Report on work done for NIO GSMT book

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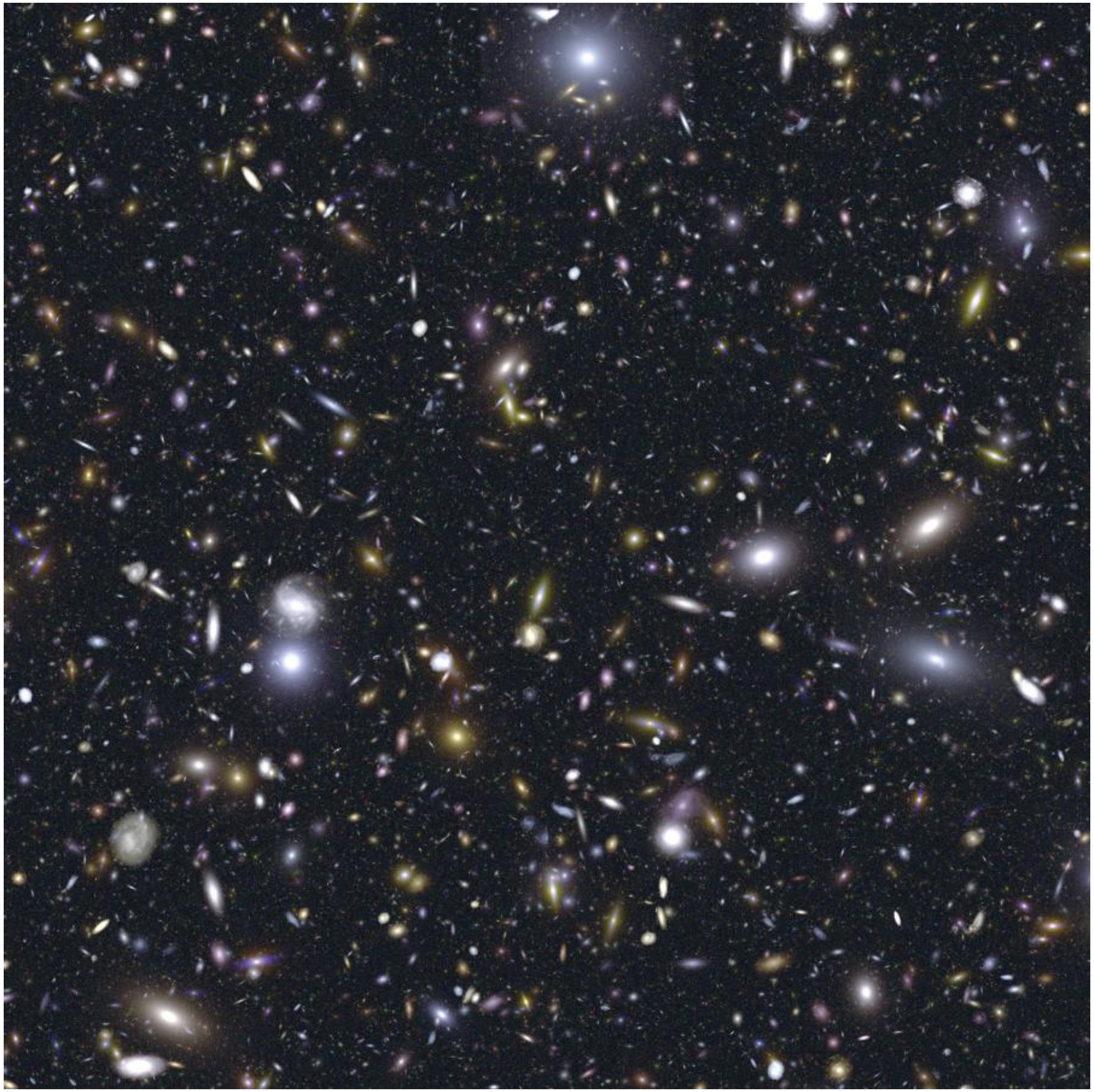
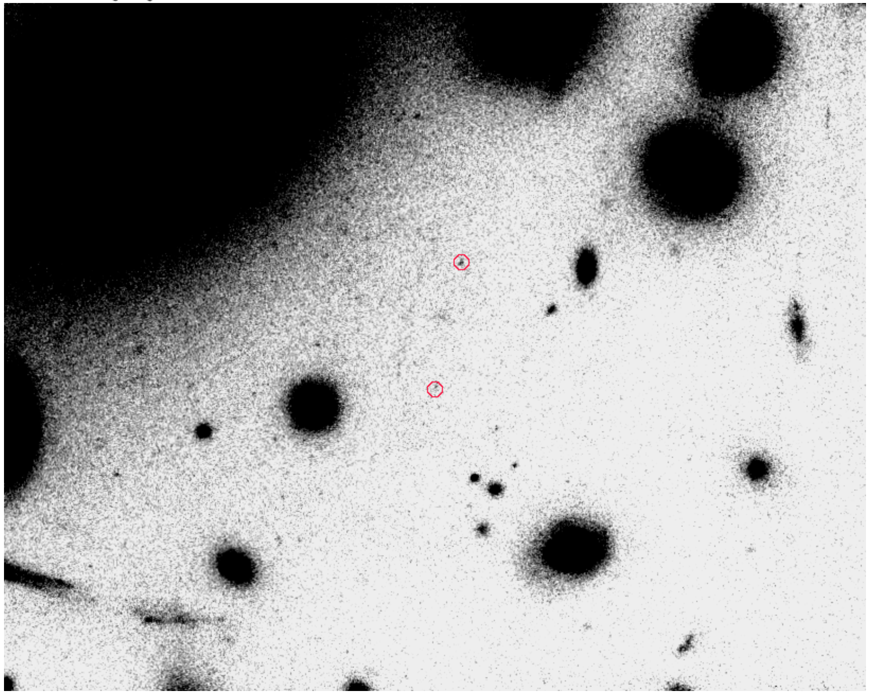
Simulated
NGST Image
(Im 2001)

