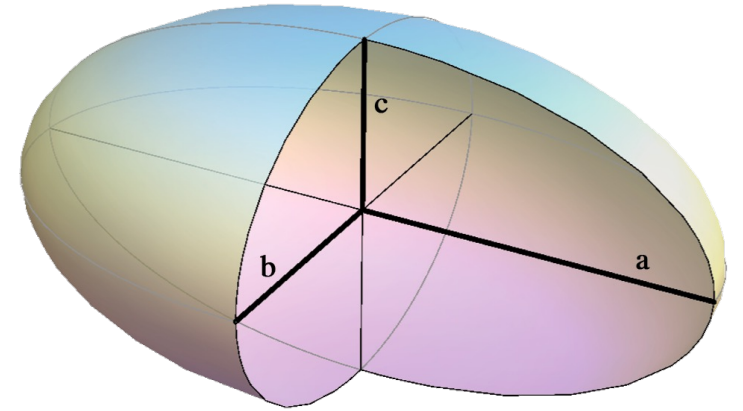


3D intrinsic shapes of quiescent galaxies in observations and simulations

Junkai Zhang

Zhang+2022, MNRAS, 513, 4814

Stijn Wuyts, Callum Witten, Charlotte R. Avery,
Lei Hao, Raman Sharma, Juntai Shen, Jun
Toshikawa and Carolin Villforth



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OBSERVATION

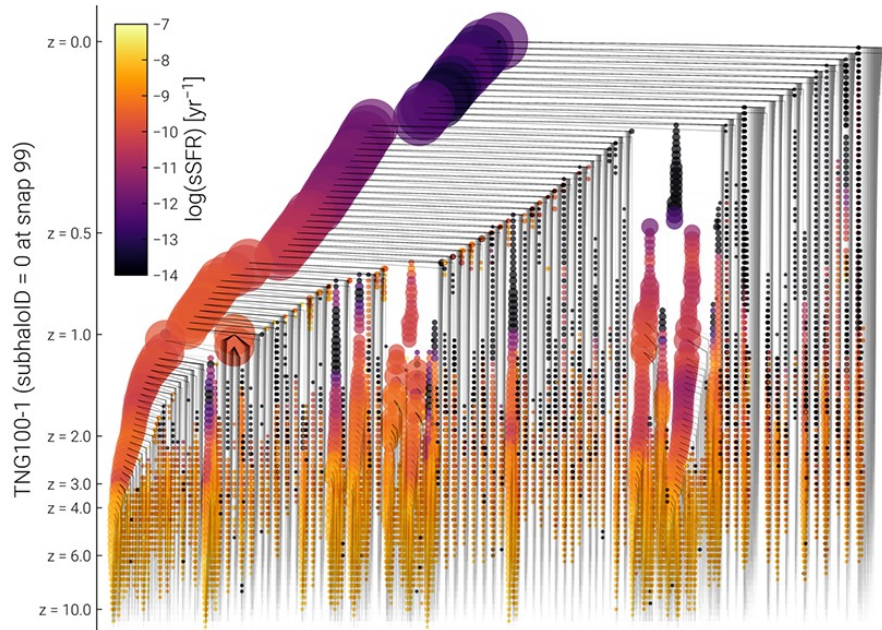


- High-quality **HSC-SSP** i-band imaging
- **KiDS+VIKING** *ugrizYJHK_s* photometry
- Wide area: 257 deg²
- Large sample:

2,731,511 galaxies with $\log(M) > 9$ at $0 < z < 0.9$
478,677 quiescent galaxies

