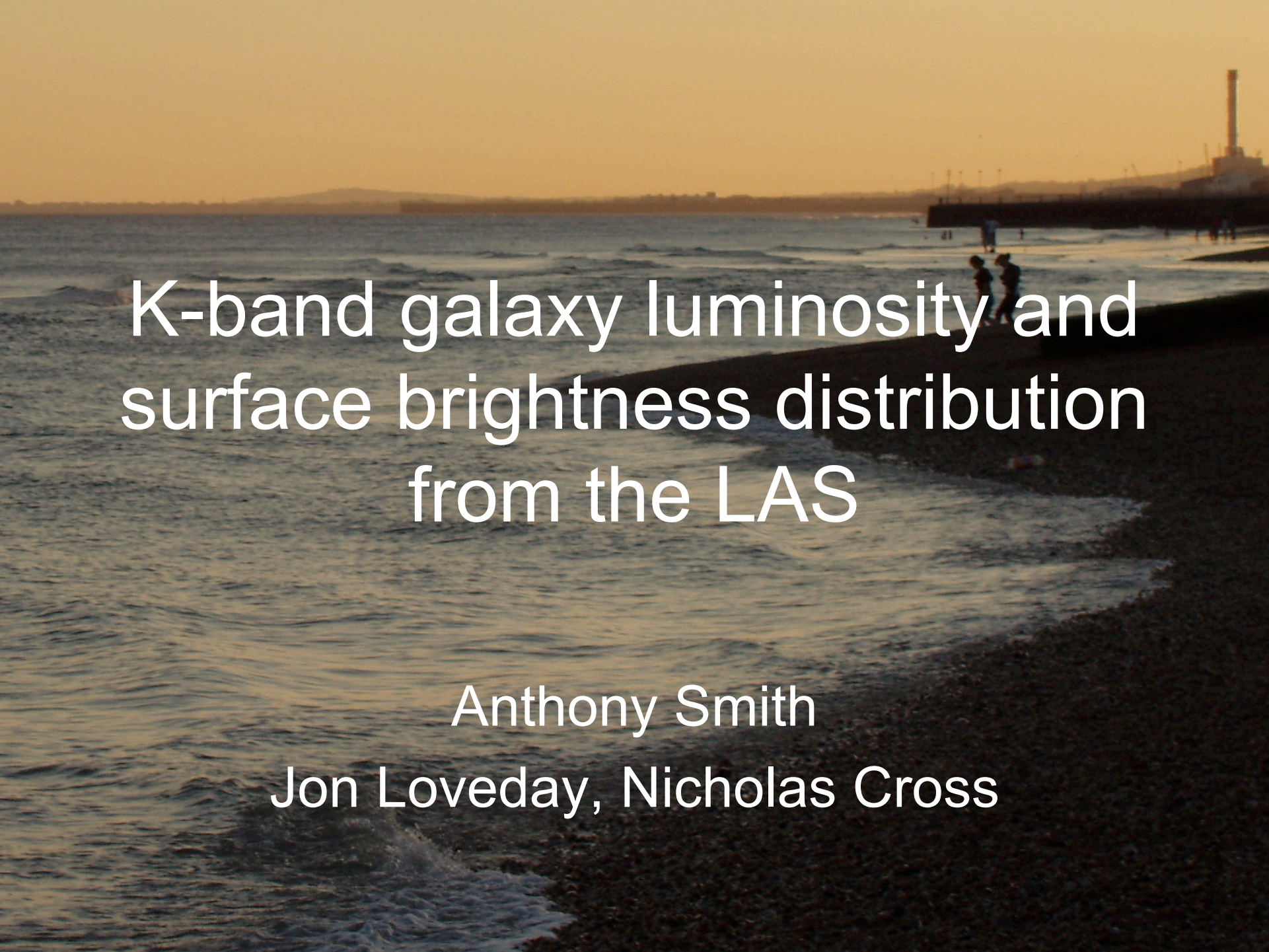

K-band galaxy luminosity and surface brightness distribution from the LAS

Anthony Smith

Jon Loveday, Nicholas Cross

Aims

- Census
  - Not just luminosity
- Low-redshift
  - Wider range of galaxy types
  - Fewer problems with evolution corrections or selection effects
- Near-infrared
  - **Dust** better than in optical
  - **K-corrections** better than in optical
  - **M/L ratios** better than in optical
- Luminosity function & surface brightness

Outline

- Data
- Account for unreliable measurements
  - Deblending
  - Large galaxies
- Luminosity function etc.

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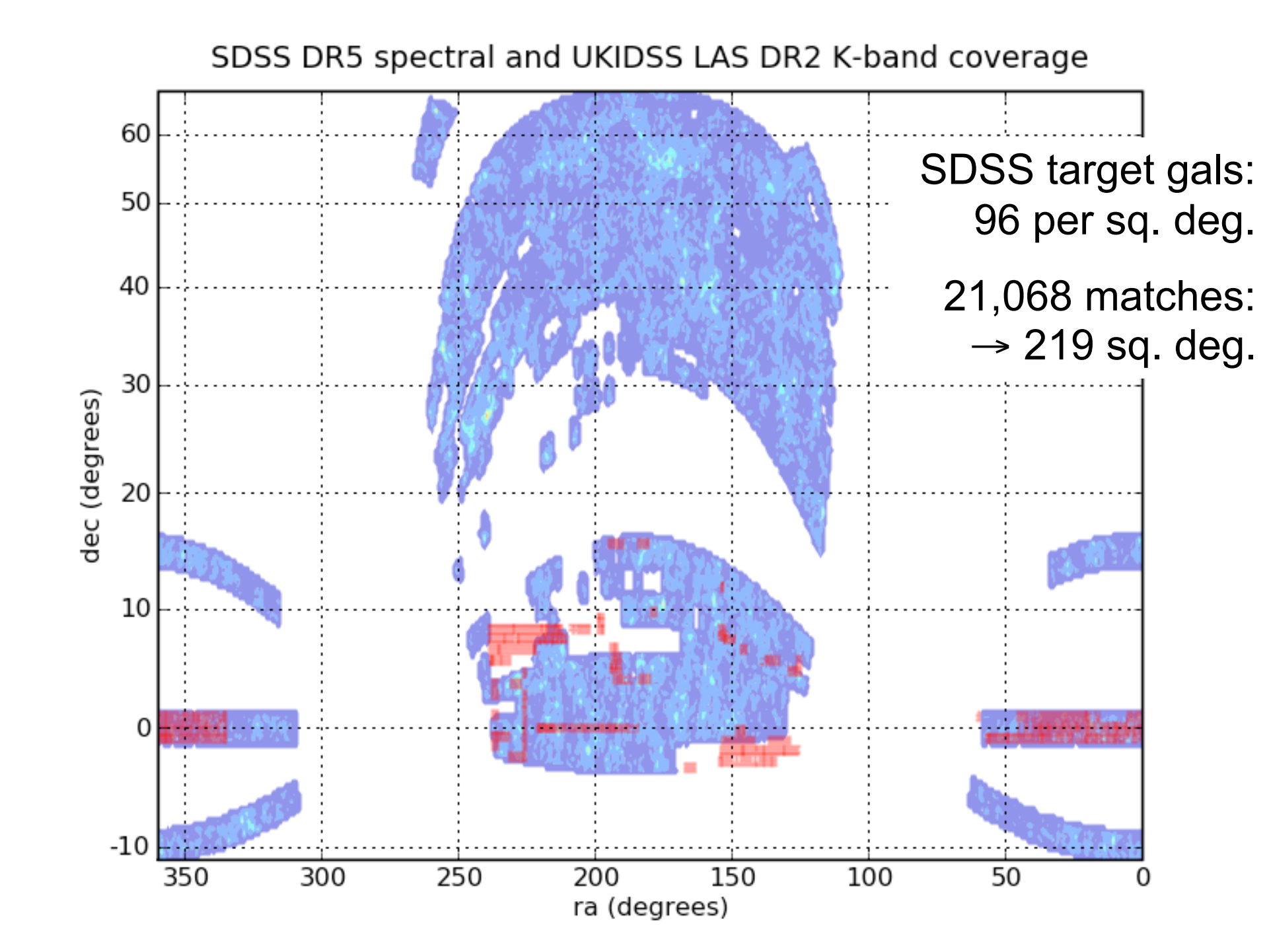
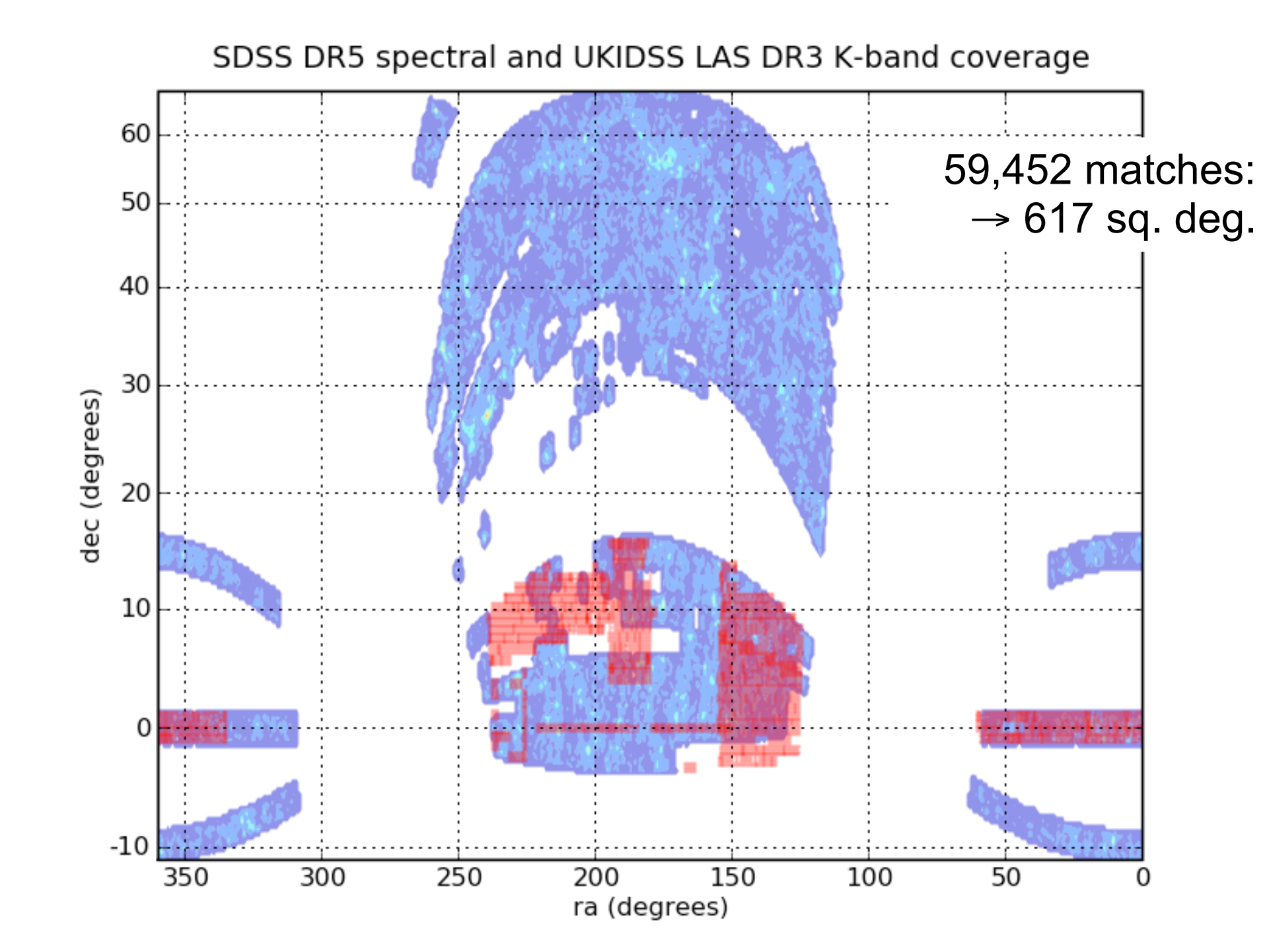
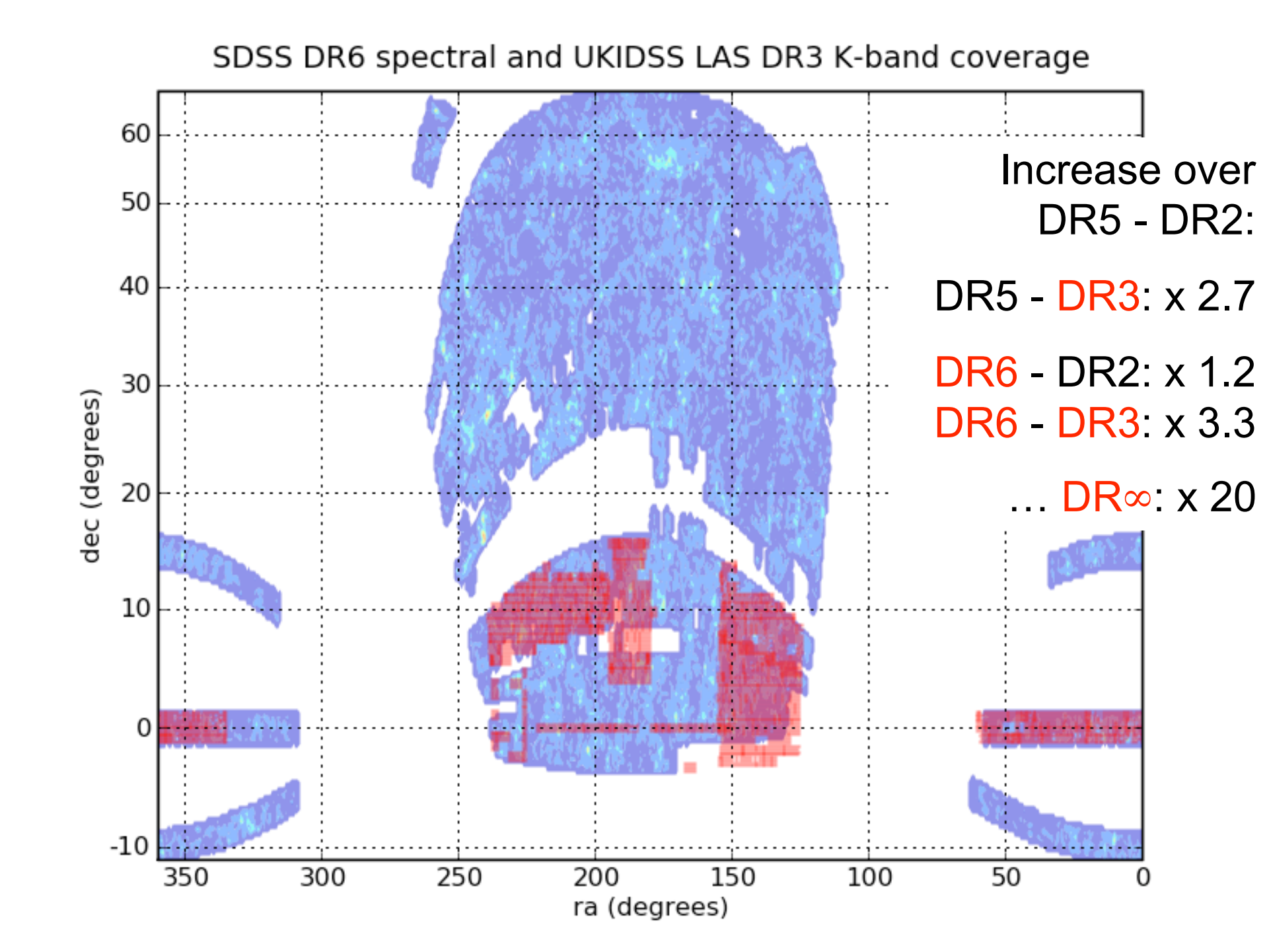
Data

