

Selection bias note

Simulation setup

Pixel scale: 0.187 arcsec (CFHTLenS)

PSF: Moffat, FWHM=0.7 arcsec, the typical value in CFHTLenS

Galaxy: disc-dominated & bulge-dominated (9:1), random walk

Radius:

$$\log_e(r_d) = -1.145 - 0.269(i_{814} - 23), \quad P(r) \propto r \exp[-(r/a)^\alpha], \quad a = r_d/0.833, \alpha = 4/3$$

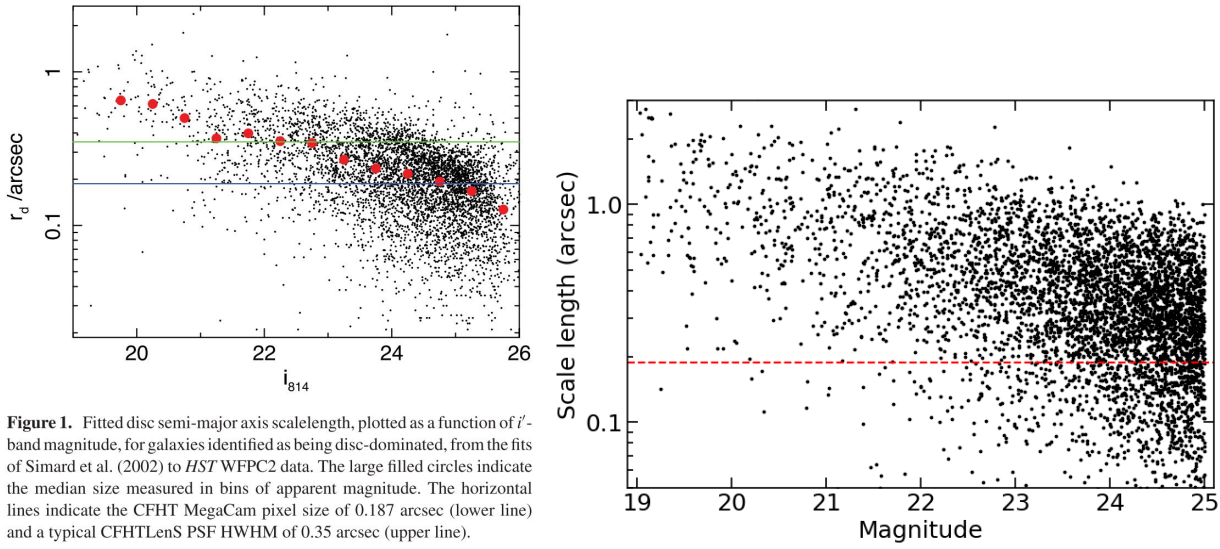


Figure 1. Fitted disc semi-major axis scalelength, plotted as a function of i' -band magnitude, for galaxies identified as being disc-dominated, from the fits of Simard et al. (2002) to *HST* WFPC2 data. The large filled circles indicate the median size measured in bins of apparent magnitude. The horizontal lines indicate the CFHT MegaCam pixel size of 0.187 arcsec (lower line) and a typical CFHTLenS PSF FWHM of 0.35 arcsec (upper line).

PDF of ellipticity

a. disc:

$$P(e) = Ae[1 - \exp(-\frac{e - e_{max}}{a})]/[(1 + e)(e^2 + e_0^2)^{1/2}], \quad e_{max} = 0.804, e_0 = 0.0256, a = 0.2539$$

b. bulge:

$$P(e) \propto e \exp[-be - ce^2], \quad b = 2.368, c = 6.691$$

Bulge-to-total ratio:

$$f(ratio) = \exp[-\frac{ratio^2}{2\sigma^2}], \quad \sigma = 0.1$$

Random walk:

