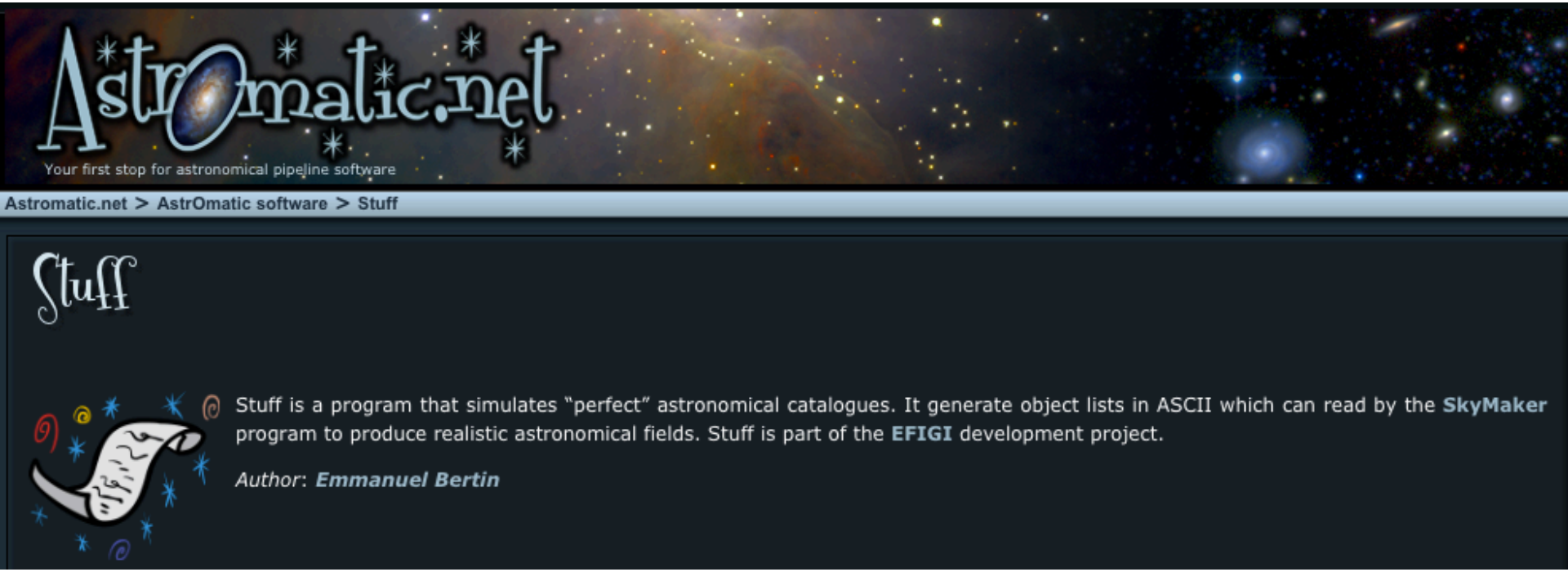
ASTRODEEP
optical & near-IR simulations

Aim: produce a self-consistent set of simulated images in various bands to test softwares and source detection algorithms

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Method: Stuff + SkyMaker



Inputs: area (15x15 arcmin), image specifics, Hubble types, LF parameters, etc…

Stuff input parameters

```
#------------------------------- Image ------------------------------------

CATALOG_NAME    ACS_f435w.list,ACS_f775w.list,IRAC_ch1.list,ACS_f606w.list,VIMOS_U.list,ACS_f850lp.list,WFC3_f160w.list,HawkI_Ks.list  # o
utput catalog file name(s)
IMAGE_WIDTH     15000           # width of the simulated frame
IMAGE_HEIGHT    15000           # height of the simulated frame
PIXEL_SIZE      0.06            # pixel size (arcsec)
MAG_LIMITS      10.0,50.0       # allowed range of apparent magnitudes

#---------------------- Zero-points and Background ------------------------

COLLECT_AREA    64.0            # Effective collecting area(s) (in m2)
GAIN            1.0             # Detector conversion factor(s) (in e-/ADU)
SED_BACKGROUND  zodiacal        # Background SED

#------------------------------- Passbands --------------------------------

PASSBAND_REF    other/norm/Filter03_ACS_f435w_norm.txt    # Calibration passband
REFDETECT_TYPE  ENERGY          # Ref. detector type: "PHOTONS" or "ENERGY"
PASSBAND_OBS    other/norm/Filter03_ACS_f435w_norm.txt,other/norm/Filter05_ACS_f775w_norm.txt,other/norm/Filter13_IRAC_ch1_norm.txt,other/
norm/Filter04_ACS_f606w_norm.txt,other/norm/Filter02_VIMOS_U_norm.txt,other/norm/Filter06_ACS_f850lp_norm.txt,other/norm/Filter10_WFC3_f16
0w_norm.txt,other/norm/Filter12_HawkI_Ks_norm.txt  # Observed passband(s)
OBSDETECT_TYPE  PHOTONS         # Obs. detector type: "PHOTONS" or "ENERGY"

#------------------------------ Cosmology ---------------------------------

H0              70.0            # Hubble constant (km.s-1.Mpc-1)
OMEGA_M         0.3             # Matter density in units of critical density
OMEGA_LAMBDA    0.7             # Cosmol constant in units of critical density
DISTANCE_STEP   5.0             # Integration step along z (h-1.Mpc)

#---------------------- Spectral Energy Distributions ---------------------

SED_CALIB       AB              # SED that defines the magnitude system
SED_GALAXIES    E,Sbc,Scd,Im    # SEDs for galaxy components

SEDINDEX_BULGE  1,1,1,1,1,1     # bulge SED indices in SED_GALAXIES
SEDINDEX_DISK   1,1,2,2,4,4     # disk SED indices in SED_GALAXIES
```