2’x2’

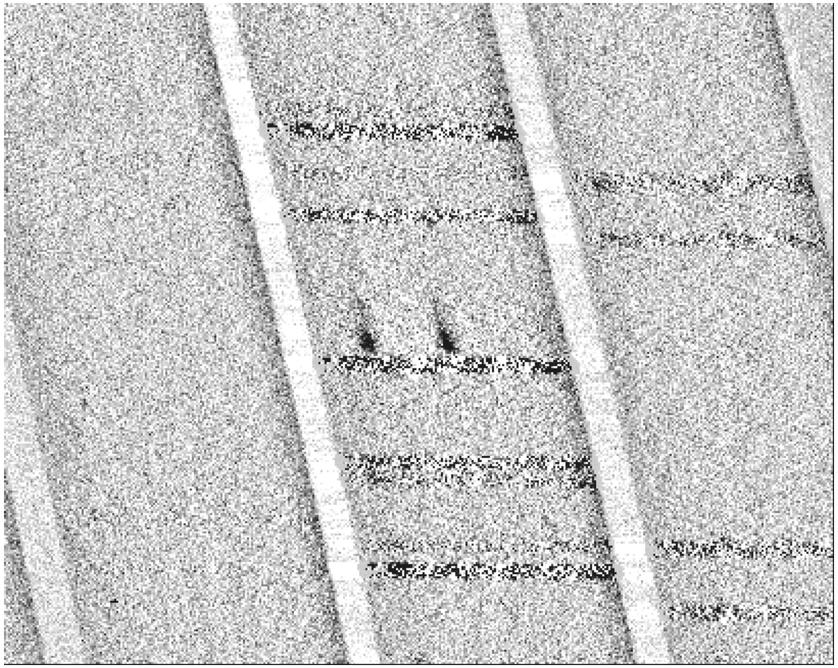
10 hr exposure



High z Lyman α Emitters



Ellis et al. z=5.6 lensed Lyman Alpha emitters
Brighter object observed I=26, lensed by factor ~33



ELT MEIFU
Emission Line Sensitivity Calculation

'Natural Seeing'

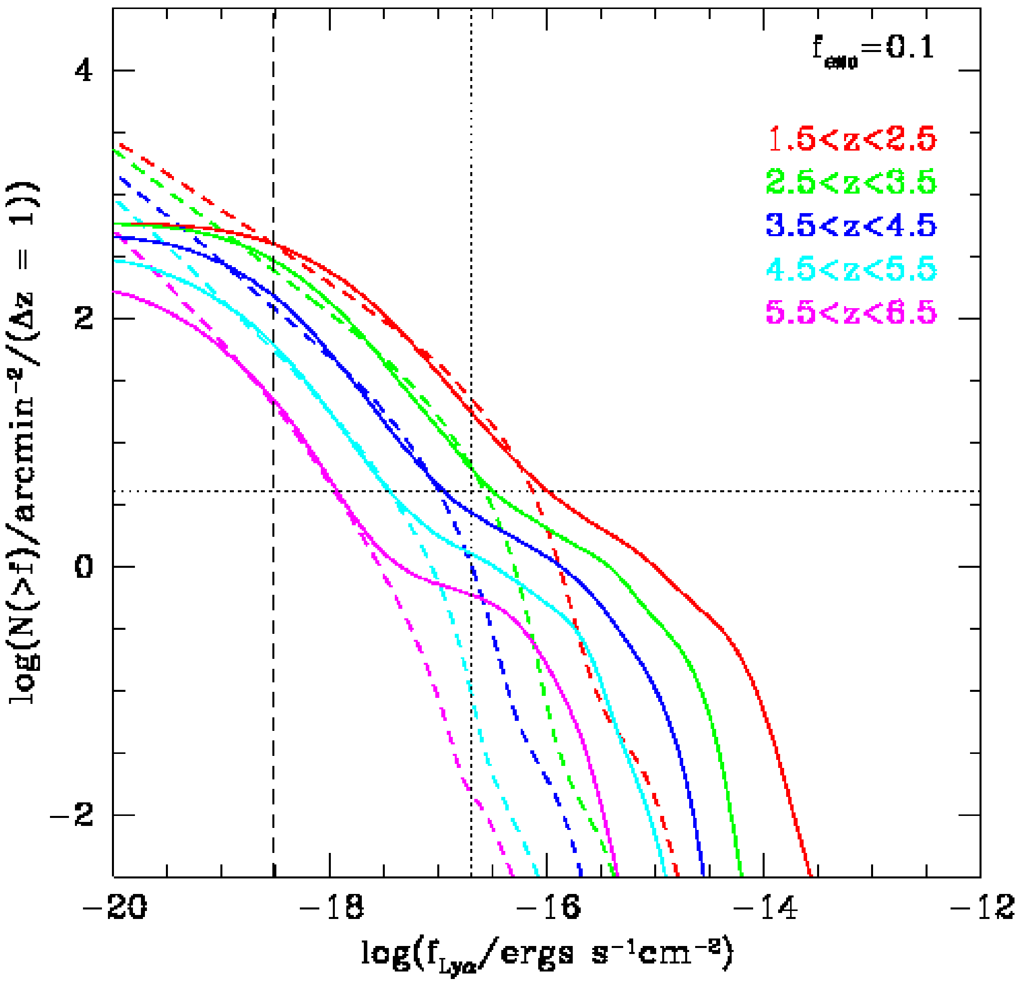
- Exposure 4x8 hours (~10^5 seconds), sky I=19.9
- 27% sky-to-hard-disk throughput
- 50% of object flux in 0.6x0.6 arcsec box
- All of line flux in 2 spectral pixels (1.7 nm)
- 5σ Detection for 3×10^{-19} ergs cm^{-2} s^{-1}
- Z=6 (Observed λ=851.2 nm) gives 1×10^{41} ergs s^{-1} luminosity

