Galaxy Zoo: Inclination Dependent Dust Attenuation in Visually Classified Spirals

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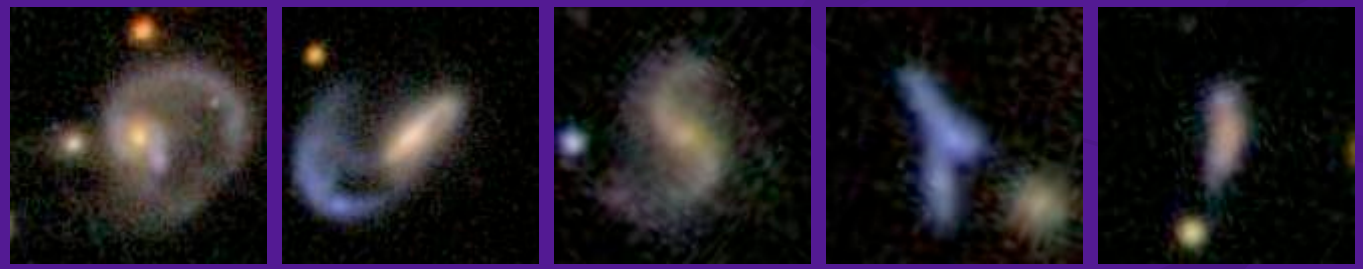
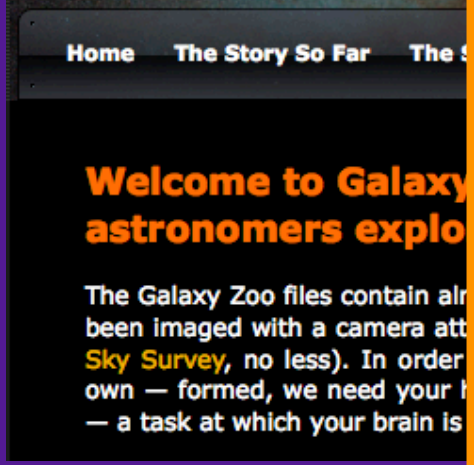
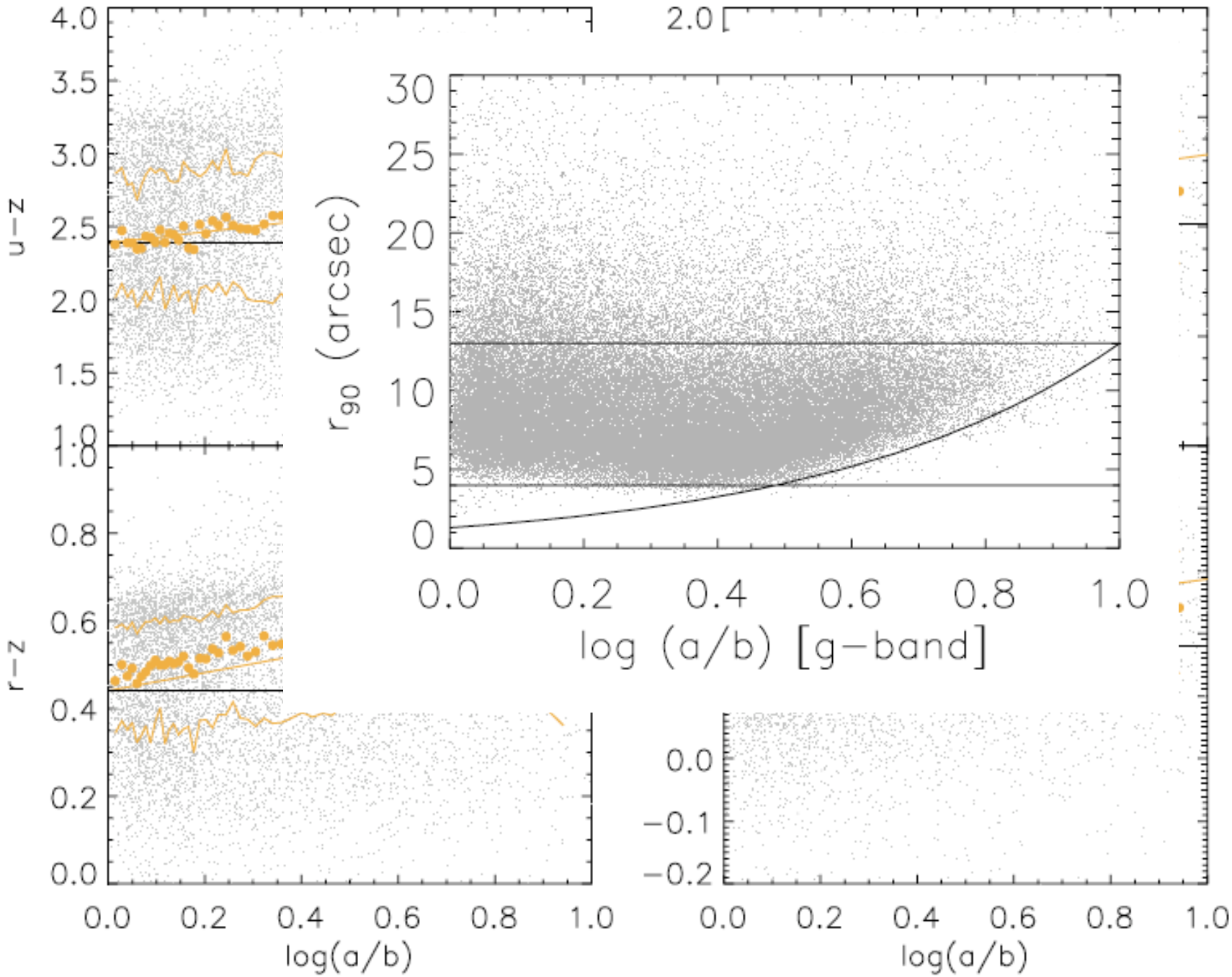


