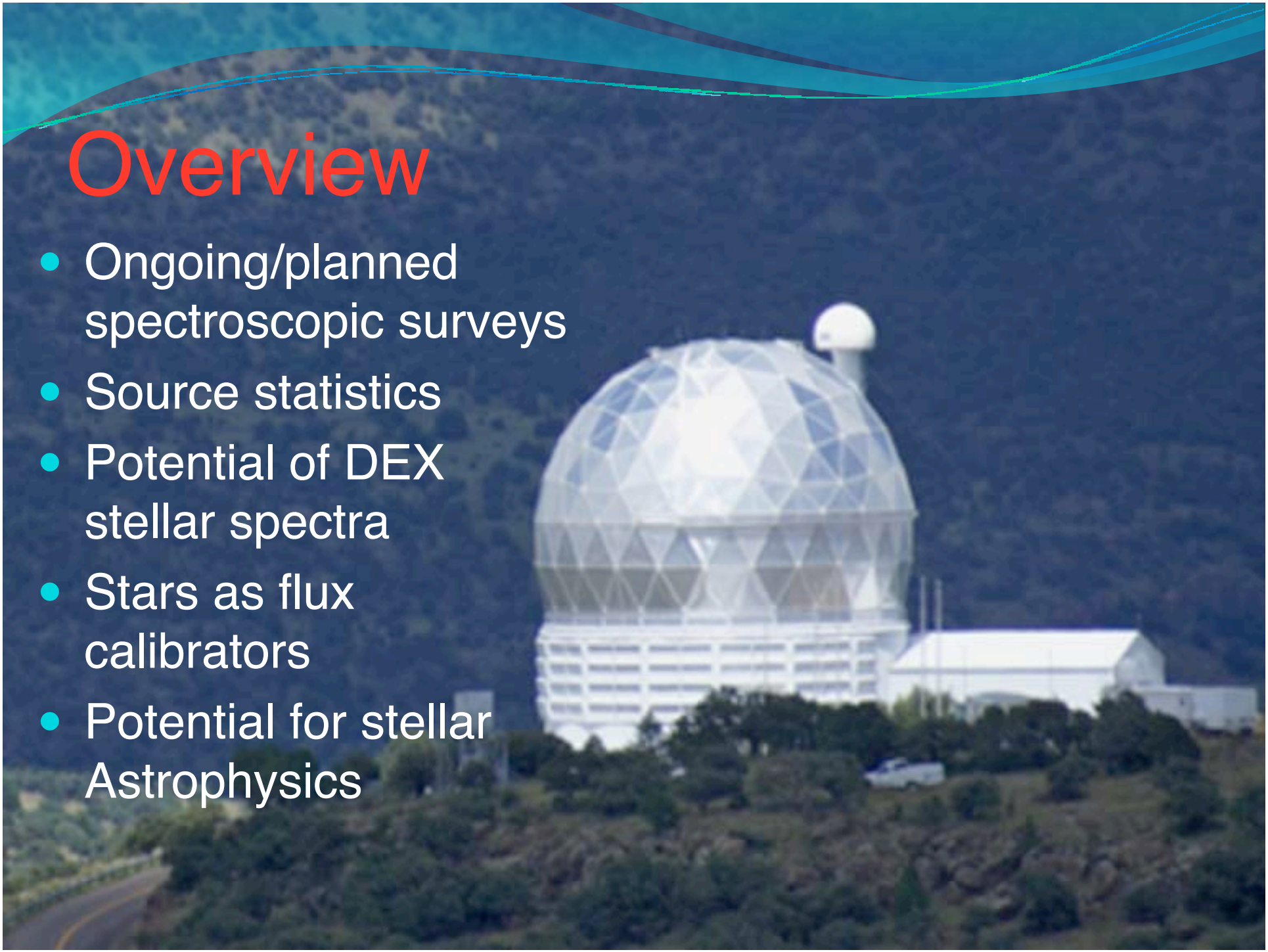
DEX stars

Carlos Allende Prieto

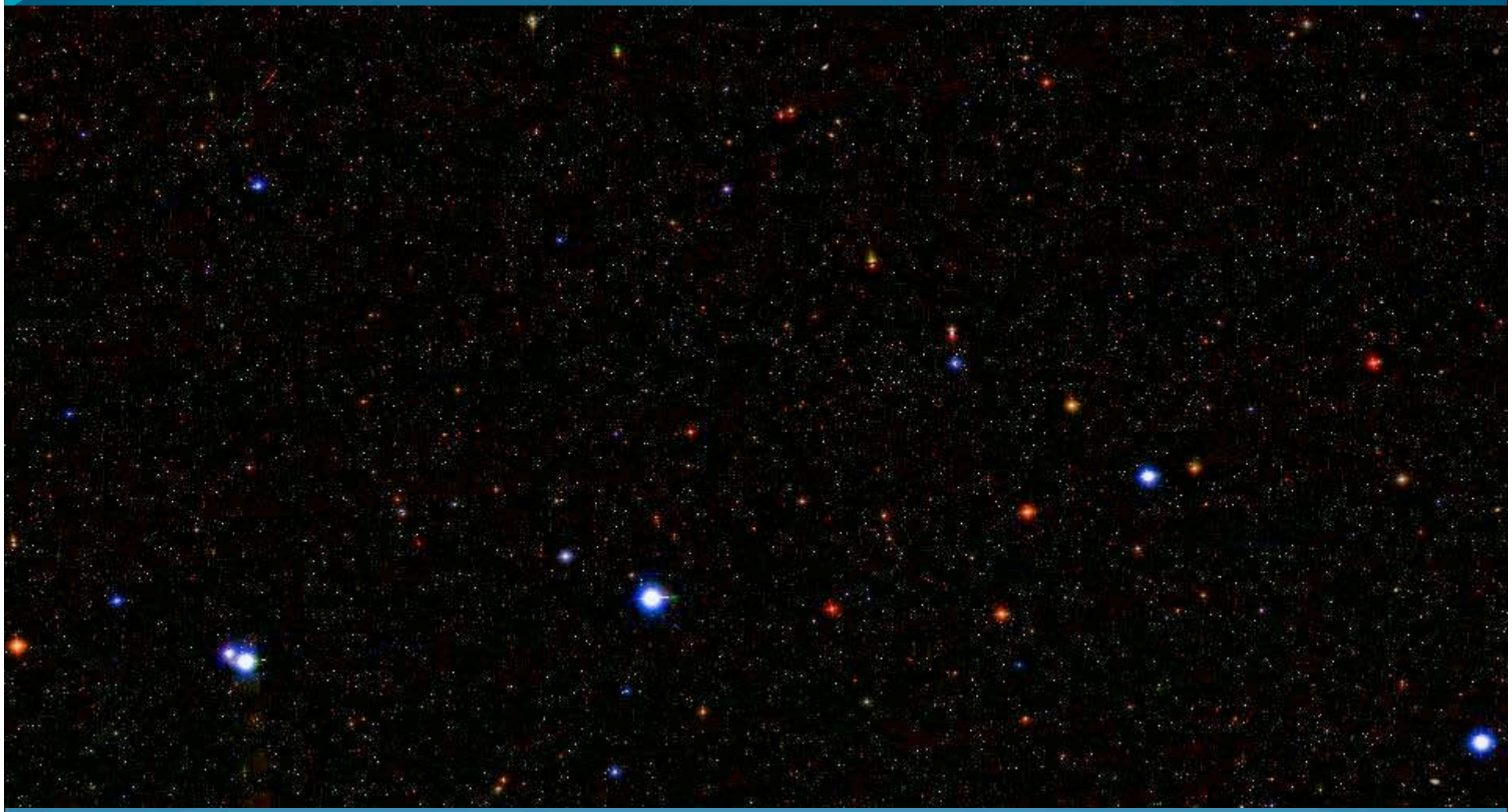
Overview

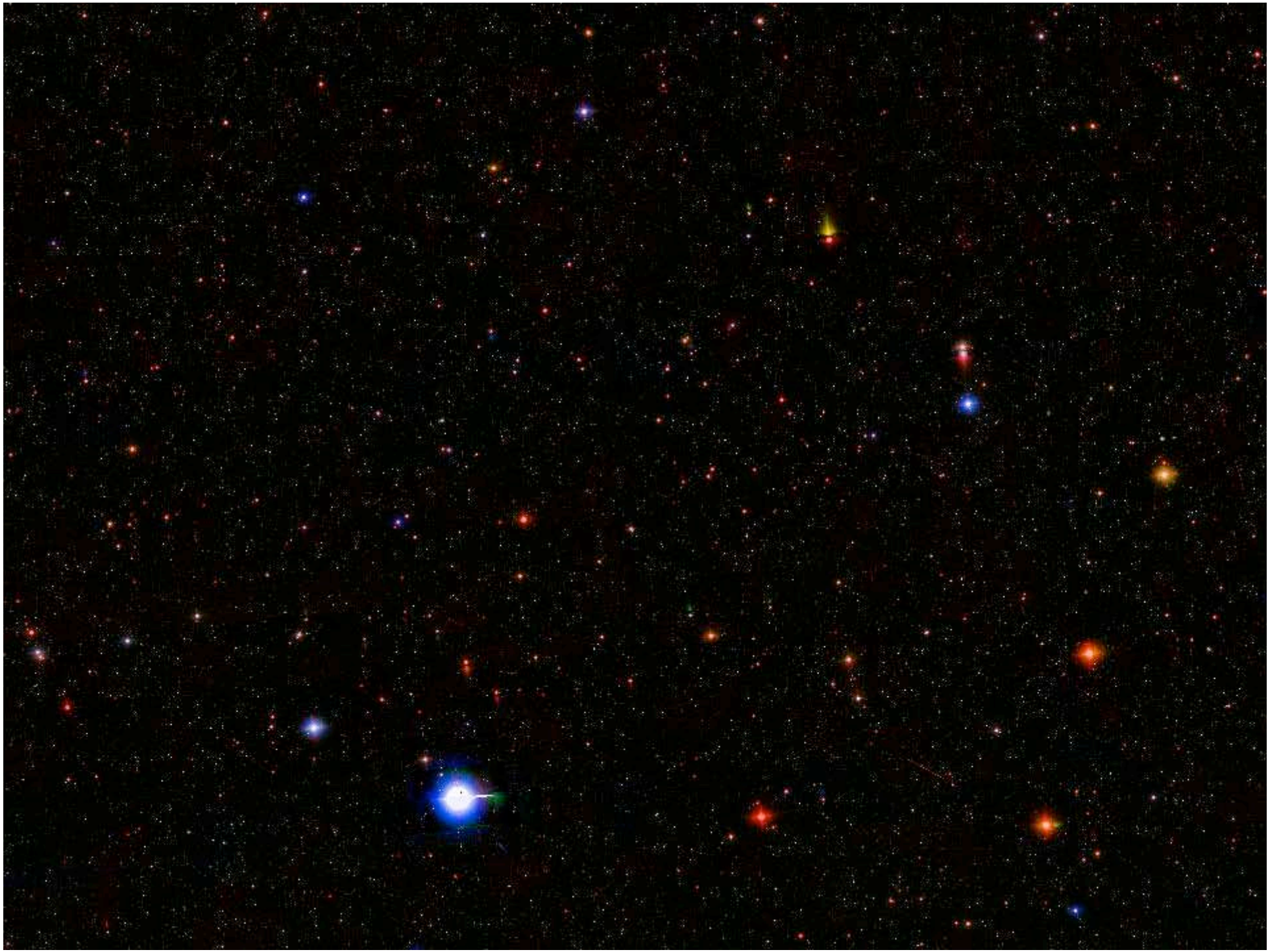
- Ongoing/planned spectroscopic surveys
- Source statistics
- Potential of DEX stellar spectra
- Stars as flux calibrators
- Potential for stellar Astrophysics