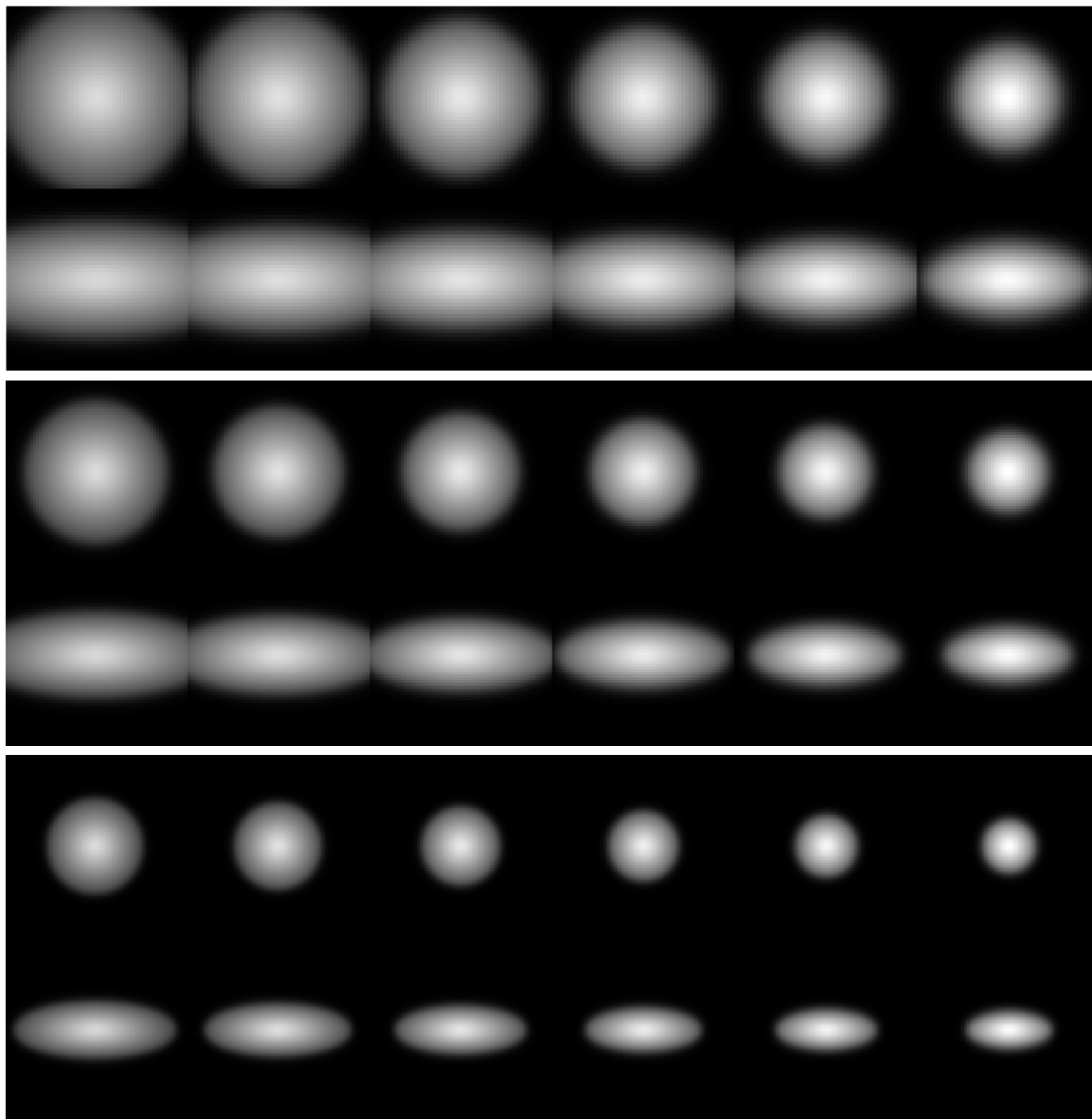
a. CPP: 45 points, max radius = 8

b. galsim: 200 points, half_light_radius and flux are the same as galsim galaxy sample