- LAS DR2 and SDSS DR5
  - Matched on WSA
- SDSS main galaxy sample (+ spec-*z*)
  - Bright galaxies targetted for spectroscopy
  - Spectral class: not using UKIDSS classifications
- Assume all SDSS galaxies detectable in LAS
  - Seems reasonable
- Number of matches → effective area


SDSS DR5 spectral and UKIDSS LAS DR2 K-band coverage
SDSS target gals:
96 per sq. deg.
21,068 matches:
→ 219 sq. deg.
dec (degrees)
ra (degrees)
60
50
40
30
20
10
0
-10
350
300
250
200
150
100
50
0


SDSS DR5 spectral and UKIDSS LAS DR3 K-band coverage
59,452 matches:
→ 617 sq. deg.
dec (degrees)
ra (degrees)
60
50
40
30
20
10
0
-10
350
300
250
200
150
100
50
0


SDSS DR6 spectral and UKIDSS LAS DR3 K-band coverage
dec (degrees)
ra (degrees)
60
50
40
30
20
10
0
-10
350
300
250
200
150
100
50
0
Increase over
DR5 - DR2:
DR5 - DR3: x 2.7
DR6 - DR2: x 1.2
DR6 - DR3: x 3.3
… DR∞: x 20

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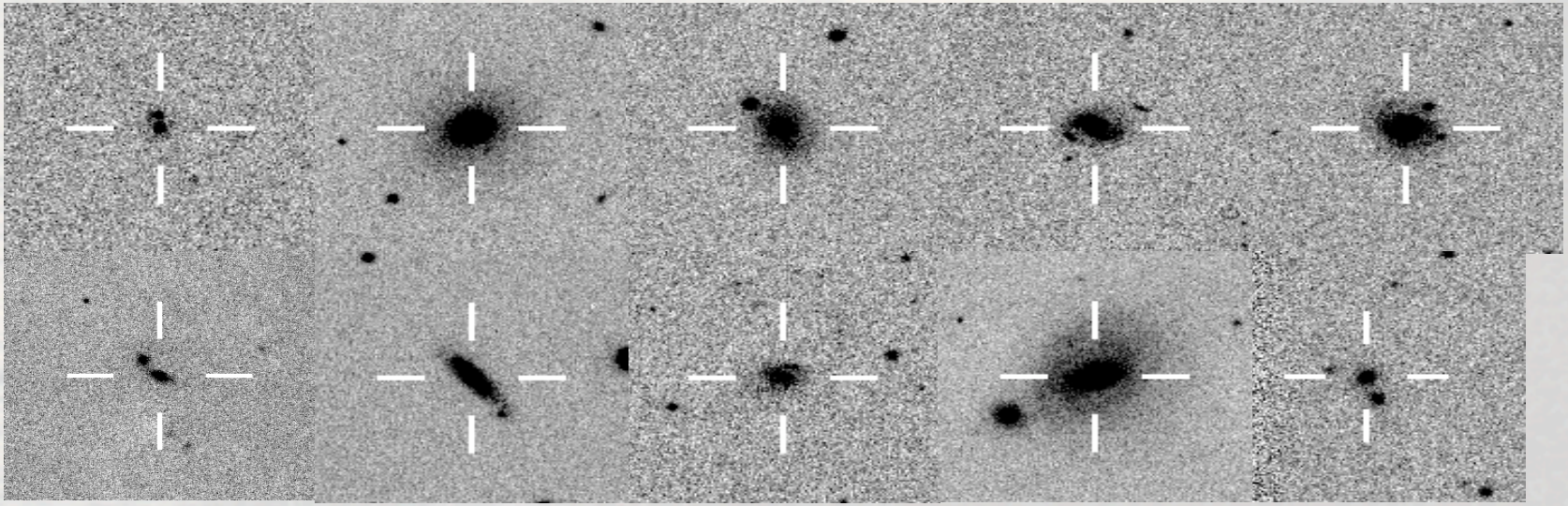
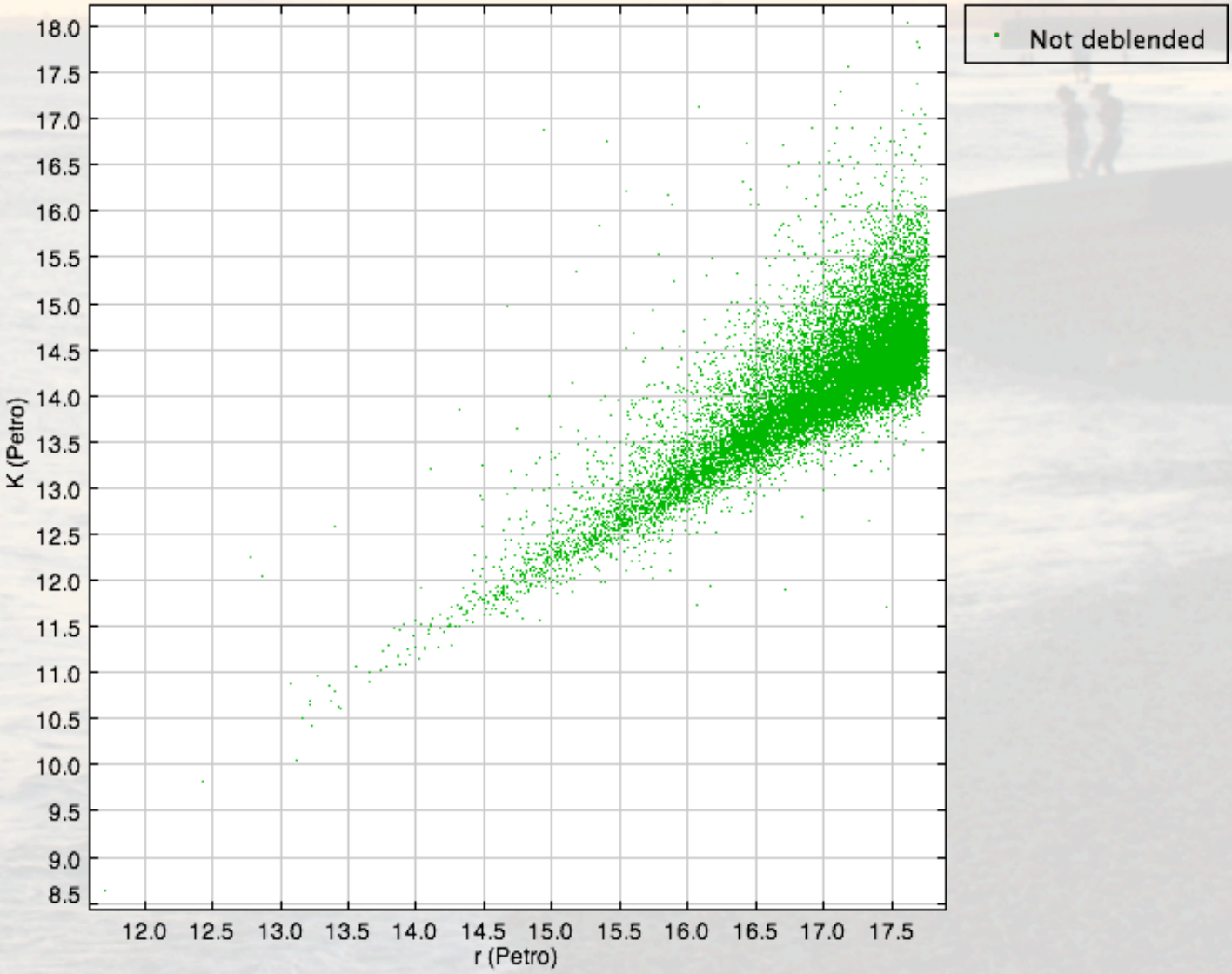
Deblending