Aihara+2019; Kuijken+2019

SIMULATION

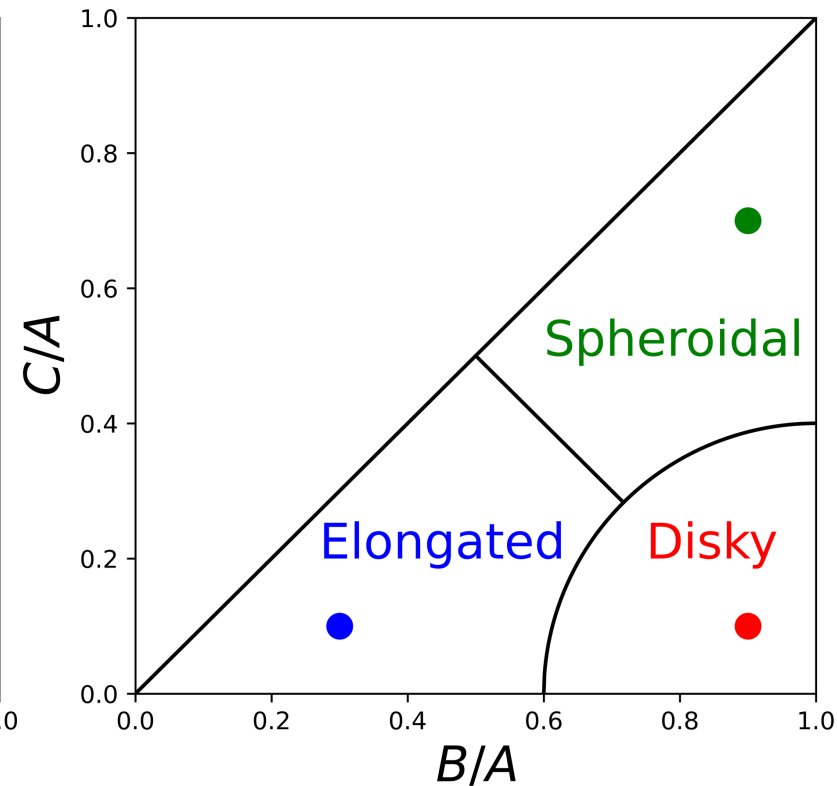
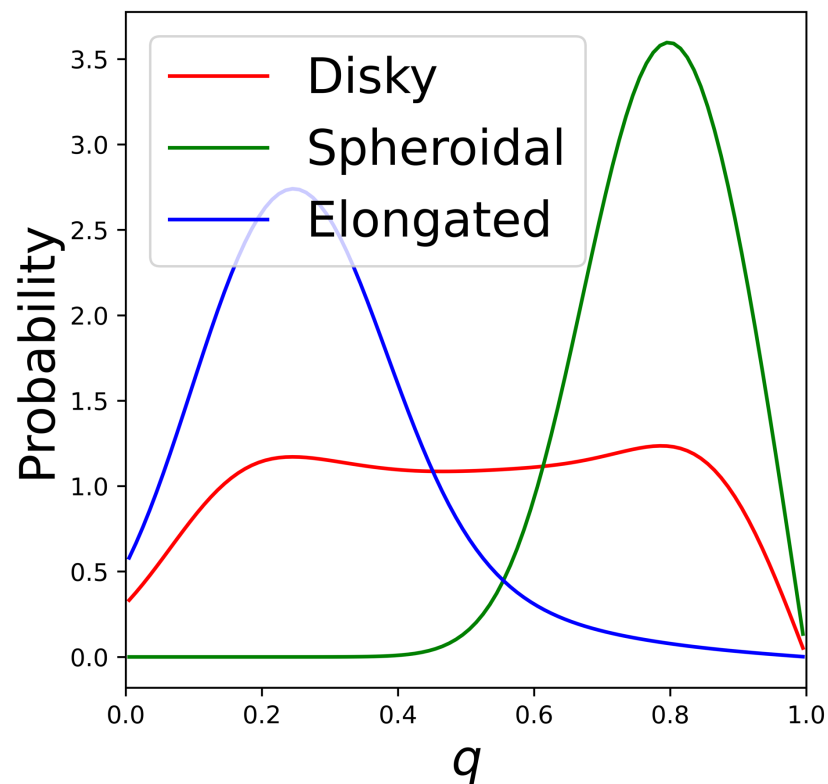


- **IllustrisTNG** cosmological hydro simulation
- TNG100 (+ TNG50 for convergence tests)
- Info on assembly histories (ex-situ fractions)
- Compared different 3D shape measurements

