

# Magnification effects in galaxy-galaxy lensing

Sandra Unruh

20.12.2019

GCCL internode seminar

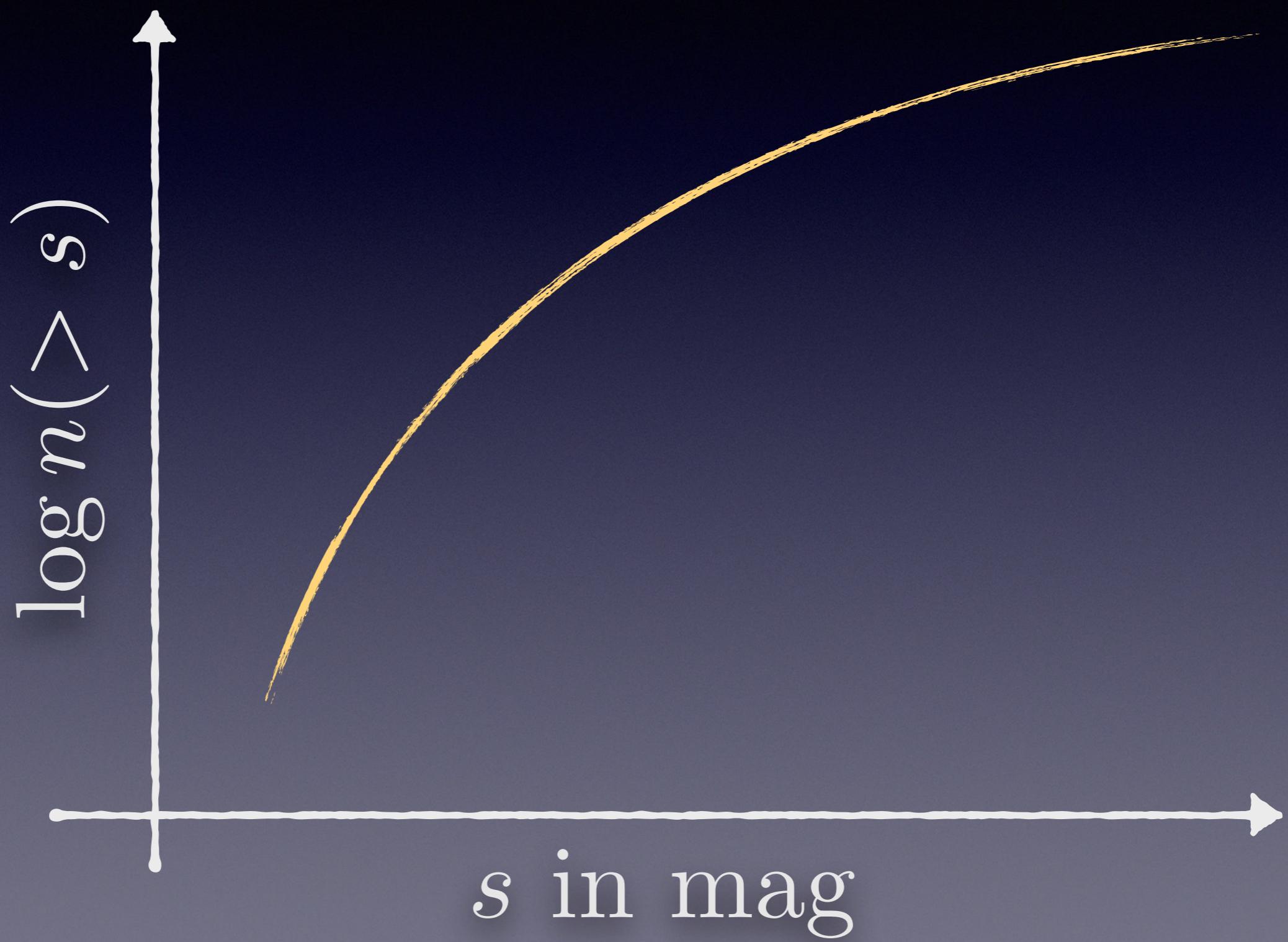
# Conclusions

- magnification affects lens and source galaxies, but lenses are more important
- impact depends on redshifts, limiting magnitudes and angle on the sky
- the lensing signal can be influenced up to 45%, mass estimates up to 55%