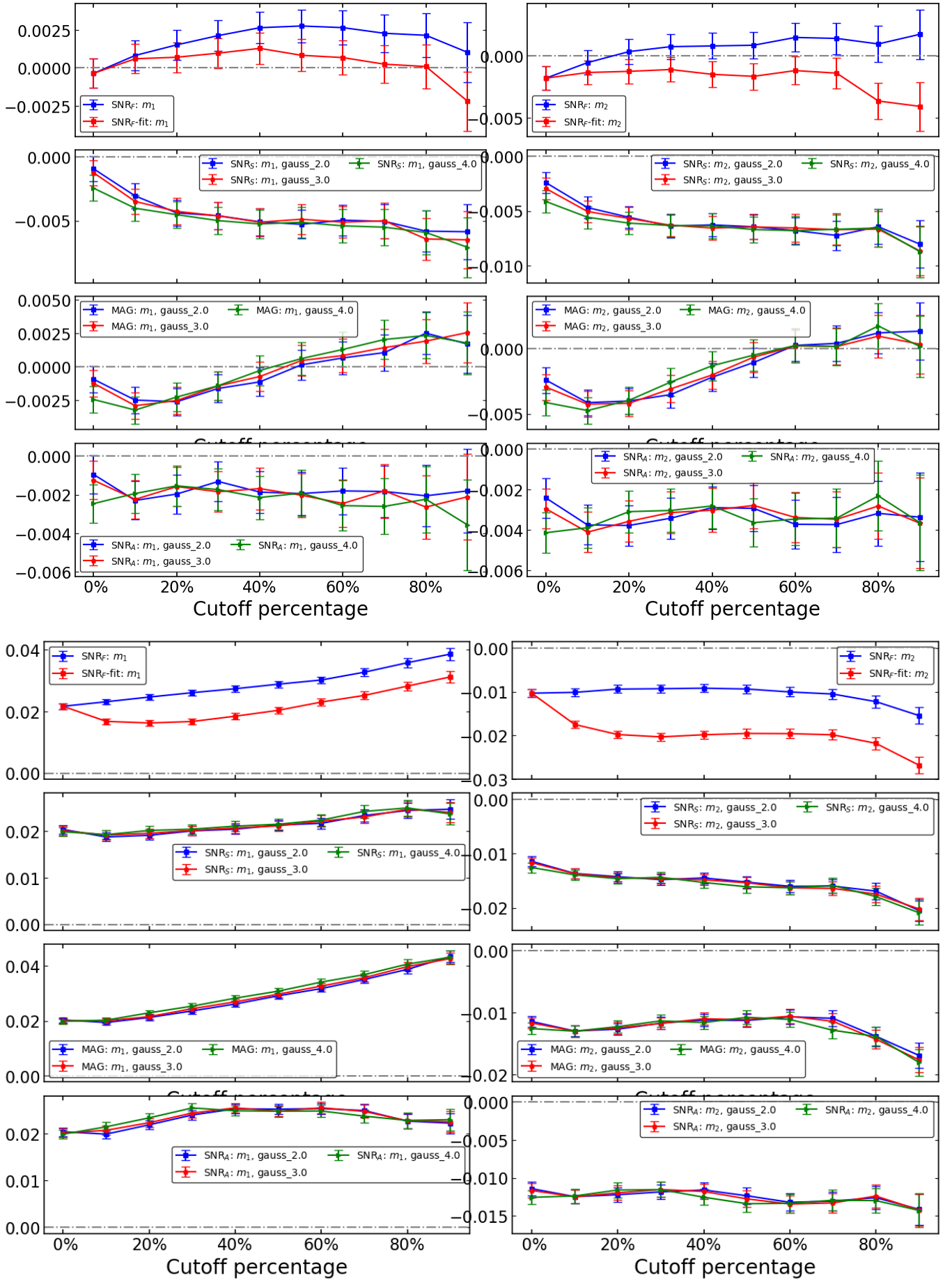
Selection bias

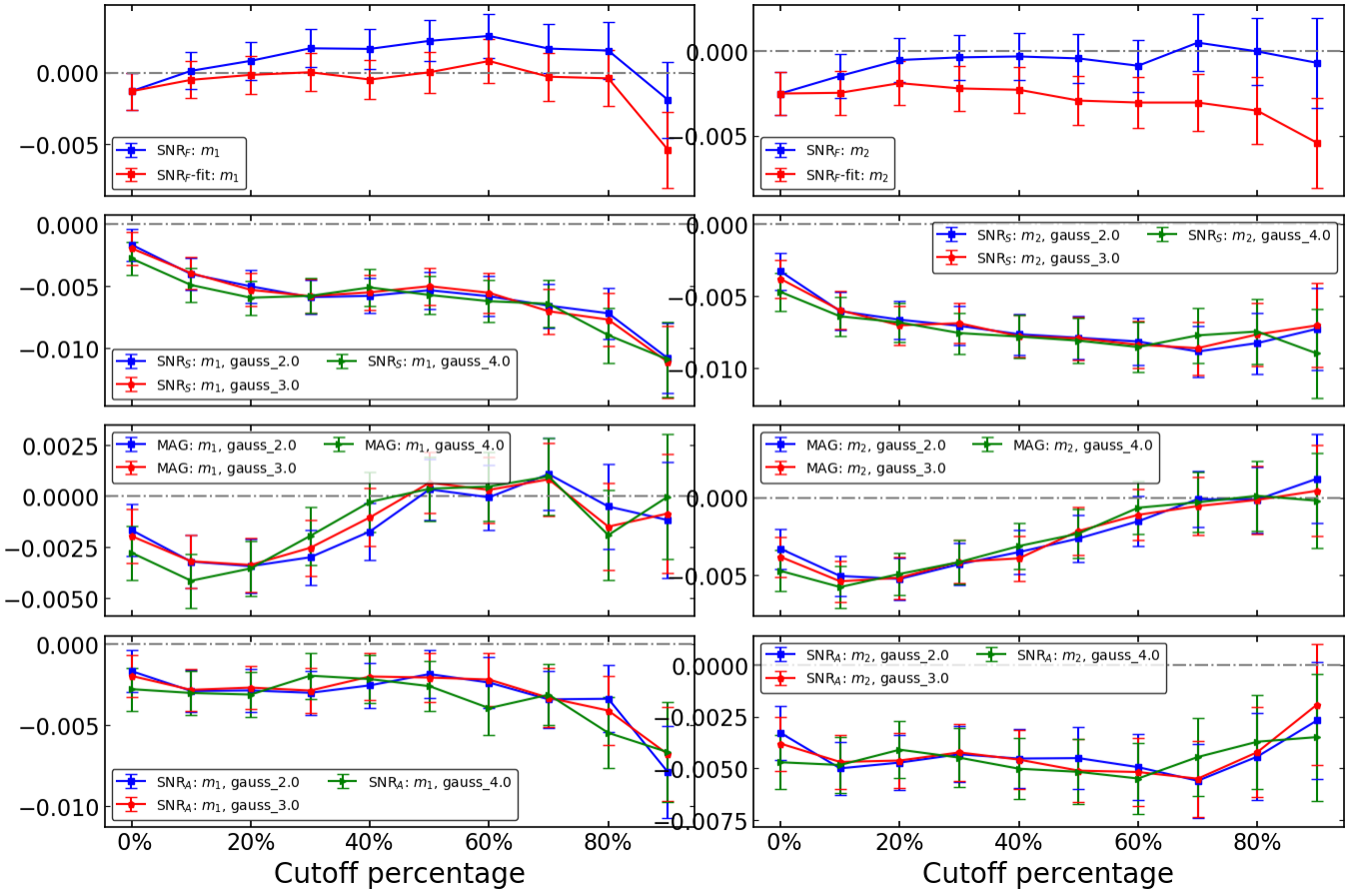
Origin: the selection function correlates with the shear signal