Stuff input parameters

```
#---------------------------- Galaxy types --------------------------------

HUBBLE_TYPE      -6.0,-2.0,2.0,4.0,10.0,10.0      # Simien & deVaucouleurs 86
BULGE_FRACTION   1.0,0.57,0.32,0.16,0.0,0.0    # Simien & deVaucouleurs 86
                                 # B/T in ref. band for each galaxy component

#----------------------- Galaxy luminosity functions ----------------------

LF_PHISTAR       1.188e-3,1.188e-3,1.728e-3,1.2e-3,0.15e-2,1.05e-4
                                 # Schechter's phi* density parameter (h3.Mpc-3)
LF_MSTAR         -19.58,-19.58,-19.53,-19.17,-25.15,-25.15
                                 # Schechter's M* absolute magnitude
LF_ALPHA         -0.54,-0.54,-0.99,-1.24,-1.30,-1.55
                                 # Schechter's alpha parameter
LF_MAGLIMITS     -27.0,-13.0     # bounds to the luminosity function

LF_PHISTAREVOL   -1.7,-1.7,-1.2,-1.2,-3.,1.37
                                 # Density evolution factor dln(phi*)/dln(1+z)
LF_MSTAREVOL     -1.0,-1.0,-1.0,-1.0,-1.5,1.5
                                 # Luminosity evolution factor dM*/dln(1+z)

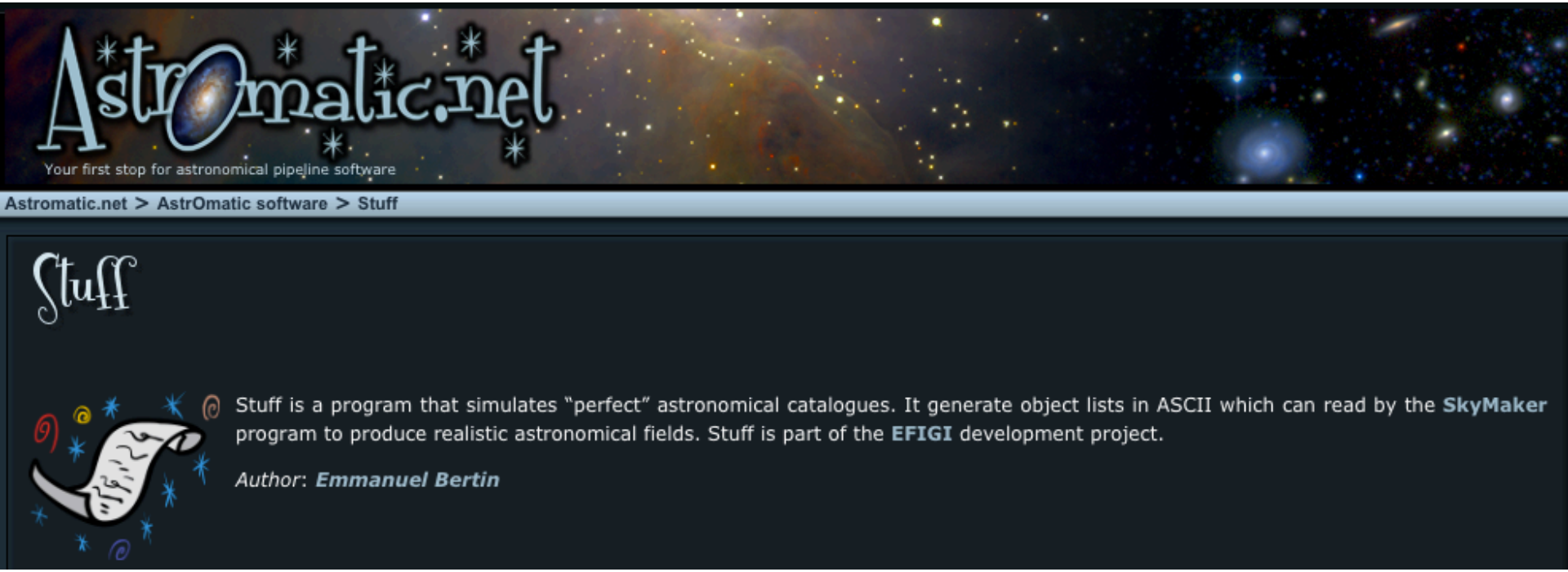
#---------------------------- Extinction ----------------------------------

EXTINCT_NAME     LMC.ext         # Internal extinction law
DISK_EXTINCT     0.0,0.75,1.23,1.47,1.23,1.23
                                 # de Vaucouleurs' alpha (extinction parameter)

#---------------------------- Disk sizes ----------------------------------

DISK_BETA        -0.214          # Beta parameter of the disk size distribution
DISK_RSTAR       3.85            # re* parameter of the disk size distribution
                                 # (h-1.kpc) (see de Jong & Lacey 2000)
DISK_SIGMAL      0.36            # sigma_lambda parameter of the disk size
                                 # distribution (see de Jong & Lacey 2000)
```