# Magnification

# Magnification effects

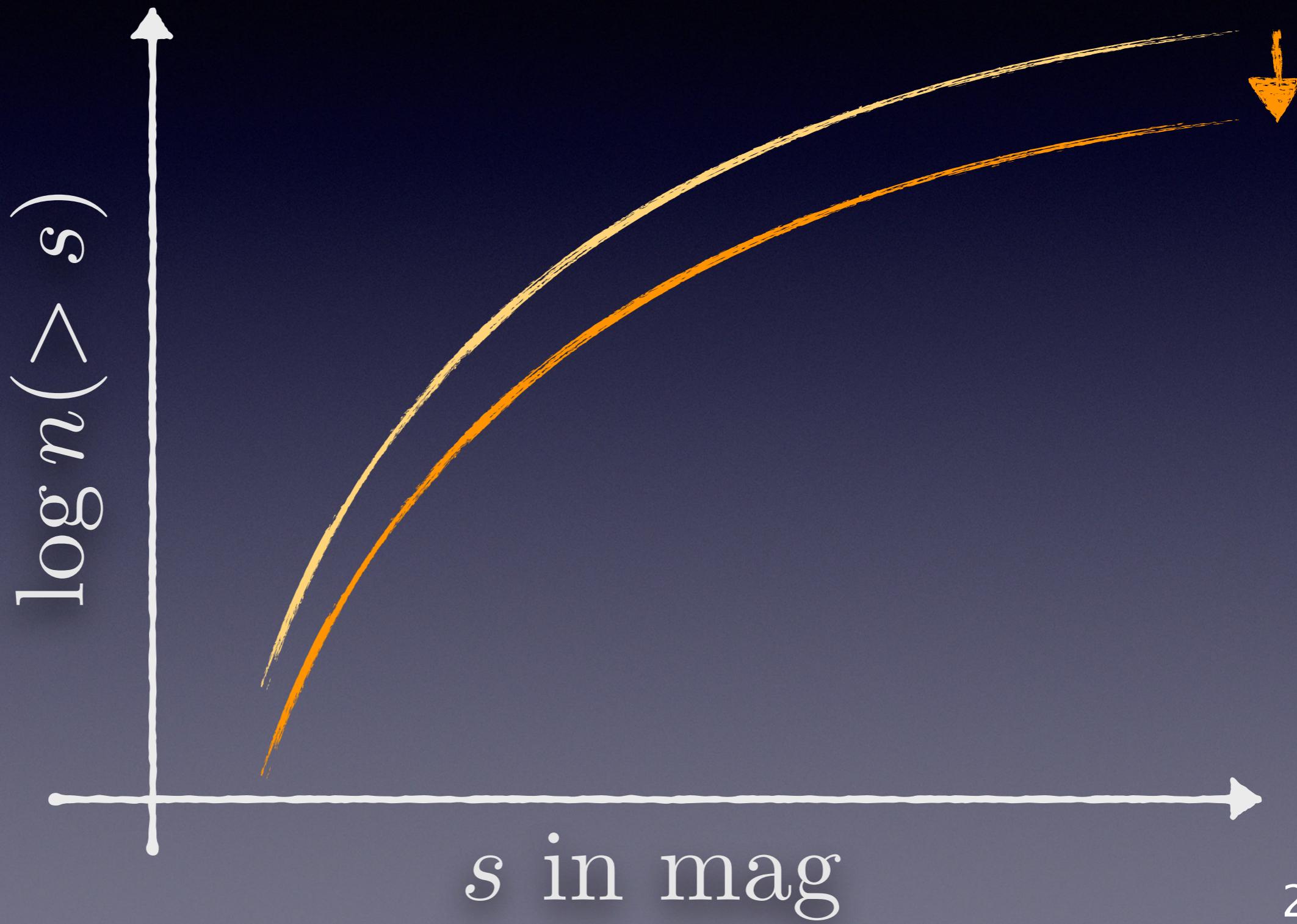
$$\mu > 1$$



# Magnification effects

$$\mu > 1$$

change  
of area

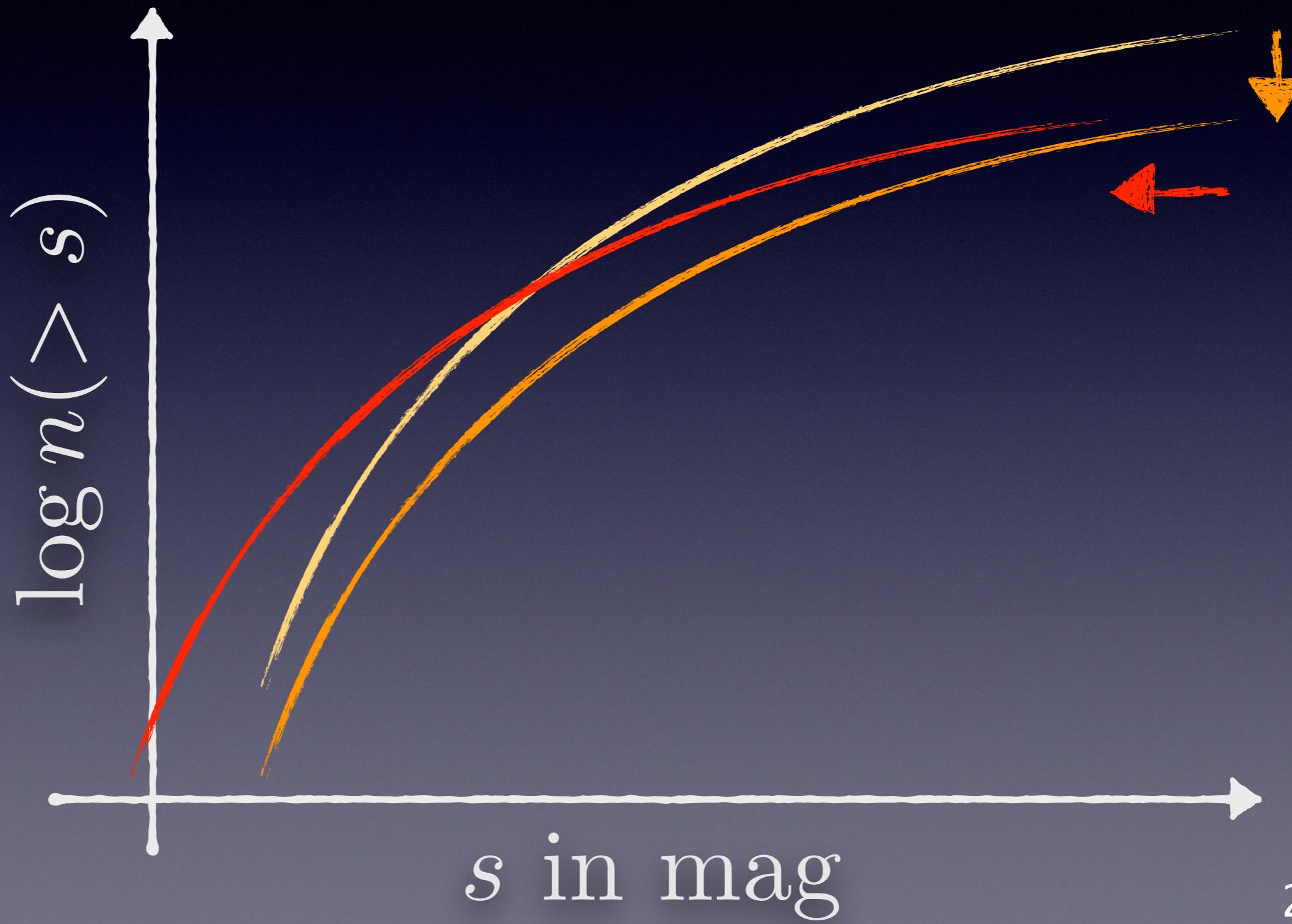


# Magnification effects

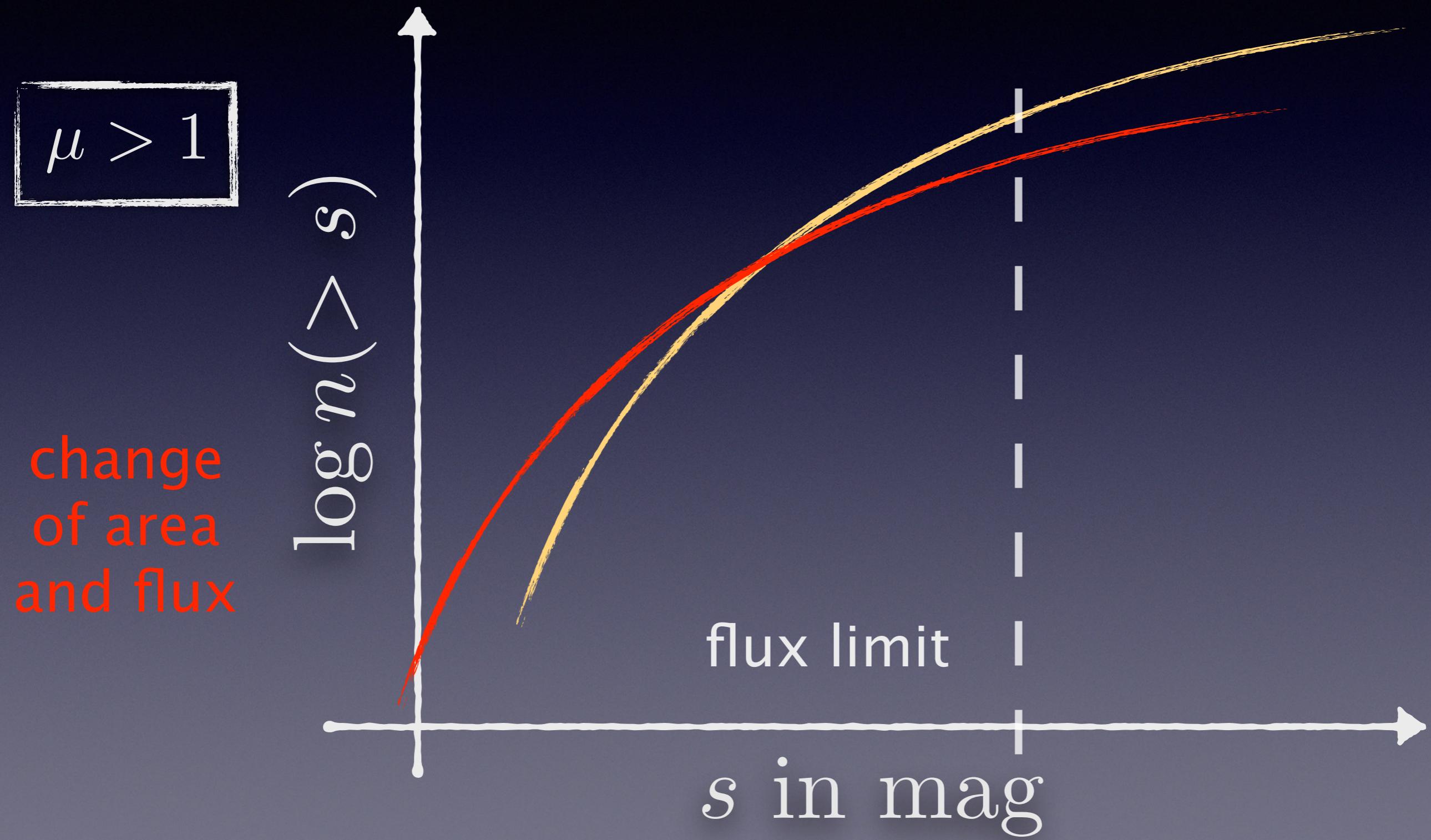
$$\mu > 1$$

change  
of area

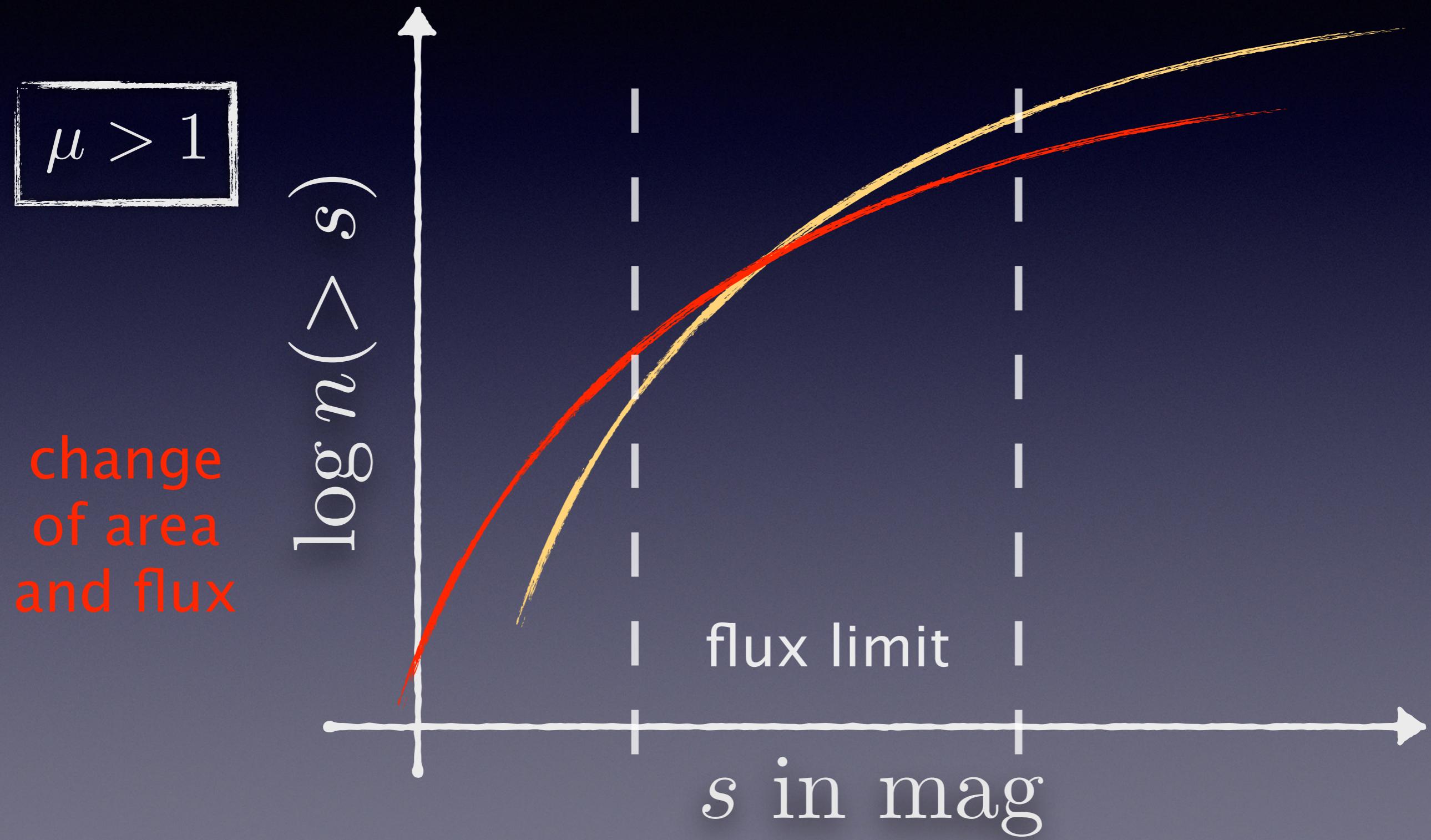
change  
of flux



# Magnification effects



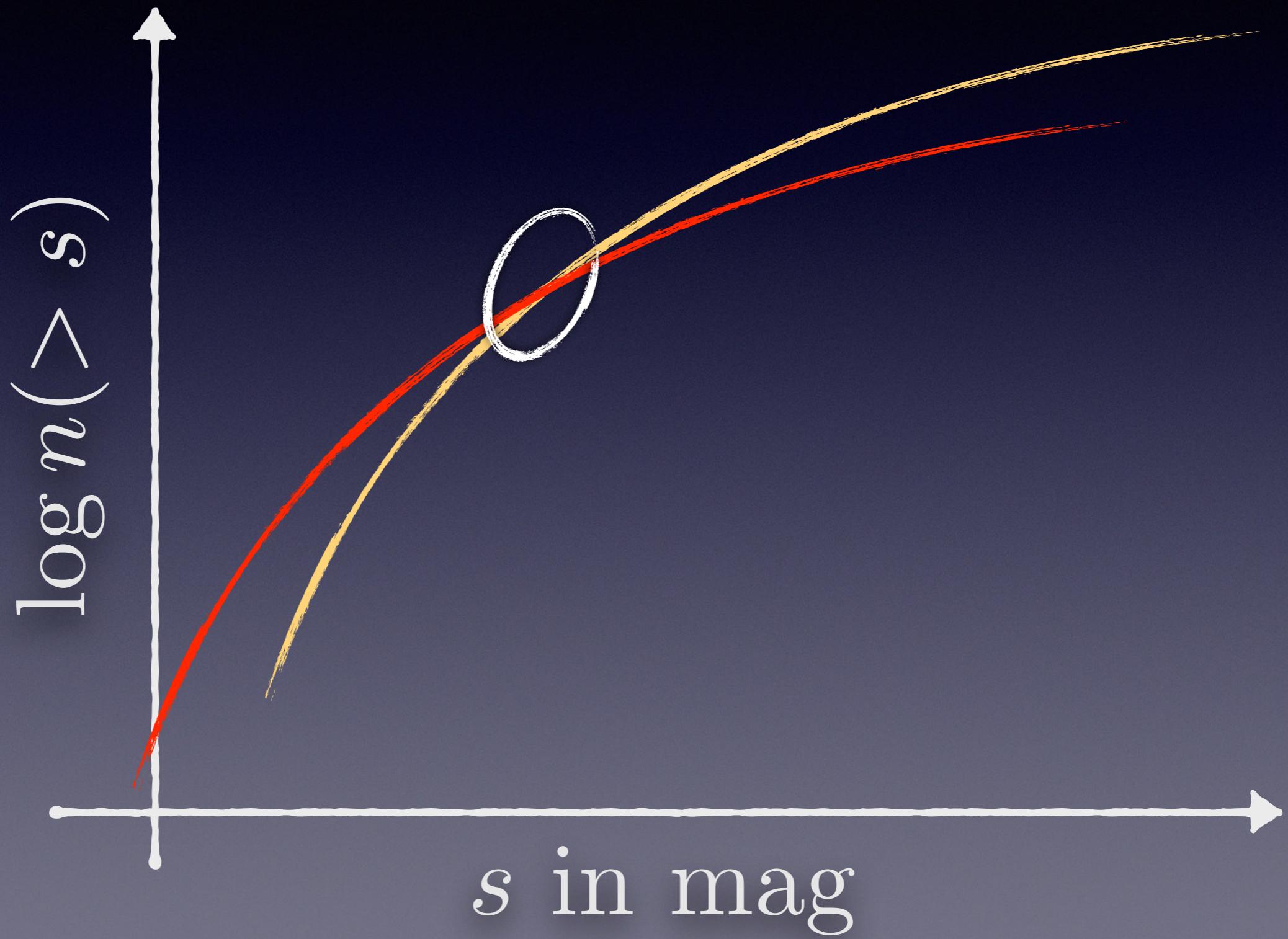
# Magnification effects



# Magnification effects

$$\mu > 1$$