Truncation due to finite stamp size



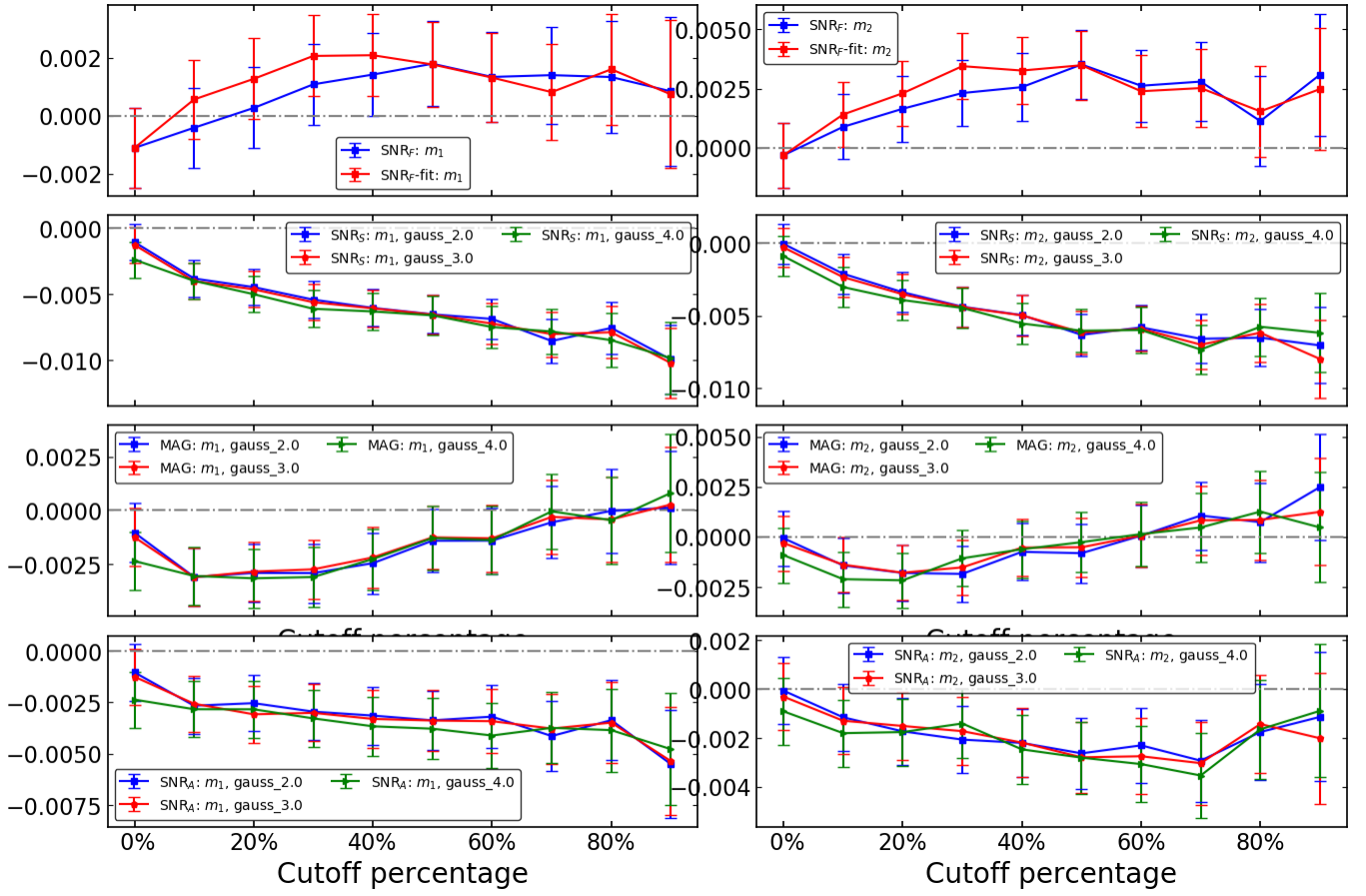
noise free, $48 \times 48, 64 \times 64, 96 \times 96$ magnitude: 20, scale radius(arcsec): 1.0(left) \sim 0.5(right), btr=0 (the most extensive profile)