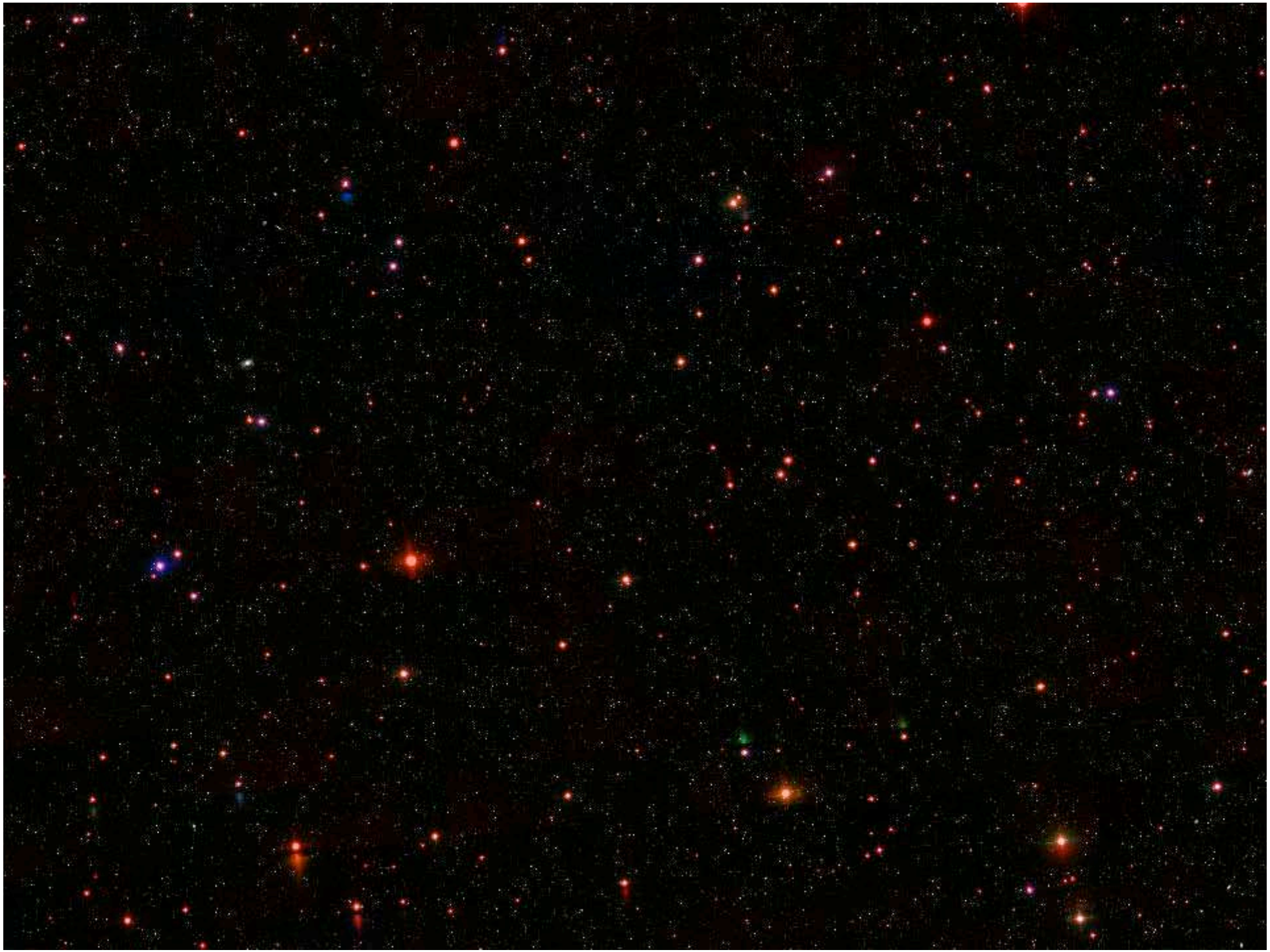


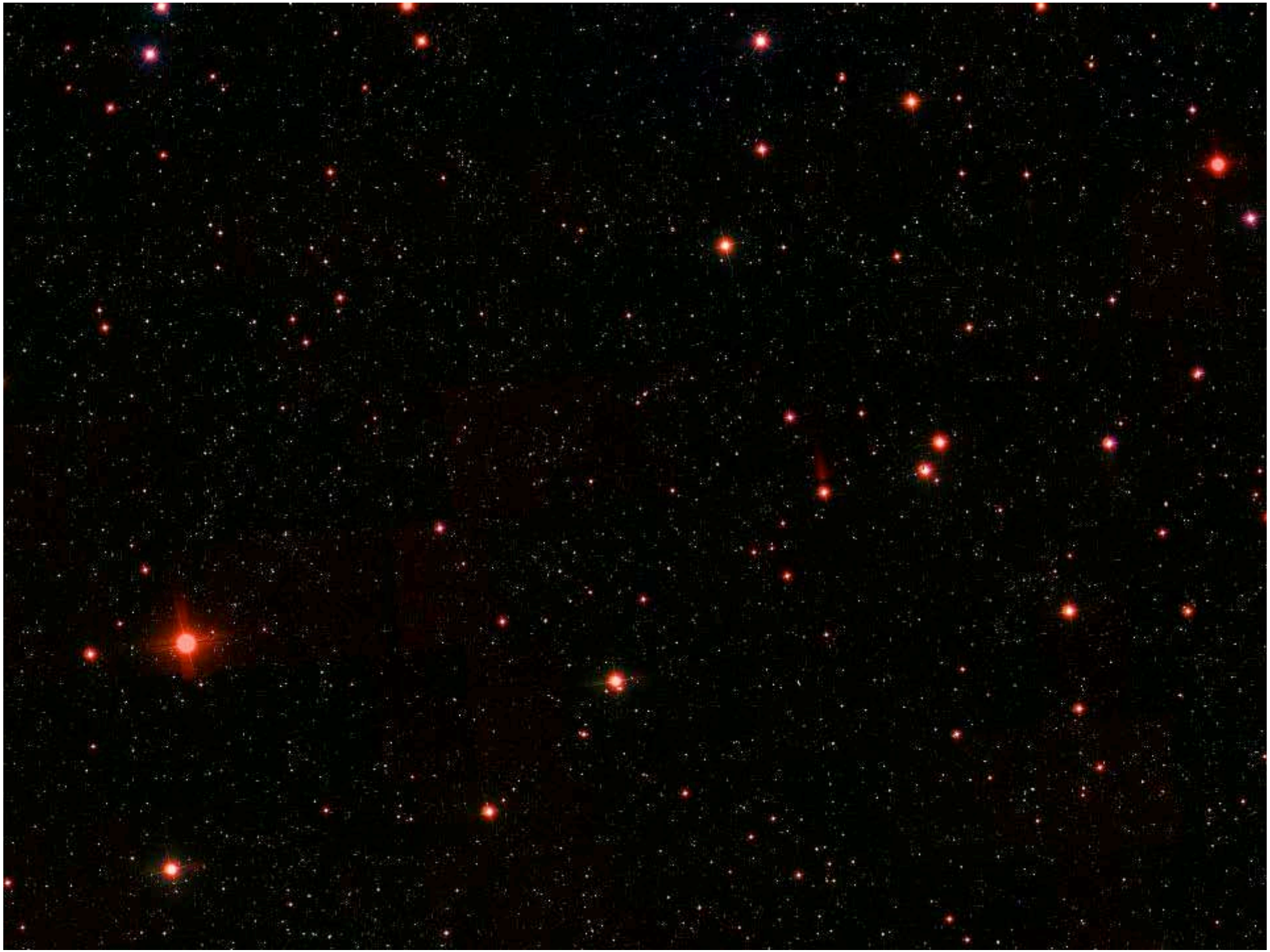
DEX

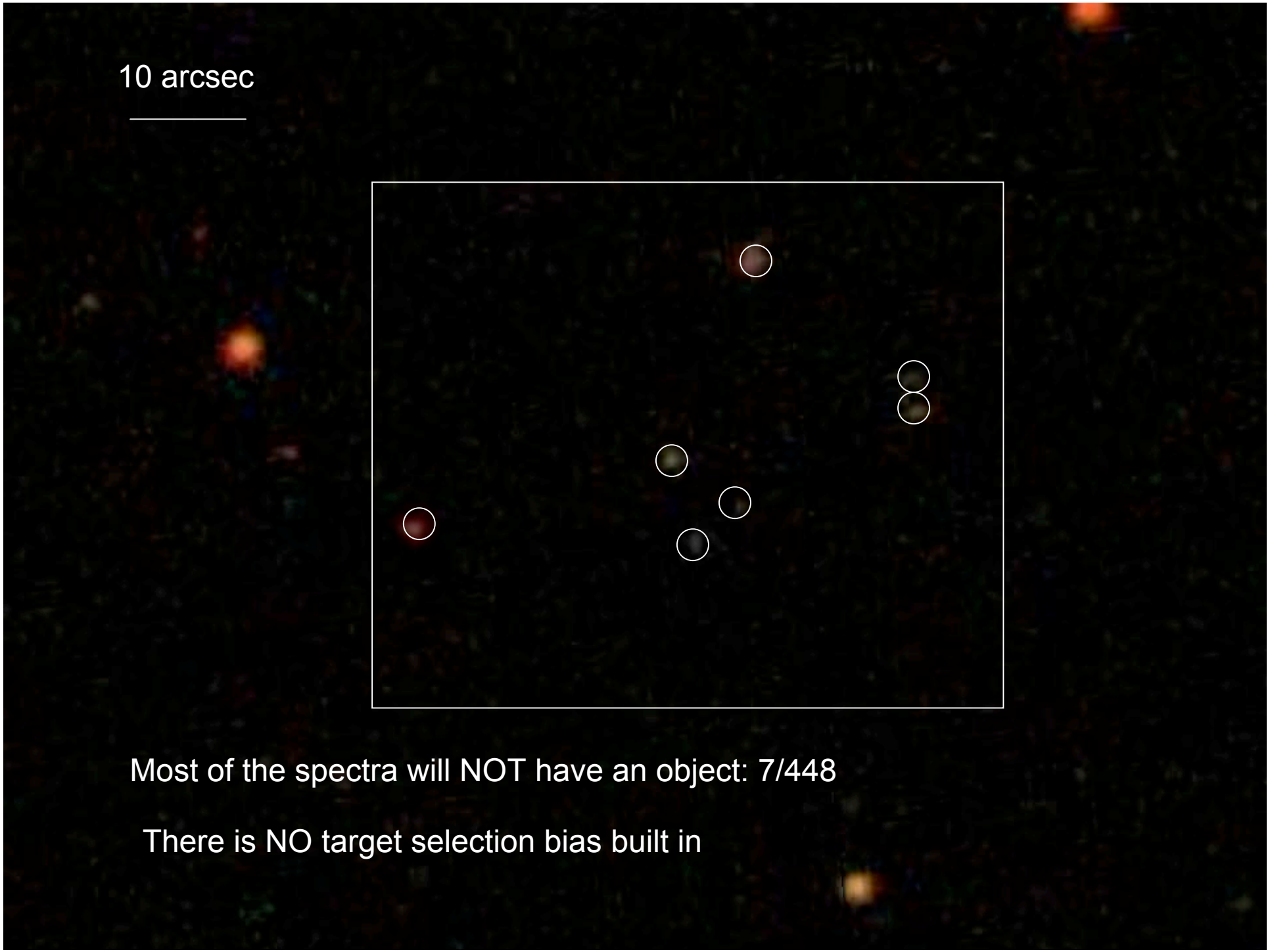
~ 400 deg^2
SDSS color image
centered at (α,δ) ~ (188,58) deg











Most of the spectra will NOT have an object: 7/448

There is NO target selection bias built in