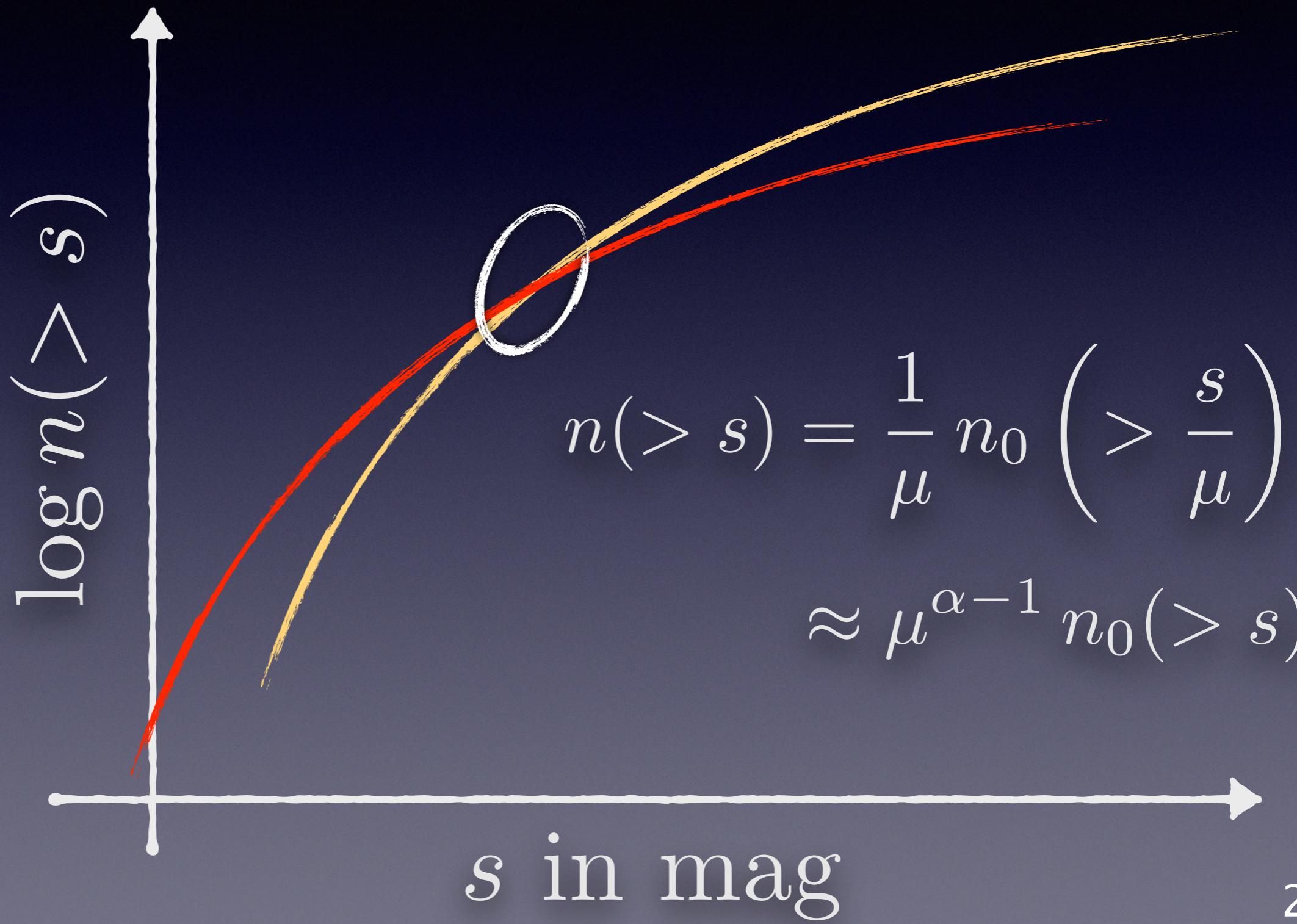
change  
of area  
and flux



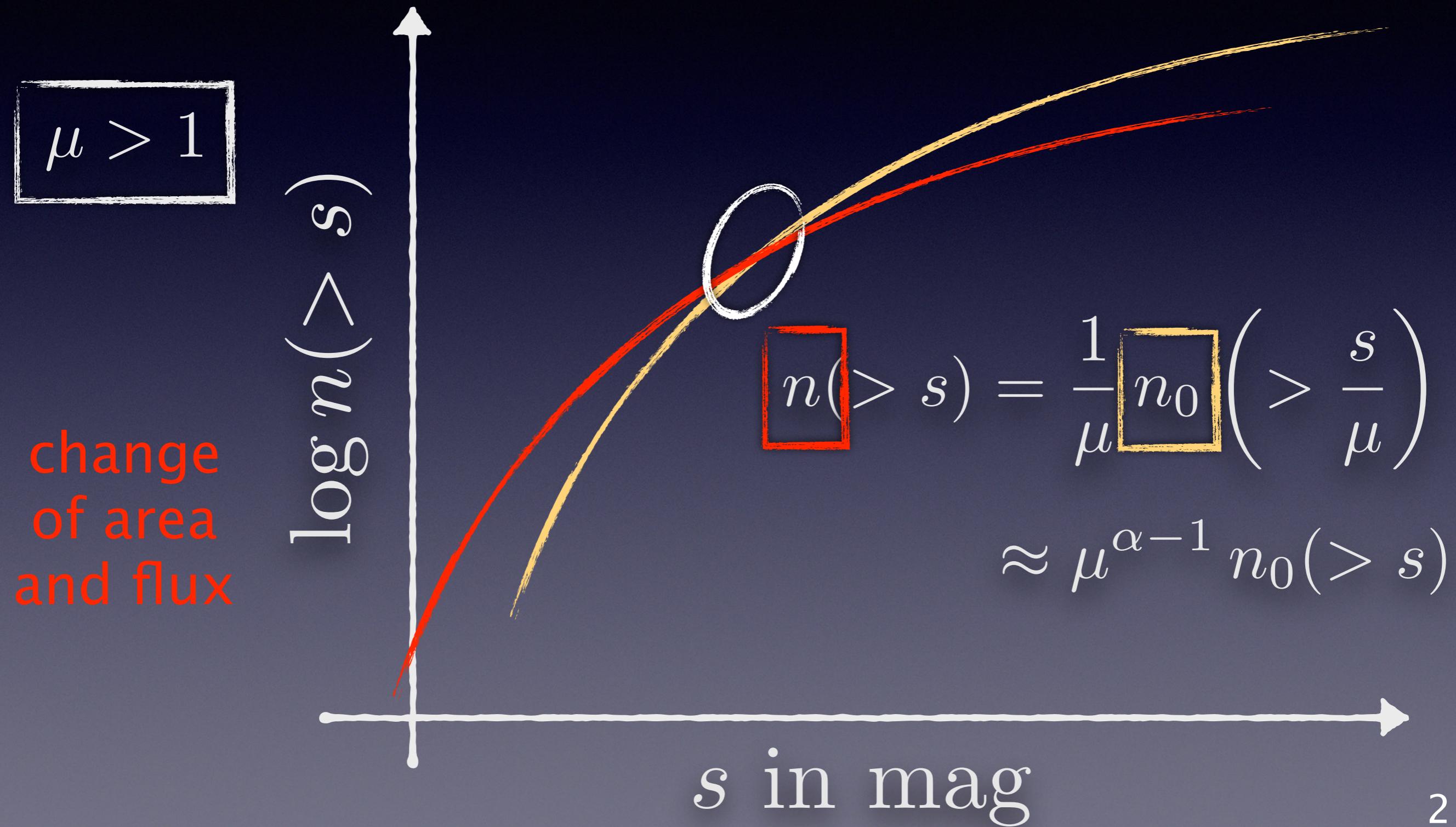
# Magnification effects

$$\mu > 1$$

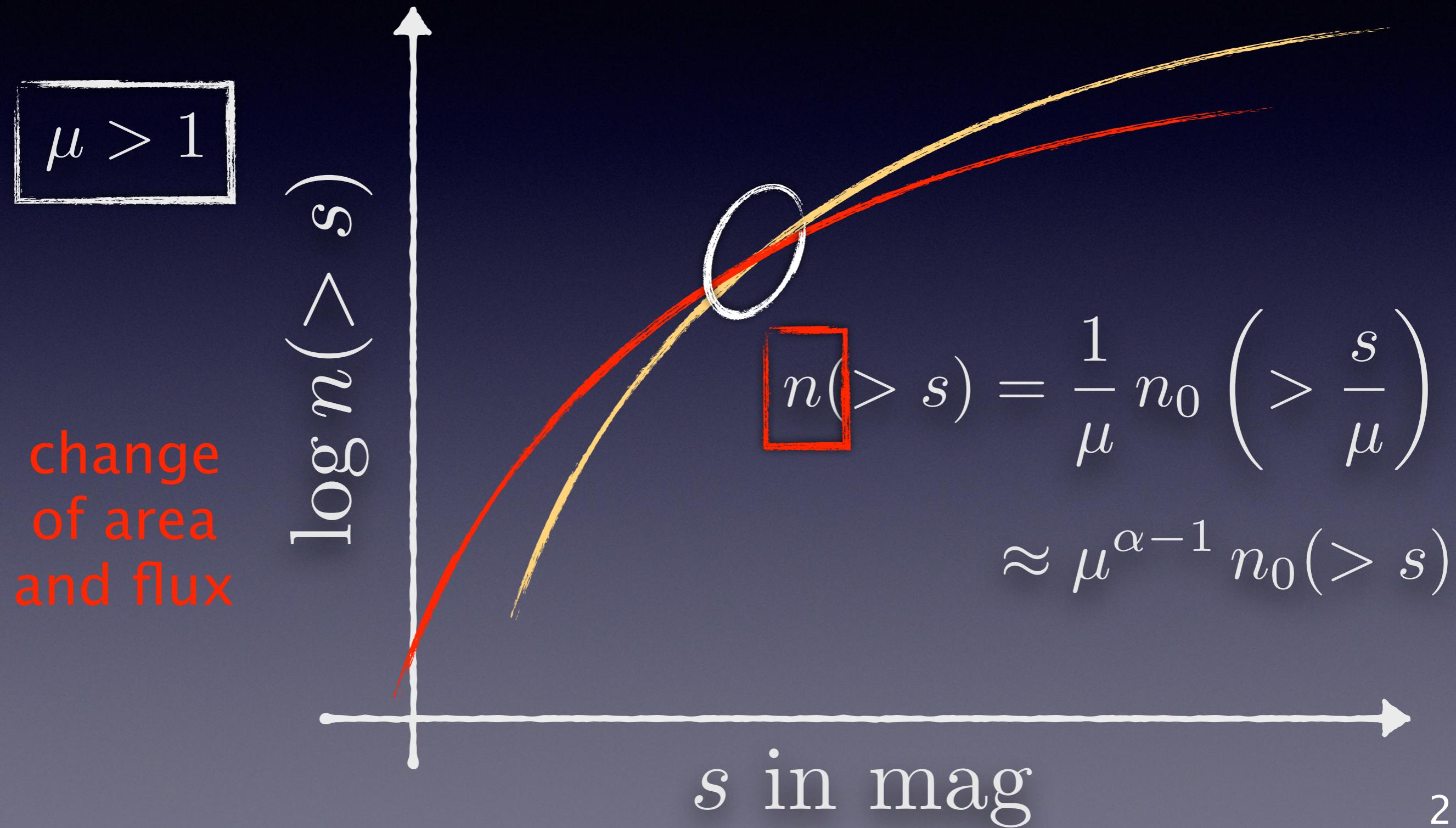
change  
of area  
and flux



# Magnification effects



# Magnification effects



# Galaxy-galaxy lensing

foreground  
galaxy positions

background  
galaxy shapes



line-of-sight



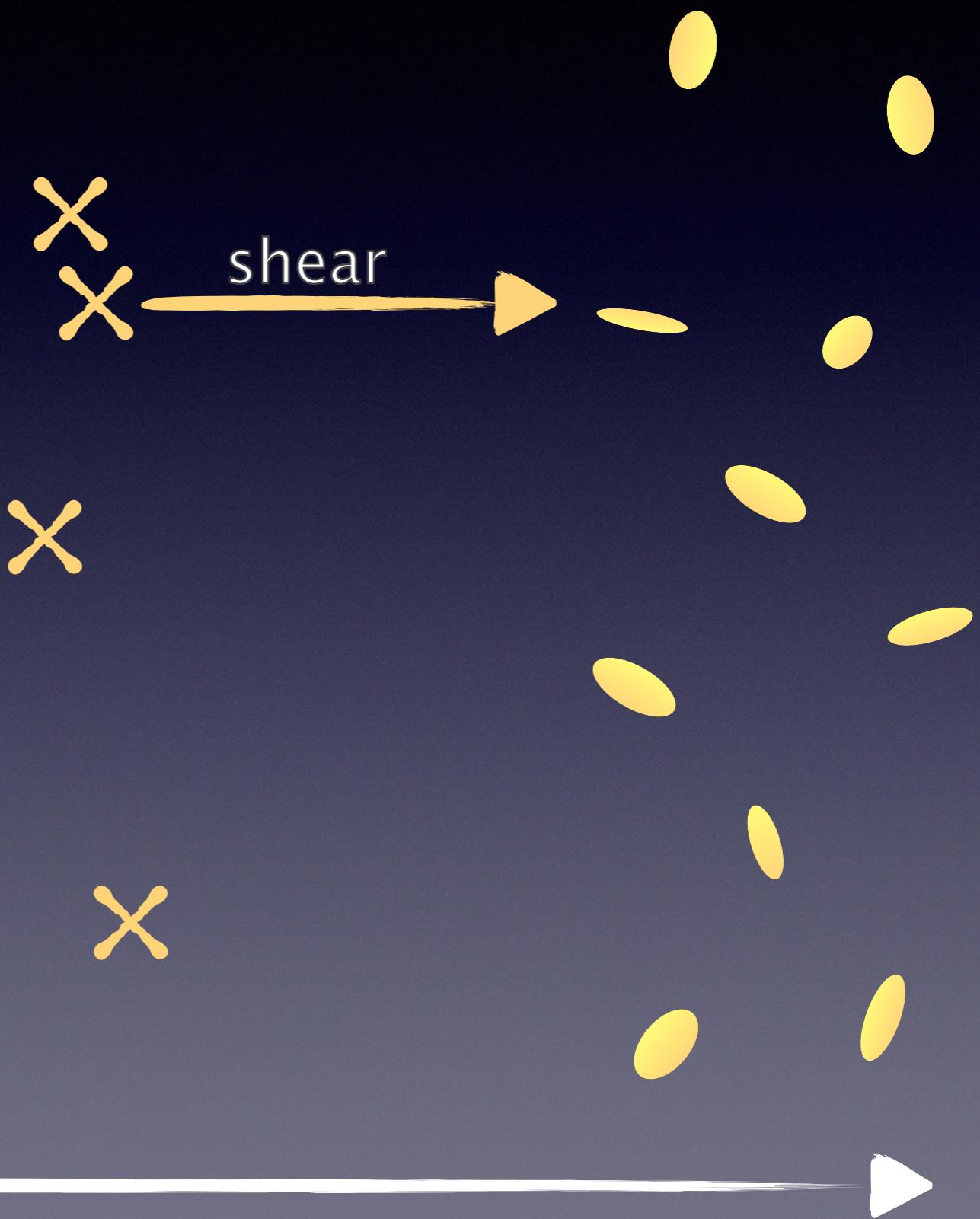
# Galaxy-galaxy lensing

$$\langle \gamma_t \rangle(\theta) = \langle \kappa_g(\theta') \gamma_t(\theta' + \theta) \rangle$$

line-of-sight

foreground  
galaxy positions

background  
galaxy shapes



# Simulated data

- ray-tracing through Millennium Simulation  
(Hilbert et al. 2009) (Springel et al. 2005)
- 4x4 deg<sup>2</sup> field-of-view resolved on 4096<sup>2</sup> pixel with 64 realizations per redshift
- galaxy catalogues from semi-analytical galaxy formation models  
(Henriques et al. 2015)
- fit the resulting shear profile with a halo-model approach  
(Martin, PhD thesis 2019, paper in prep)