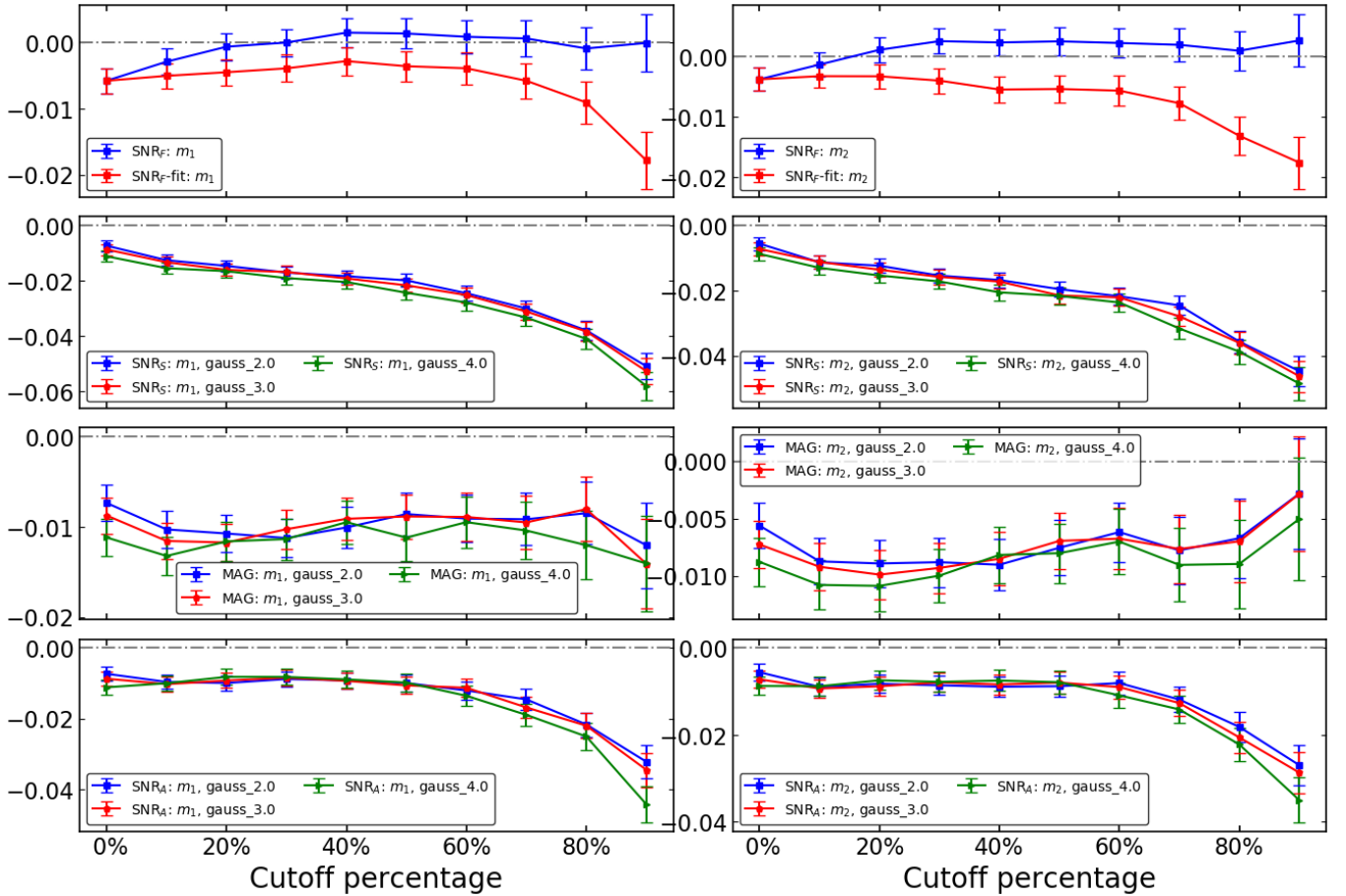


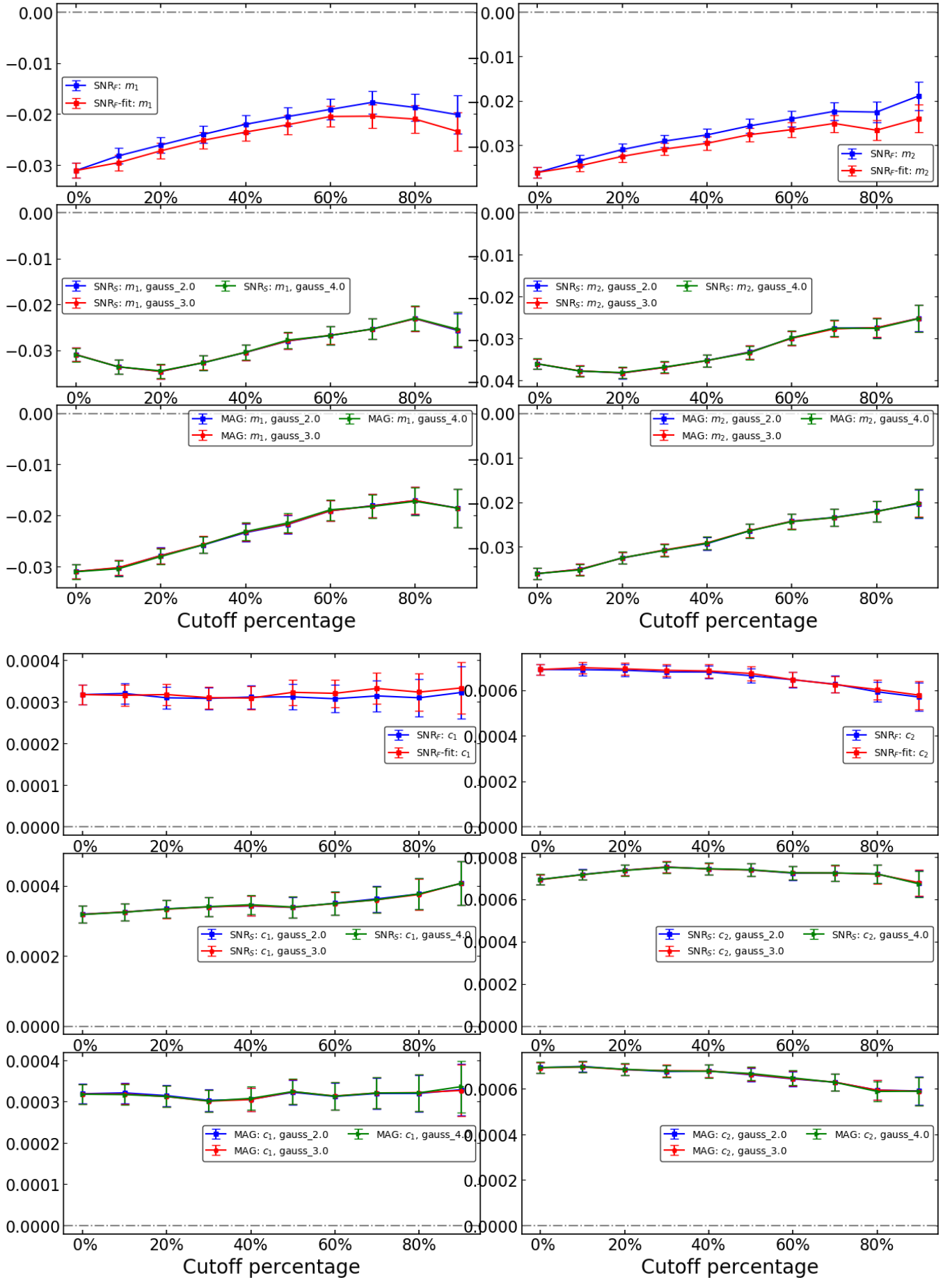
Upper: 10 million galaxies, 48×48 , Scale radius $0.2 \sim 0.9$. Middle: 10 million galaxies, 32×32 , Scale radius $0.2 \sim 0.9$ Lower: 5 million galaxies, 48×48 , Scale radius $0.2 \sim 0.9$