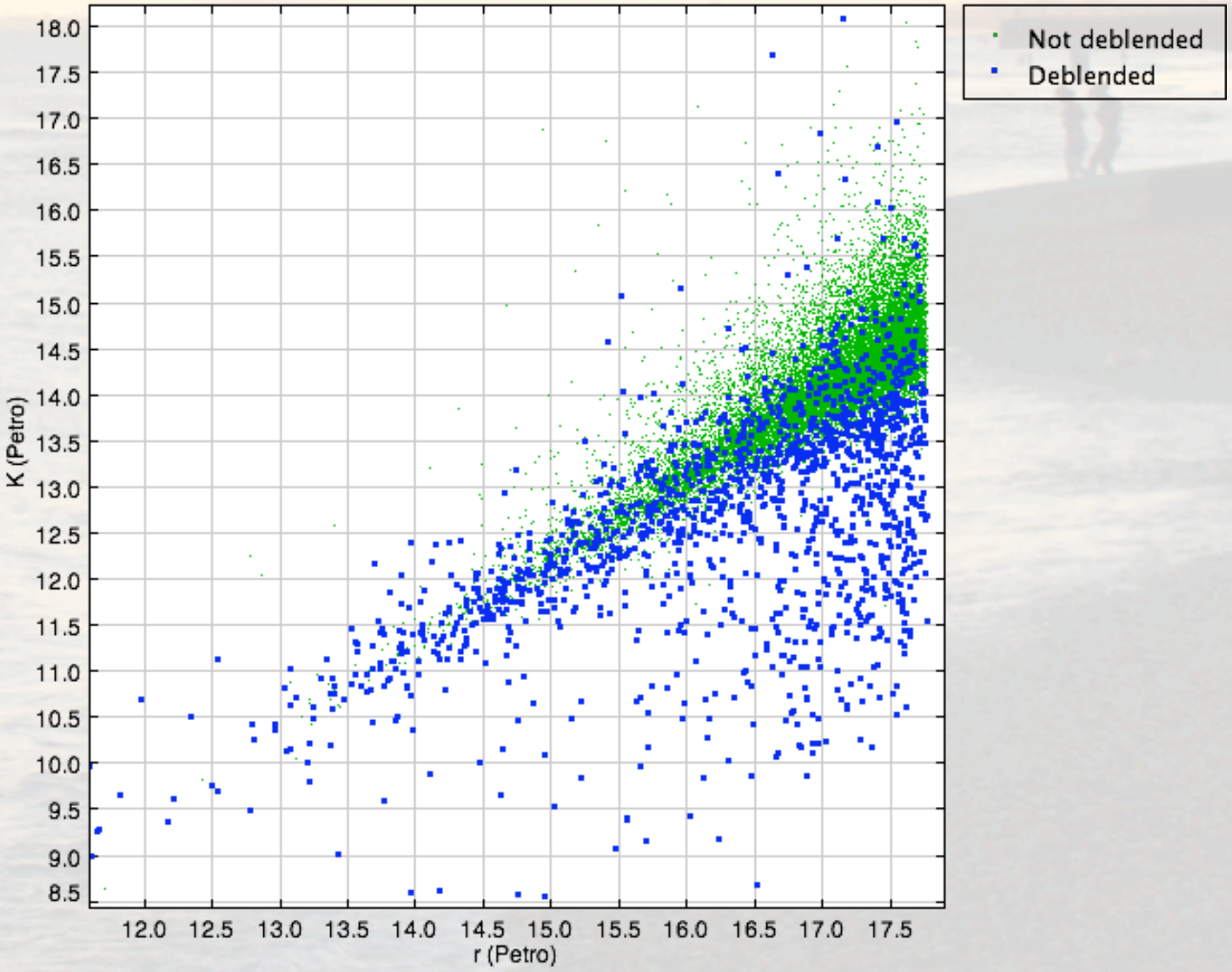
- ppErrBits: bit flag 4 (16)
- Affects 8% of matched sample
- Petrosian magnitudes too bright (under-deblending)