Emission Line Sensitivity Calculation

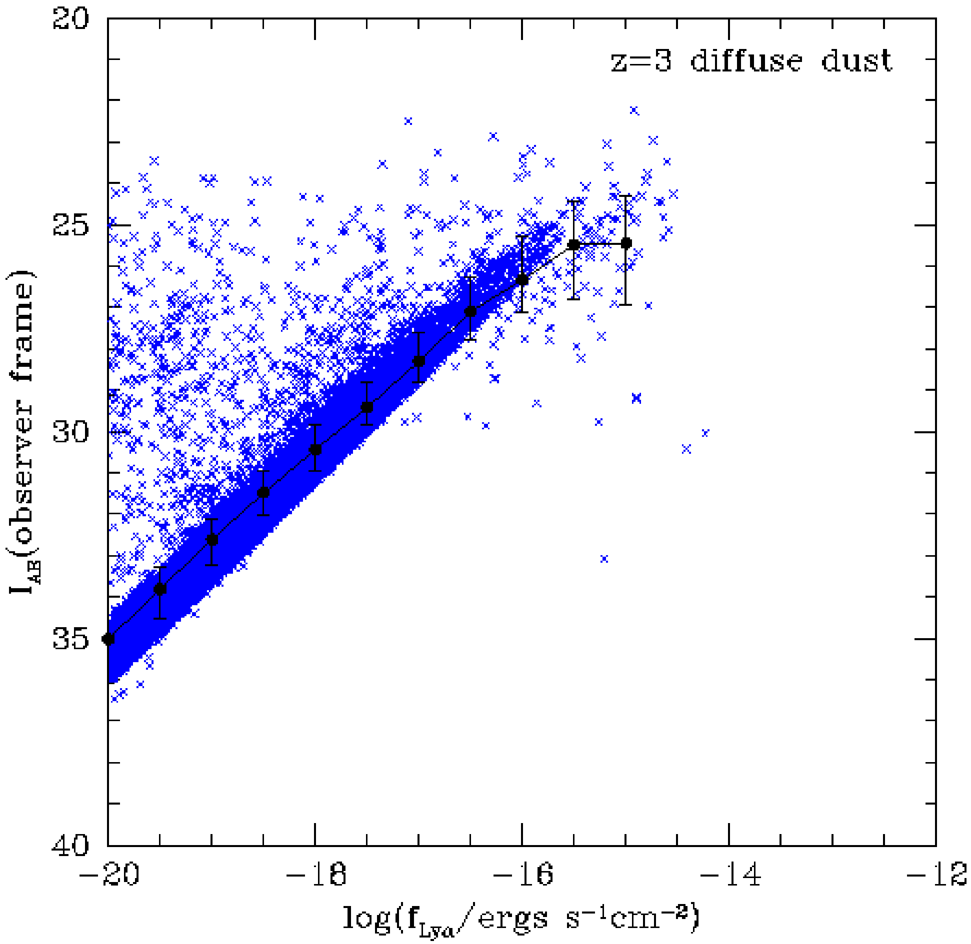
AO corrected and ‘diffraction limited’