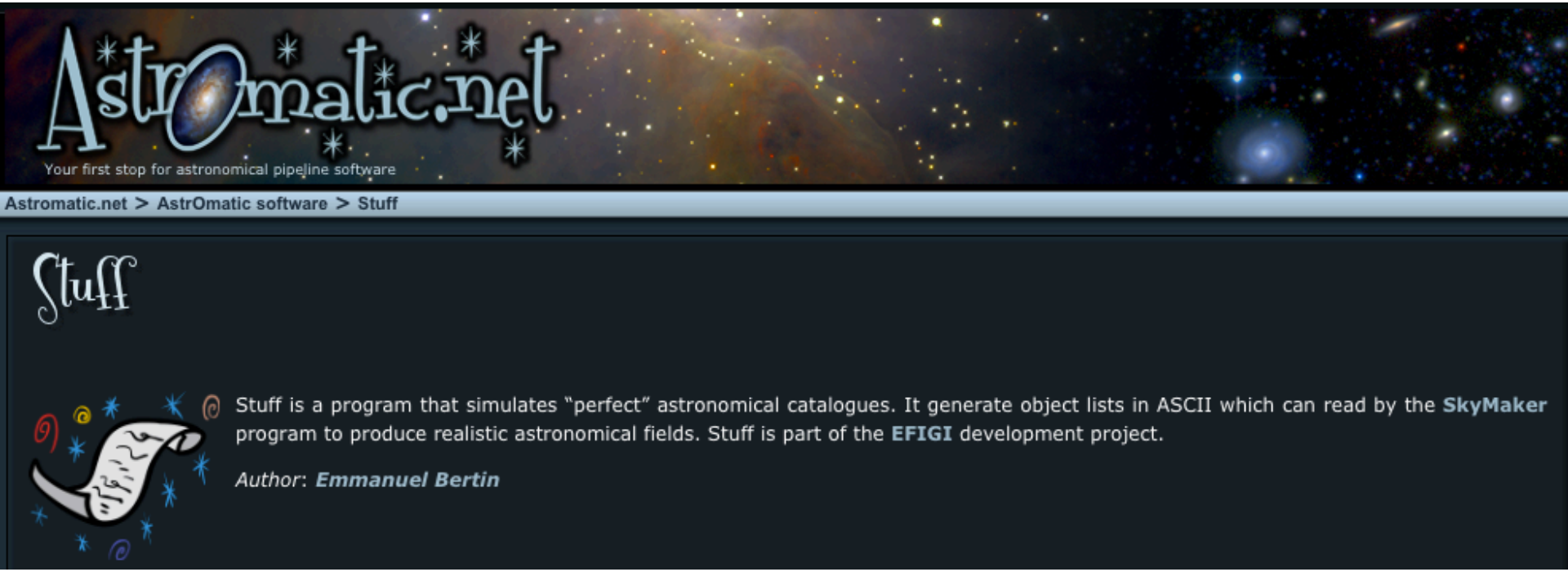
Method: Stuff + SkyMaker



Inputs: area (15x15 arcmin), image specifics, LF parameters, Hubble types, etc…

Outputs: positions (x,y), redshifts, total magnitudes in 8 bands, and for each band: bulge/total, morphological information, stellar/galaxy index

Method: Stuff + SkyMaker

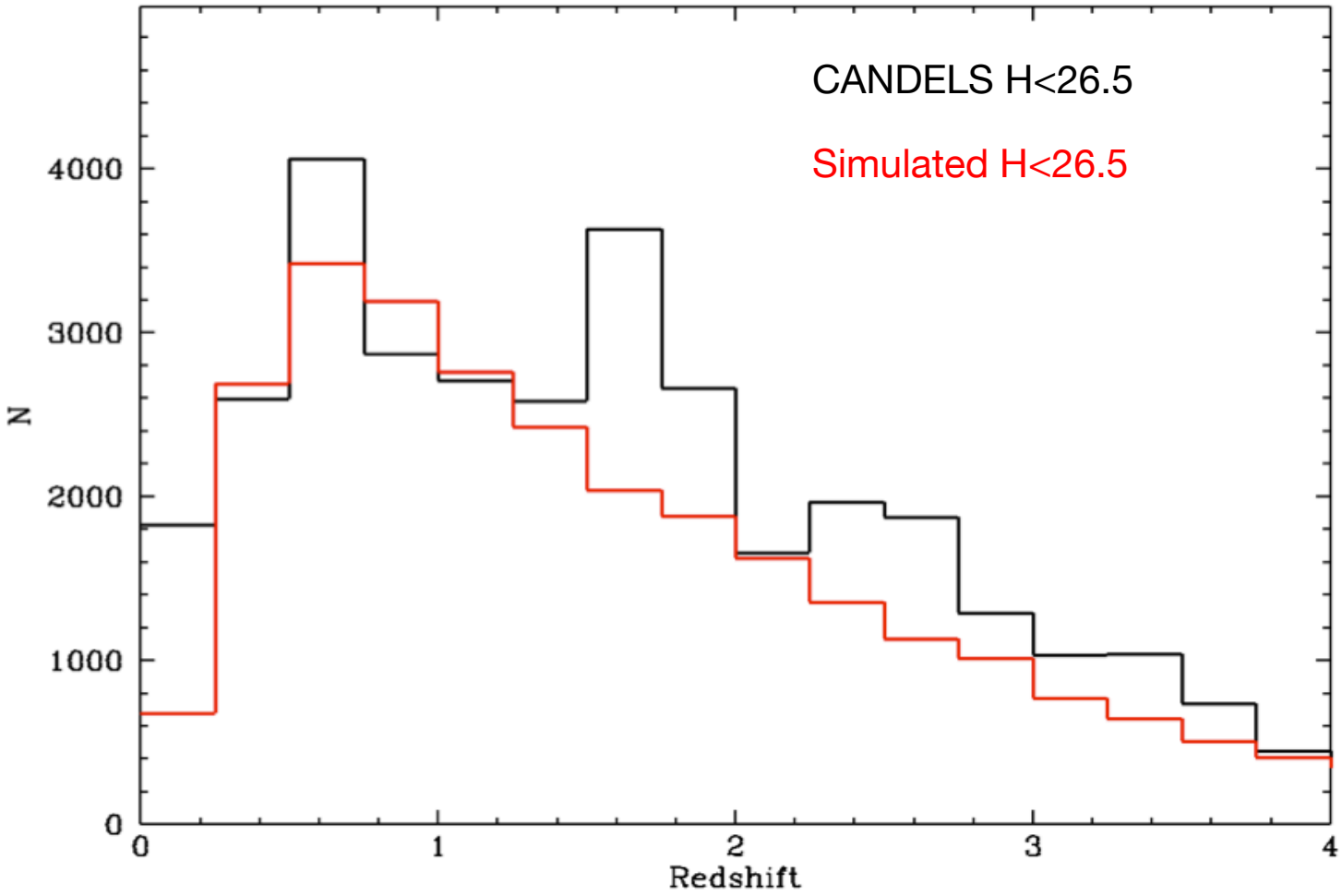


Stuff input parameters have been tweaked in order to reproduce the observed redshift distribution.

Magnitudes have been empirically corrected as function of redshift in order to reproduce number counts:

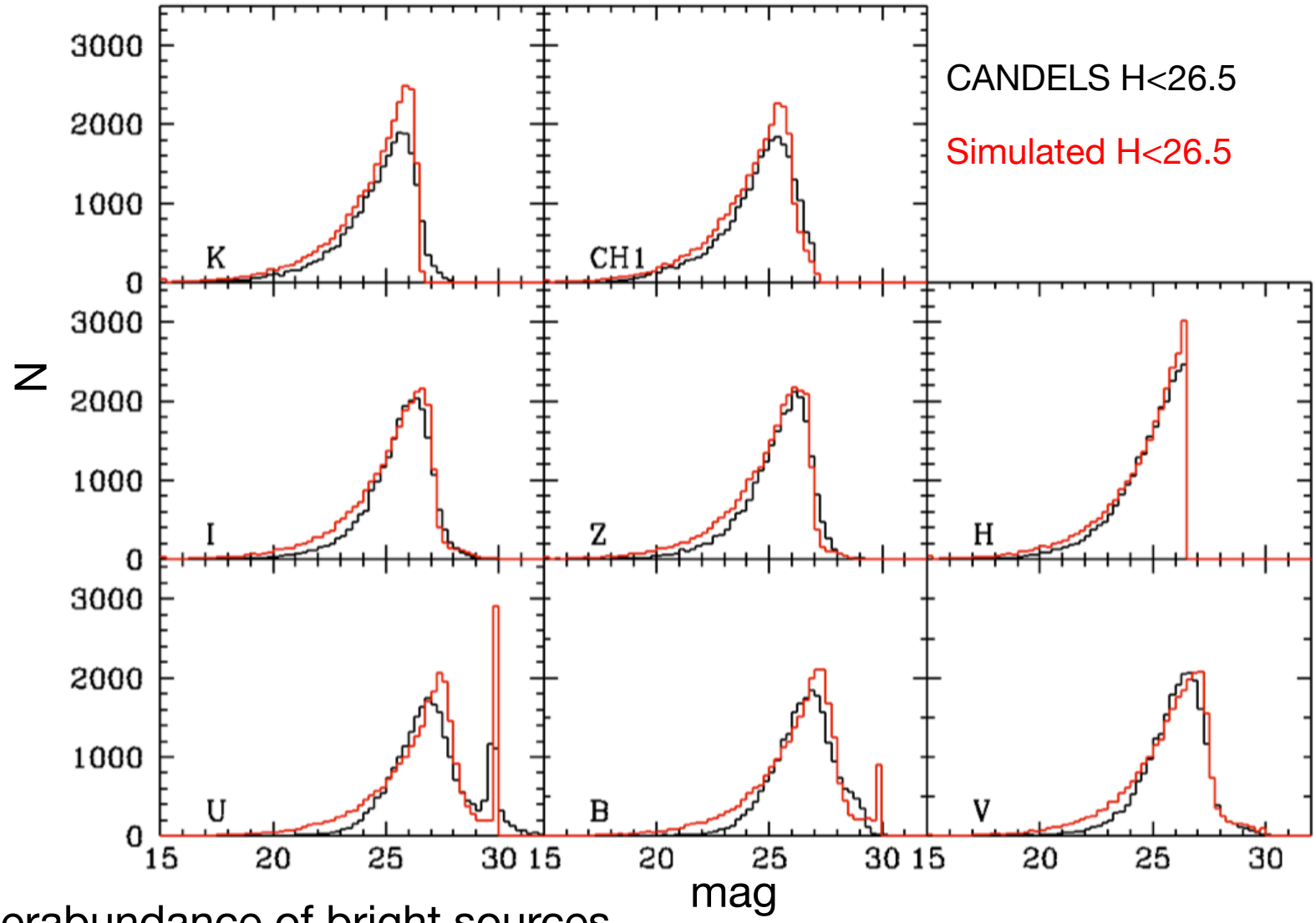
$$mag_{CORR} = mag_{STUFF} + \alpha\,(1+z) \quad \text{with } -0.1<\alpha<0.2 \text{ depending on the band}$$