# Magnification effects on foreground galaxies

foreground  
galaxy positions

background  
galaxy shapes



line-of-sight

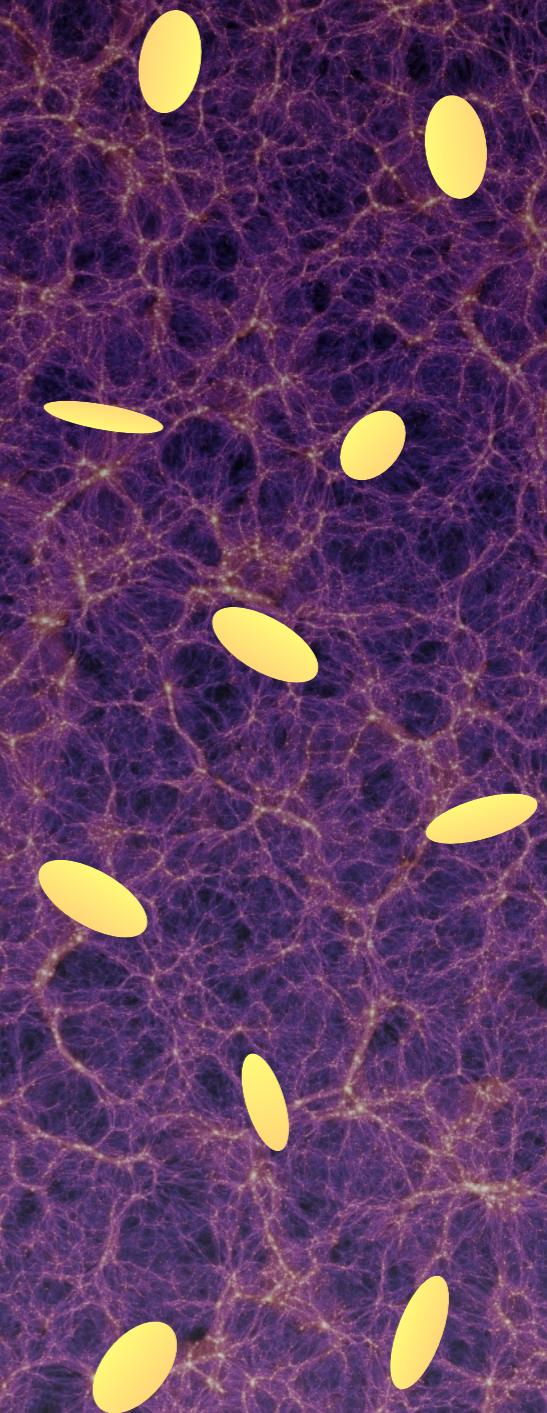


foreground  
galaxy positions

background  
galaxy shapes



line-of-sight



foreground  
galaxy positions

background  
galaxy shapes

change of observed  
number density

line-of-sight

foreground  
galaxy positions

background  
galaxy shapes

change of observed  
number density

shear

line-of-sight

# Analytic approximation

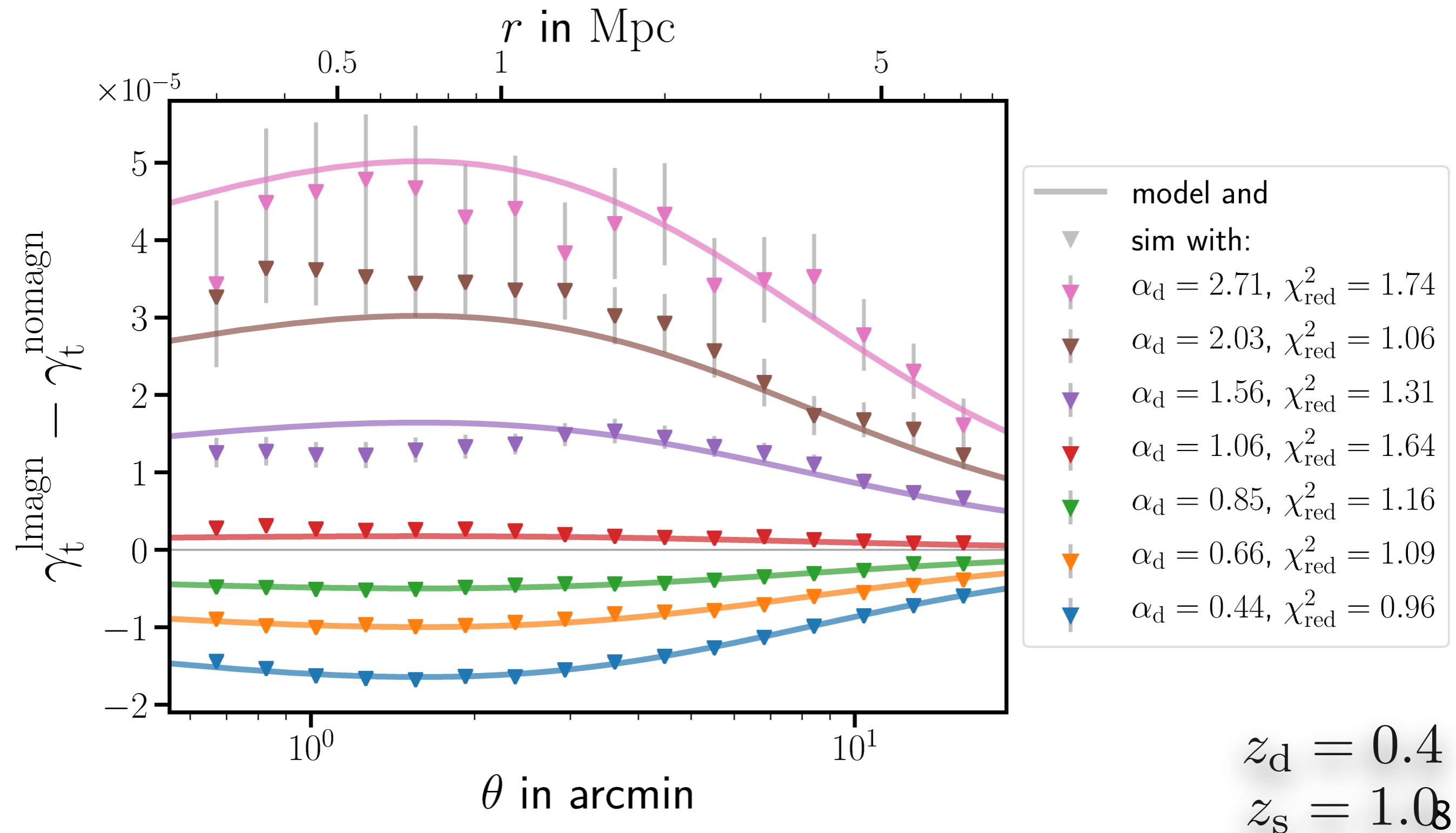
$$\gamma_t = \gamma_t^{\text{nomagn}} + 2(\alpha_d - 1)\gamma_t^{\text{LSS}}$$



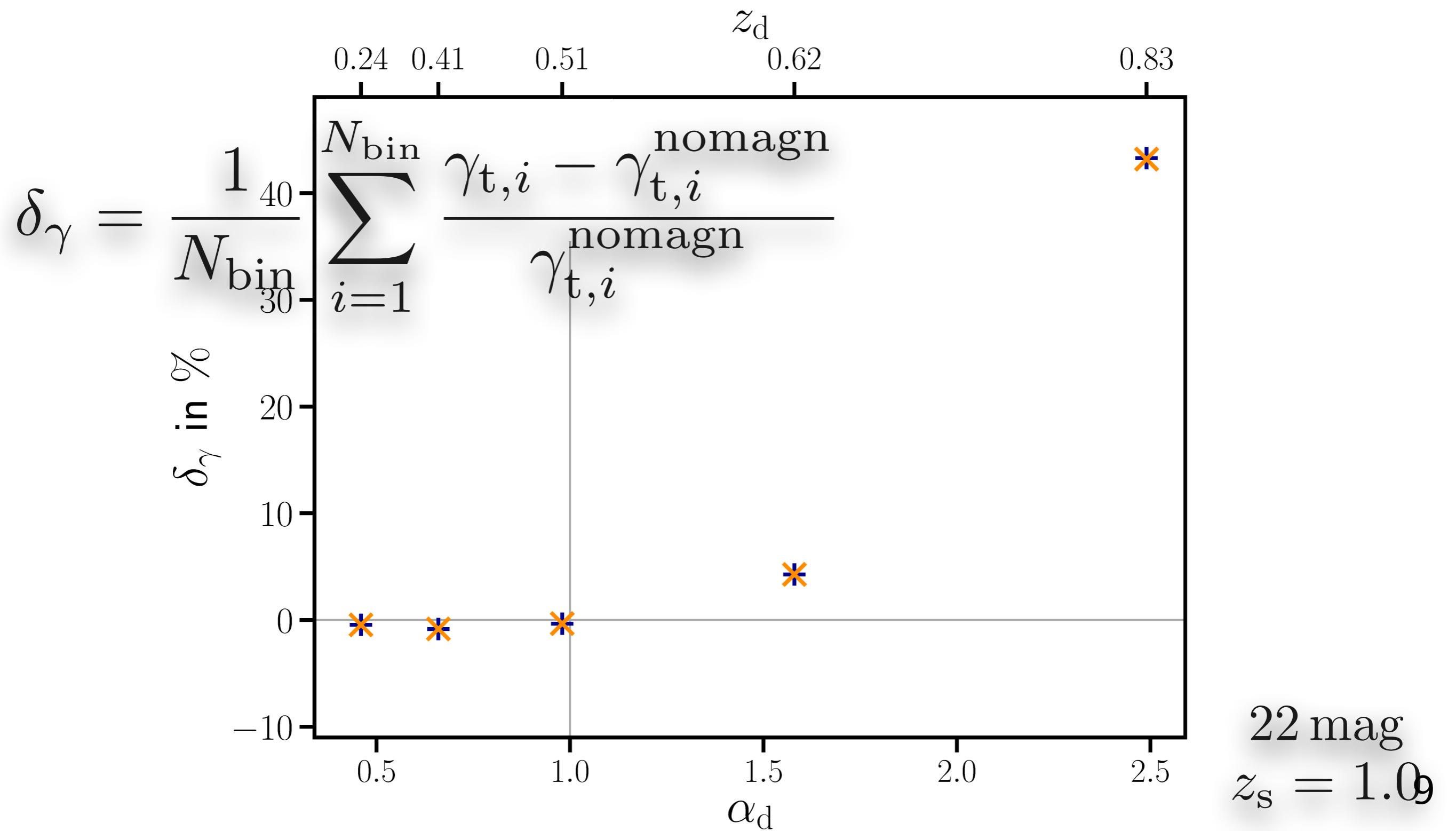
weighted integral over  
matter power spectrum

$$\gamma_t^{\text{LSS}} = \frac{9H_0^3\Omega_m^2}{4c^3} \int_0^\infty d\ell \ell J_2(\ell\theta) \int_0^{z_d} dz \frac{H_0}{H(z)} \frac{D(z, z_d)D(z, z_s)}{D_d D_s} P_m \left( \frac{\ell + 1/2}{(1+z)D(z)}; z \right)$$

