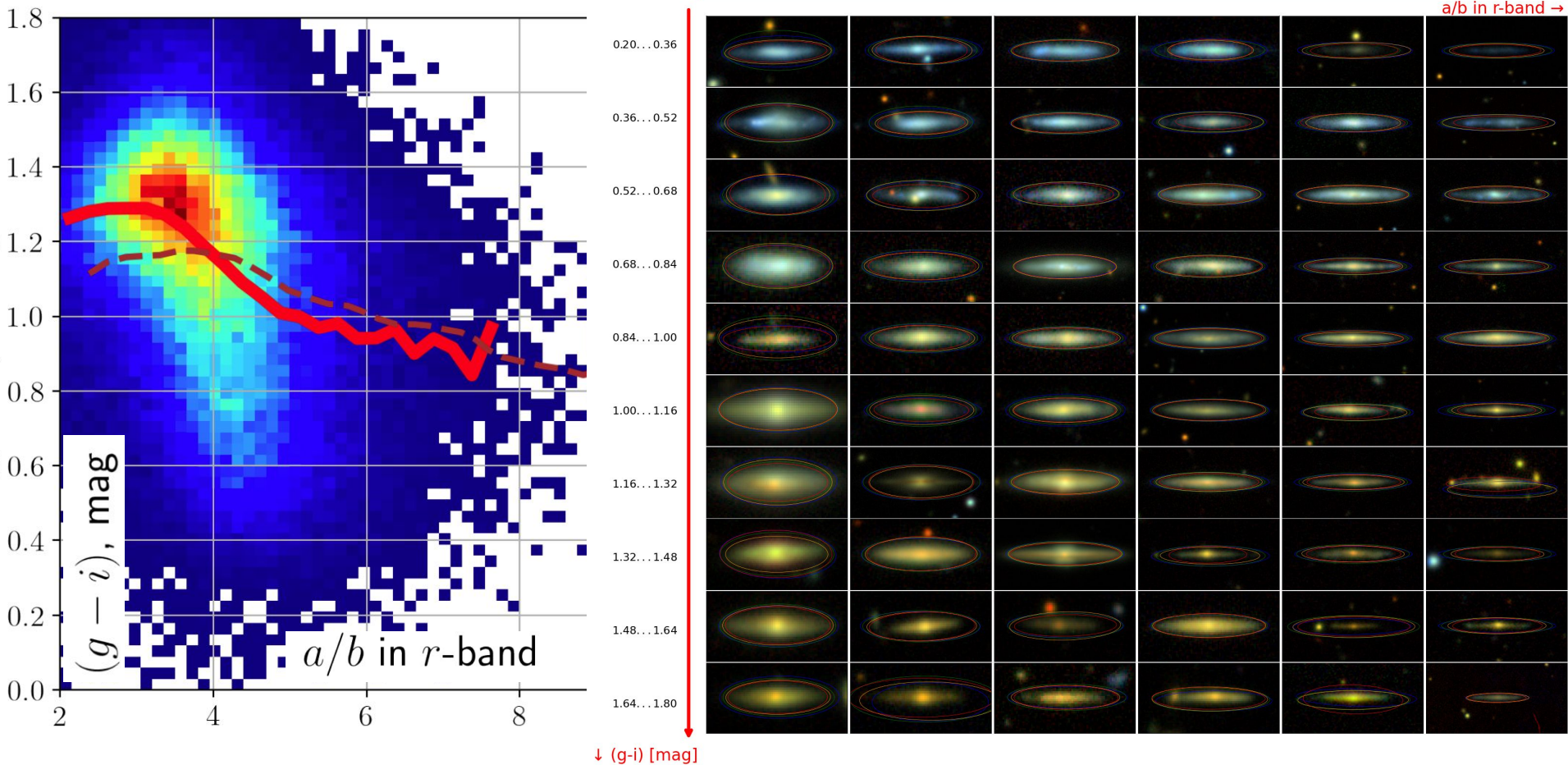
How to find more: data & method



Walmsley+2025
2512.23691

“We only provide a class label for the subset (287k) of galaxies where a **class label can be confidently assigned**. We consider as high confidence galaxies where a single answer received over half of all volunteer votes (an absolute majority), for all of the questions needed to derive our summary label, and where the galaxy received at least 30 volunteer votes in total.”