- Assumption as in previous slide, except:
- 50% of object flux in 0.2x0.2 arcsec box
- 5σ Detection for 1×10^{-19} ergs cm^{-2} s^{-1}
- Z=6 (Observed λ=851.2 nm) gives 3×10^{40} ergs s^{-1} luminosity
- 50% of object flux in 0.006x0.006 arcsec box (50% EE diameter for 30m Airy Pattern at 790 nm)
- N.B. this also implies a different plate scale to sample this properly.
- 5σ Detection for 3×10^{-21} ergs cm^{-2} s^{-1}
- Z=6 (Observed λ=851.2 nm) gives 1×10^{39} ergs s^{-1} luminosity

Semi-analytic surface density prediction



Semi-analytic continuum mag prediction

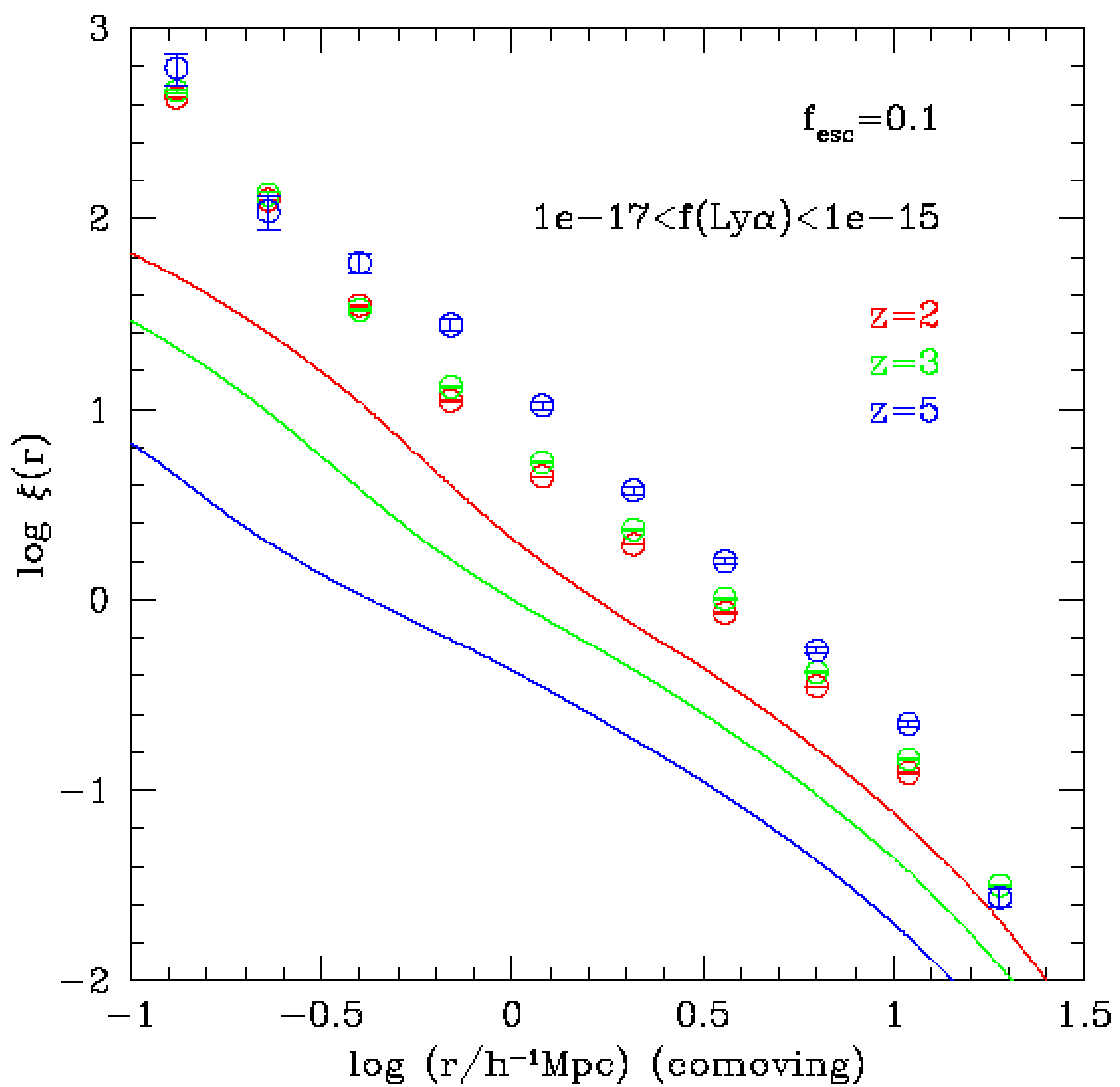


Spatial Correlation Function in co-moving coordinates for Lyman α emitters.

Assumed constant fixed escape fraction.