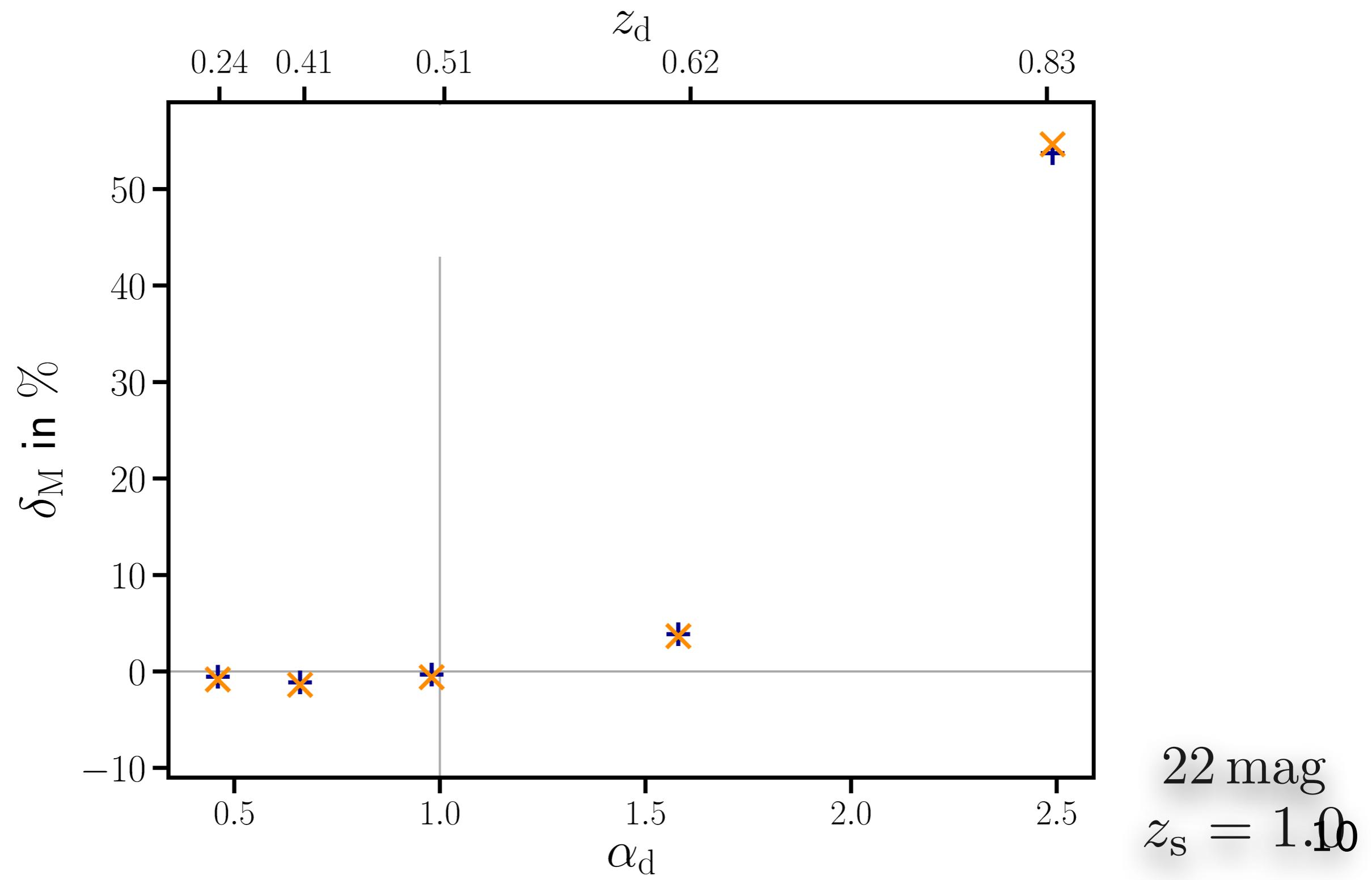
# Magnification effect as a function of lim. magnitude