The brighter, the larger. So as the cutoff threshold increasing, the effects of truncation will be more obvious and will give rise to multiplicative bias. However, it seems that the fitting SNR_F will correct it. But the correction will be useless when the stamp becomes smaller. The middle panel show a obvious multiplicative bias.



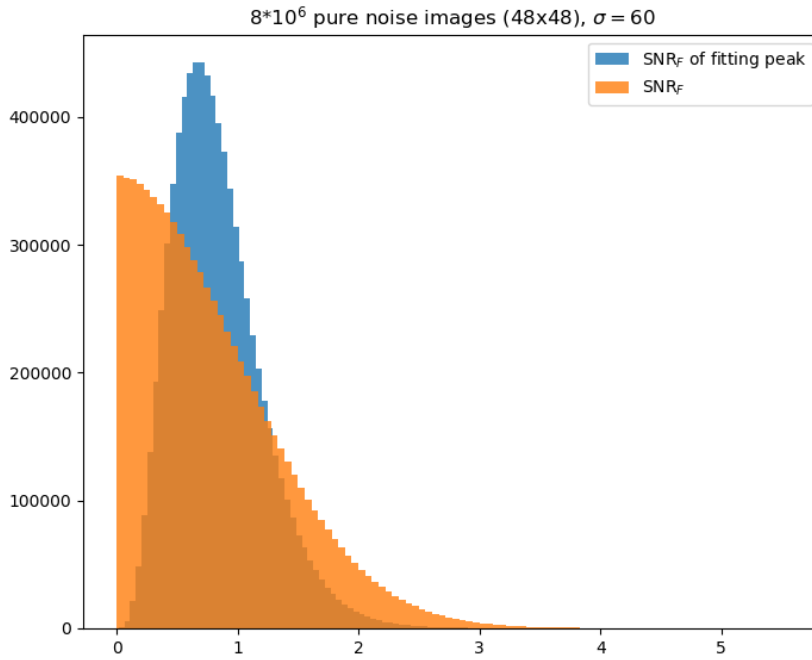
5 million galaxies, 96×96 , Scale radius $0.3 \sim 1.0$, mag: 20 \sim 24.8





Results of 3 million smoothed galaxies (and PSF), 48×48 , with the same properties as CFHTLenS. The results of smoothed galaxies (non-smoothed PSF) are almost the same.

$$SNR_F$$



The SNR_F 's, orange histogram, are measured from 8×10^6 pure noise images (48×48). The blue histogram shows the PDF of SNR_F measured from fitting peaks. The non-fitting SNR_F 's peak at ~ 0 which means no source detection. That confirms to our intuities. However, as the definition shows, the SNR_F of pure source should be 1 as what the histogram shows. The fitting algorithm constrains the PDF and makes it peaks at 1. As we see, using the fitting one as selection criterion will give rise to selection bias.