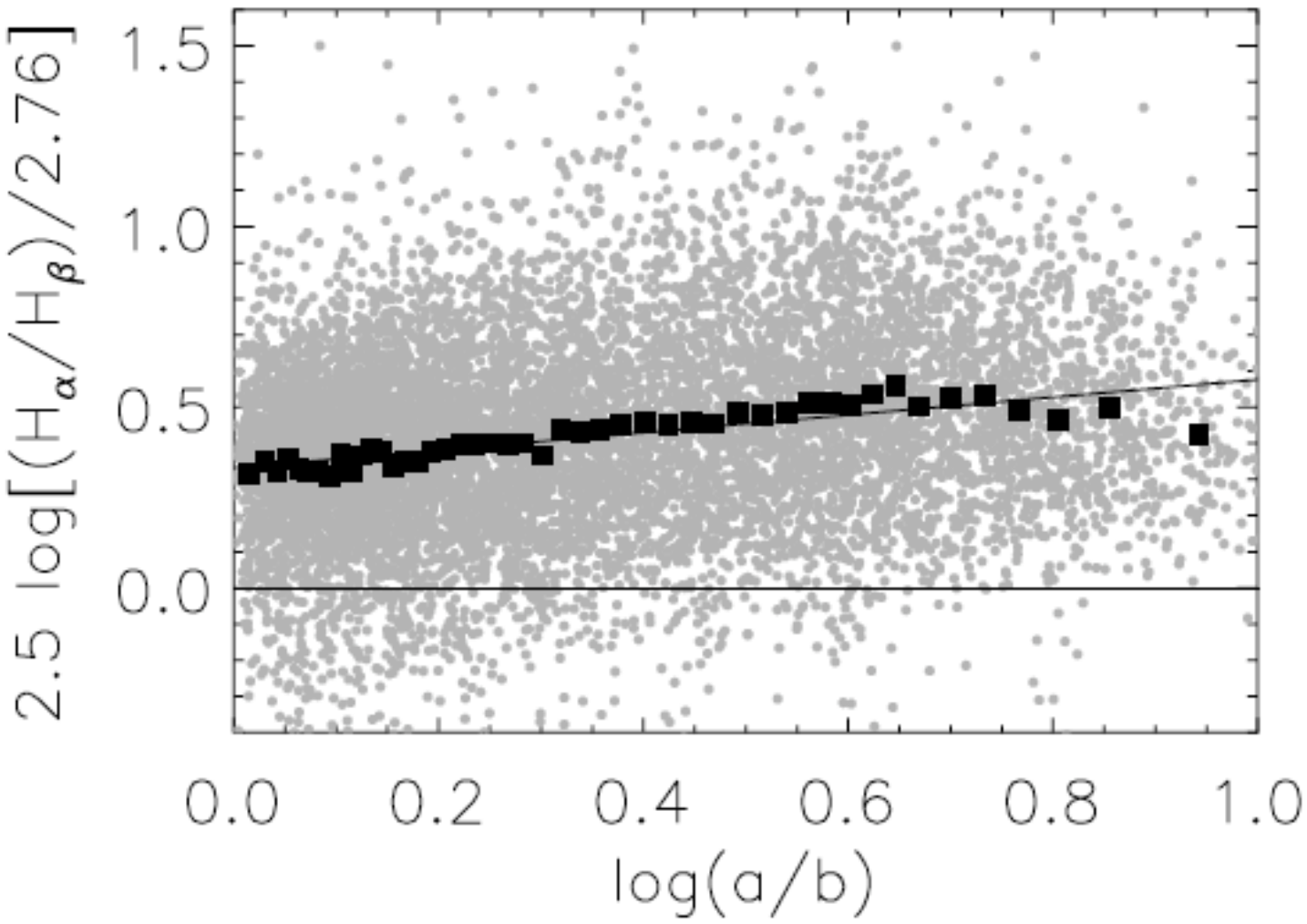


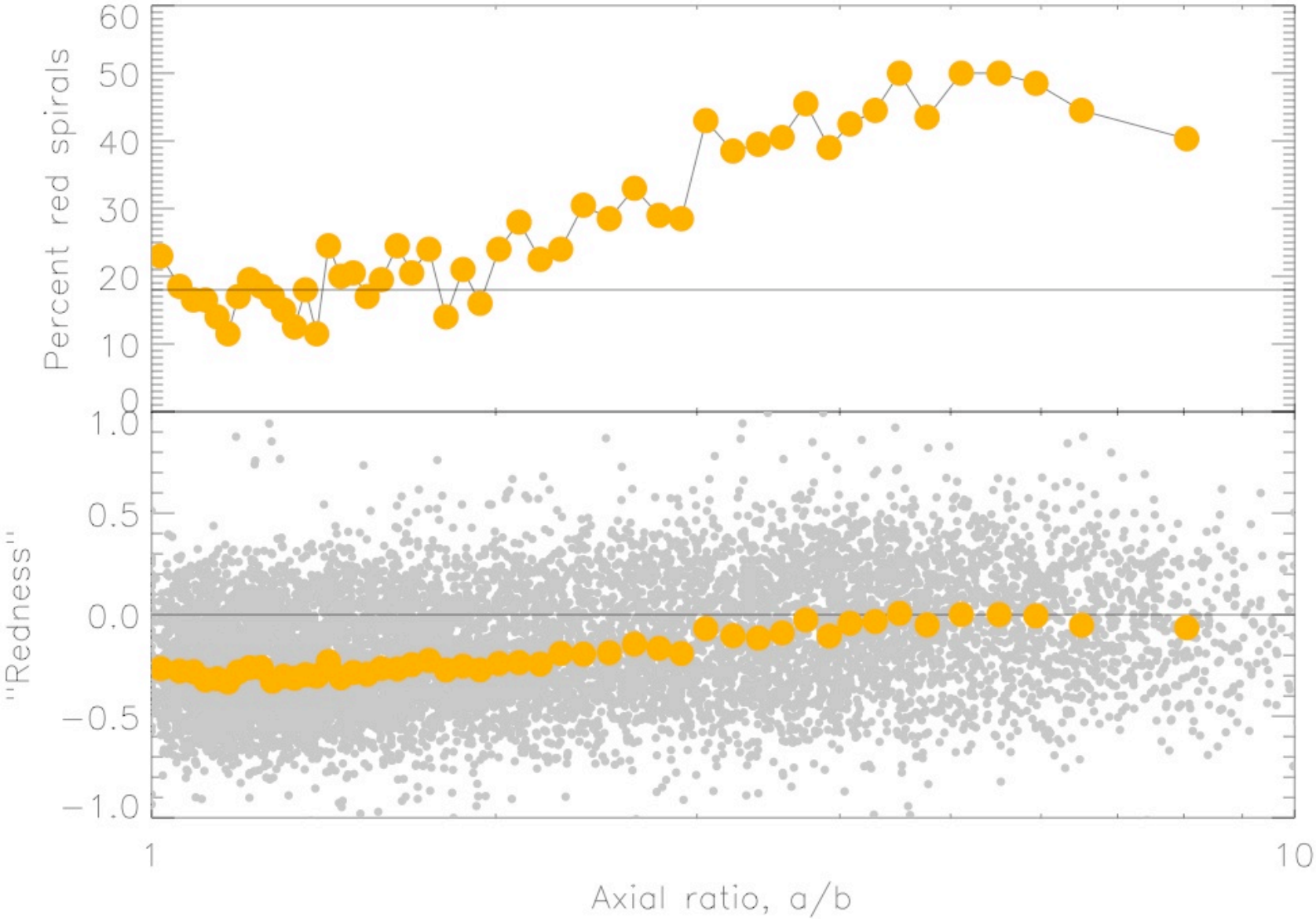
www.galaxyzoo.o

- Over 80000 volunteers classified galaxies in Zoo 1 (2007-2008)
- 1 million galaxies with 20+ classifications each (mean N=38)
  - spiral (edge-on, clockwise, anti-clockwise)
  - elliptical
  - merger
  - don't know
- ~ 80,000 spirals with pspiral > 80%


u−z
r−z
log(a/b)
log(a/b)
r_{90} (arcsec)
log (a/b) [g−band]