Single flux range

Points = Lyman α emitters
Lines = Dark Matter



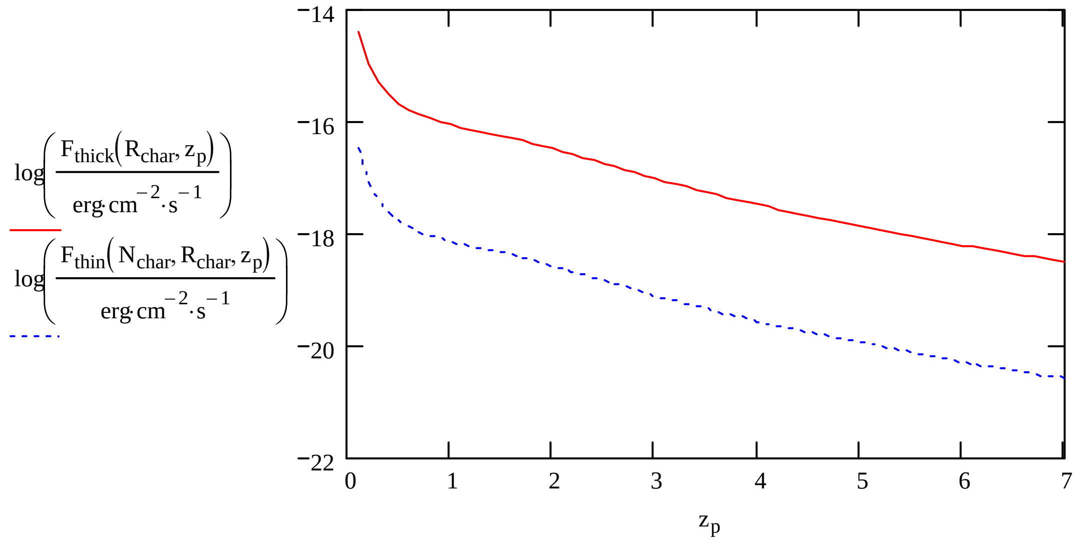
Fluorescent Lyman Alpha Emitters

- Can we detect neutral hydrogen clouds excited by the general UV background?
- Gould and Weinberg 1996, ApJ, 468
- Bunker, Marleau and Graham 1998, AJ, 116, 2086

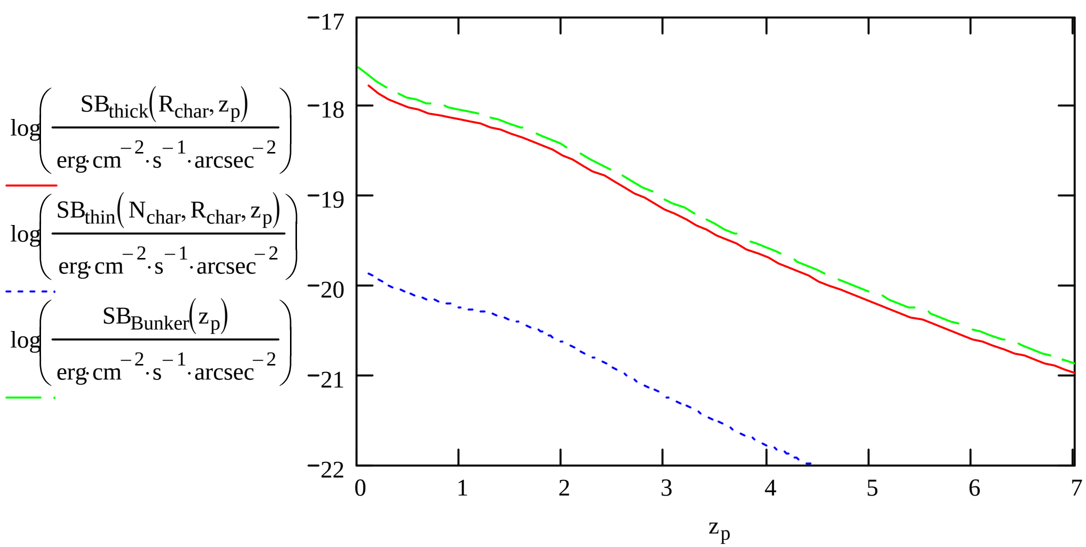
Re-Calculate above using most recent estimates for the UV background

- Calculations done in mathCAD, electronic version of this (and also the sensitivity calculation) will be included in the final delivery.
- Algorithm:
    - Assume ‘consensus’ cosmology
    - Use Haardt and Madau (1996) functional form for UV background strength and shape as function of z, but with latest version for parameters (Haardt, Private Comunication, CUBA code)
    - Use Power law approx. to hydrogen photoionisation cross section (simplifies code, but not necessary)
    - Consider clouds both optically thin and optically thick to UV background as separate cases using Gould and Weinberg formalism
    - Calculate cloud luminosities given a characteristic size
    - Convert these to fluxes and surface brightnesses given the redshift
    - Given known number of absorbers as a function of column density and redshift, and assuming the same characteristic size, calculate volume density of clouds expected satisfying given flux and surface brightness limits.