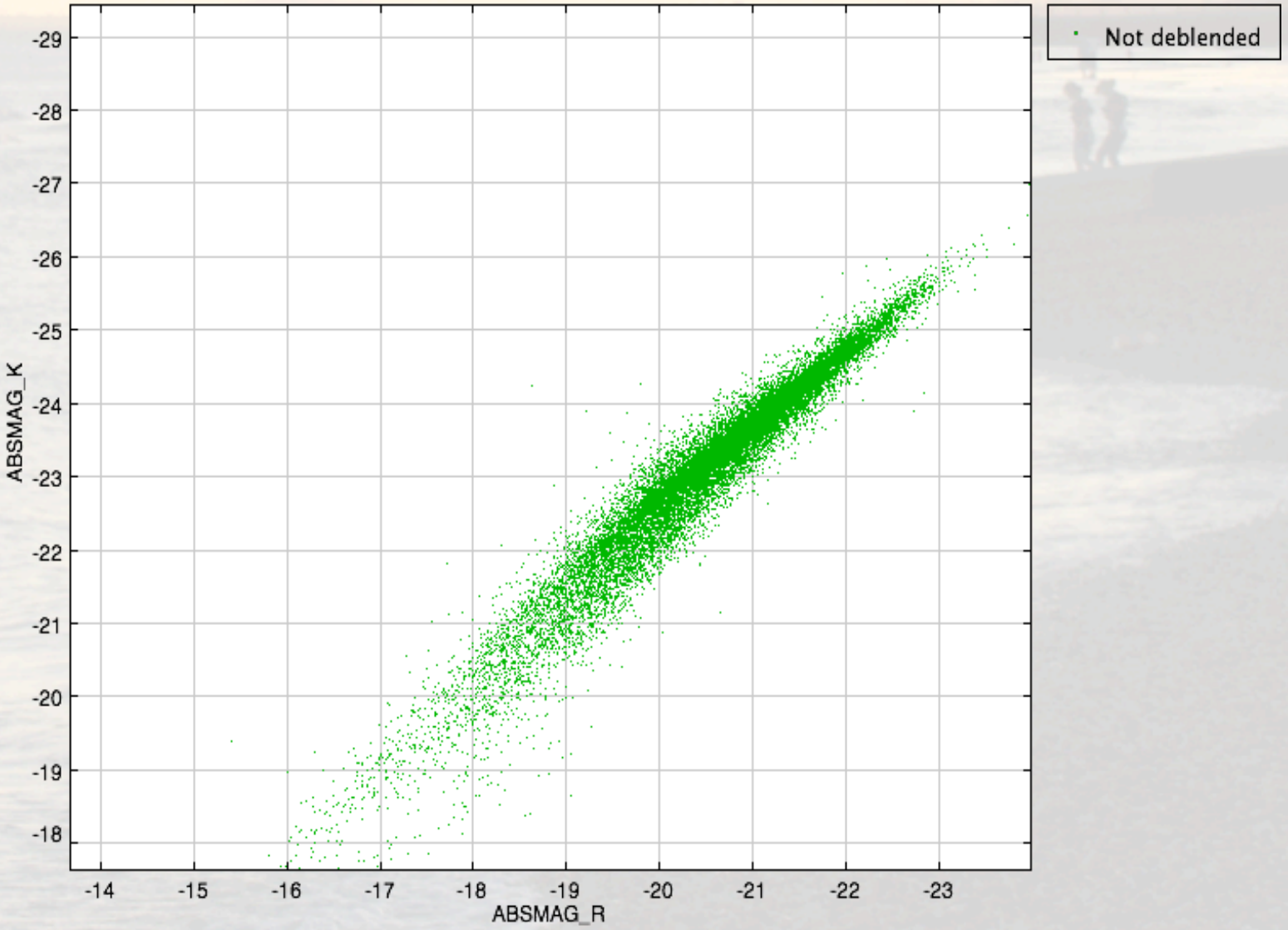
Deblending: Petrosian mags



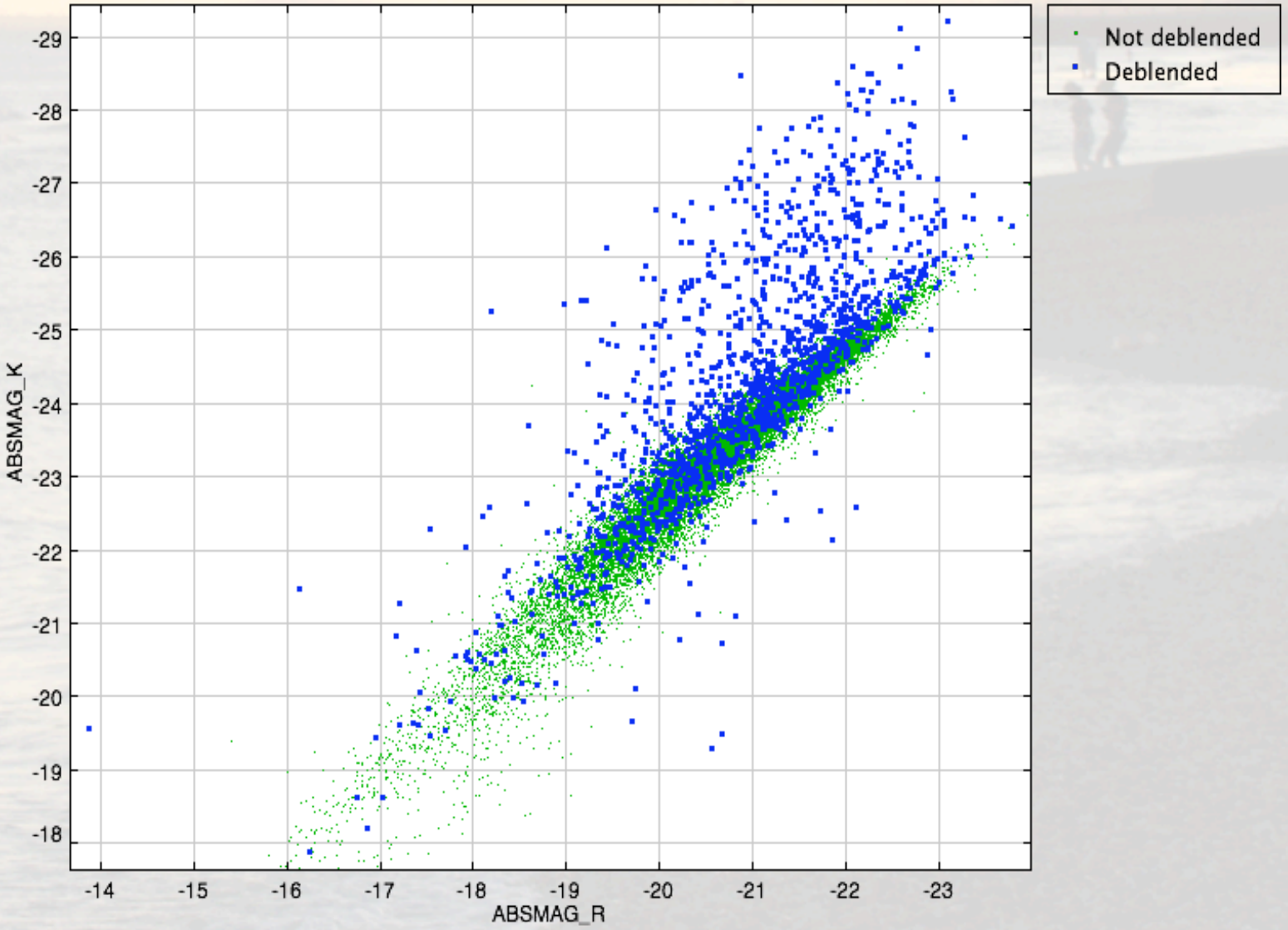
Deblending: Petrosian mags



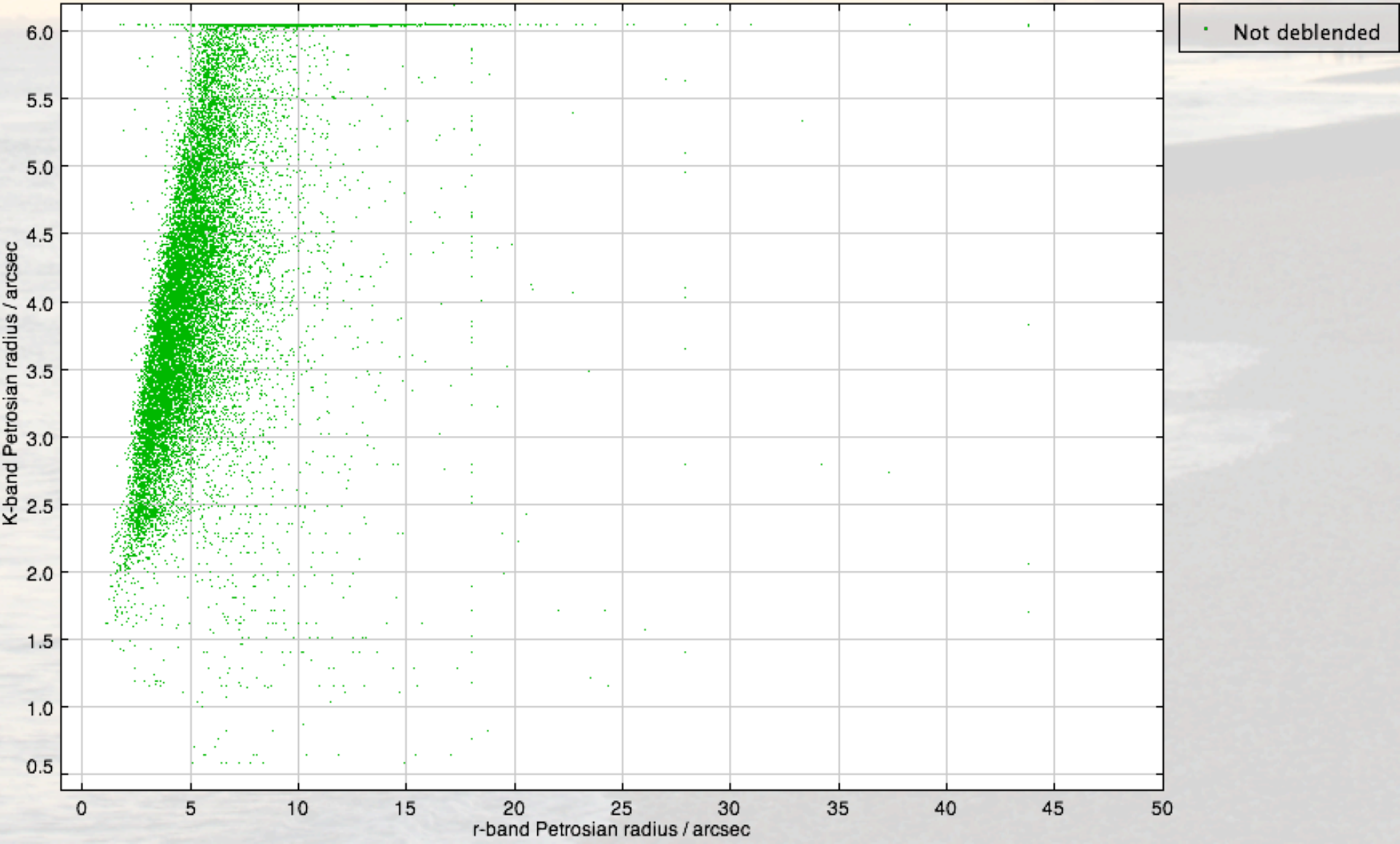
Deblending: abs mag (Petro)



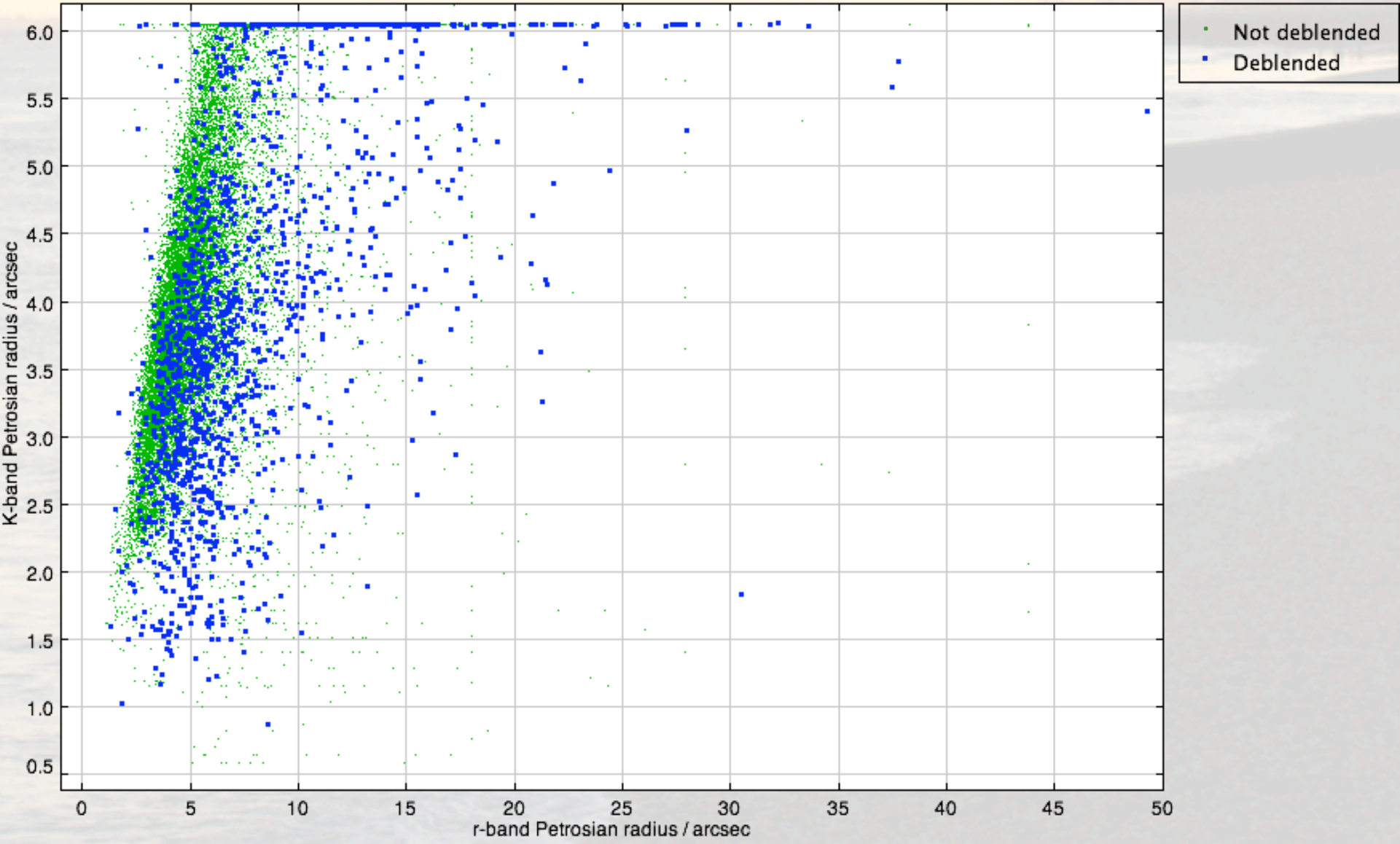
Deblending: abs mag (Petro)