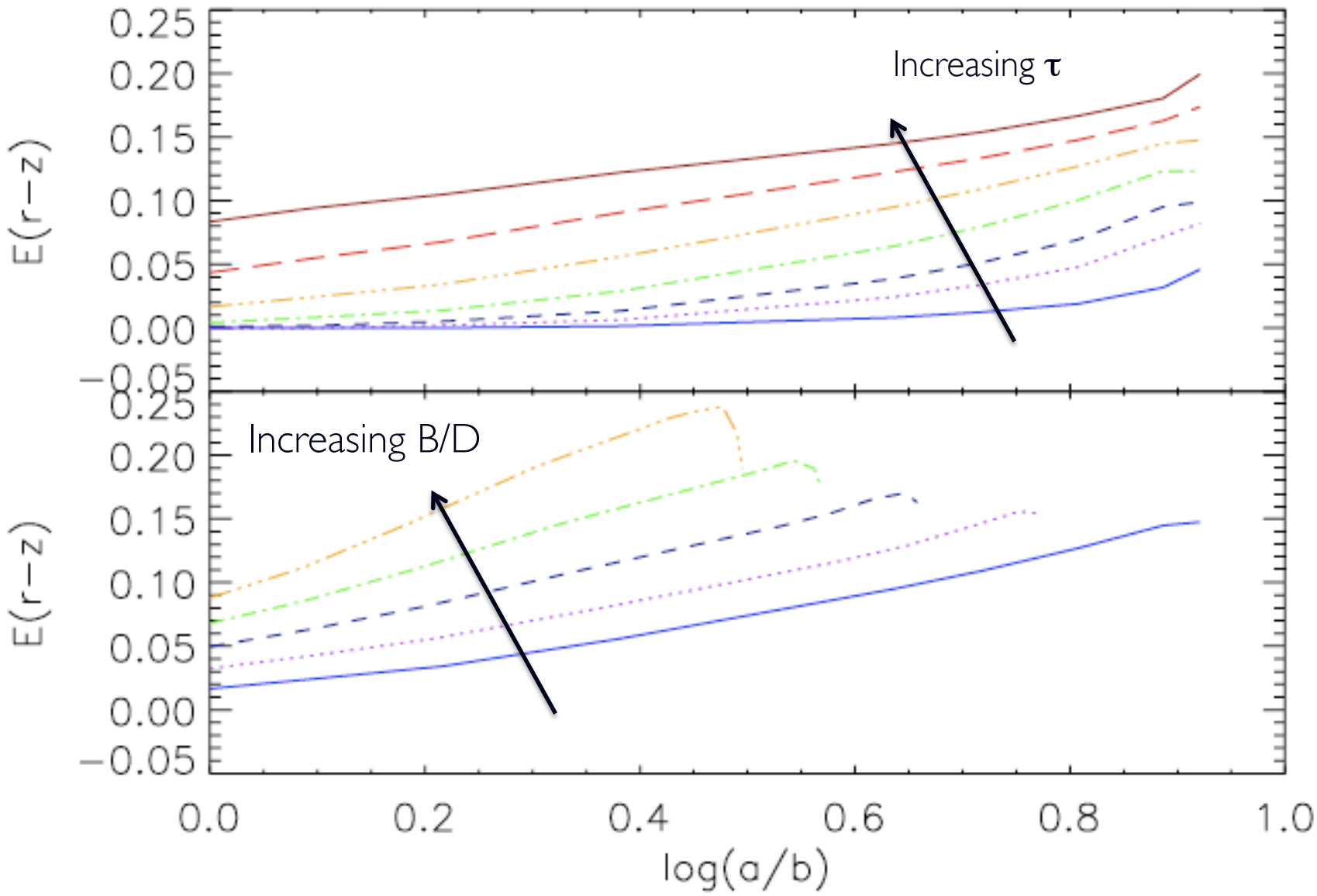
Balmer Decrement

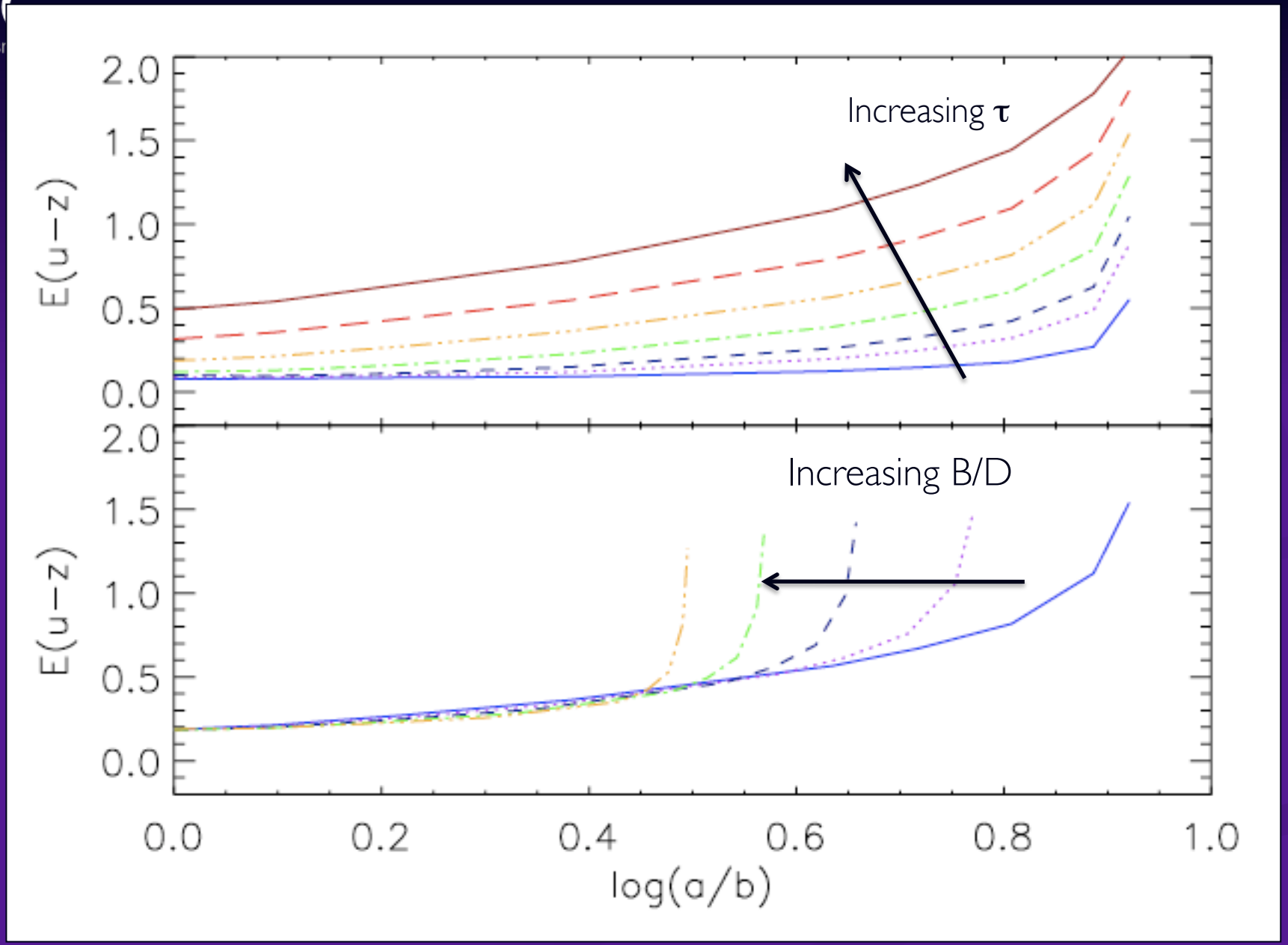



Percent red spirals
60
50
40
30
20
10
0
"Redness"
1.0
0.5
0.0
−0.5
−1.0
1
10
Axial ratio, a/b