Ongoing and planned spectroscopic surveys of Galactic stars

- SDSS-I, SDSS-II/III SEGUE

  R=2,000 380 < λ < 900 nm 14<V<18 (2.5m 640 fibers)

- APOGEE (SDSS-III)

  R=22,500 1500 < λ < 1700 nm 9<V<15 (7<H<12.5)

  (SDSS 2.5m, 300 fibers)

- RAVE

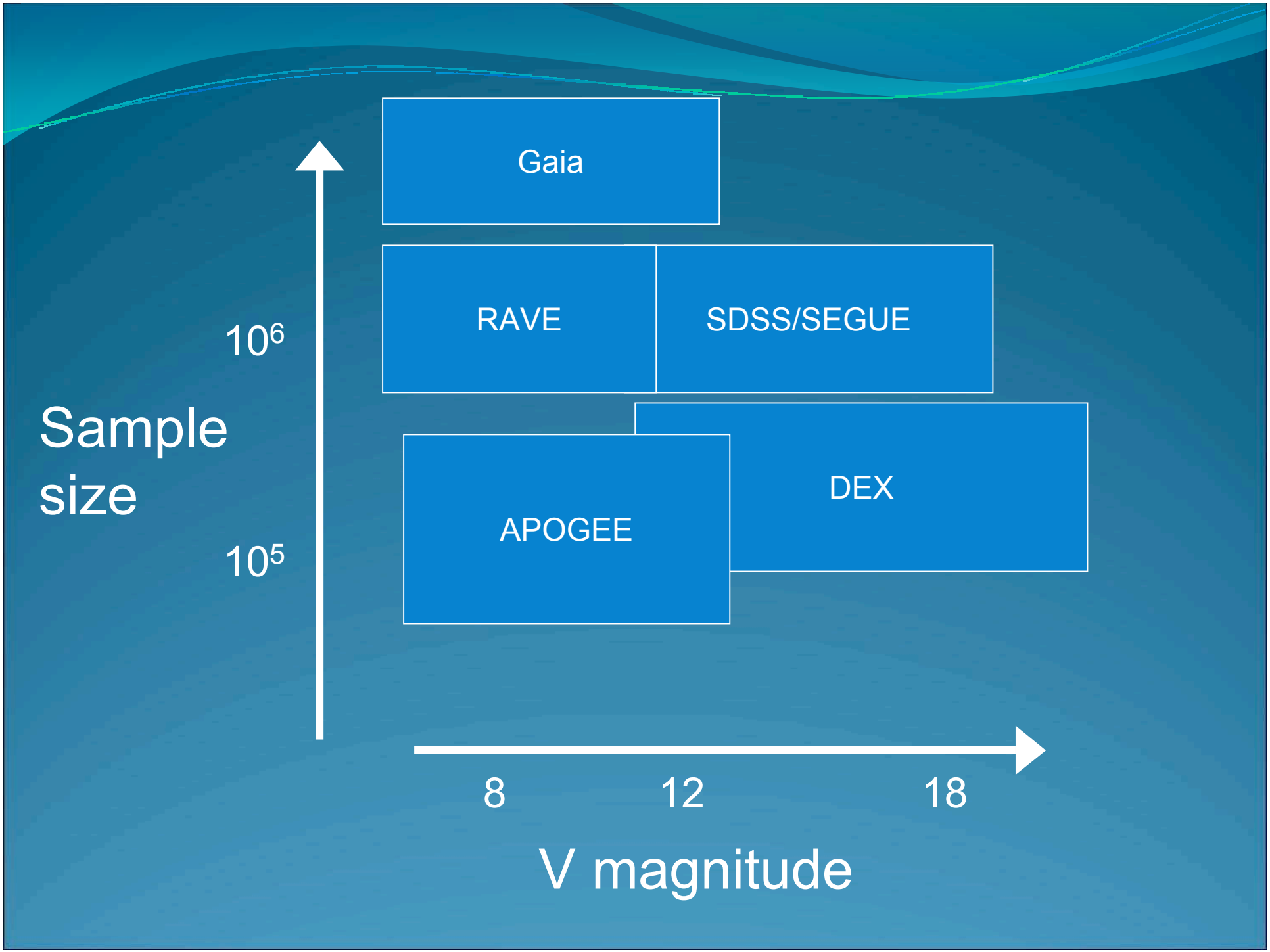
  R=7,500 840 < λ < 870 nm 9<V<13 (1.2m UK Schmidt 6dF 150 fibers)