Redshift distributions: comparison with CANDELS GOODS-S catalog



Clustering not included

Number counts: comparison with CANDELS GOODS-S catalog



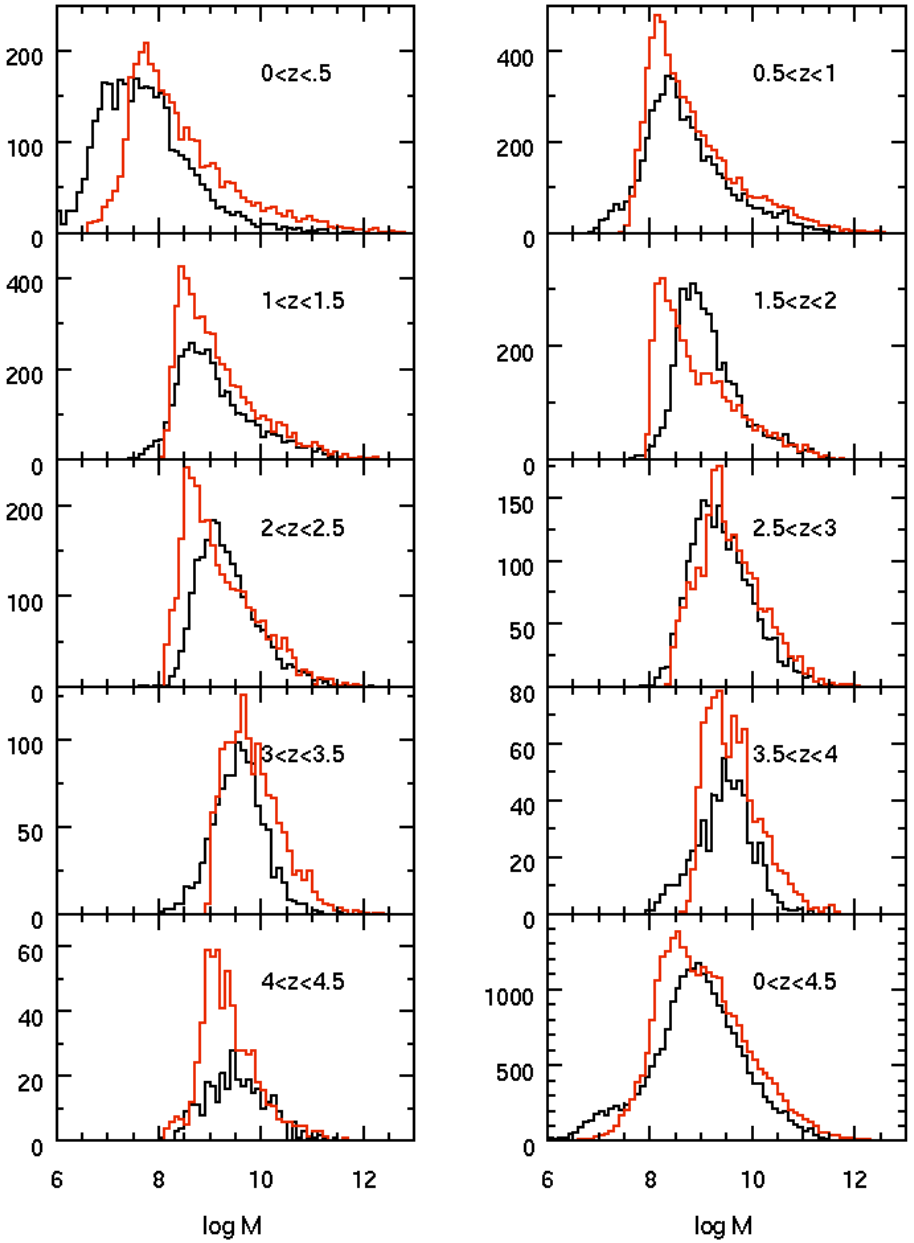
Slight overabundance of bright sources

Physical parameters: comparison with CANDELS GOODS-S catalog