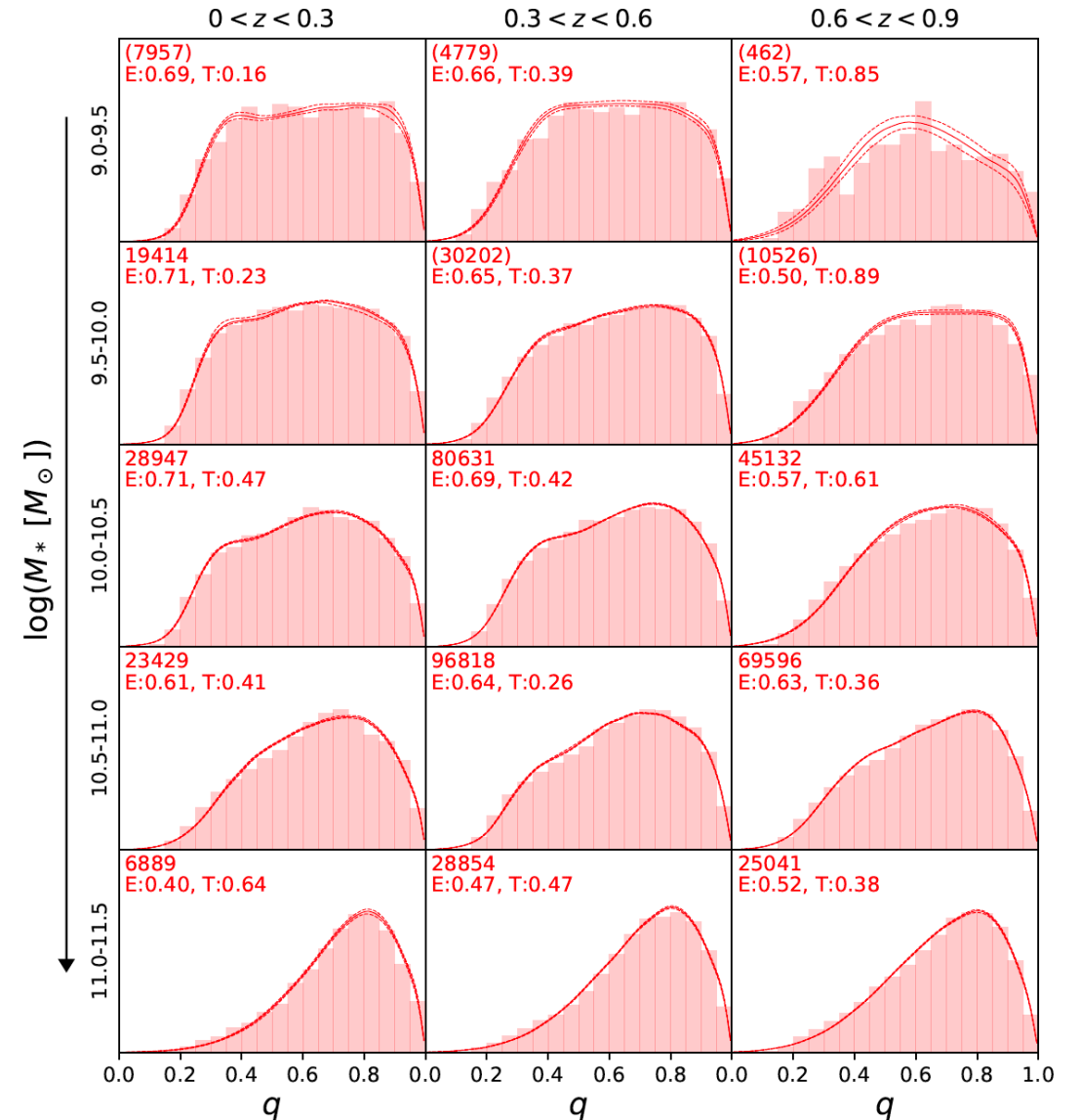
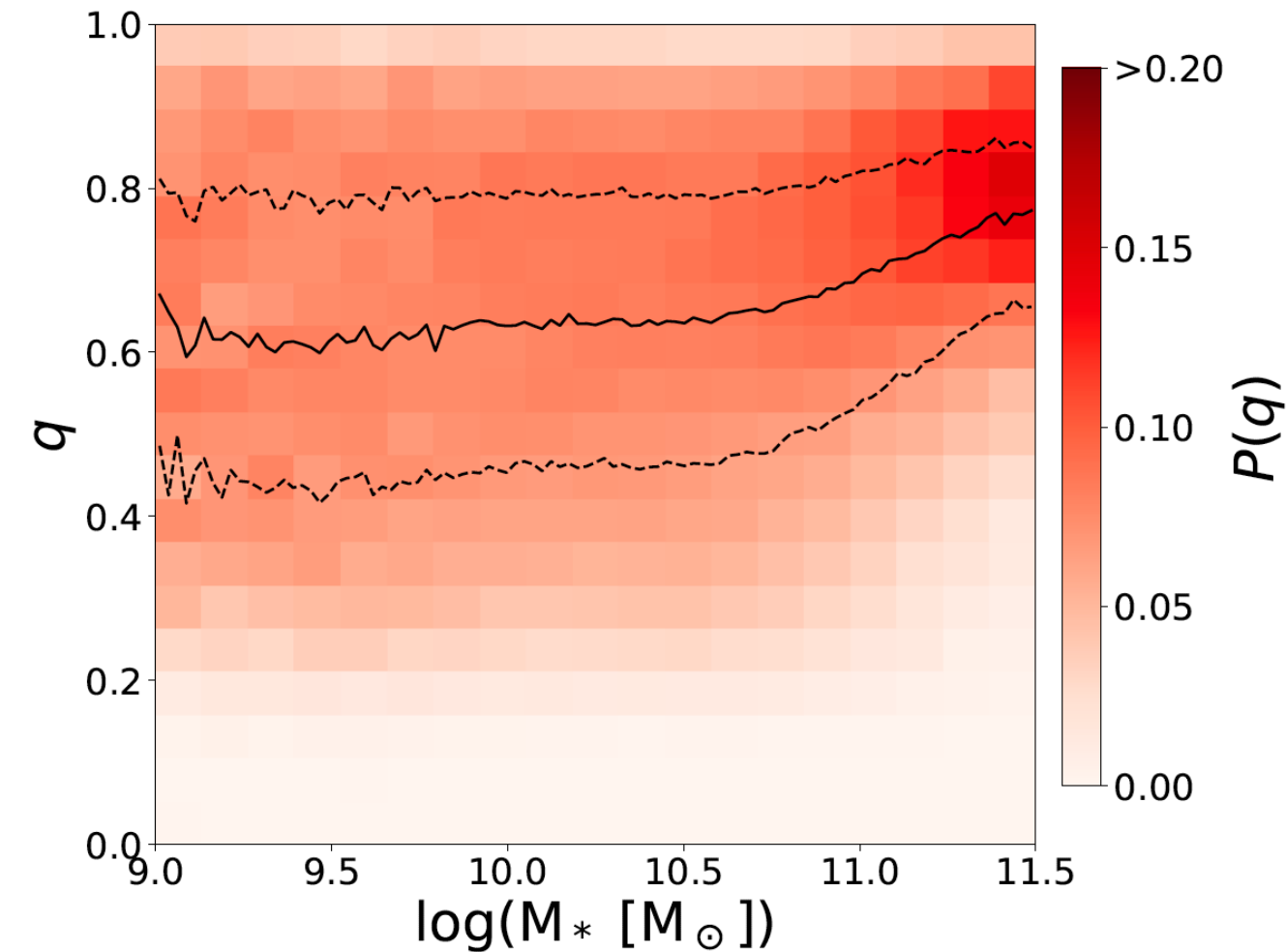
Nelson+2018