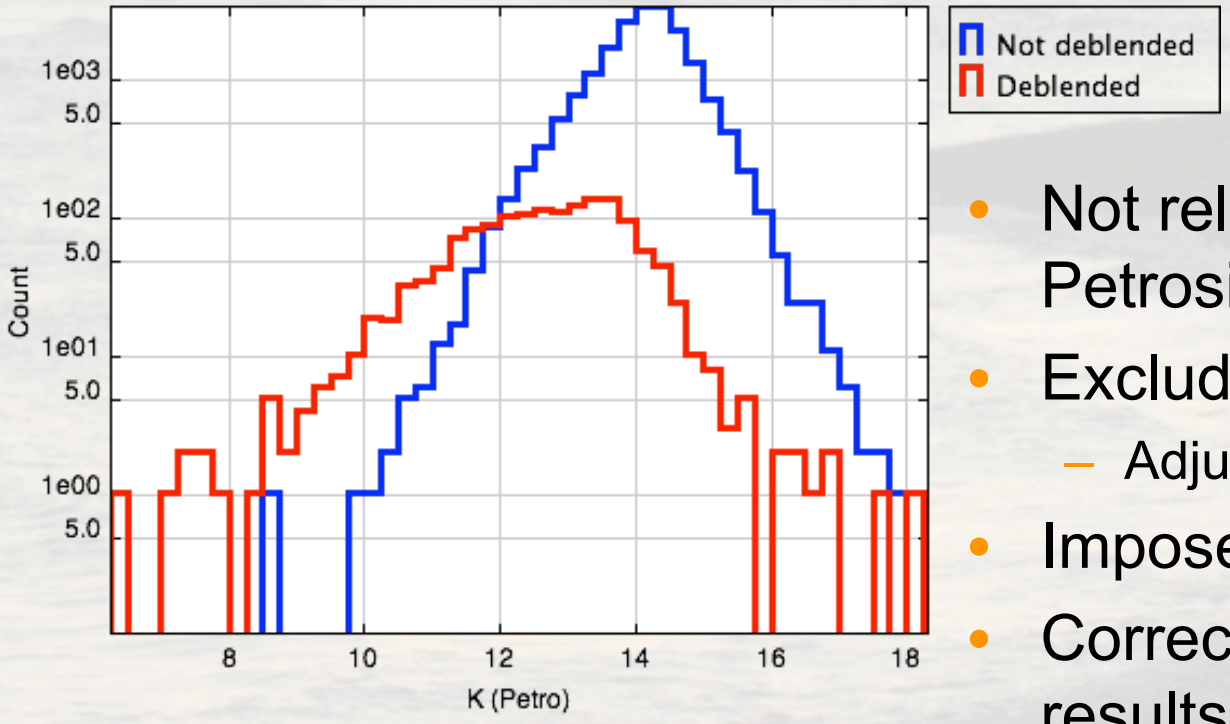
Deblending: Petrosian radius



Deblending: Petrosian radius

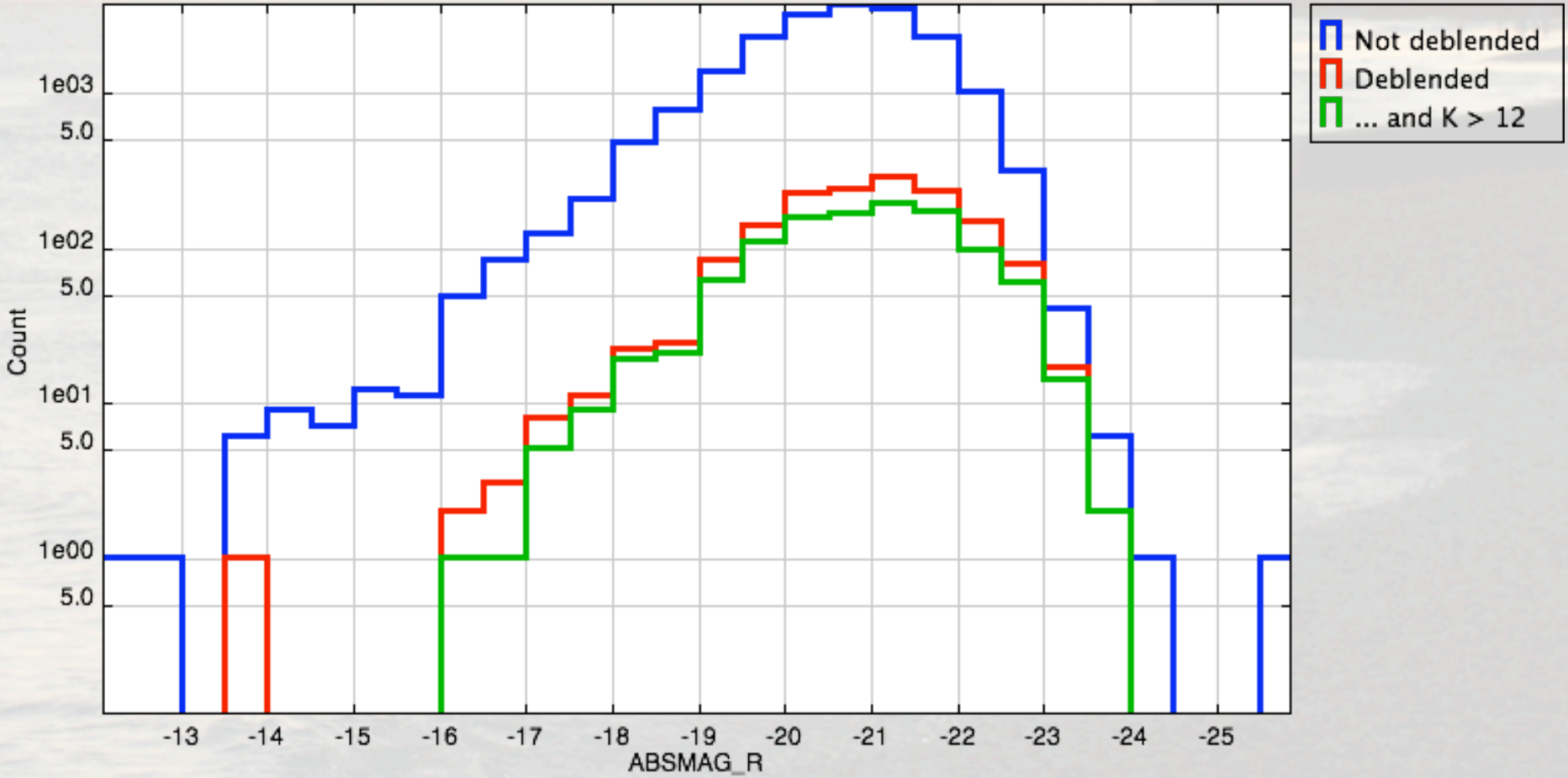


Deblending



- Not reliable with Petrosian magnitudes
- Exclude from sample
  - Adjust effective area
- Impose limit of K>12
- Correction to final results?
  - Assuming *r*-band good

K-band deblended: *r*-band M_r



Outline

- Data
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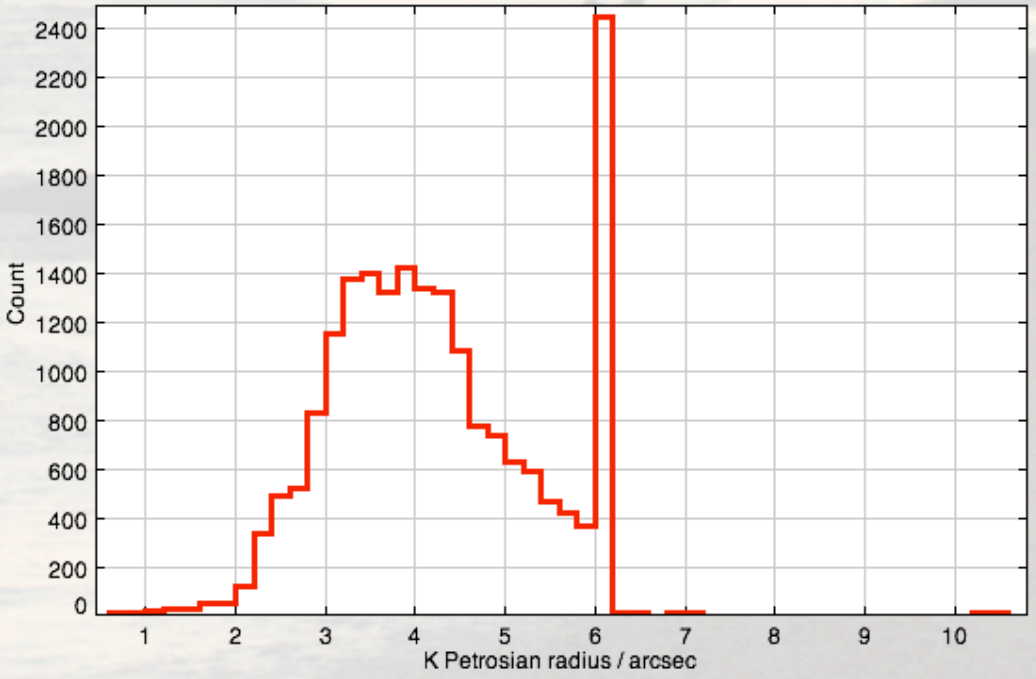
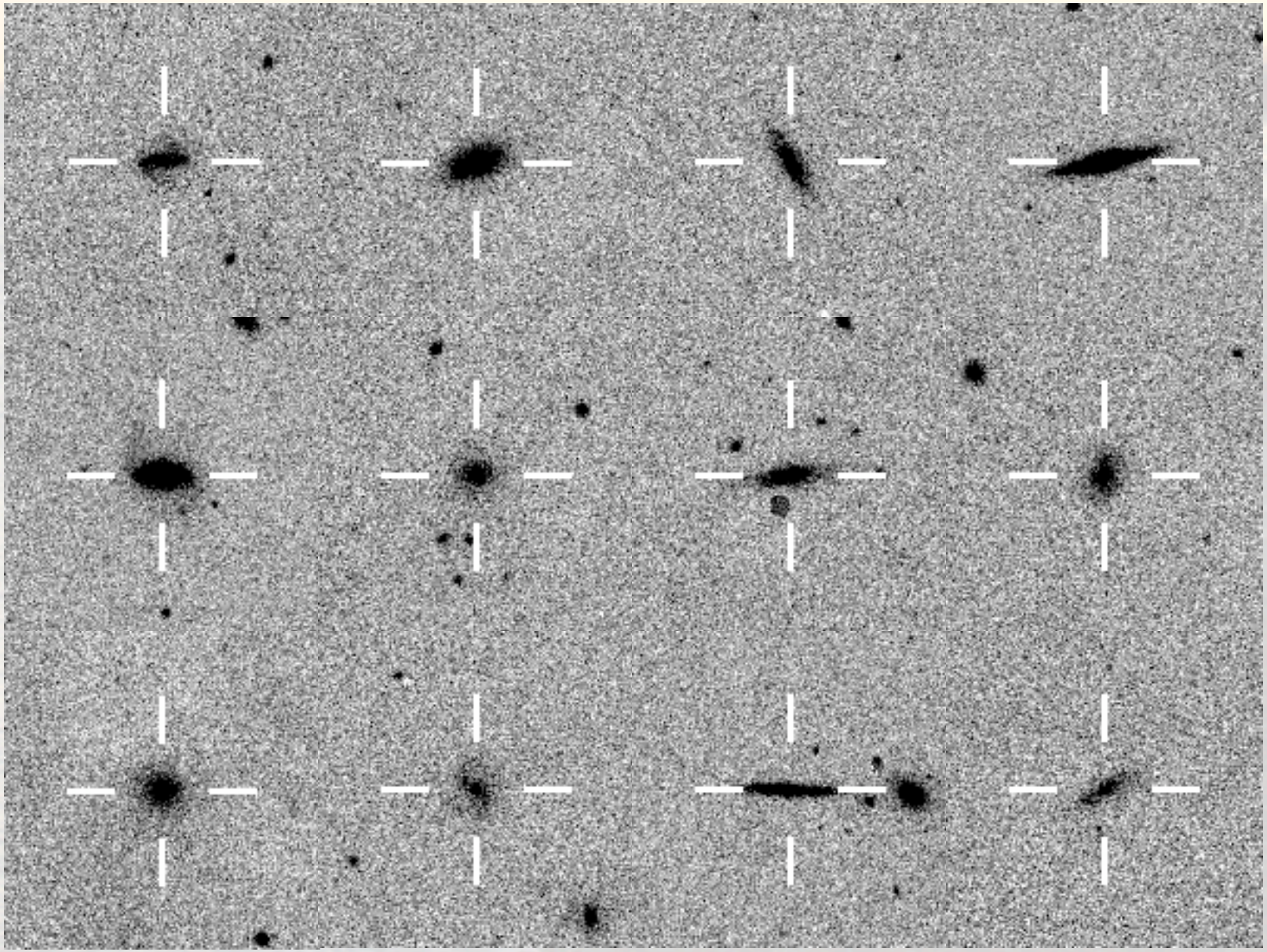
Large galaxies

- Sky very bright in NIR
- Limit of 24” for circular apertures
  - 6” Petrosian radius
- 12% of remaining sample have radius clipped
  - “Petrosian radius” → too small
  - “Petrosian magnitude” → too faint