Scientific results III: inverse flattening vs color



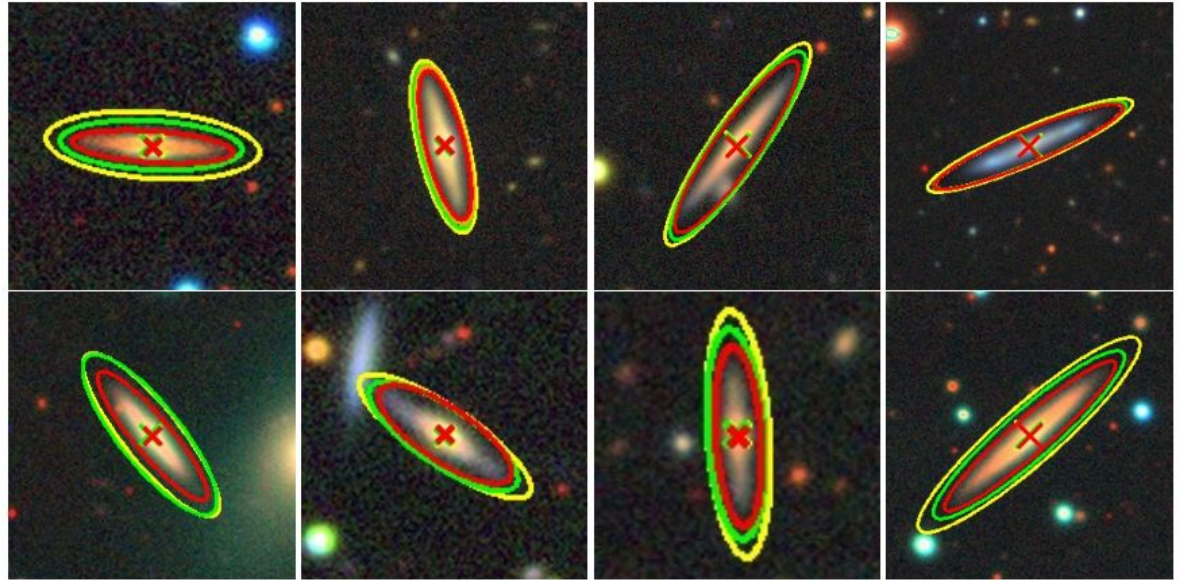


Figure 2. Examples of objects classified as truly edge-on galaxies. More images can be found in Appendix E and in the EGIDE project site <https://www.sao.ru/edgeon/catalogs.php?cat=EGIDE>.