3D intrinsic shapes from observations

- Simplify as triaxial ellipsoids viewed from random viewing angles
- Reproduce joint axial ratio & size distribution
- Allow distribution of shapes rather than all identical shapes

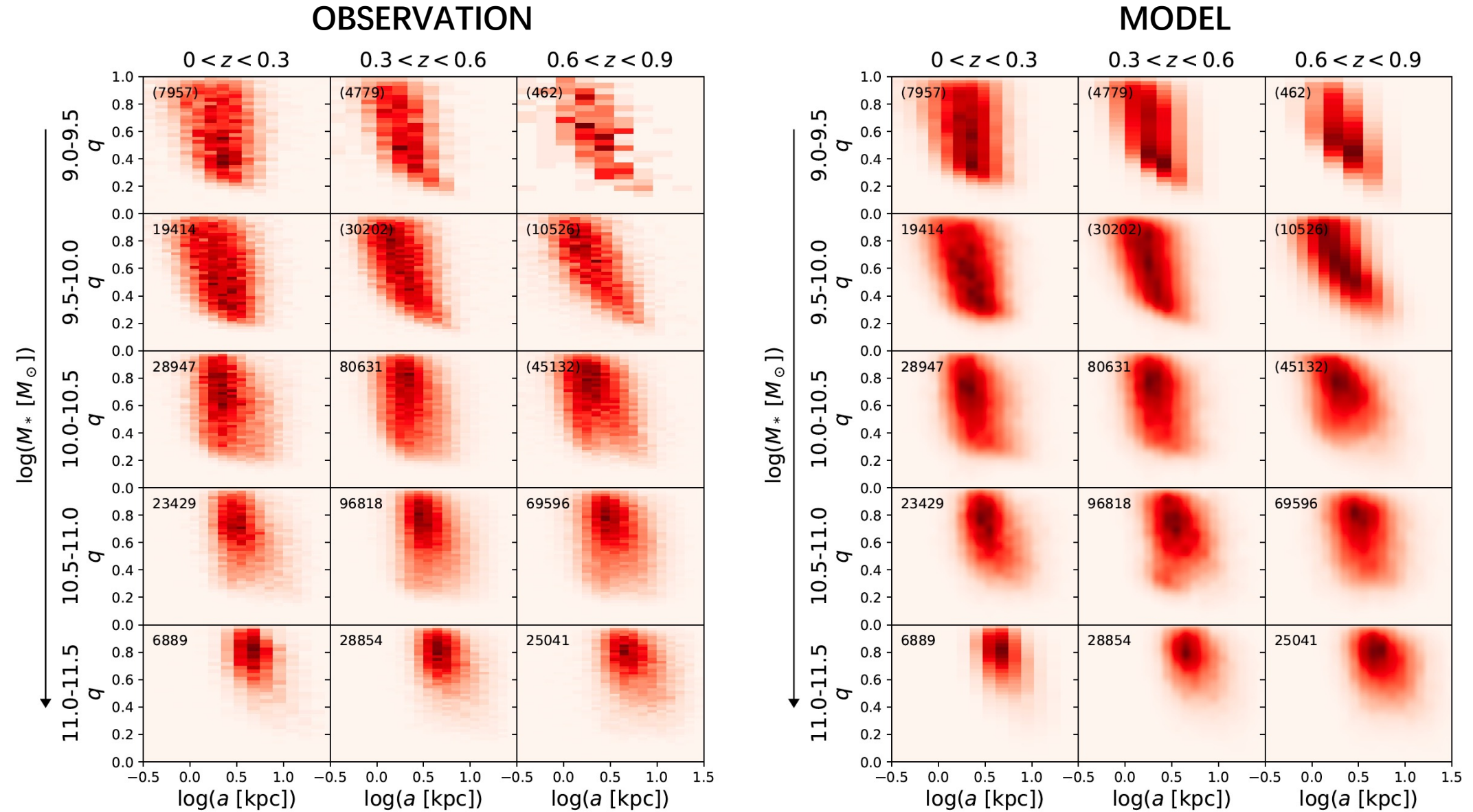


All QGs: spheroidal galaxies dominate at high masses



Zhang+2022; also van der Wel+2009; Holden+2012

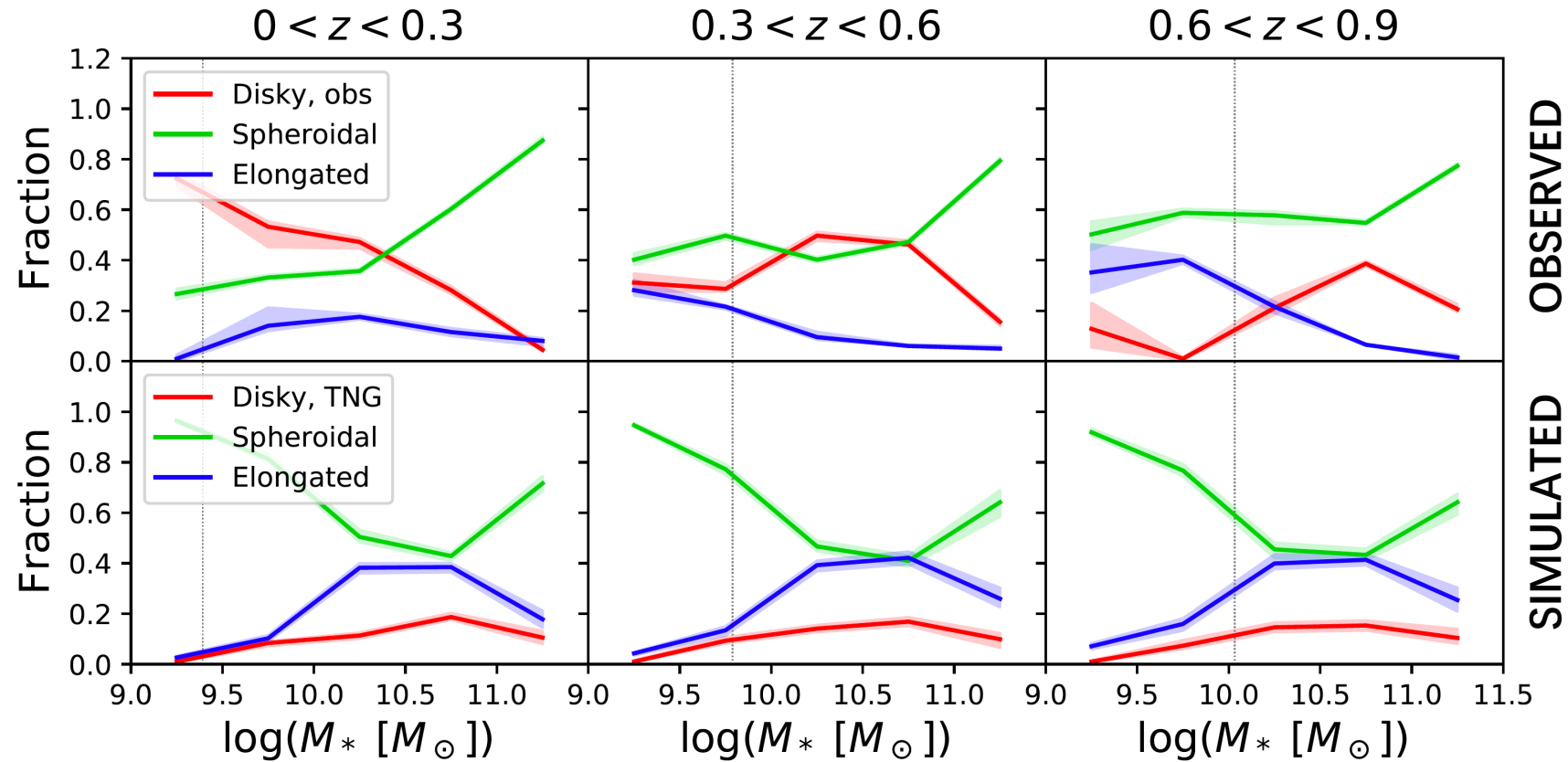
All QGs: spheroidal galaxies dominate at high masses