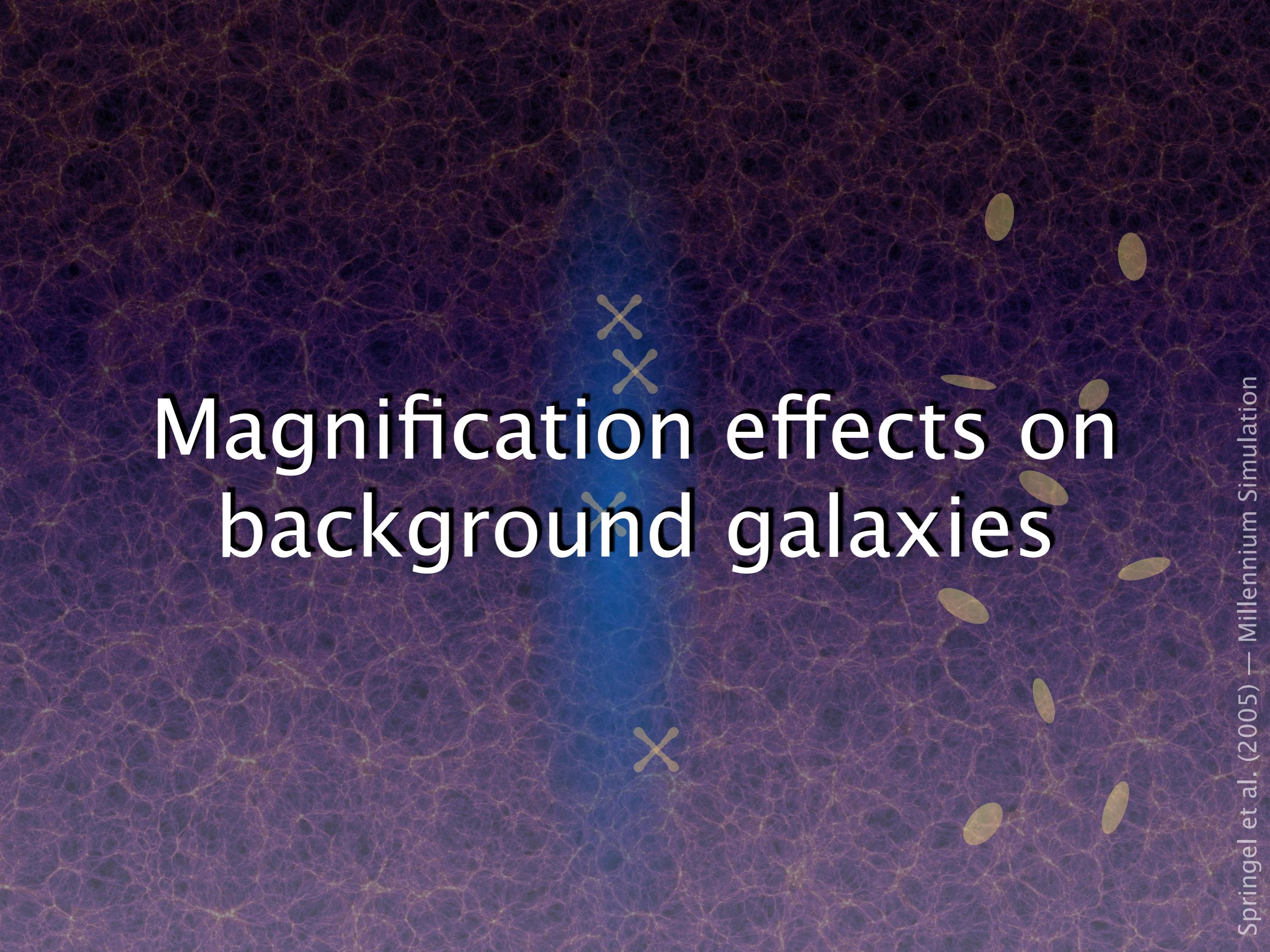


# Magnification effect as a function of redshift



# Magnification effect as a function of redshift





# Magnification effects on background galaxies

foreground  
galaxy positions

background  
galaxy shapes



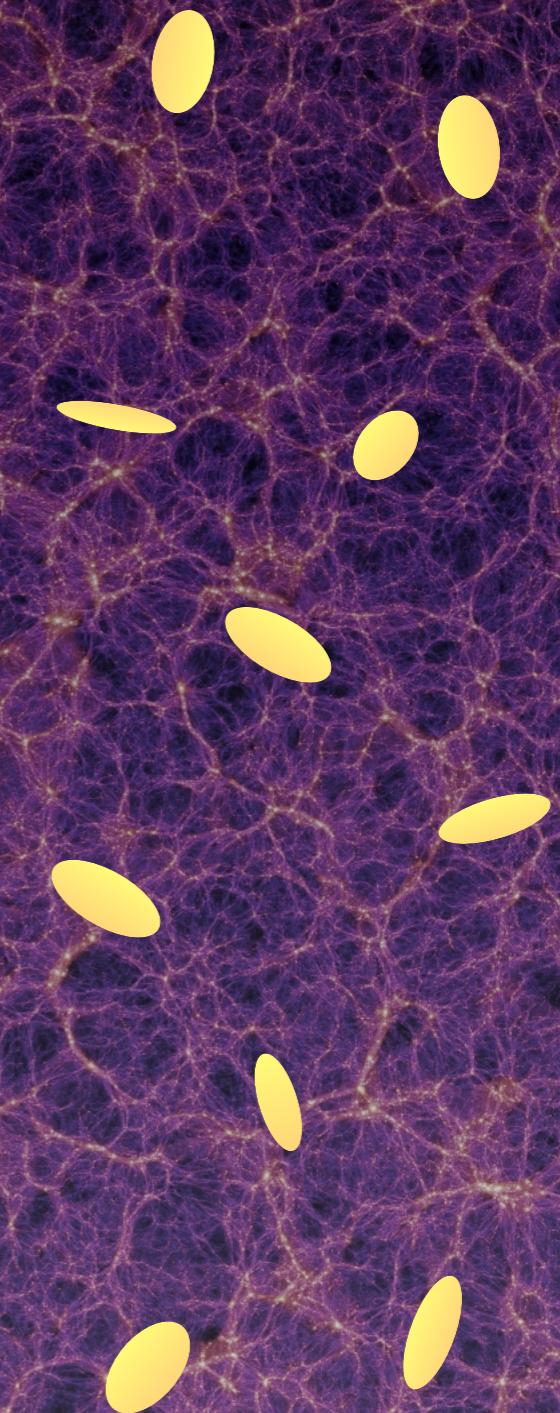
line-of-sight



foreground  
galaxy positions

background  
galaxy shapes

line-of-sight



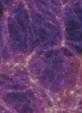
# foreground galaxy positions

# background galaxy shapes

# line-of-sight



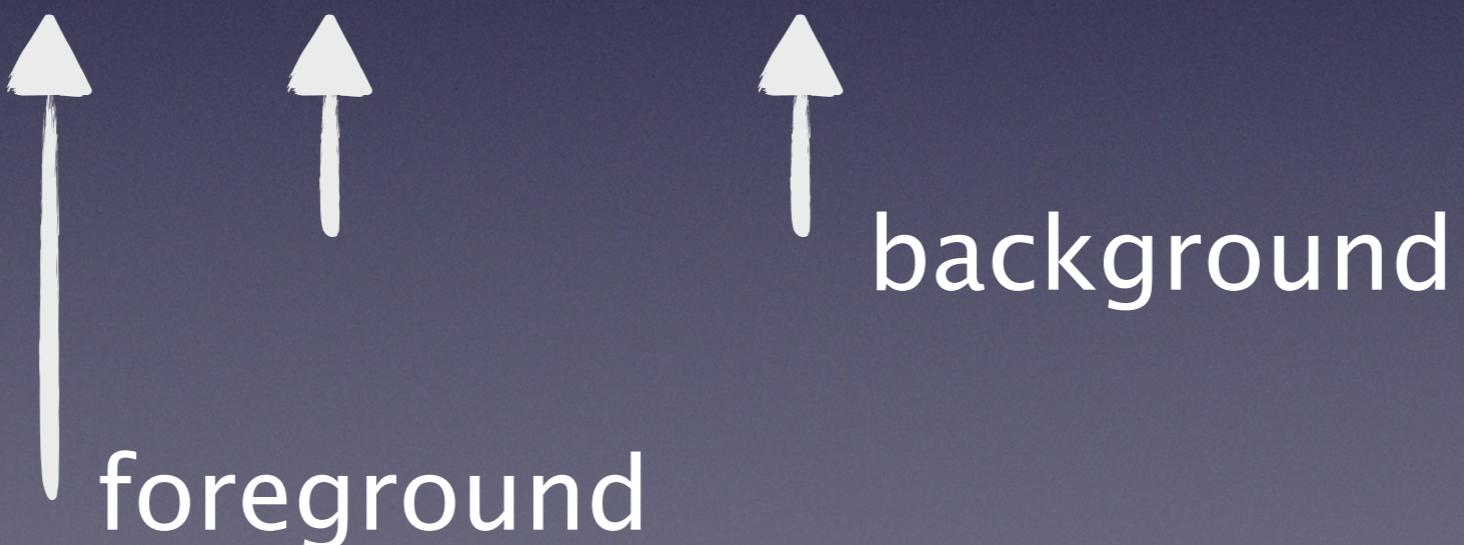
# change of observed number density



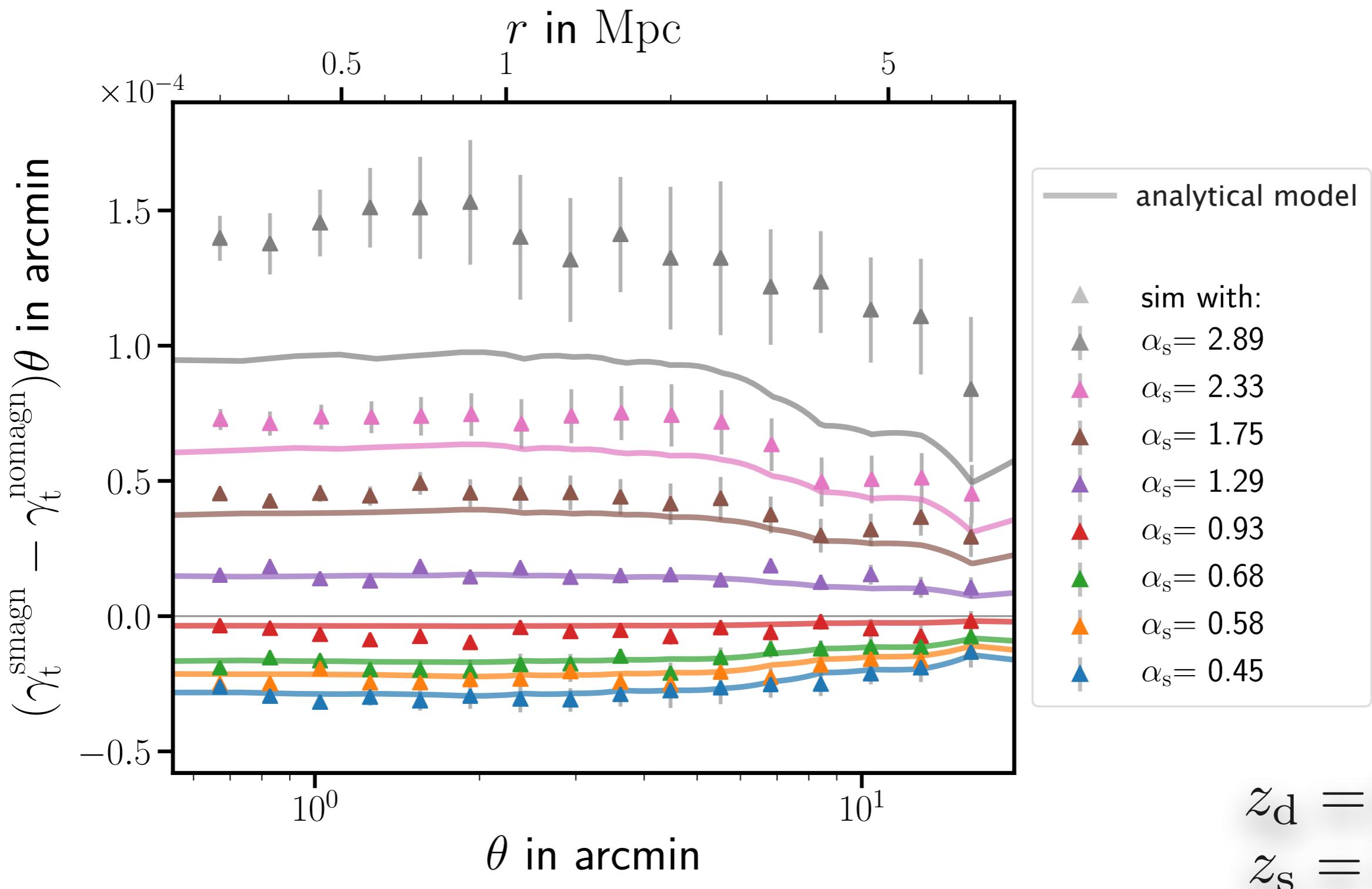
# Analytic approximation

$$\langle \gamma_t \rangle = \langle \gamma_t^{\text{nomagn}} \rangle + 2(\alpha_s - 1) \langle \gamma_t^{\text{3GL}} \rangle$$