Large galaxies



Outline

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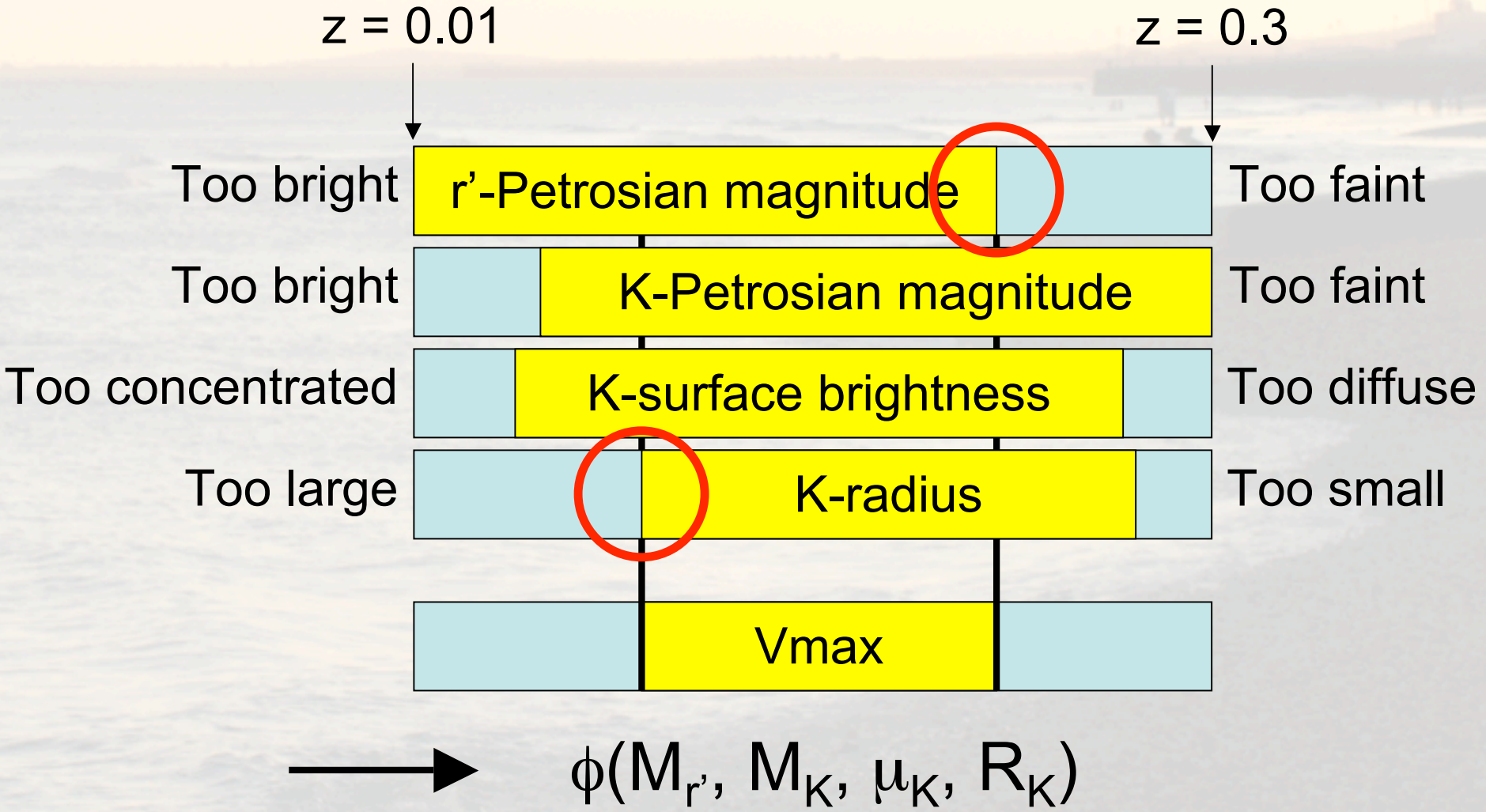
Multivariate space density

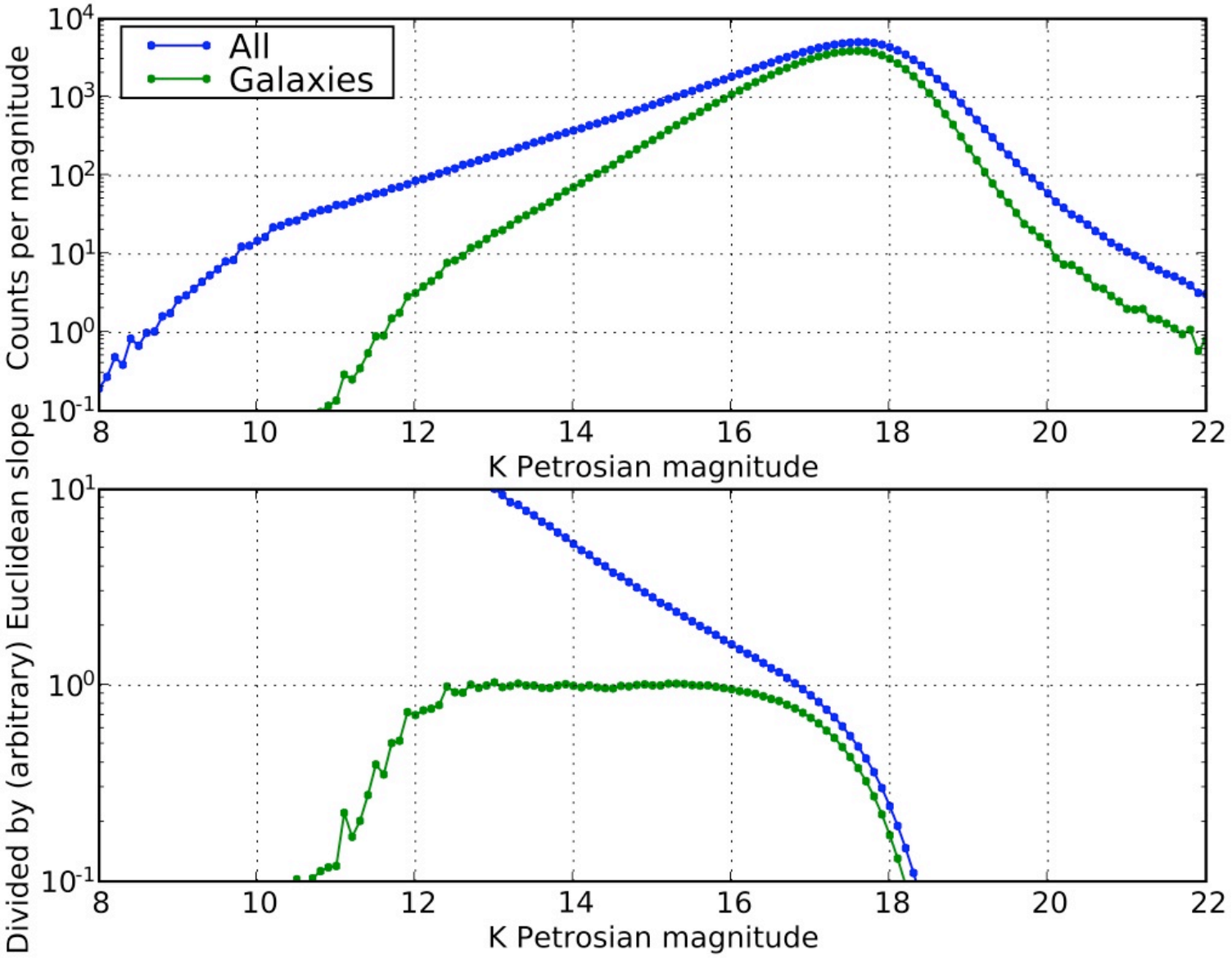
- Extension of luminosity function
  - *K*-band luminosity
  - *r*-band luminosity
  - *K*-band Petrosian radius
  - *K*-band effective surface brightness
    - Within half-light radius (from Nick Cross)
- Take all (?) selections effects into account
- 1/Vmax and SWML