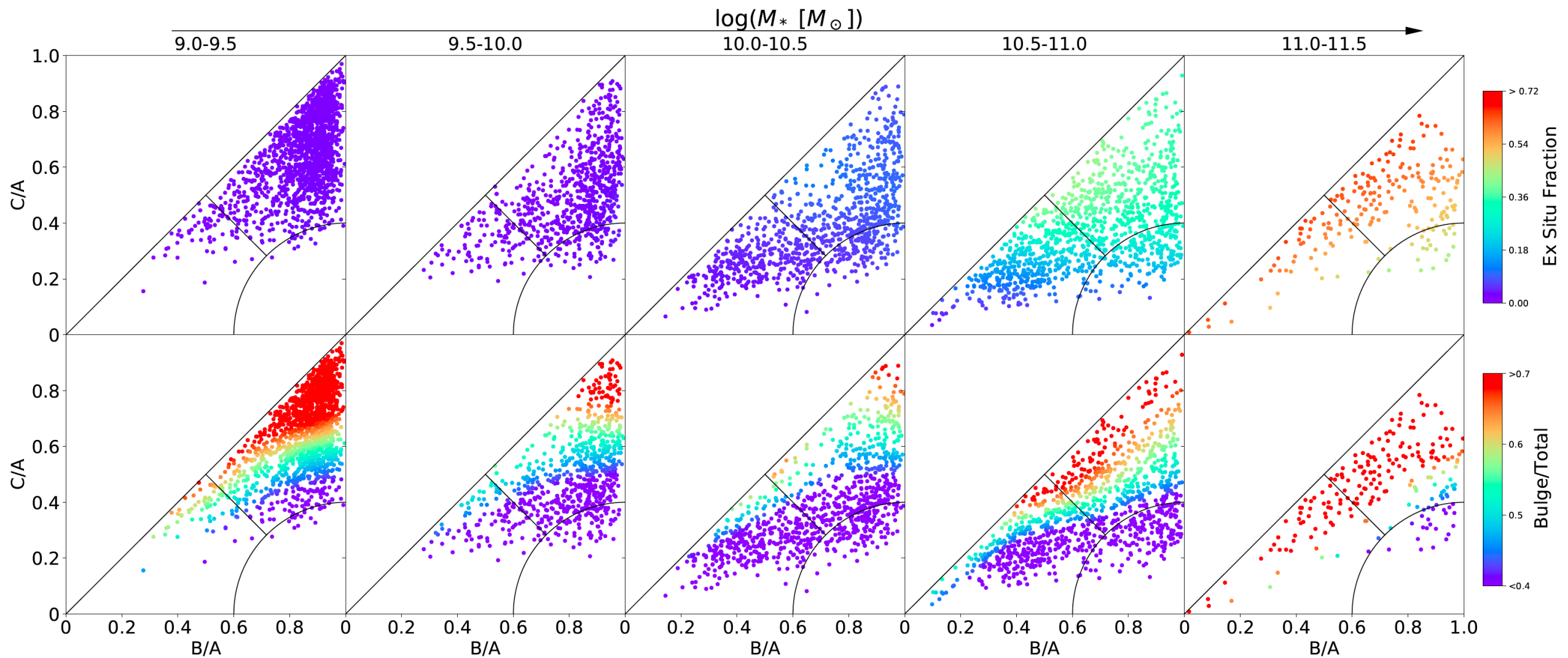


Shape families at different z and $\log(M)$

OBS vs SIM

- TNG show similar upturn in spheroidal fraction from intermediate to high mass
- Significant differences between obs and sim at low to intermediate masses!