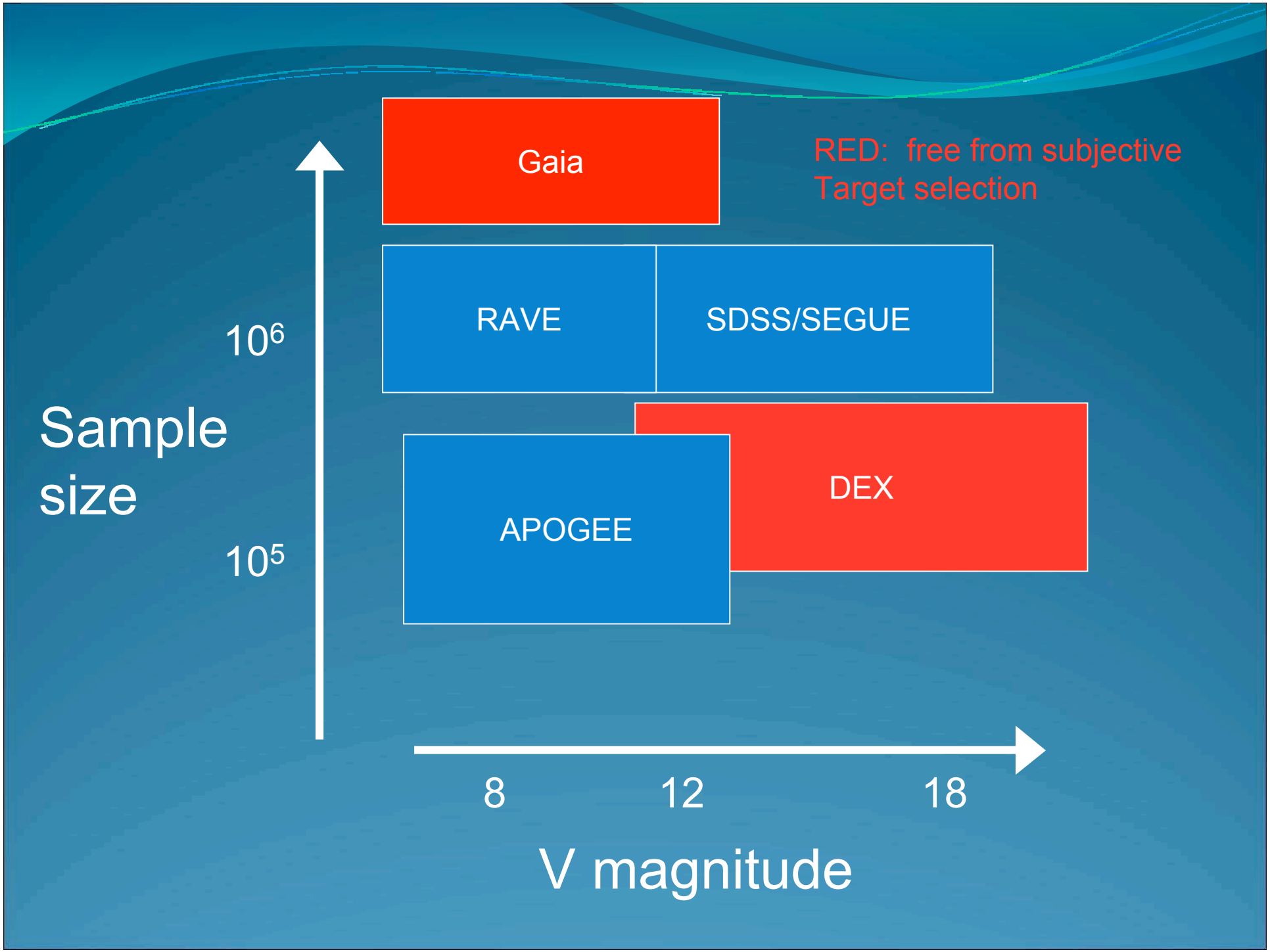
- Gaia

  R=11,500 847 < λ < 874 nm V<15 (space, 2x1.45x0.5 m^2)

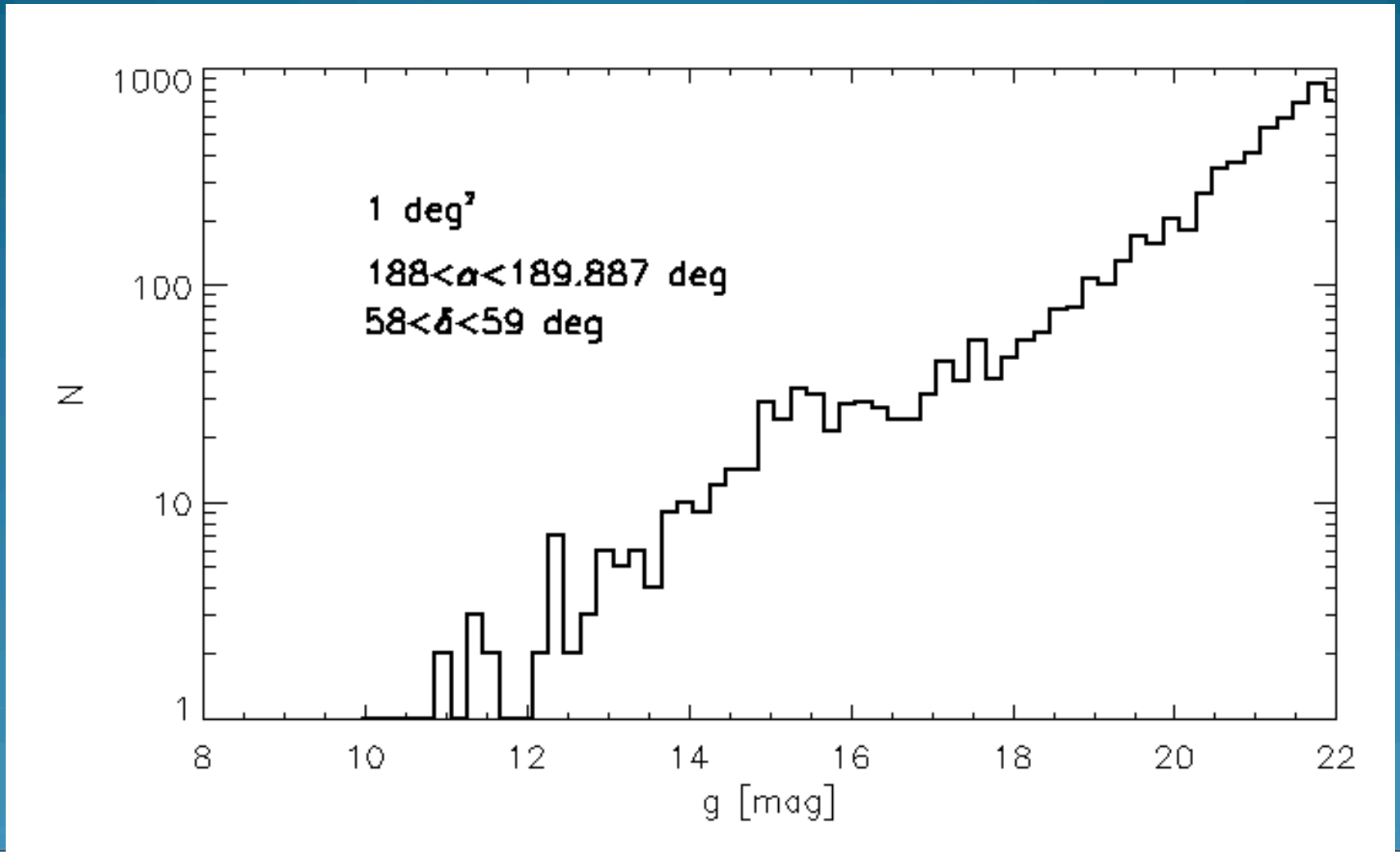
- DEX

  R=700 350 < λ < 550 nm 14<V<21 (10m HET 43,000 fibers)

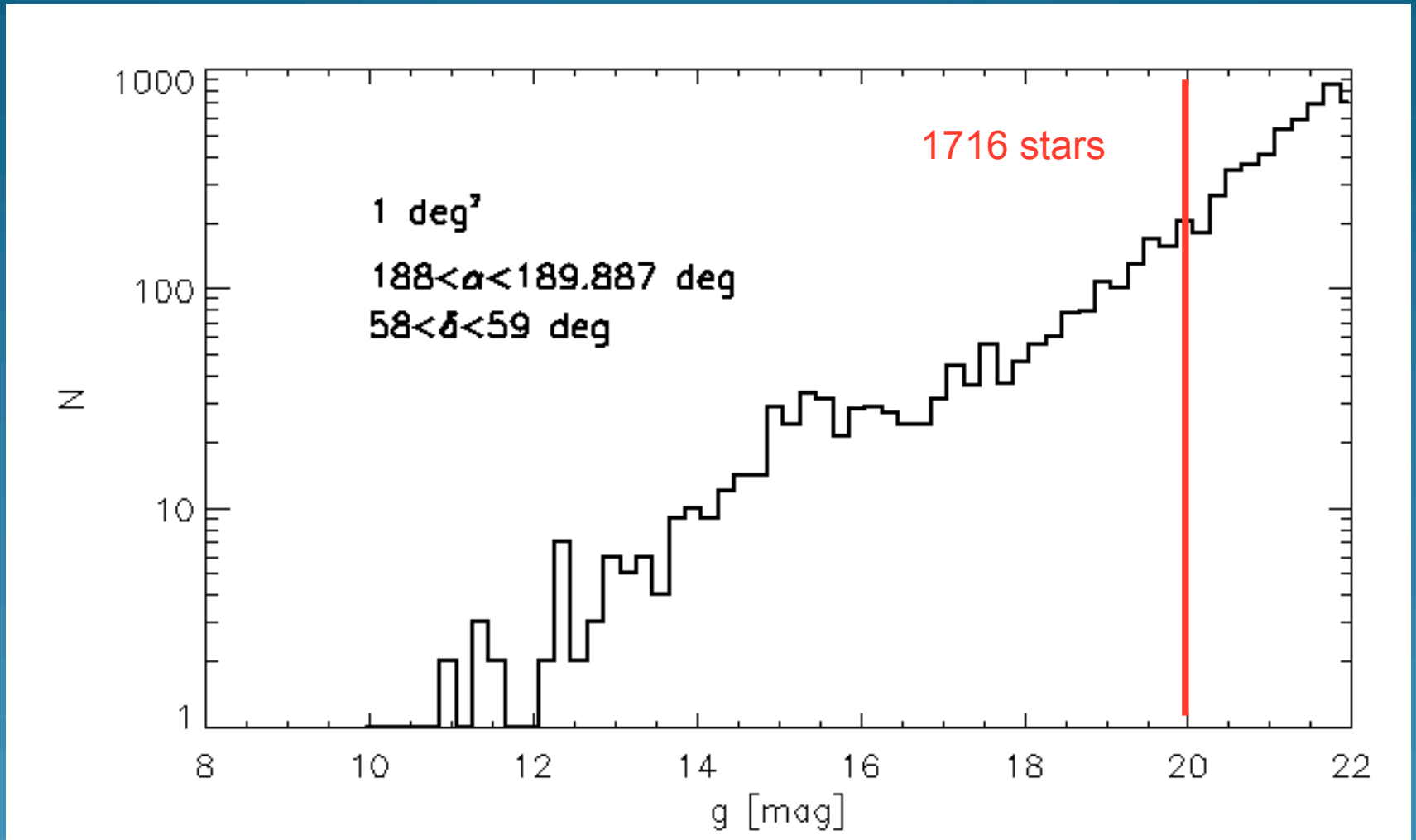

Gaia
RAVE
SDSS/SEGUE
DEX
APOGEE
Sample size
10^6
10^5
8
12
18
V magnitude


Gaia
RED: free from subjective
Target selection
RAVE
SDSS/SEGUE
DEX
APOGEE
10^6
10^5
Sample
size
8
12
18
V magnitude