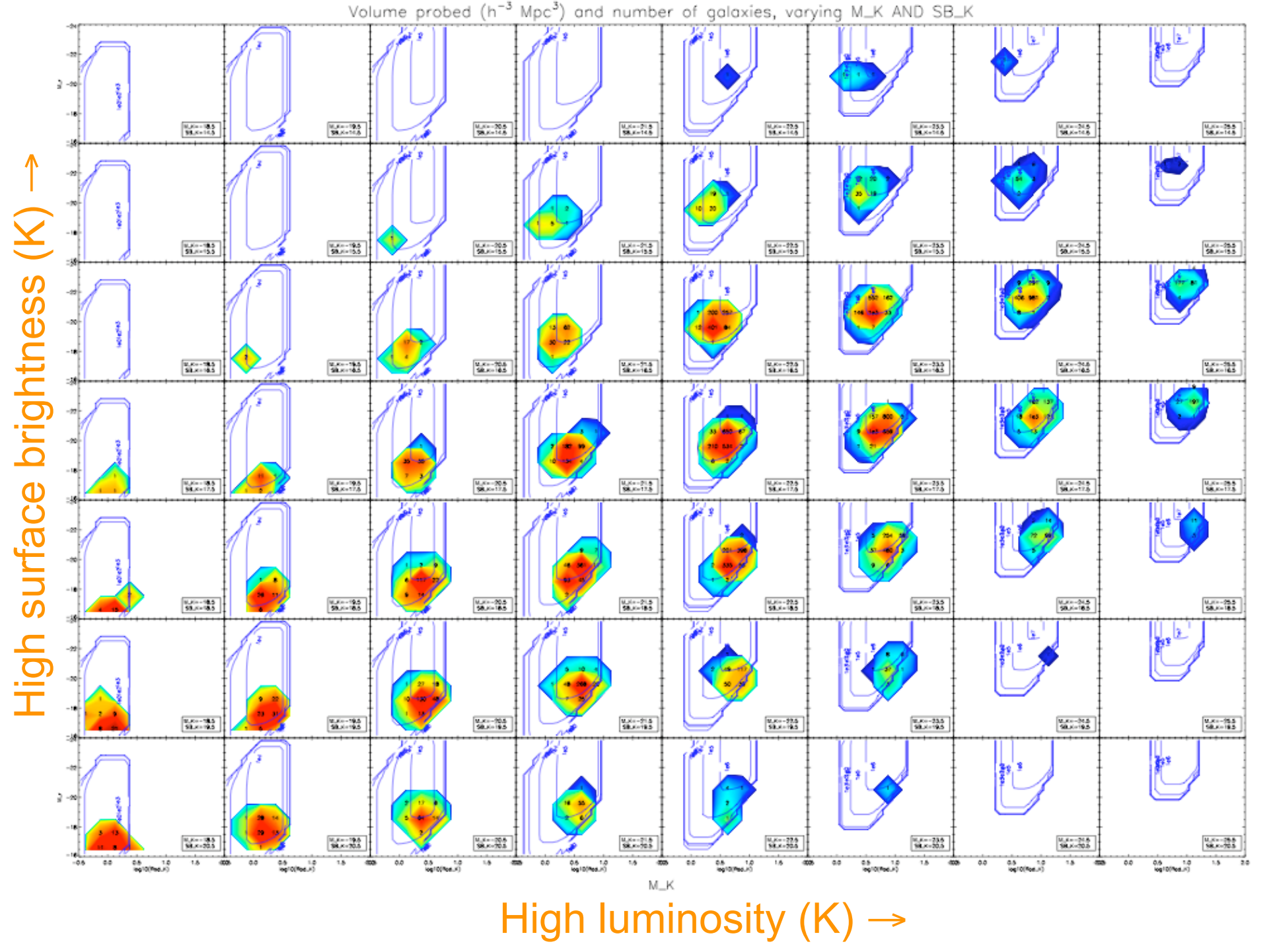
Multivariate ϕ: 1/Vmax method

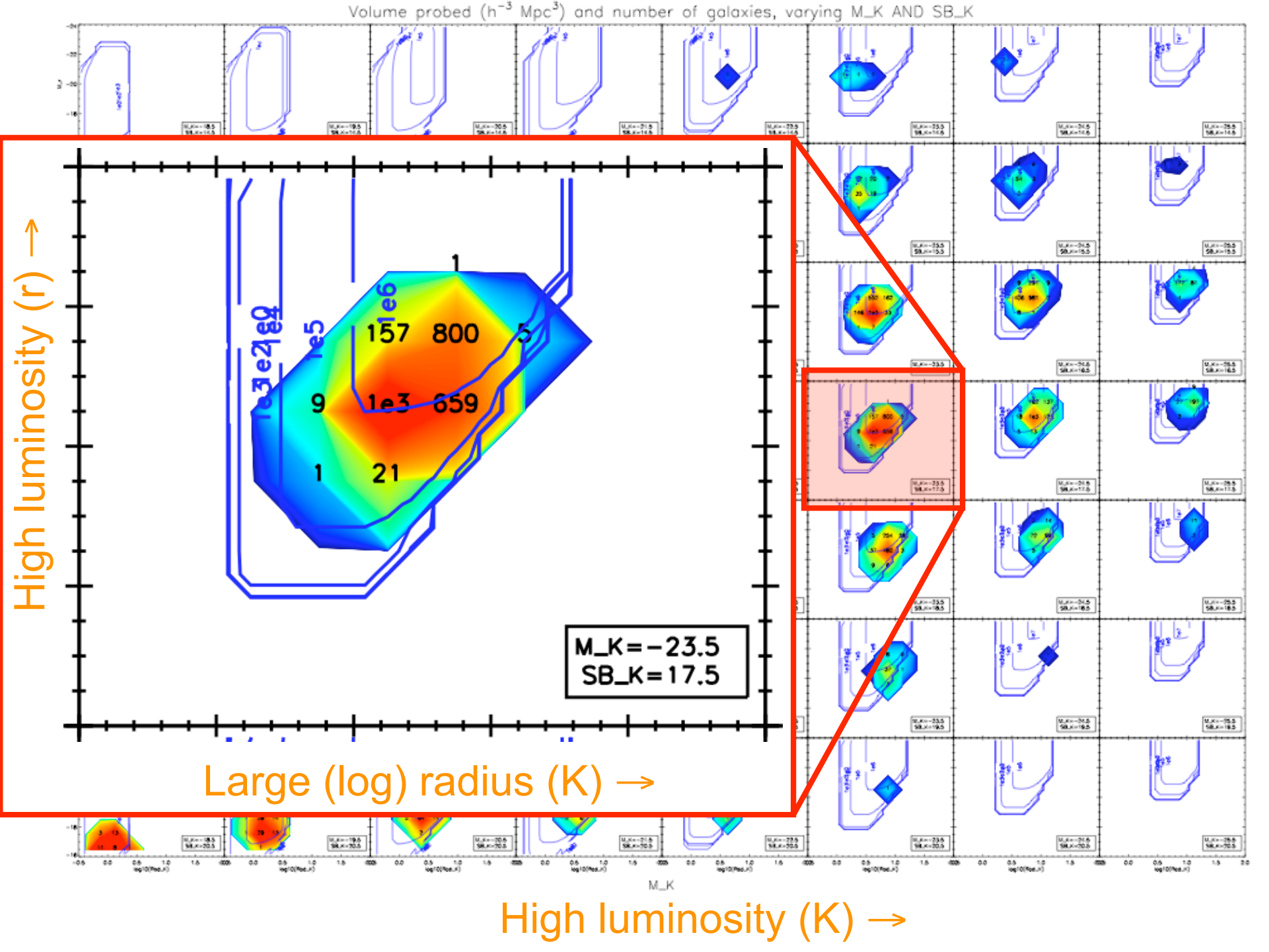


16,452 galaxies within selection limits

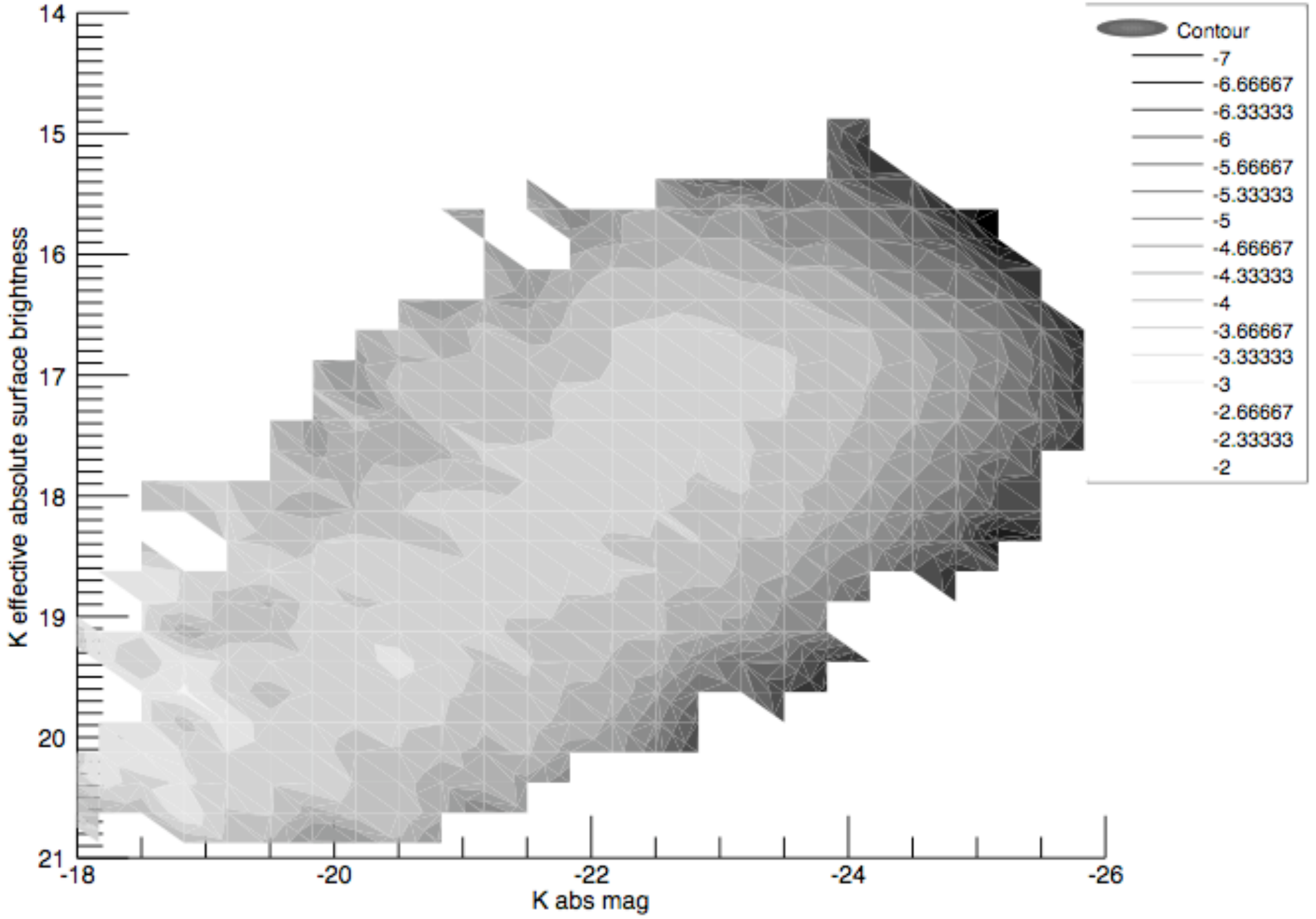
Faint limit: $K < 16$



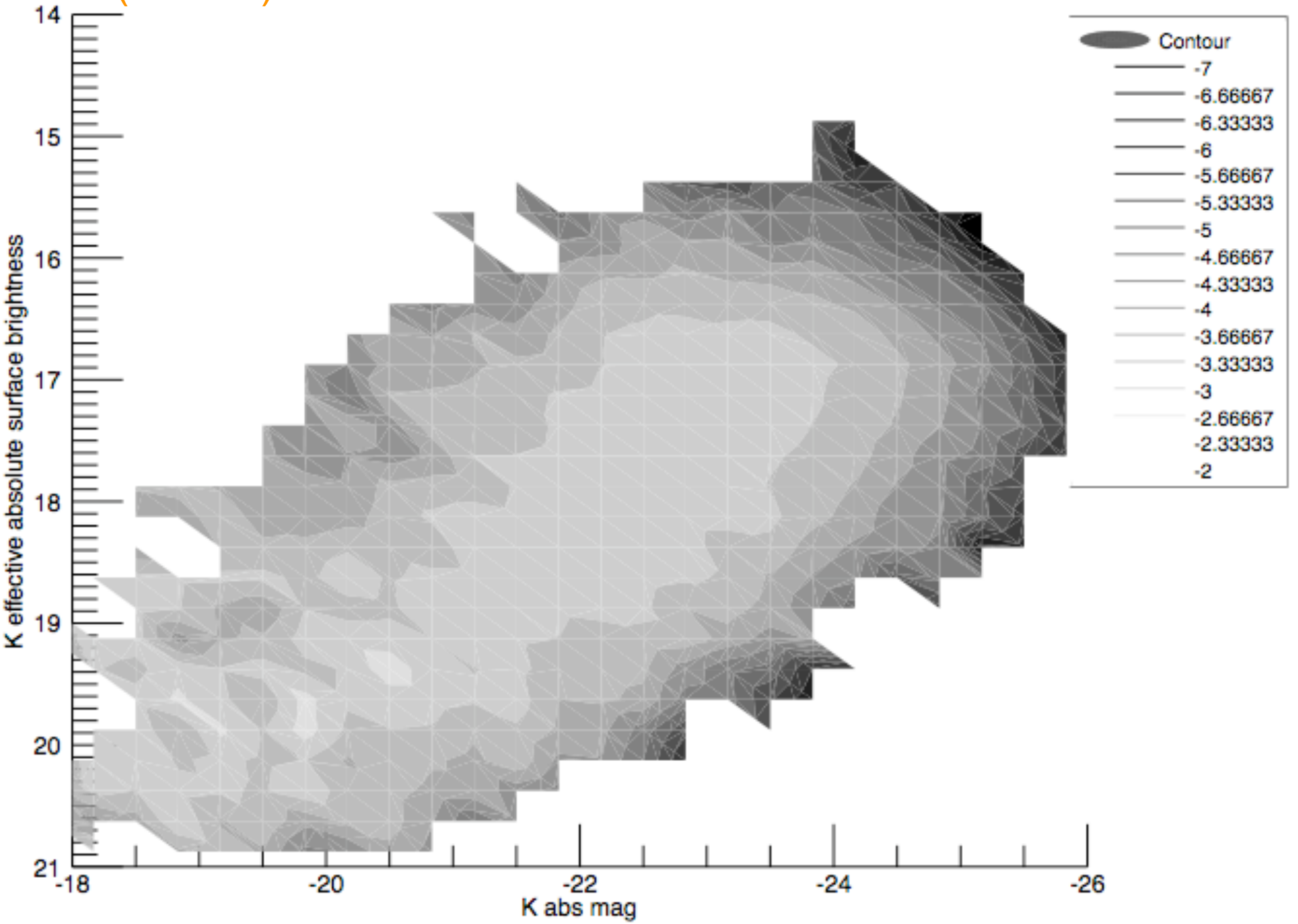

Volume probed (h^{-3} Mpc^3) and number of galaxies, varying M_K AND SB_K
High surface brightness (K) →
M_K
High luminosity (K) →


Volume probed (h^{-3} Mpc^3) and number of galaxies, varying M_K AND SB_K
High luminosity (r) →
Large (log) radius (K) →
M_K
High luminosity (K) →
1
1e6
1e5
1e4
1e3
1e2
1e1
157
800
5
9
1e3
659
1
21
M_K=−23.5
SB_K=17.5