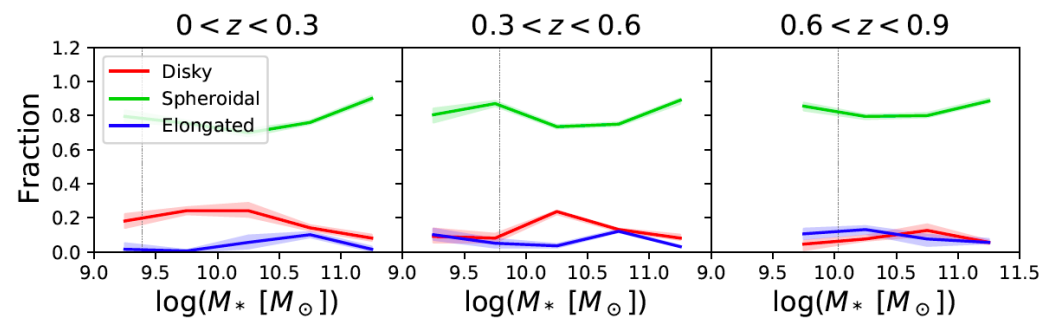
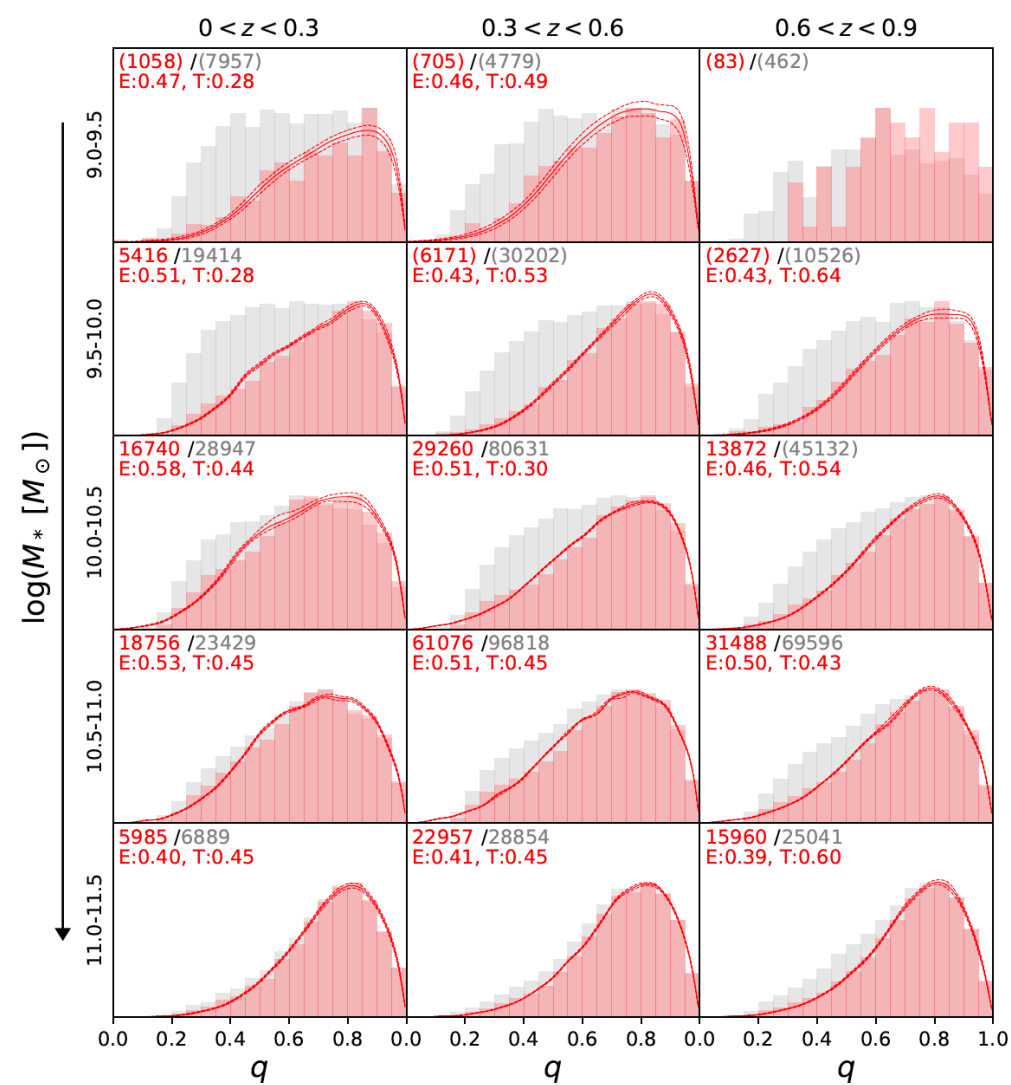