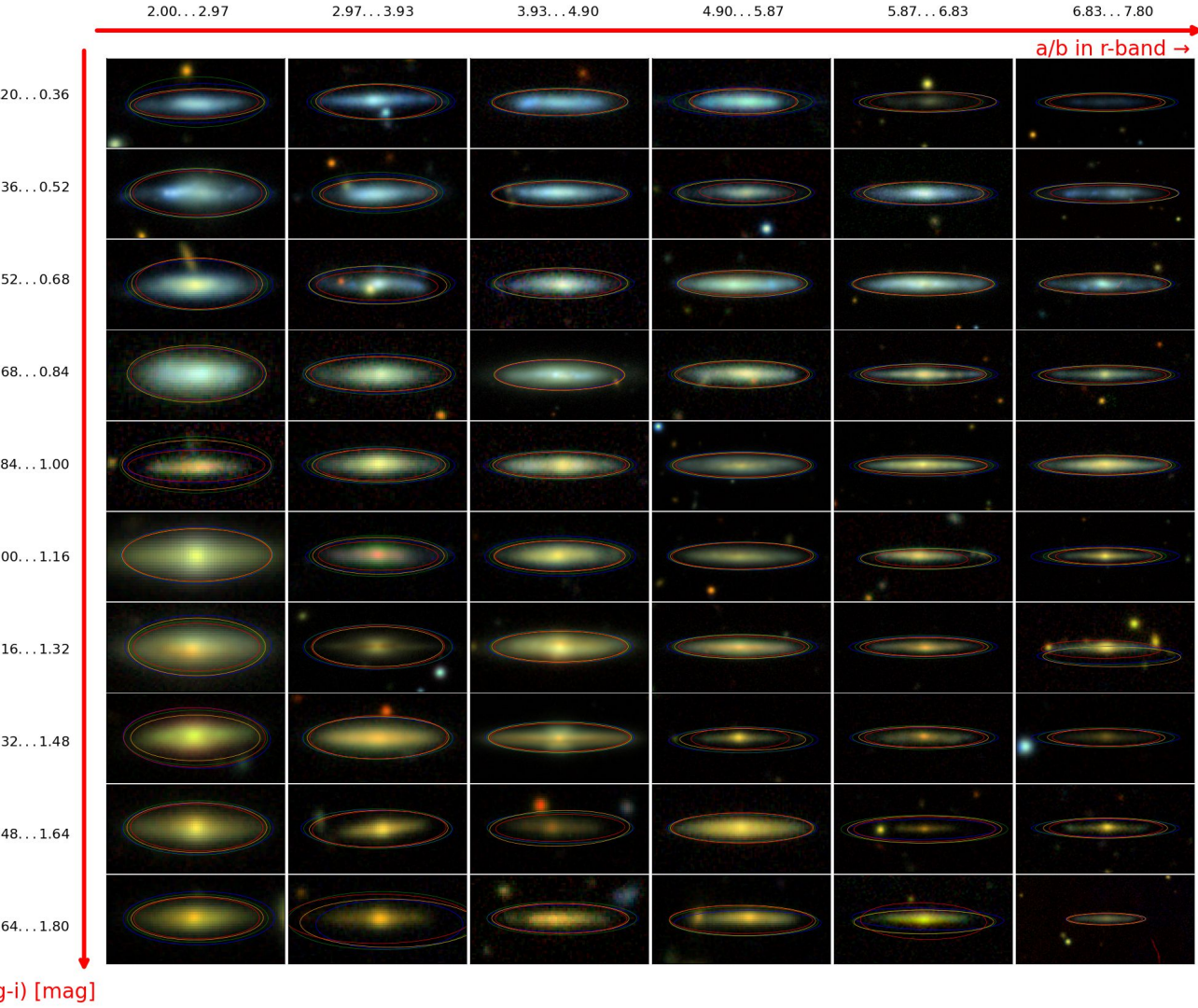
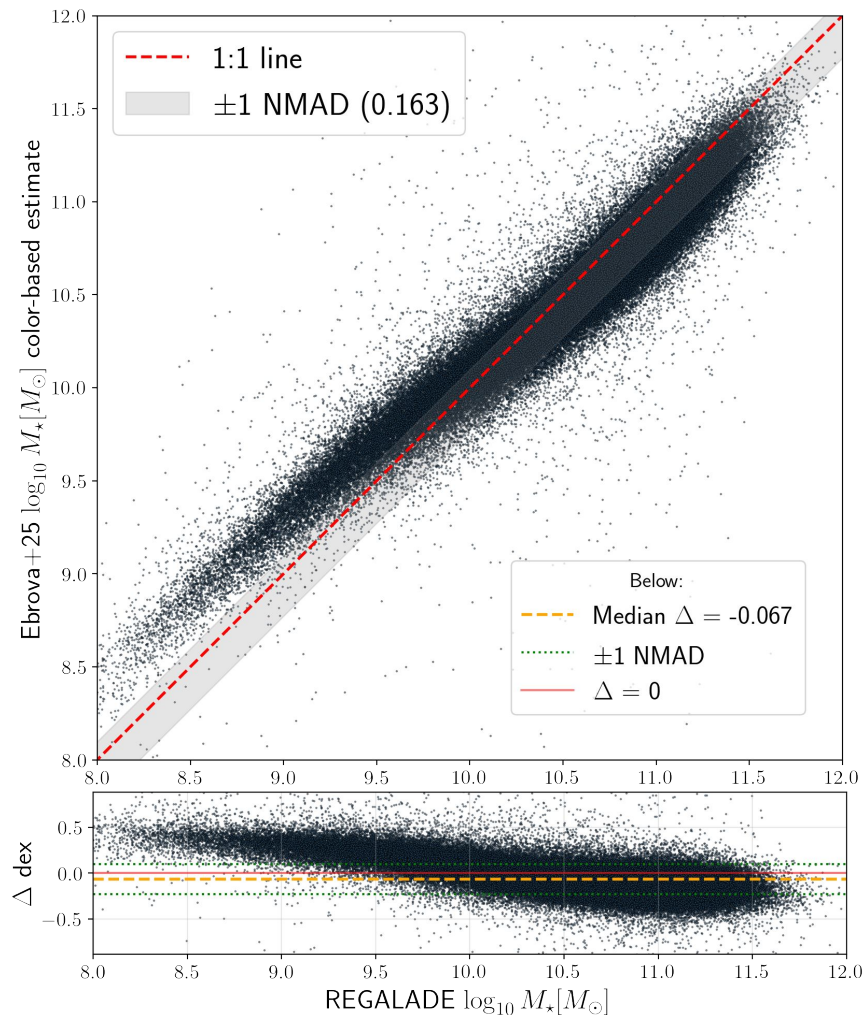
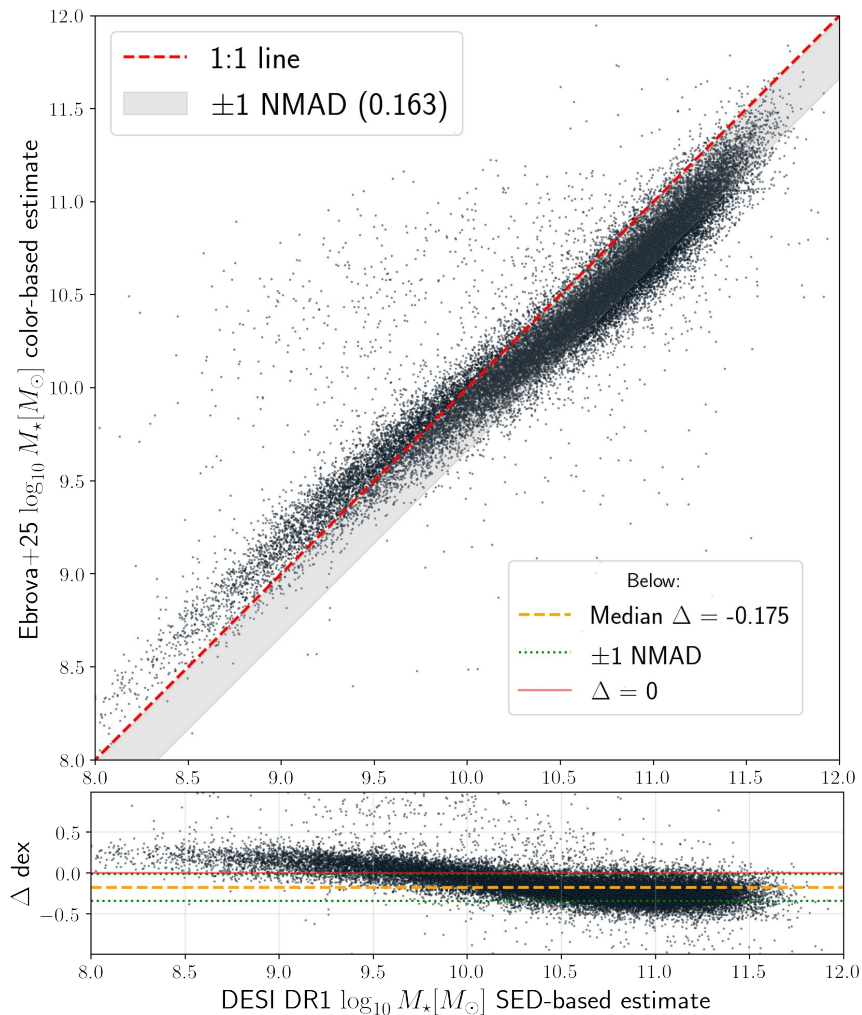
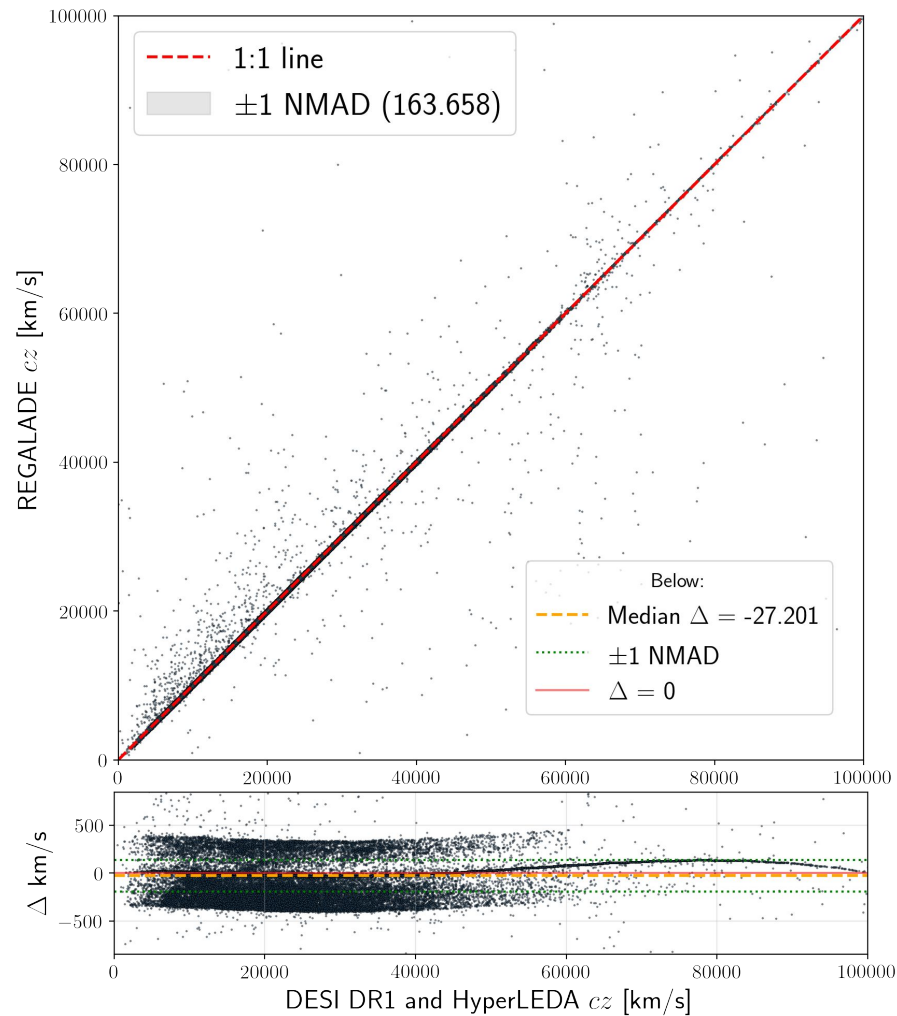
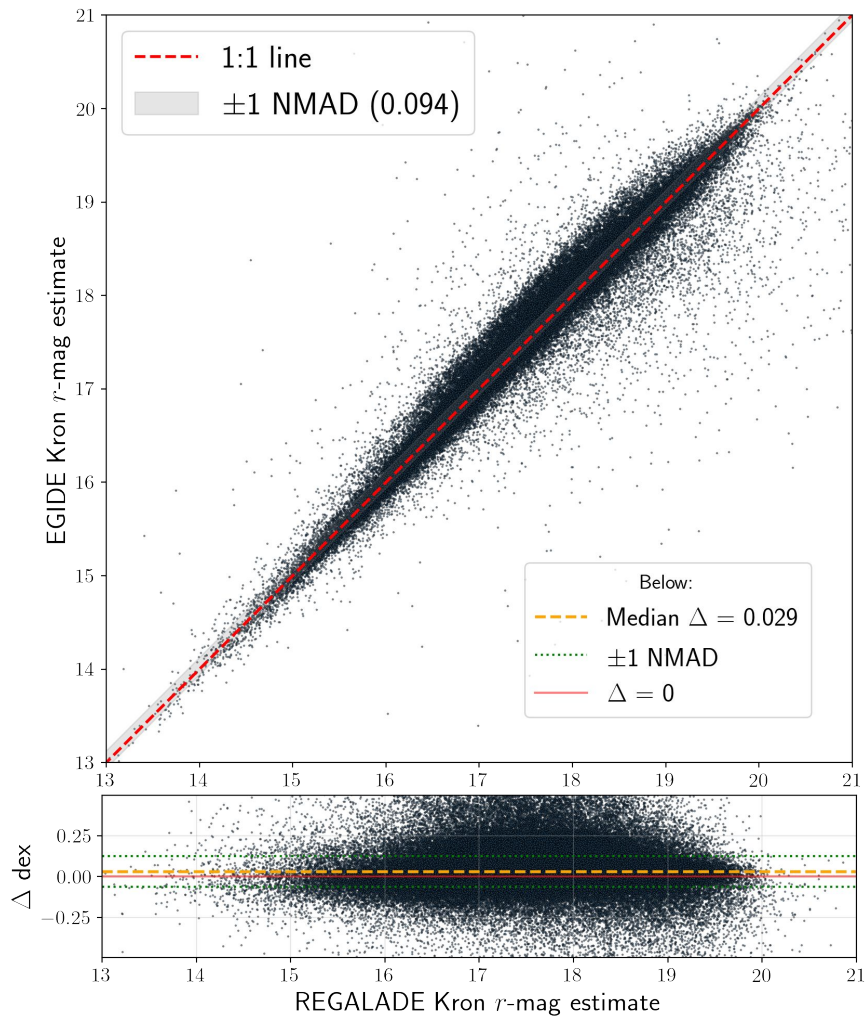


Table 1. Number of galaxies and median $q = b/a$ value for EGIPS and EGIDE samples. Values are presented for each band under consideration for the whole samples, and additionally for the large ($a_{band} > 20$ arcsec) galaxies.

band	N q		N q		N q		N q	
	EGIPS		EGIDE		EGIPS: $a > 20''$		EGIDE: $a > 20''$	
g	16550	0.205 ± 0.070	148791	0.254 ± 0.078	10745	0.180 ± 0.050	26068	0.210 ± 0.076
r	16557	0.210 ± 0.057	142807	0.263 ± 0.078	10226	0.186 ± 0.046	18516	0.218 ± 0.080
i	16558	0.215 ± 0.055	103647	0.257 ± 0.074	9690	0.191 ± 0.046	10163	0.211 ± 0.076
z	16556	0.214 ± 0.058	145790	0.257 ± 0.072	8524	0.187 ± 0.045	12102	0.205 ± 0.070







The Edge-on Galaxies in the DESI survey: EGIDE project



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