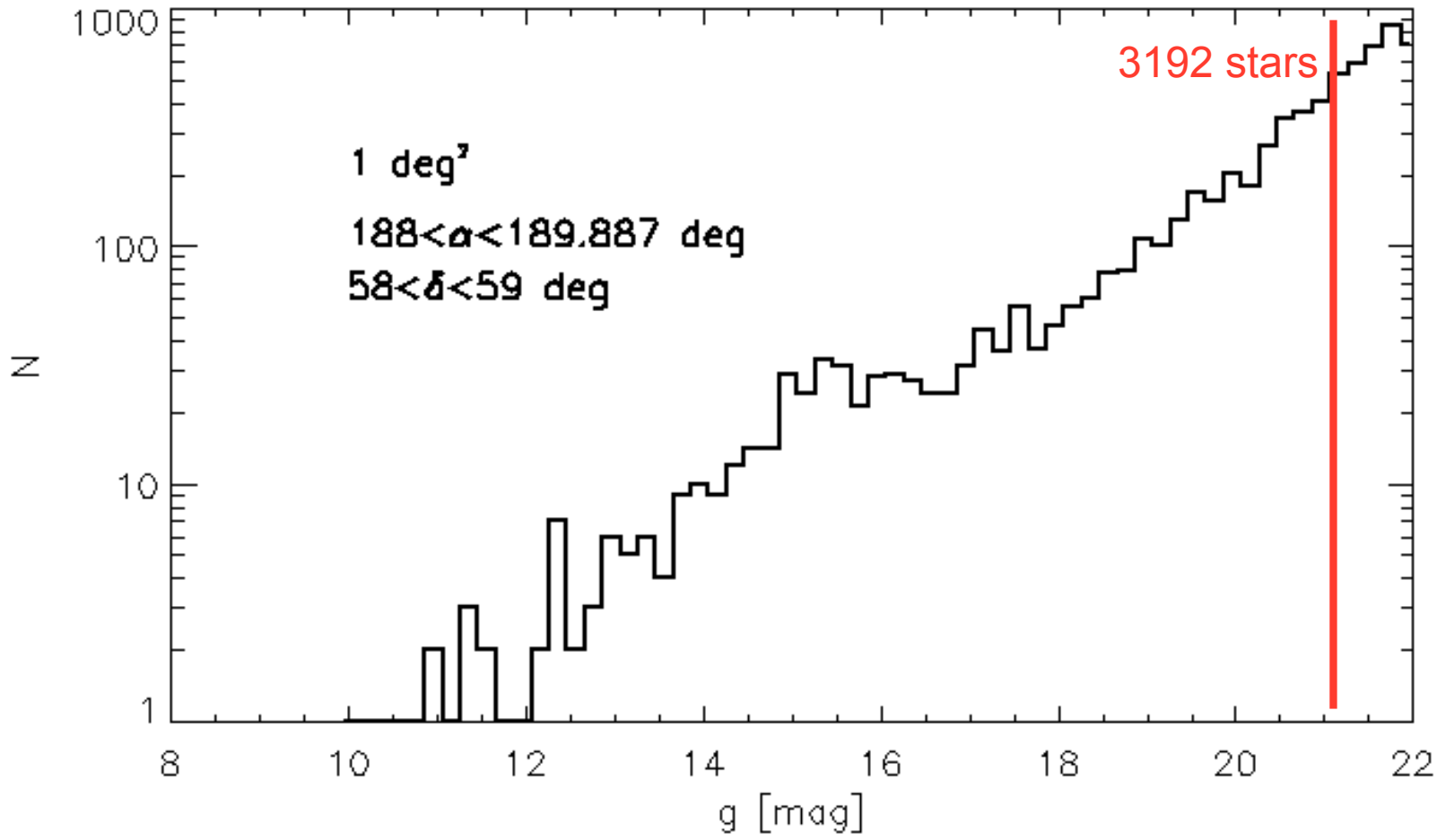
Around the center of the HETDEX field



Around the center of the HETDEX field



Around the center of the HETDEX field



4067 stars to i<20
6871 stars to I<21

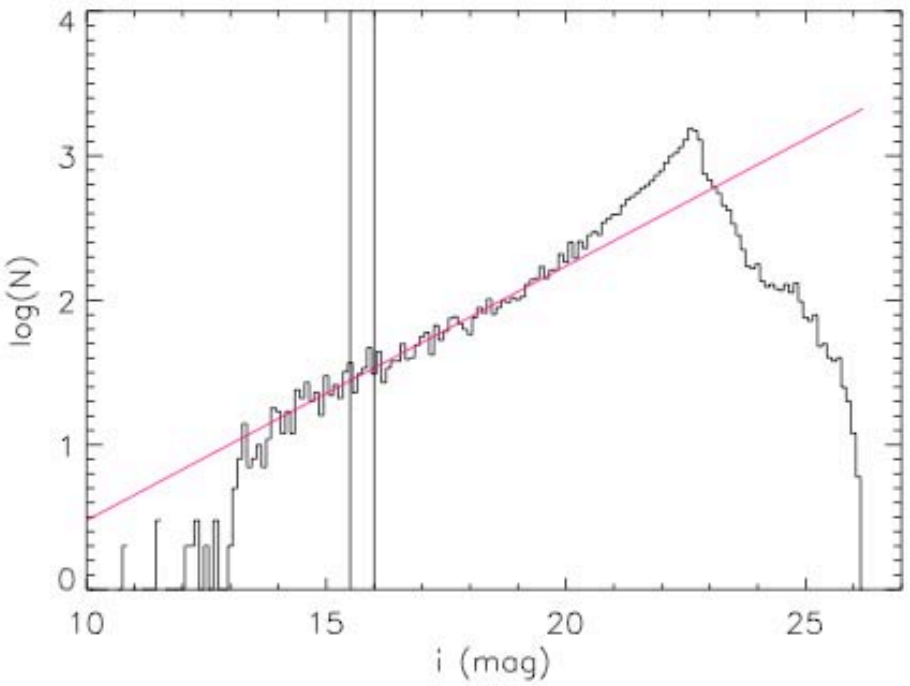


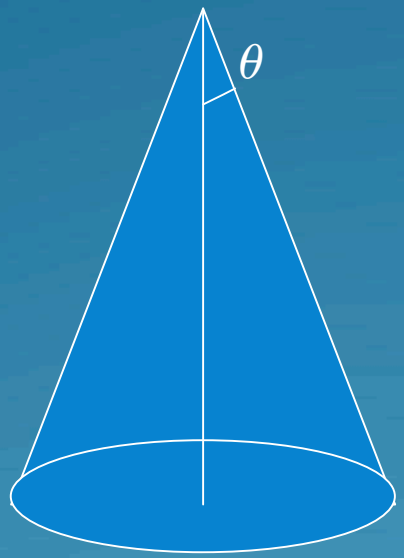
Figure 1: Stellar density as a function of SDSS i magnitude for a 1 deg^2 field near $(\alpha, \delta) = (258.4, 60.0)$. The red line is a linear least-squares fitting to the data in the range $14 < i < 20$ mag: $\log_{10} N = -1.28 + 0.18i$. The black vertical lines mark the position of $i = 15.5$ and $i = 16.0$ mag.

Source statistics

- Expect ~ 3000 -5000 stars/deg^2
- 420 deg^2 with 1/7 filling factor $\Rightarrow$ ~ 200,000 stars

- But what are they …?