TNG

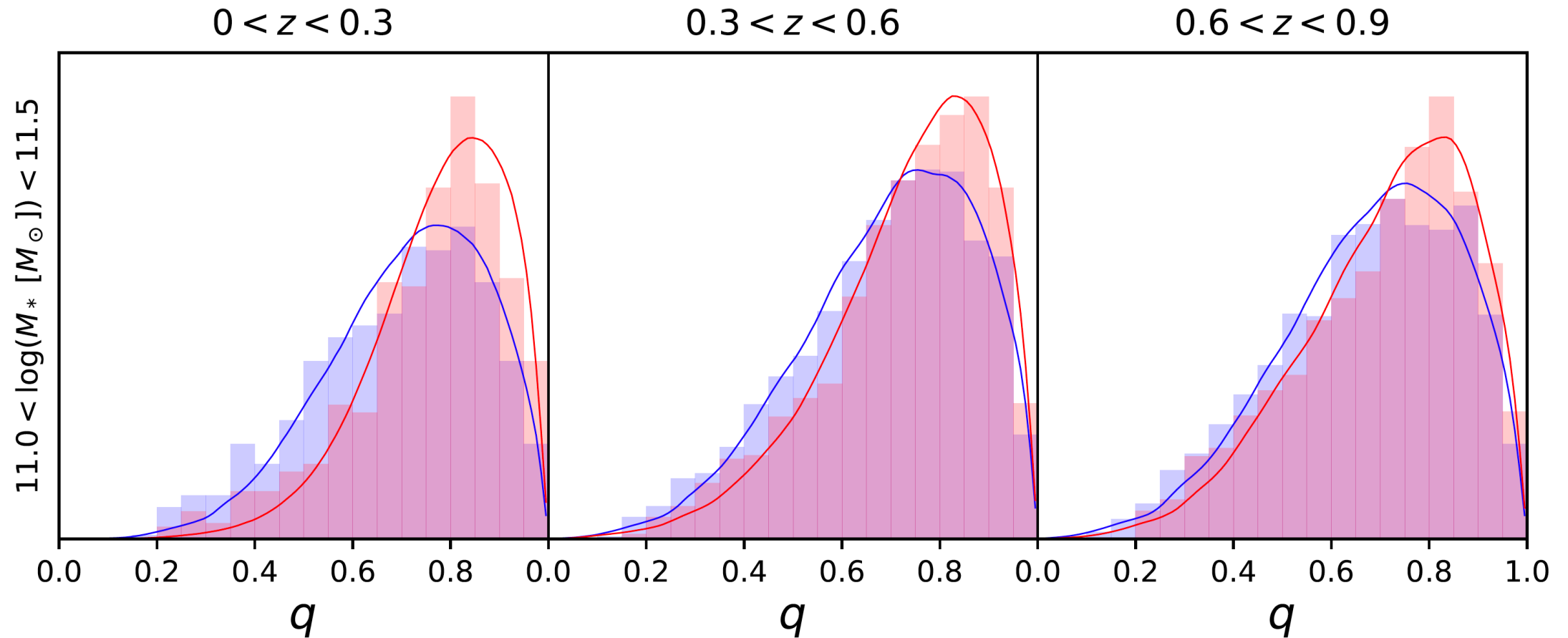
- Steep increase ex situ fraction at high mass
 - At $\log(M_*) > 10$: rounder QGs have higher ex situ fraction (@fixed M)
 - At all M_* : rounder QGs have larger bulge fraction (@fixed M)
- ==> mechanism: mergers at high mass; internal processes at low mass

de Vaucouleurs
(n=4) QGs
round at all
masses

OBS



Galaxy environment: comparing lowest/highest density



Conclusions – Obs & Sim

- QGs more spheroidal at $\log(M_*) > 11$
Violent relaxation (mergers) cause 3D shape transformation
in TNG closely related to rising ex situ fractions
- QGs of highest Bulge/Total are round in 3D at any mass
likewise in TNG: rounder \propto more bulge-dominated
- Massive QGs in densest environment are roundest
Richer merger history
- Simulation fails to reproduce the flattest/thinnest stellar structures
Common feature to other cosmological simulations & SFGs as well
(see also Pillepich+2019; Ludlow+2021; de Graaff+2022)