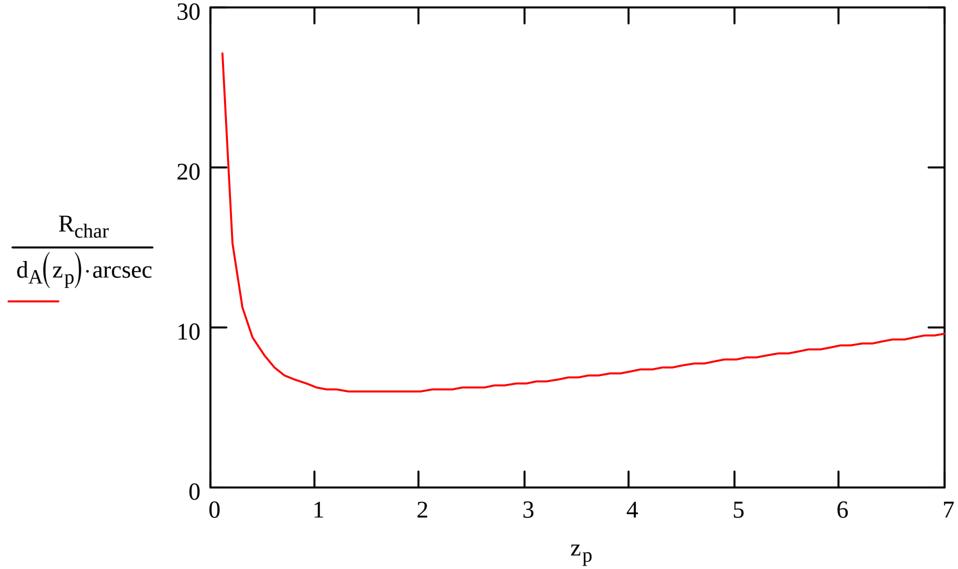
Ly α Flux



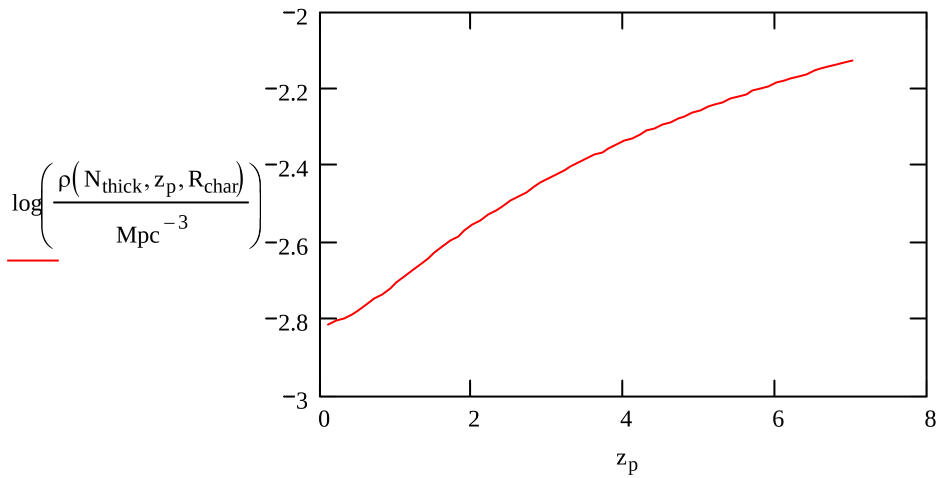
Ly α Surface Brightness



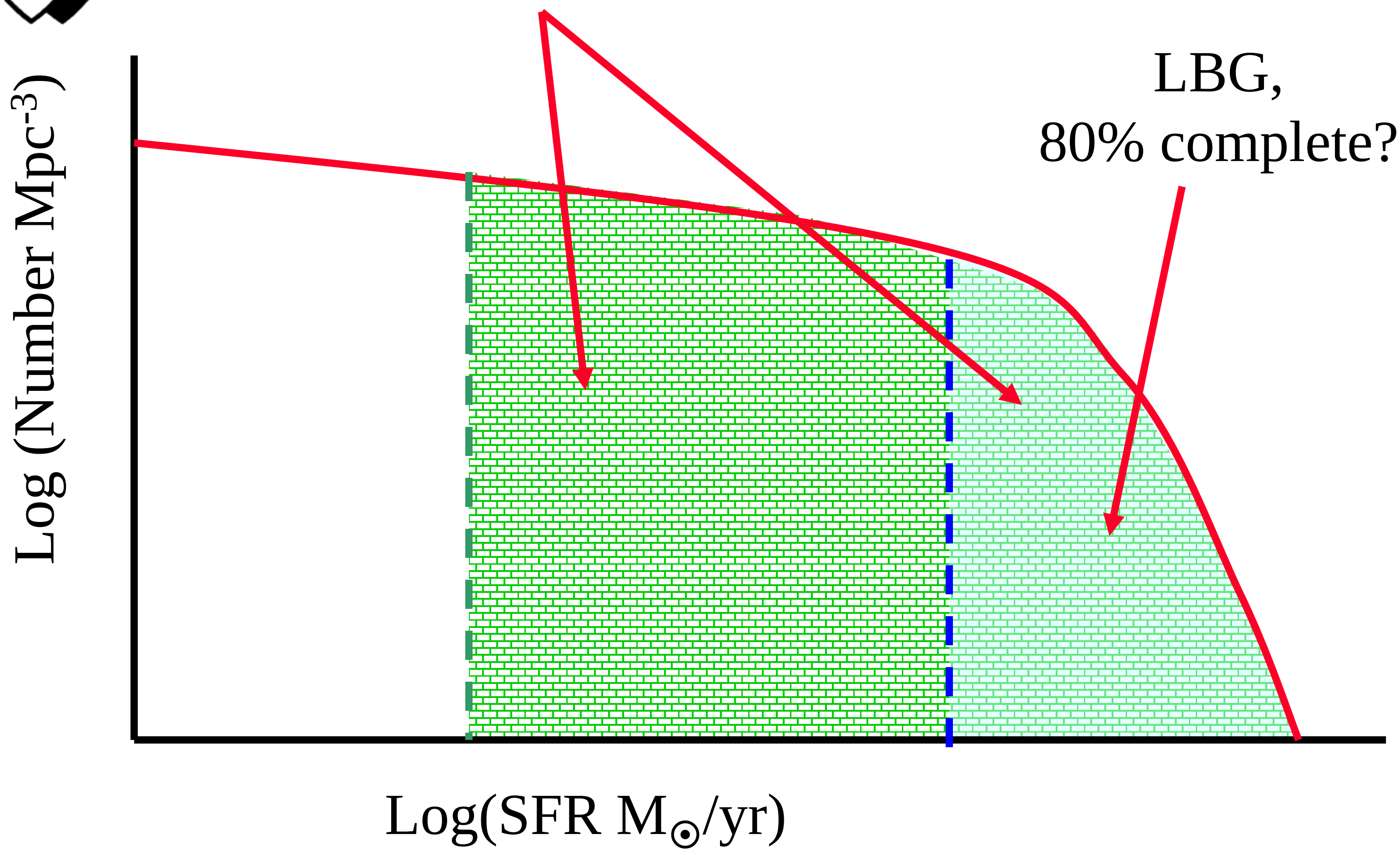
Angular Size (Rchar=50 kpc)