SED fitting with BC03 models

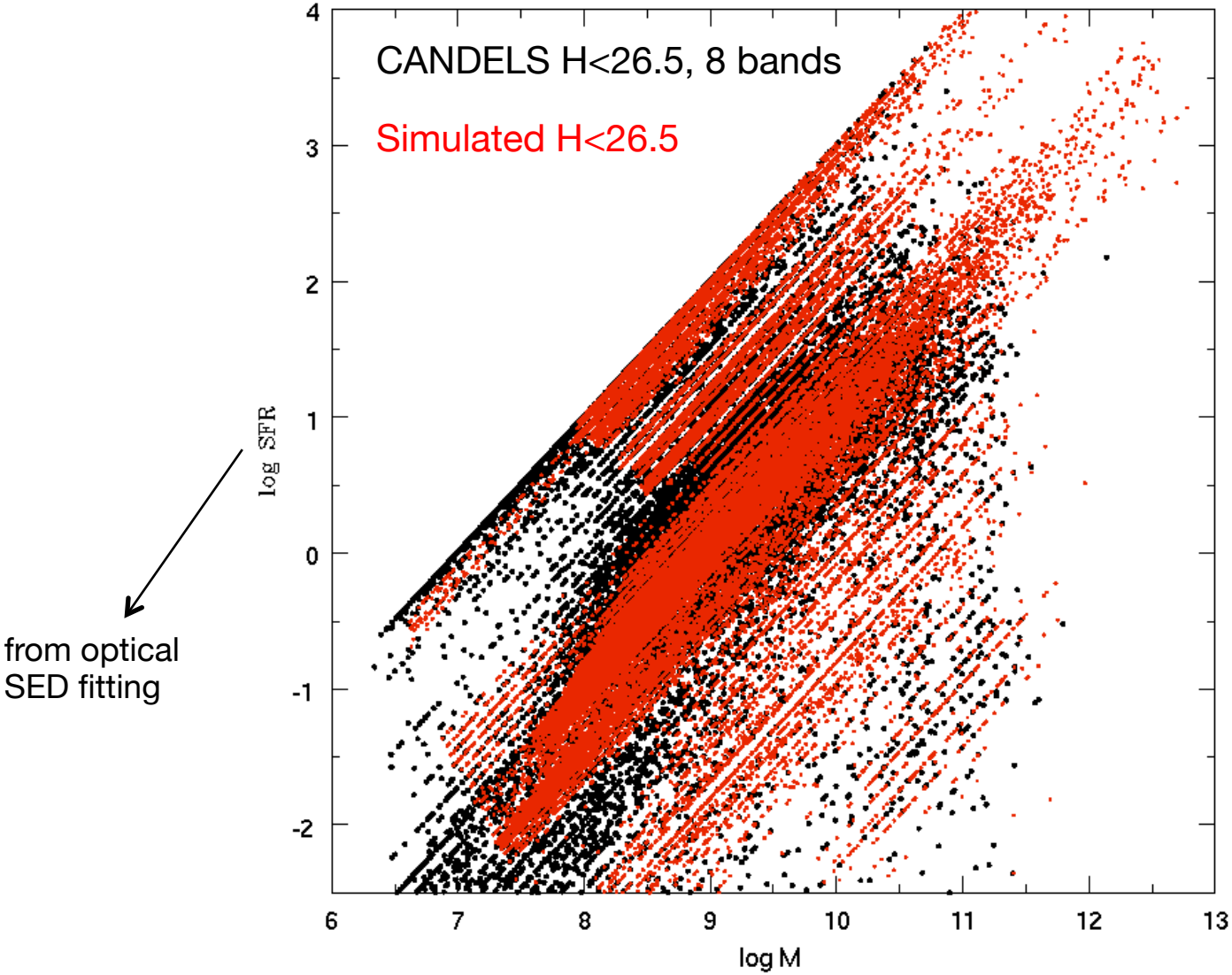
CANDELS H<26.5, 8 bands

Simulated H<26.5

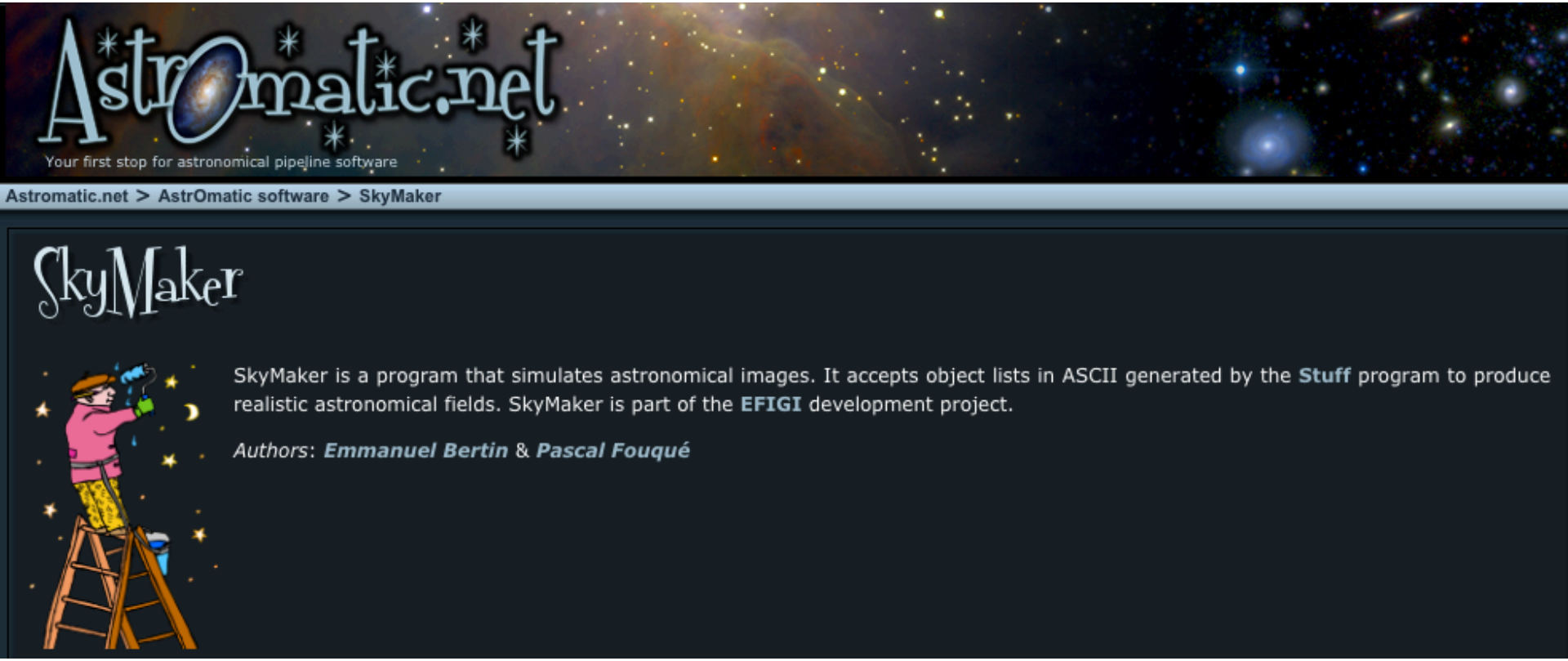


Physical parameters: comparison with CANDELS GOODS-S catalog

SED fitting with BC03 models



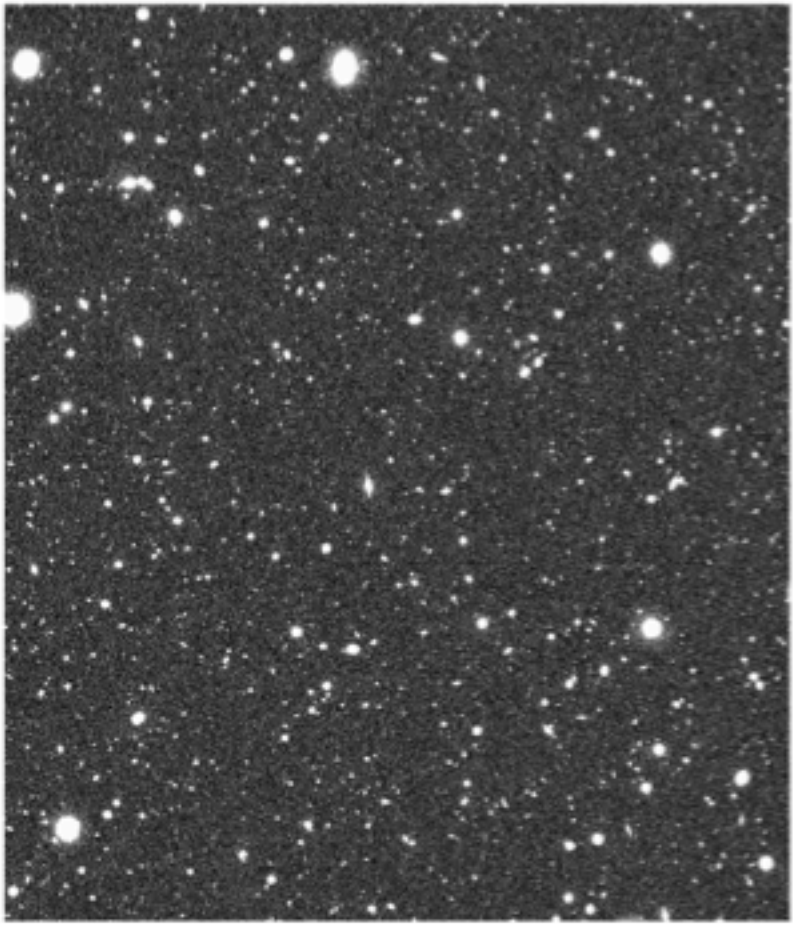