Attenuation Model for Spiral Galaxies

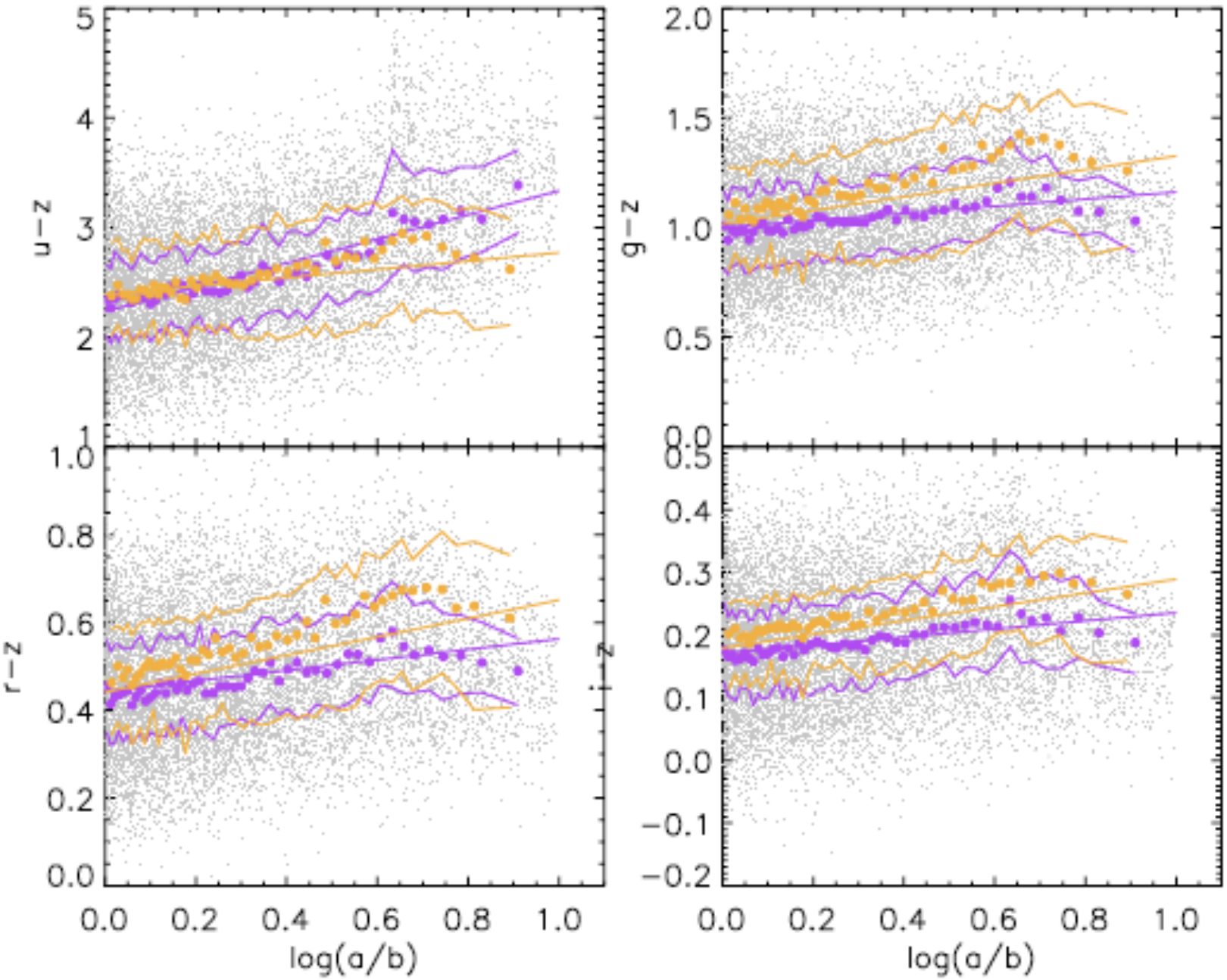
- From Tuffs etal 2004, A&A 419, 821
  - Bulge, disk (OIR) and thin disk (UV)
    - scale lengths/heights of stellar and dust disks, and physical size of bulge set by observations of edge-on galaxies
    - Inputs:
      - bulge-disk luminosity ratio, B/D
      - $\tau_B = \tau_{disk} + \tau_{thindisk}$ ($\tau_{disk} = 0.387\ \tau_{thindisk}$)
      - inclination
  - Dust is graphite/silicate mix; $a^{-3.5}$ grain size distn. "Milky Way like"
  - Model output UV2800, BVIJ; data ugriz
  - Model input - inclination; observation - axial ratio (intrinsic axial ratio as a function of B/D)


Increasing τ
Increasing B/D
E(r−z)
E(r−z)
0.25
0.20
0.15
0.10
0.05
0.00
−0.05
0.0
0.2
0.4
0.6
0.8
1.0
log(a/b)