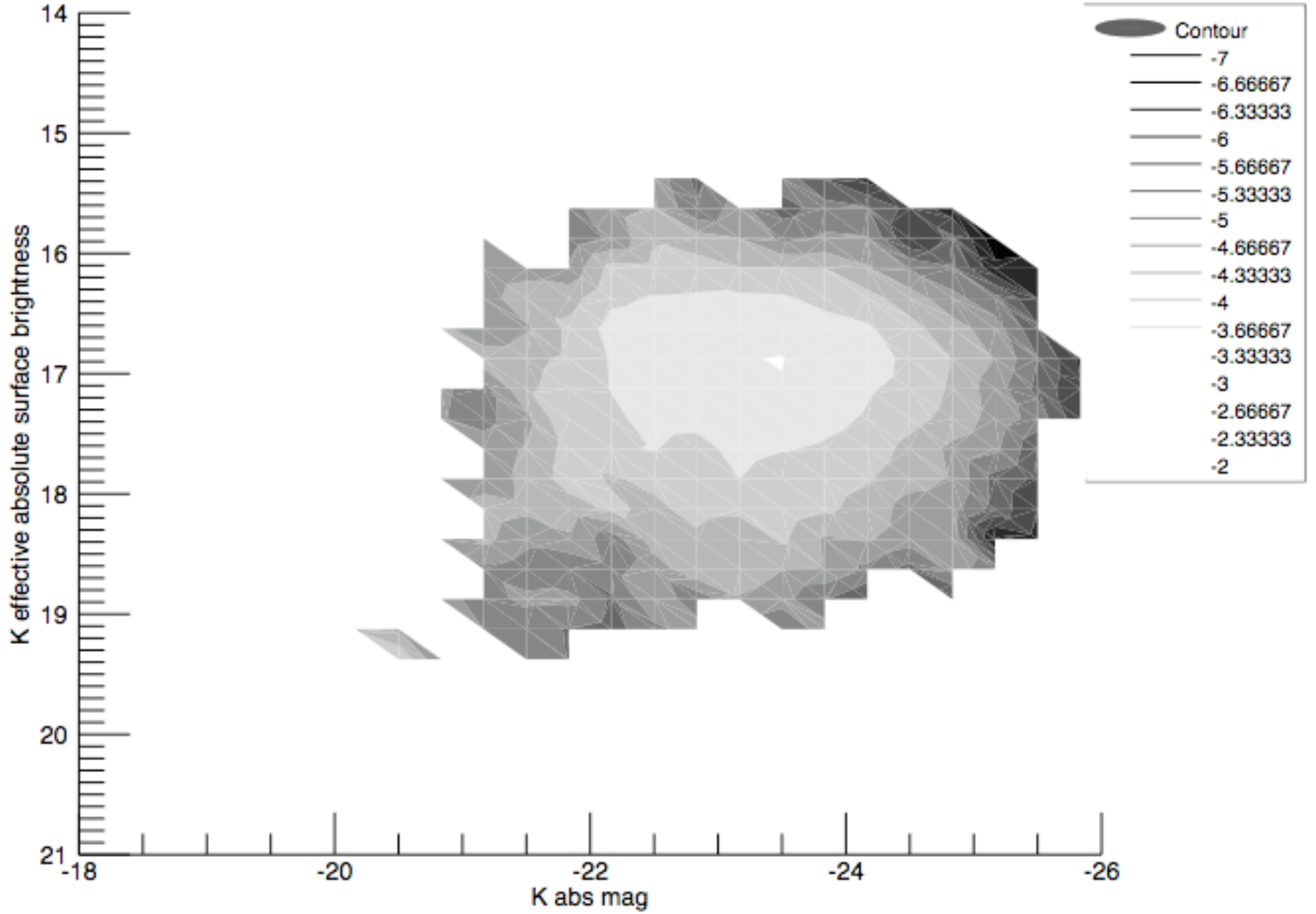
K-band Bivariate Brightness Distribution (1/Vmax)



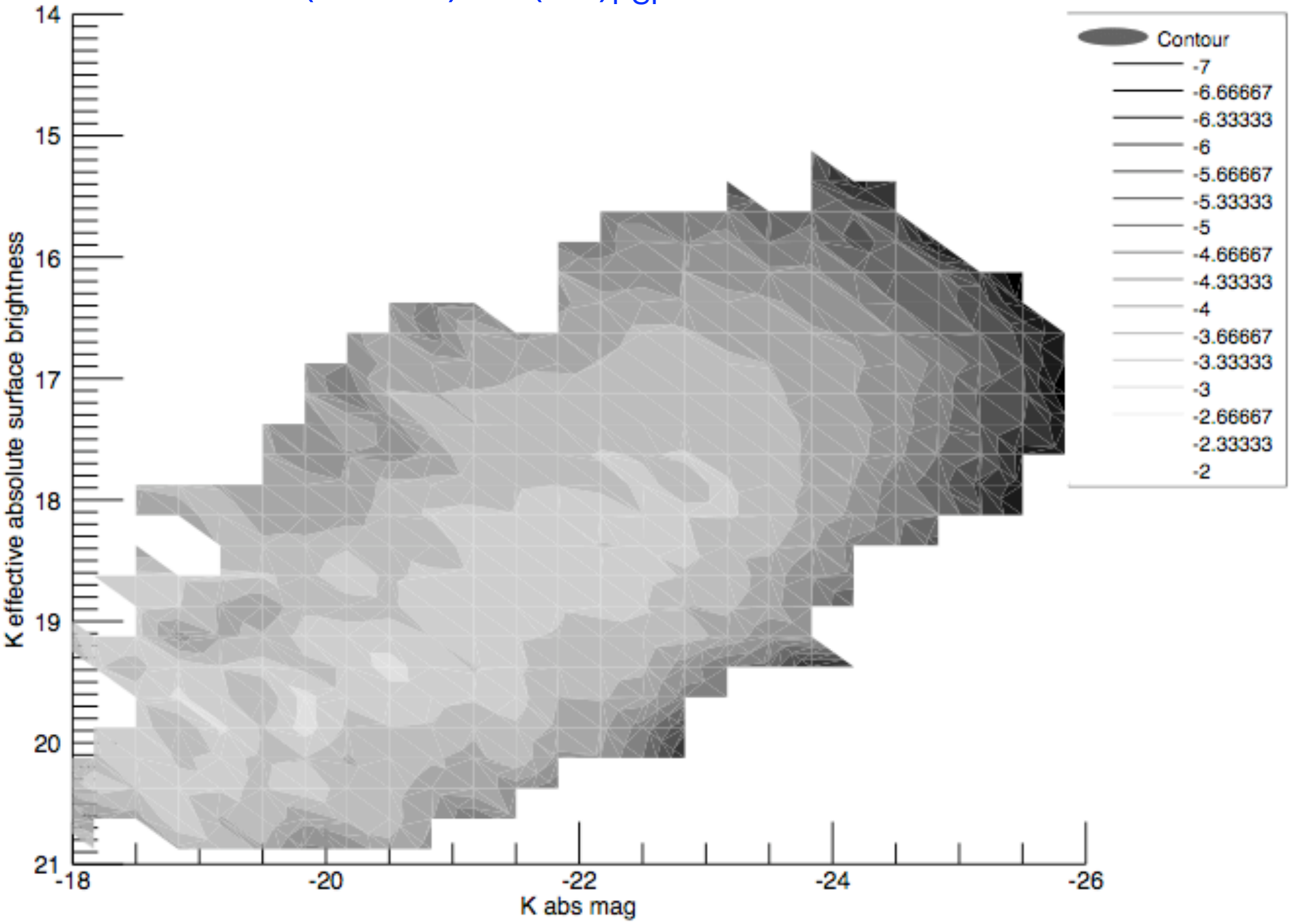
BBD (SWML)


14
15
16
17
18
19
20
21
K effective absolute surface brightness
-18
-20
-22
-24
-26
K abs mag
Contour
-7
-6.66667
-6.33333
-6
-5.66667
-5.33333
-5
-4.66667
-4.33333
-4
-3.66667
-3.33333
-3
-2.66667
-2.33333
-2

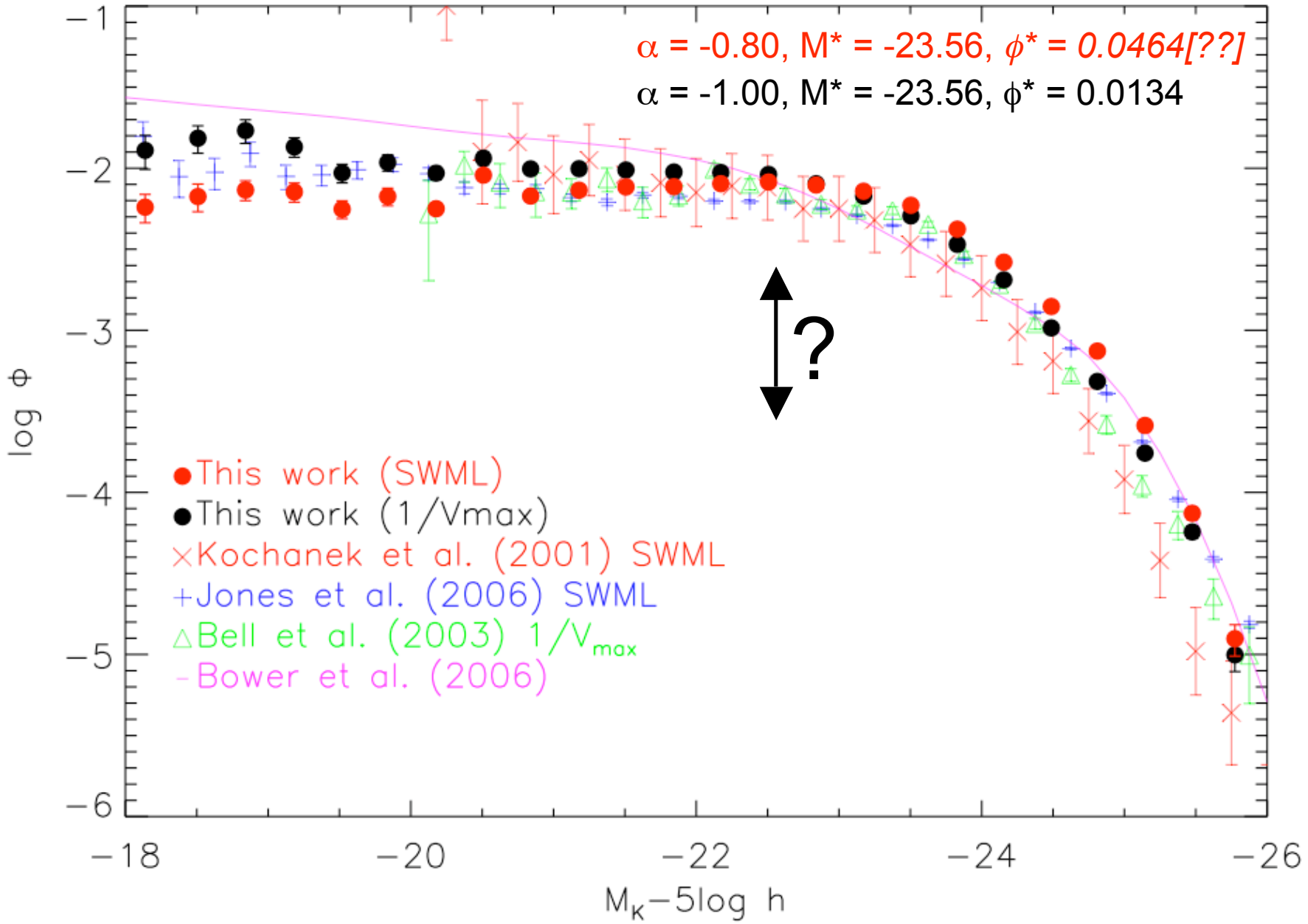
BBD red core (SWML) — $(u-r)_{PSF} > 2.35$



BBD blue core (SWML) — $(u-r)_{PSF} < 2.35$



Luminosity function



Summary

- Seems to be working
- Beware of deblending
- Beware of large galaxies
- Galaxy pipeline not ideal for large galaxies
  - Currently throwing out 20% of sample
- Christmas wish list
  - Elliptical apertures (like 2MASS)
  - Sérsic profiles & other structural measures