Method: Stuff + SkyMaker

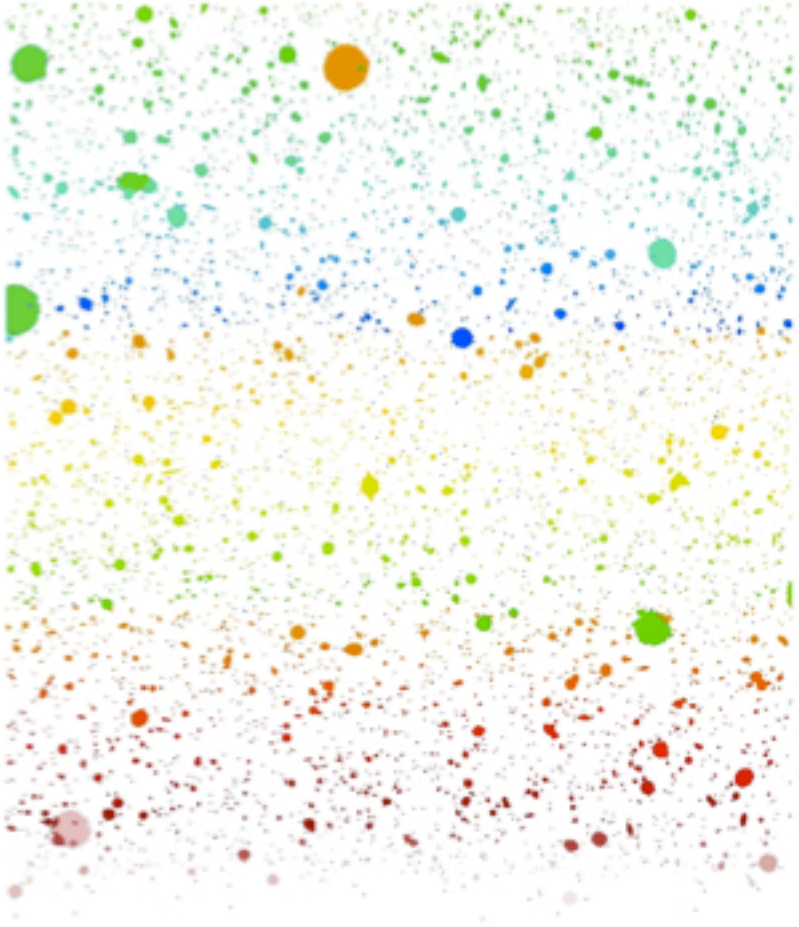


Inputs: catalogs produced by Stuff, mag limit, zero point, PSF, etc…

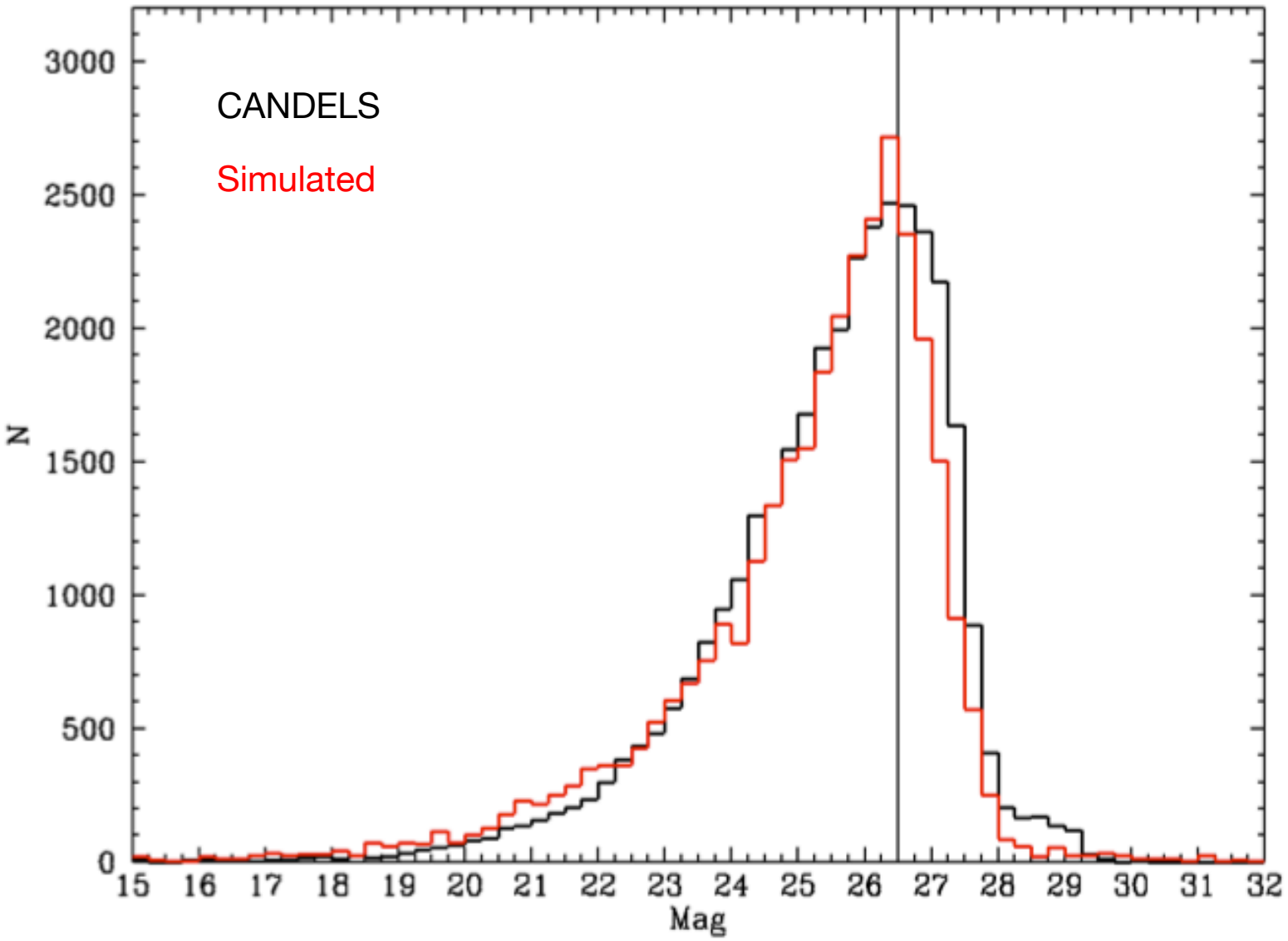
Outputs: simulated astronomical image

Sanity checks: simulated H160 WFC3 image + Sextractor run (HOT+COLD “CANDELS”)