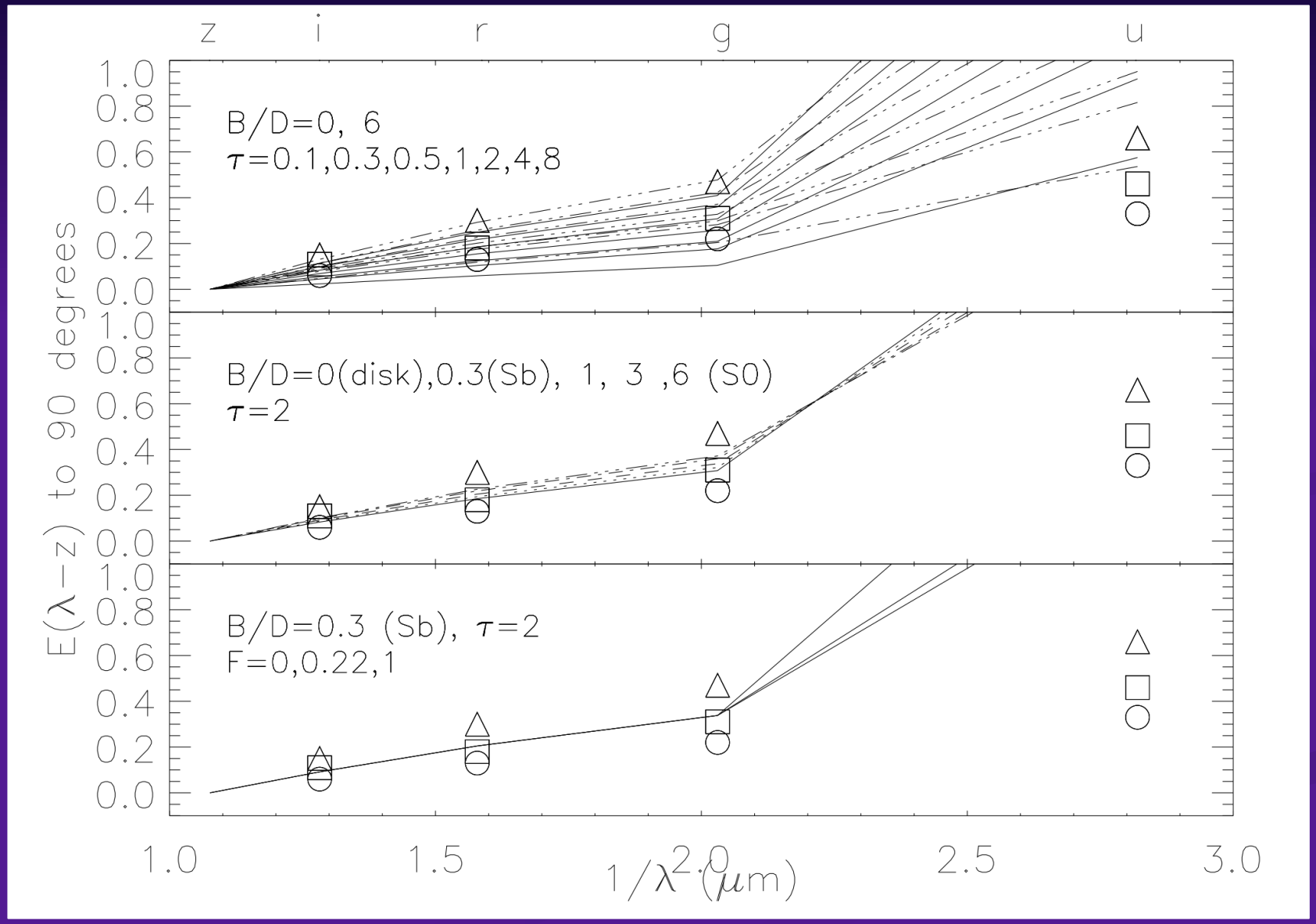

Increasing τ
Increasing B/D
E(u−z)
E(u−z)
2.0
1.5
1.0
0.5
0.0
2.0
1.5
1.0
0.5
0.0
0.0
0.2
0.4
0.6
0.8
1.0
log(a/b)

Monte Carlo Realisation

- Use frac_DeV from SDSS to estimate
  - bulge-disk ratio (from trend in MGC galaxies)
  - Instrinsic axial ratio (from SDSS)
  - Face-on colour (from SDSS)
- Input realistic ranges into Tuffs etal 2004 to simulate trends of colour with axial ratio


u−z
g−z
r−z
i−z
log(a/b)
log(a/b)

Attenuation Curve



Conclusions

- Galaxy Zoo is a fantastic database for the study of galaxy evolution
- The impact of dust attenuation as a function of viewing angle should not be neglected in spiral galaxies
- Simple models (eg. Tuffs etal 2004) can broadly reproduce the observations
  - It is difficult to disentangle the effects of geometry and dust content/properties
  - u-band attenuation is overpredicted at high inclination angles
  - r, g and i-band attenuation slightly underpredicted relative to u-band

Thank you Galaxy Zoo Team and >200,000 Volunteers

www.galaxyzoo.org