θ= 4.37 deg for DEX (60 deg^2)



$$N = \int \rho \, dV = \pi/4 \, \theta^2 \int \rho \, r^2 \, dr$$

$$M - m = 5 - 5\log_{10} d$$

The Axisymmetric Galaxy

- Thin disk

$$N \exp(-|z|/Z_h) + (-(R-R_\odot)/R_H))$$

N=1, Zh=325 pc, Rh=3500. pc

- Thick disk

$$N \exp(-|z|/Z_h) + (-(R-R_\odot)/R_H))$$

N=0.05, Zh=1200. pc, Rh=2500. pc

- Stellar halo

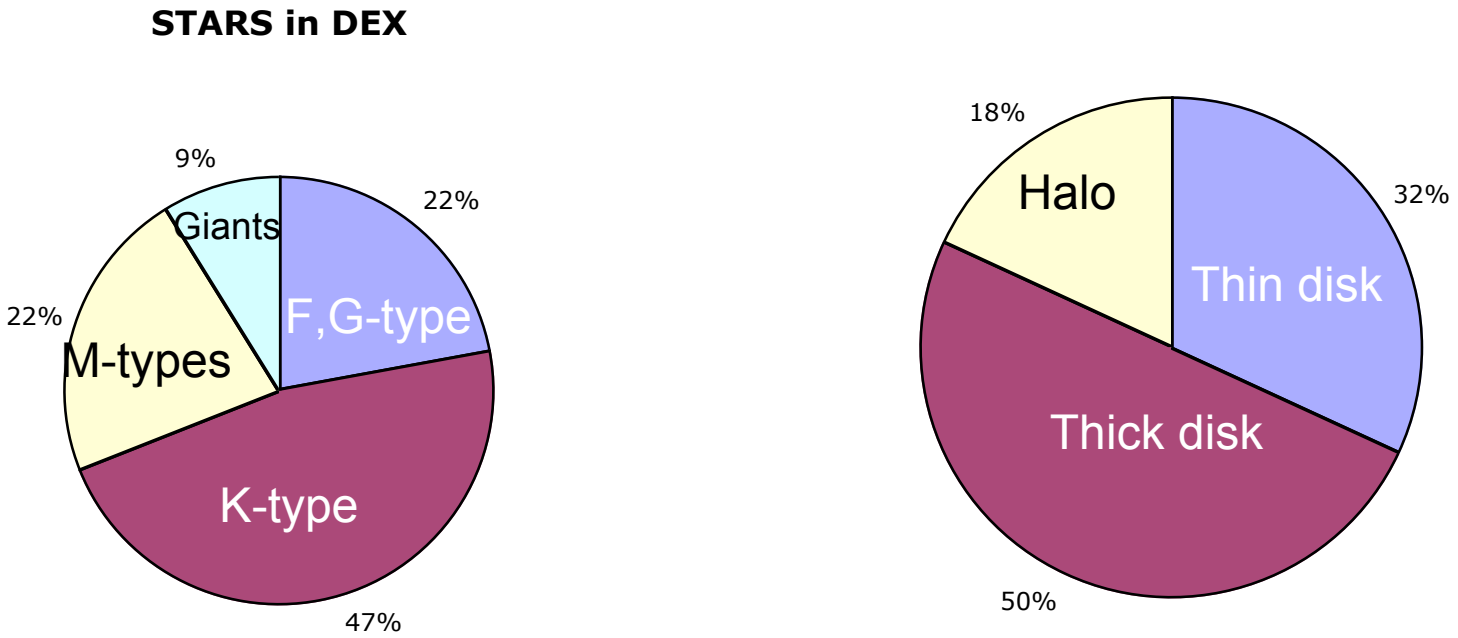
$$N \times r^{-0.875} \times \exp[-7.669 (r^{0.25} - r_s^{0.25})]$$

N=0.005, c/a=0.9, r_e=2500. pc

($R' = \sqrt{(R^2 + ((c/a)\, Z)^2)}$; $r = R'/r_e$; $r_s = R_\odot/r_e$)

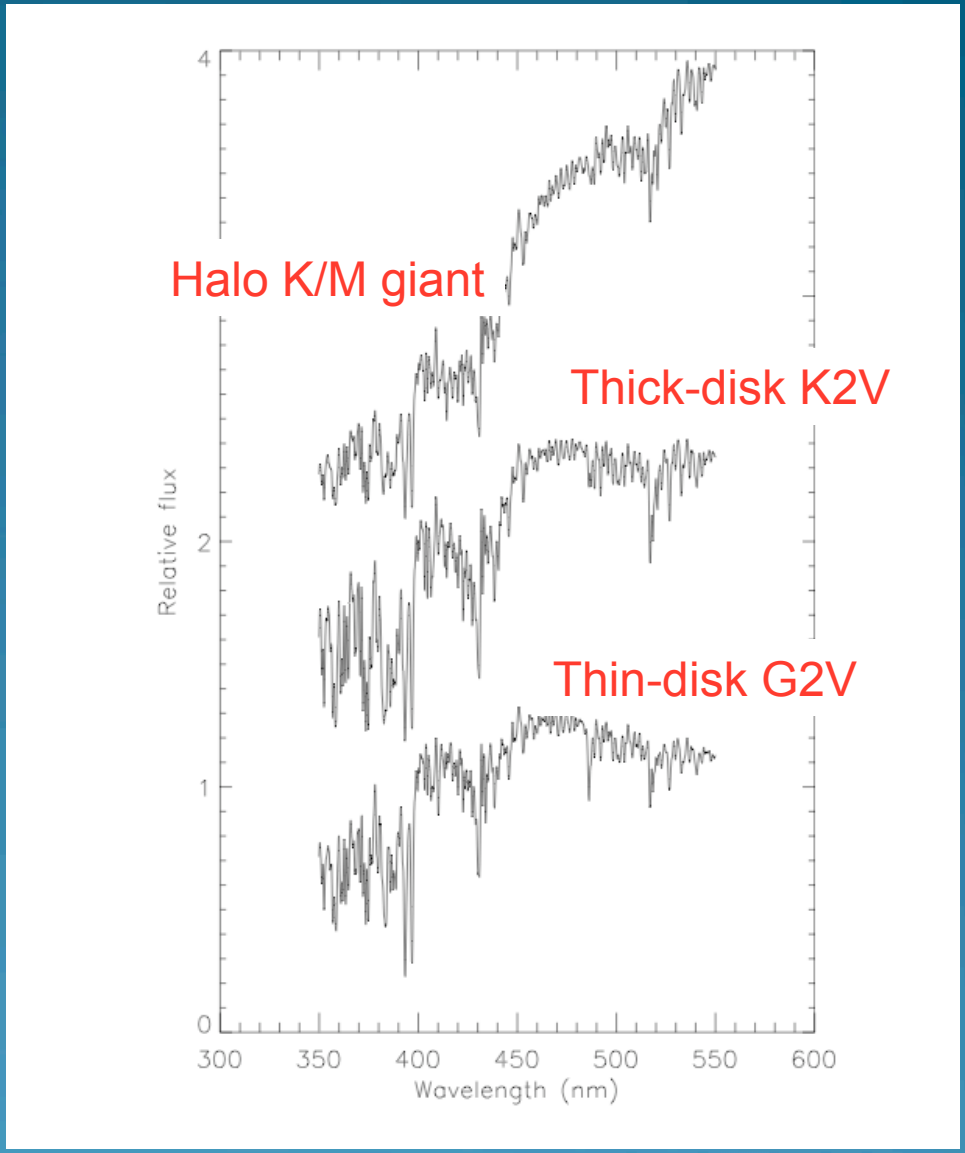
Larsen & Humphreys (2003)

Census

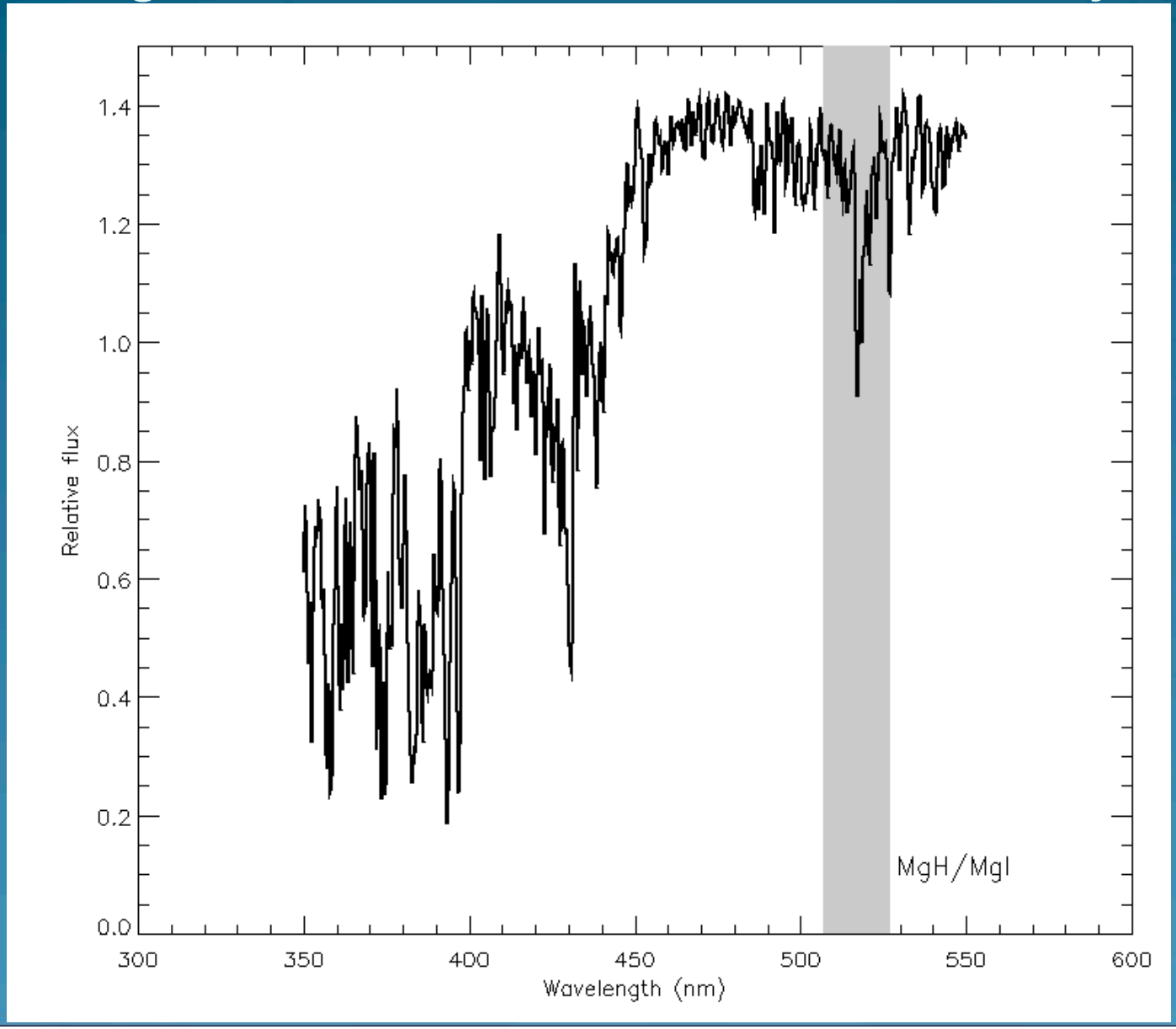

STARS in DEX
9%
22%
Giants
F,G-type
22%
M-types
K-type
47%
18%
Halo
32%
Thin disk
Thick disk
50%