Volume Density of optically thick absorber/emitters



What are we selecting?



GSMT

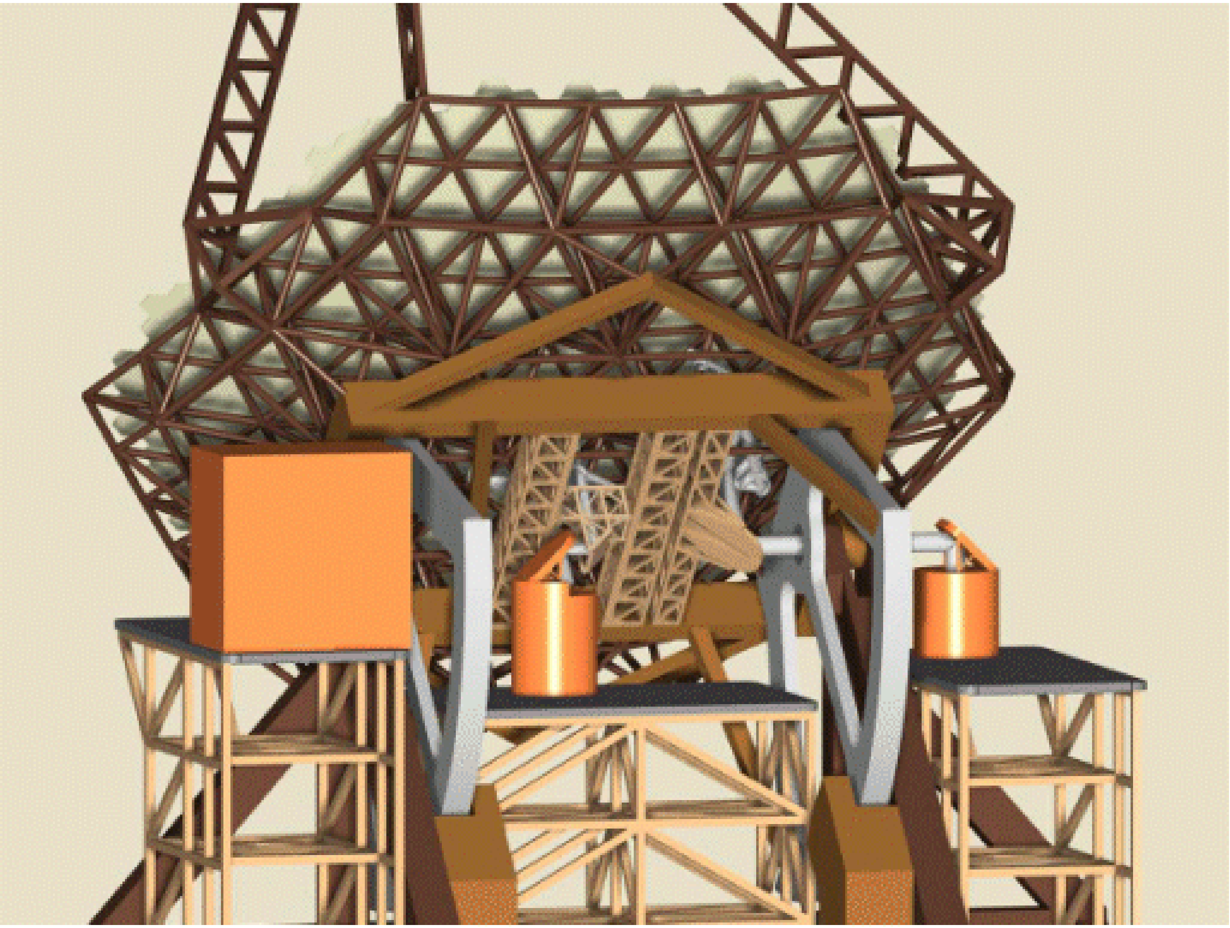
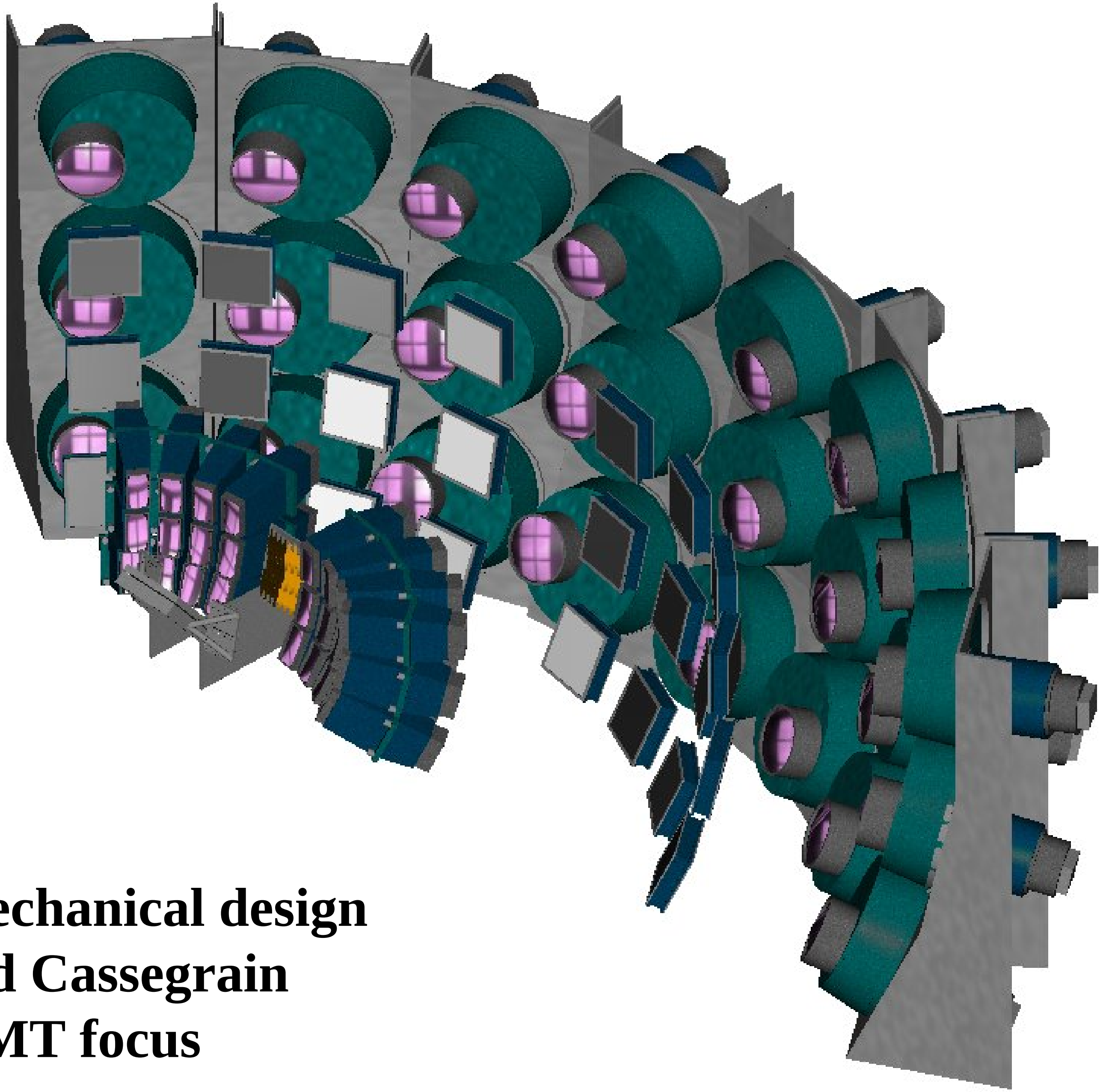


Figure 9 A view of the back of the telescope, with some structures removed for clarity, showing several configurations in which the optical path is directed to notional instruments by flat mirrors.



MEIFU Mechanical design for fixed Cassegrain GSMT focus

Ballpark Mass Budget (no lightweighing)

Fused Silica glass ~ 2.2 g/cm^3

⇒ Single Spectrograph glass mass ~ 400 kg

⇒ 1000 kg per spectrograph

⇒ 24,000 kg for all spectrographs

⇒ 16,000 kg for remaining structure

⇒ 40,000 kg for whole instrument