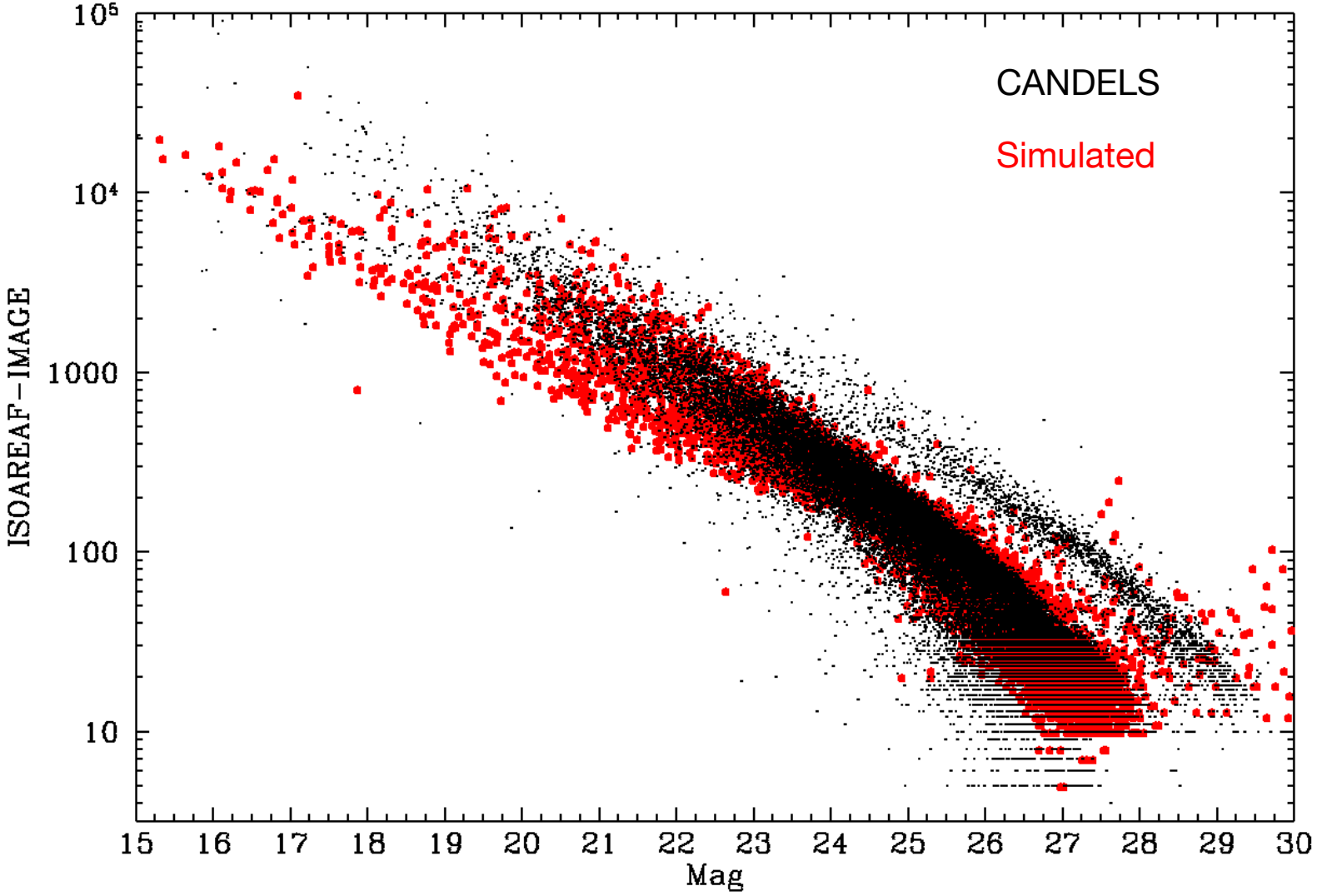




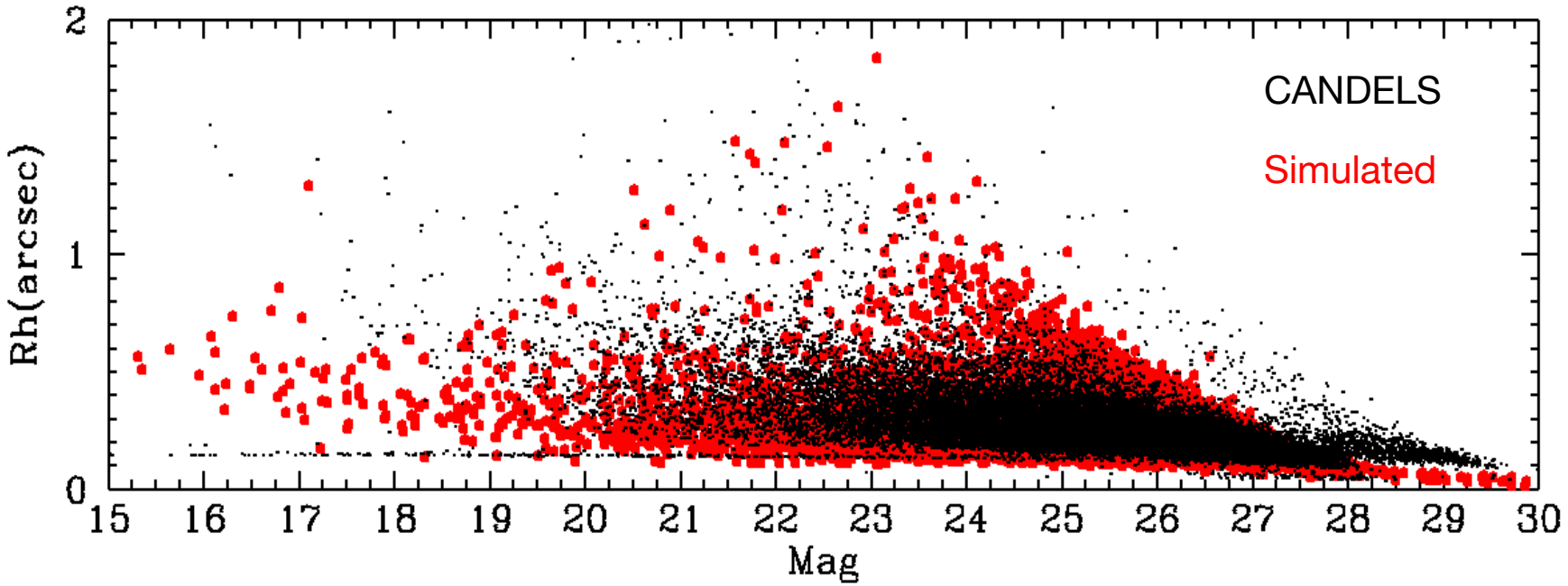
Sanity checks: magnitude counts



Sanity checks: isophotal area



Sanity checks: half-light radius



Simulated catalog (ASTRODEEP_sim_v0.5.cat) distributed within the collaboration

```
#  ID    X          Y          ra          dec          z         logMASS     SFR          Urf_Vega     Vrf_Vega     Jrf_Vega     Lnu(1400A)
#1) IDs may not be consecutive, a few unrealistic objects have been removed
#2-3) X and Y refers to a mock 15x15 WFC3 image (Pixscale=0.06") as simulated by Stuff+Skymaker
#4-5)RA, DEC correspond to an hypothetical pointing centred on the GOODS-South area
#6) redshifts as in output from Stuff
#7-12) rest-frame properties estimated through a standard SED-fitting (BC03 library, Salpeter IMF) on an 8-band photometry at fixed redshift
   1     4016.37    8956.79    53.624799   -27.150725   4.47279   10.399327   5.556        -16.629999   -18.690001   -22.27       2.278E22
   2     1350.5     11070.9    53.67474    -27.115508   4.46799   10.67861    10.679999    -17.65       -19.639999   -23.040001   6.786E22
   3     12832.6    5398.73    53.45954    -27.209841   4.46455   9.572756    366.800049   -19.16       -19.949999   -22.65       1.383E24
   4     8599.81    12749.4    53.539041   -27.087444   4.47474   6.732956    0.001198     -7.466       -9.52        -13.11       4.91E18
   5     4616.65    11519.8    53.613589   -27.108003   4.47461   7.421275    0.005843     -9.187       -11.24       -14.830001   2.395E19
   6     4802.87    9198.39    53.610071   -27.14669    4.47296   9.63769     0.9618       -14.73       -16.779999   -20.370001   3.942E21
   7     10872.0    8480.13    53.496376   -27.158543   4.46767   9.740679    4.104        -16.130001   -17.84       -21.200001   2.352E22
```

http://www.astrodeep.eu/simulated-catalog-v0-5/

Next steps:

- produce images in the other 7 bands (from U to IRAC)
  (for IRAC use the observed PSF)
- discuss issues affecting IR and X-ray simulated images

Open issues:

- Clustering? Lensing? (feedback from Corentin and Nathan)