Potential of DEX stellar spectra

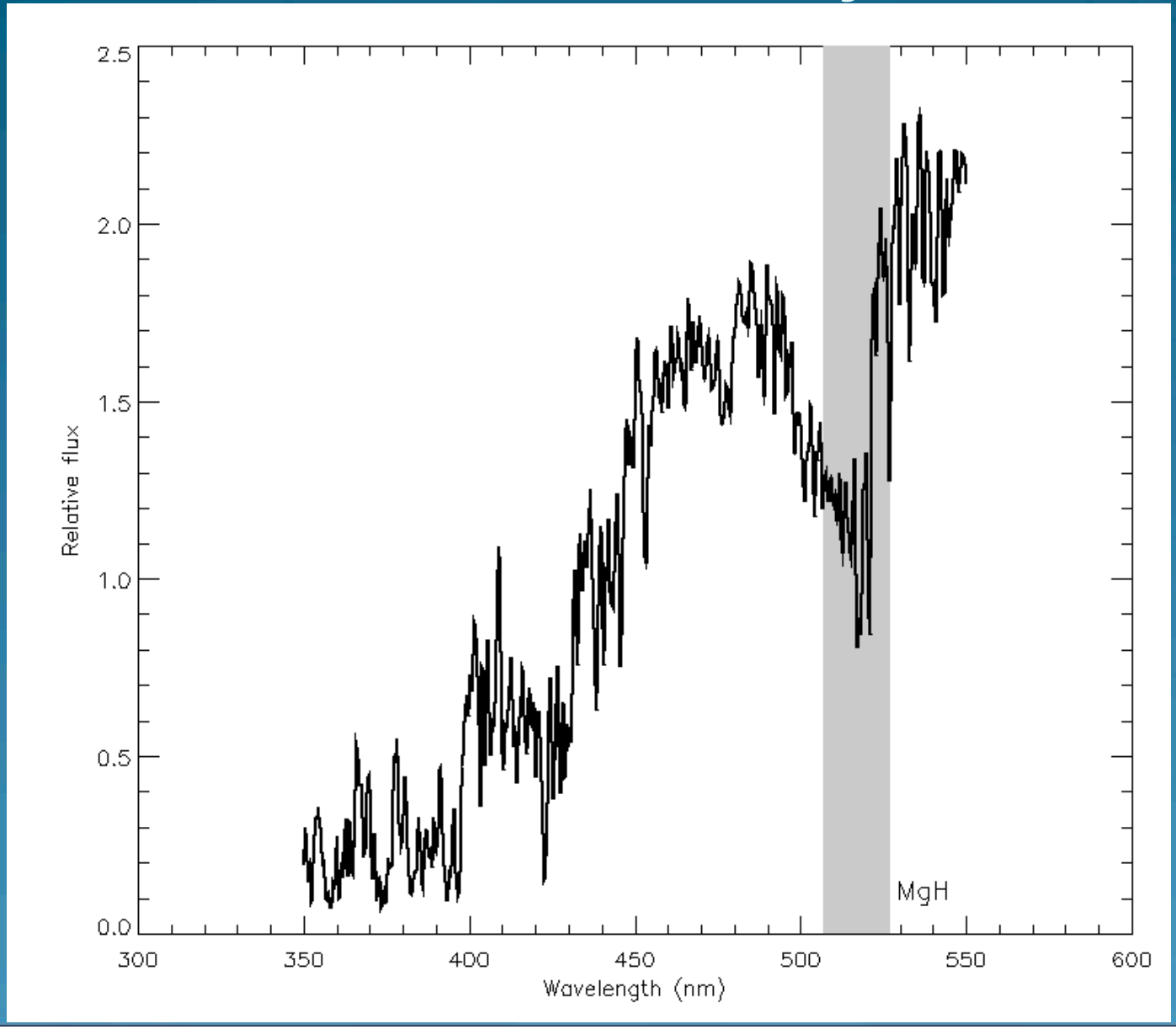
- Resolving power lower than *usual*
- *Bluer* Wavelengths



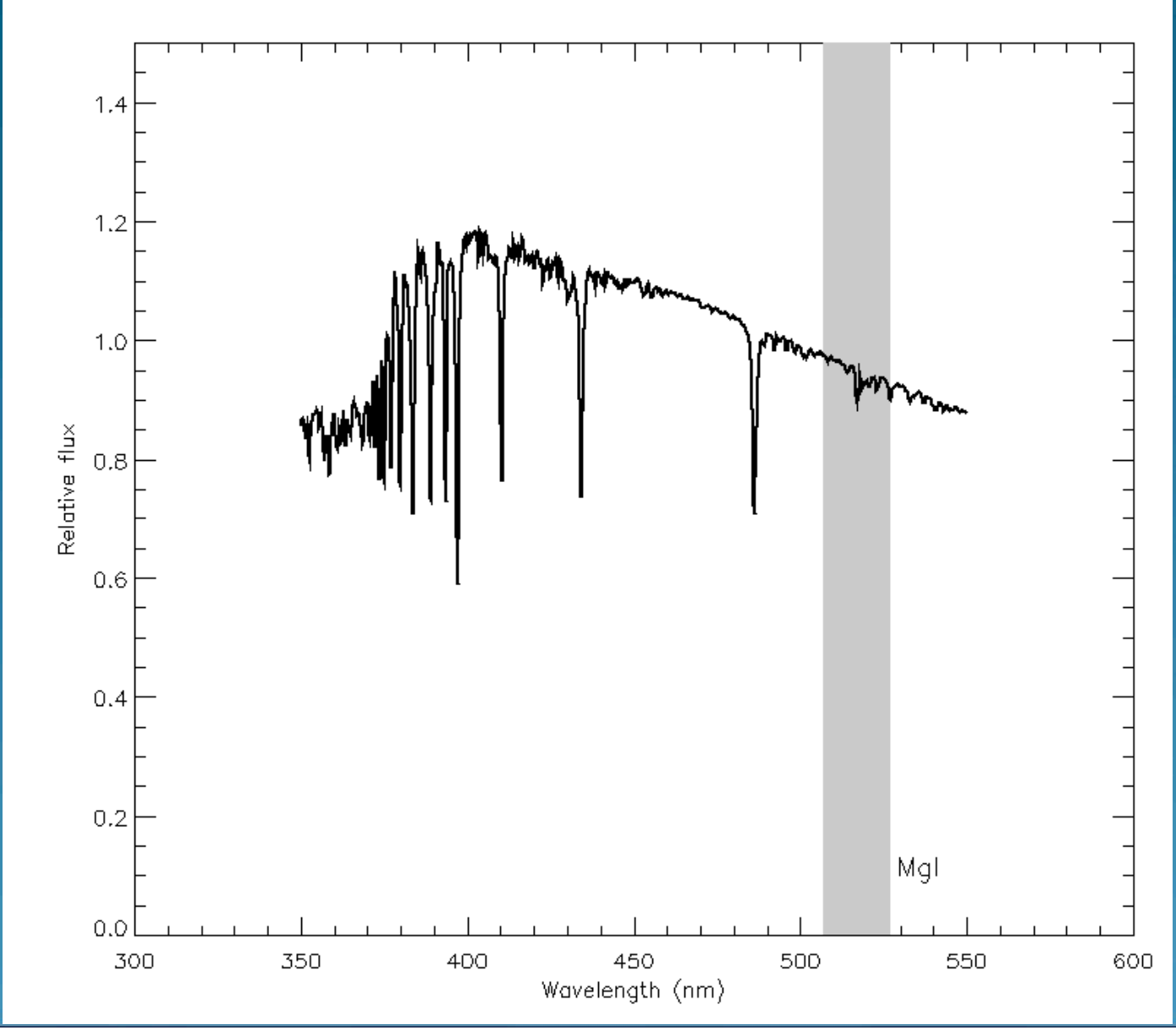
Taking a closer look …Thick-disk Early K-type



Thin disk Late-K/Early-M



Halo F-type (turnoff)

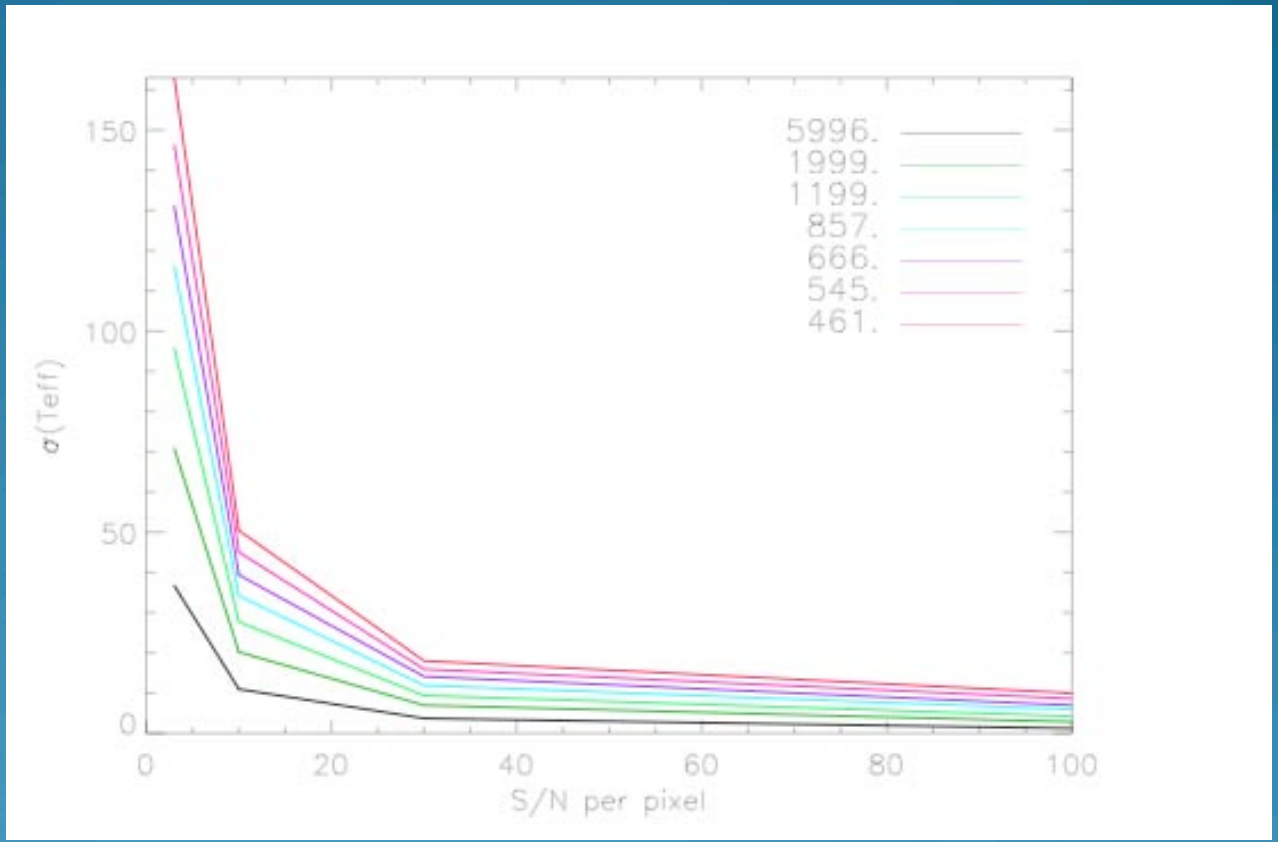


Theoretical limits

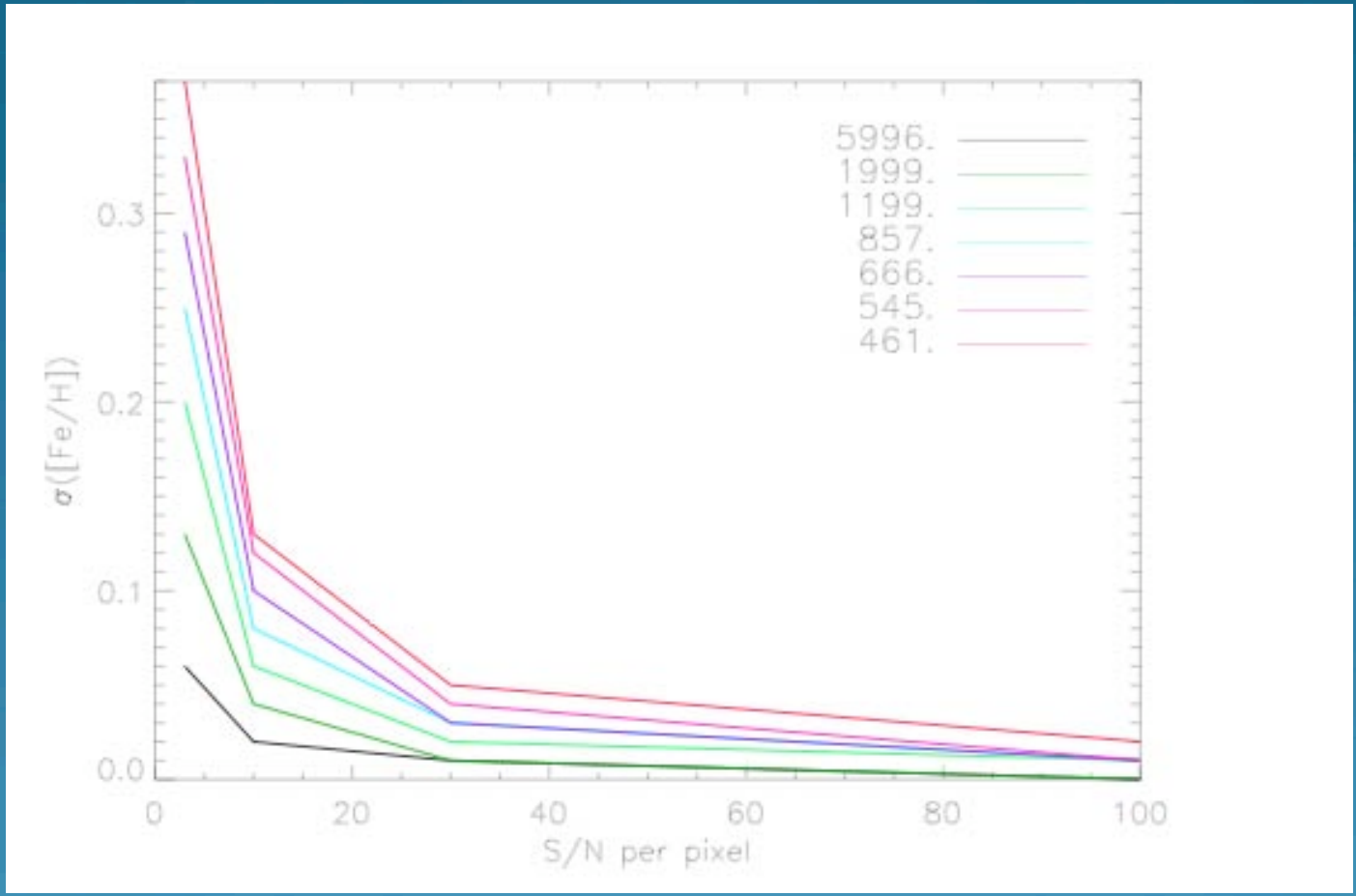
Monte Carlo simulations

Gaussian noise

3 pixels/res element

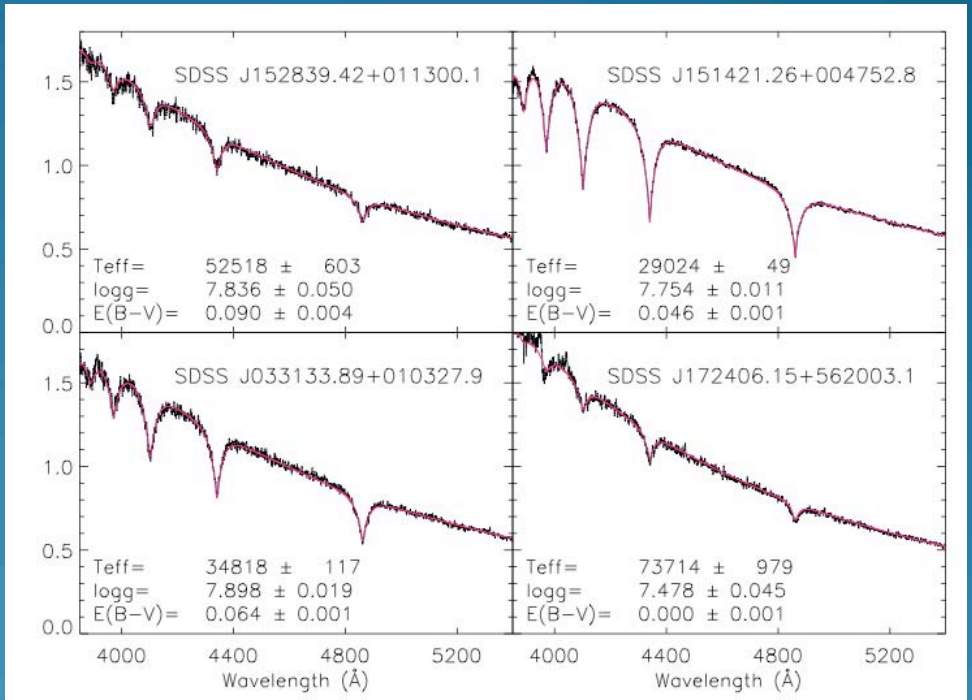


Not much of a loss at S/N > 30 …



Flux calibration

- Absolute fluxes tied to SDSS colors object by object
- Internal calibration may not suffice to get the right spectral shape
- Hot DA white dwarfs will be (naturally) observed, facilitating an HST-like flux calibration
- With a coverage of ~ 60 arcmin per pointing, there may not always be one DA available
- An intermediate step may be required: F-type subdwarfs (as in SDSS)



Allende Prieto, Hubeny, Smith 2009

Summary

- DEX has a niche as a spectroscopic survey of the Galaxy
- It will deliver *lower* spectral resolution, but not a major drawback if the S/N is high enough (> 30 per pixel)
- **Bluer** wavelengths
- A deeper magnitude limit
- And it is more efficient: 10000s vs 100s

- Most importantly, it is **unbiased**

Being unbiased DEX will be able to

1. Constrain tightly (and directly) the main Galactic populations: the thin disk, thick disk, and stellar halo
2. Provide a data pool to search for structure over a wide range of distances
3. Derive a fairly accurate census of the Milky Way: *rare* stars only present in a fraction of 0.01% will have 20 examples in the DEX database (note the SDSS *spectra of everything*)