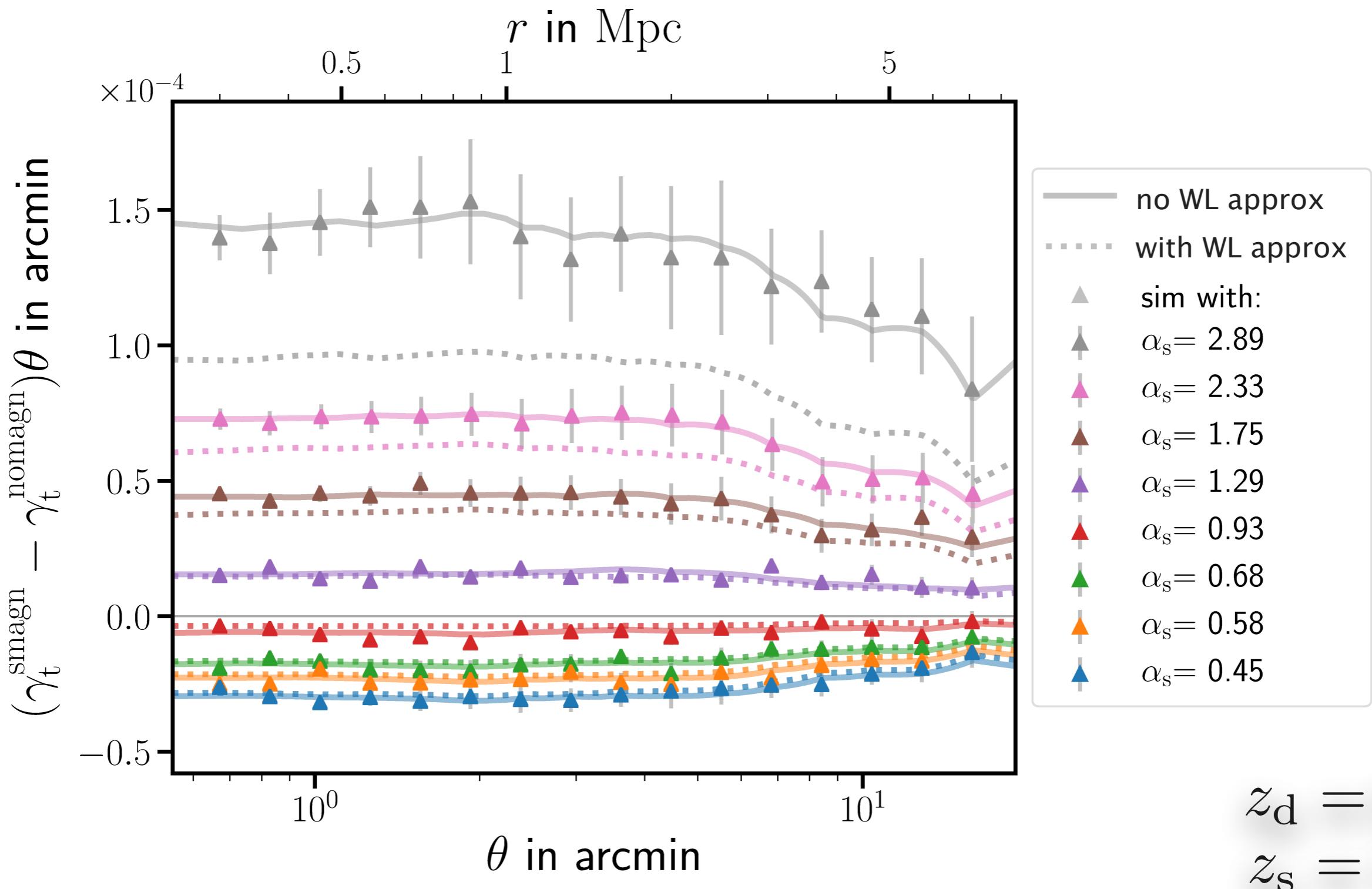
$$\gamma_t^{\text{3GL}} = \kappa_g(\theta') \gamma_t(\theta' + \theta) \kappa(\theta' + \theta)$$



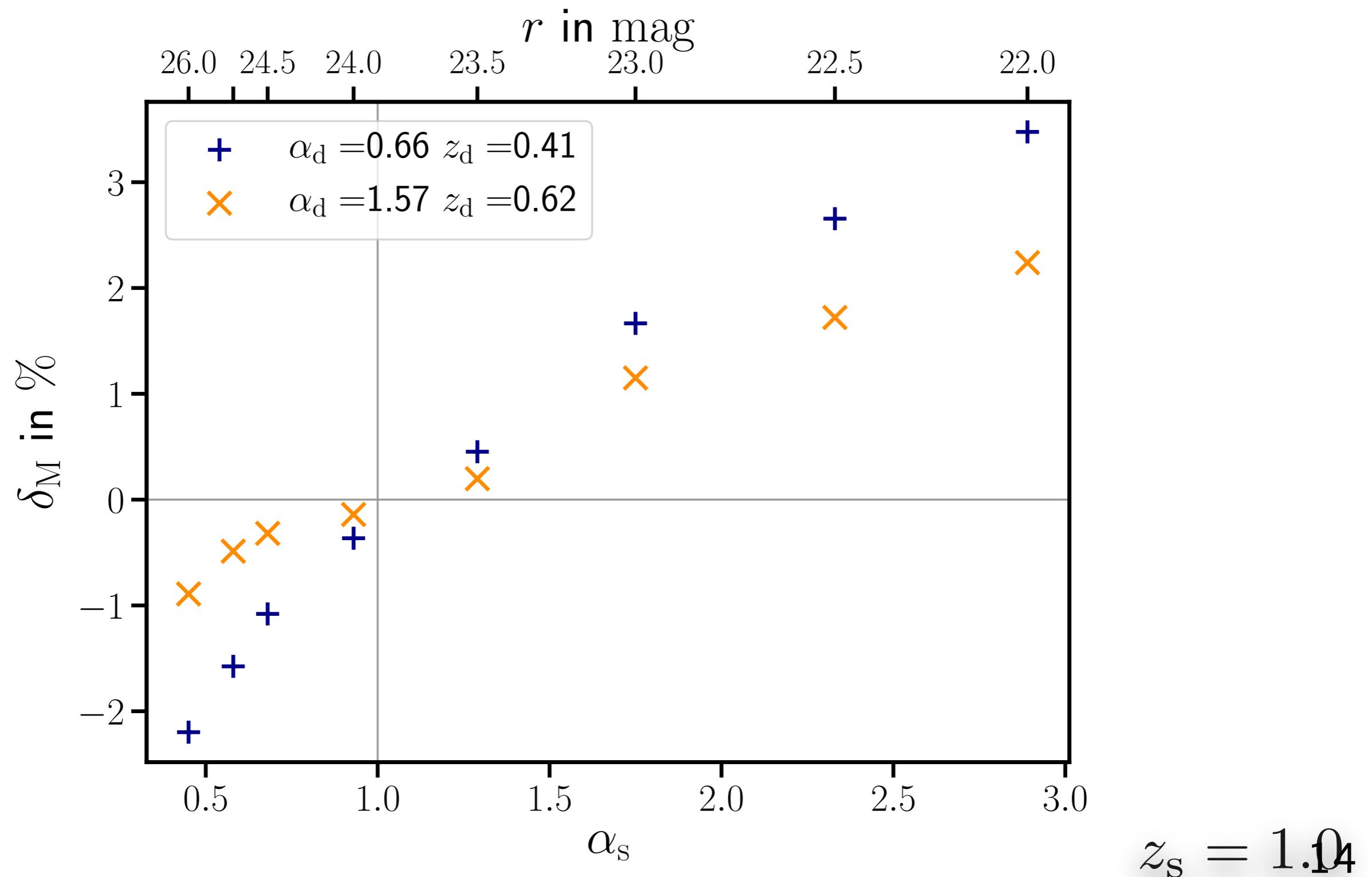
# Magnification effect as a function of lim. magnitude

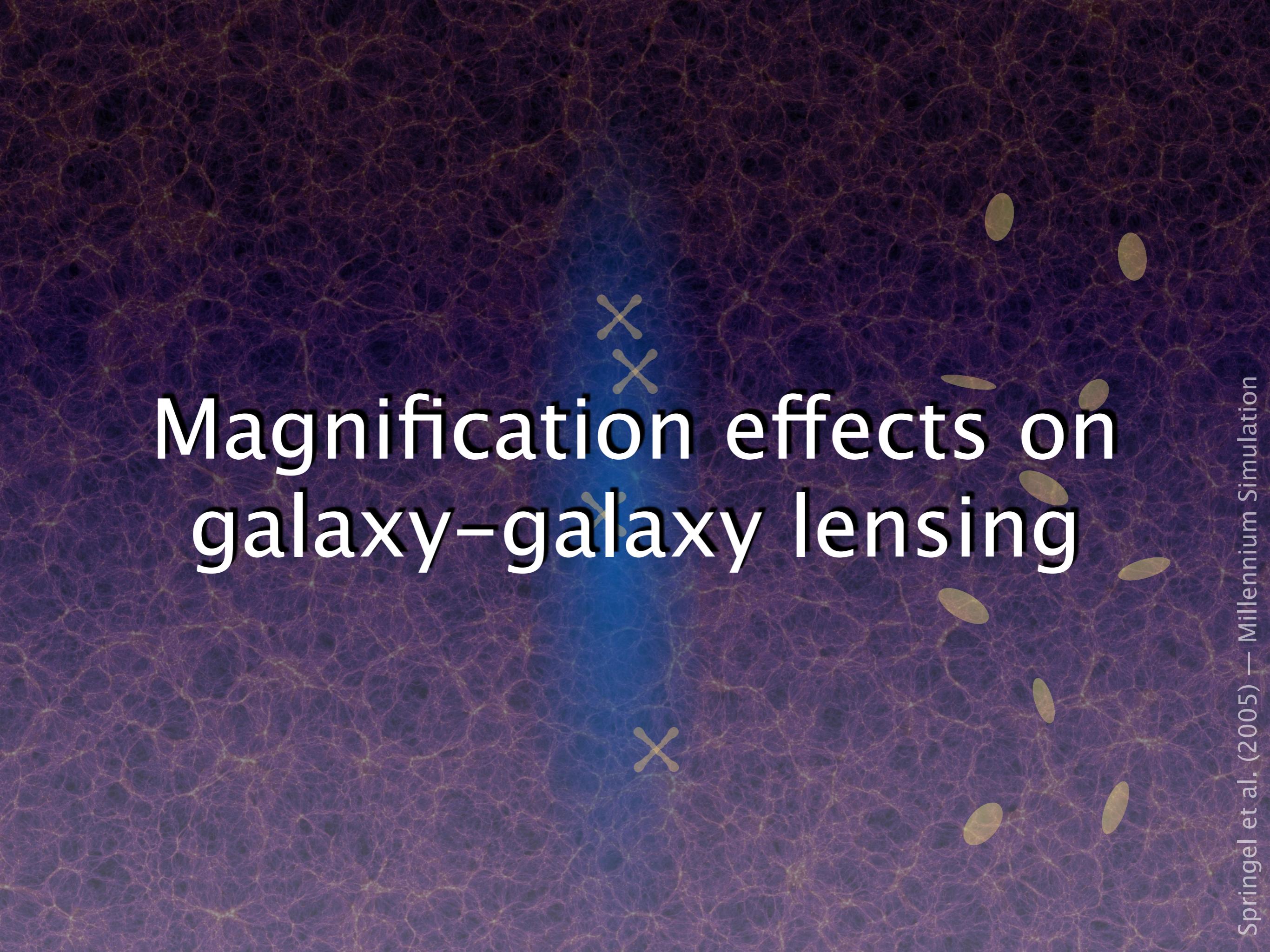


# Magnification effect as a function of lim. magnitude

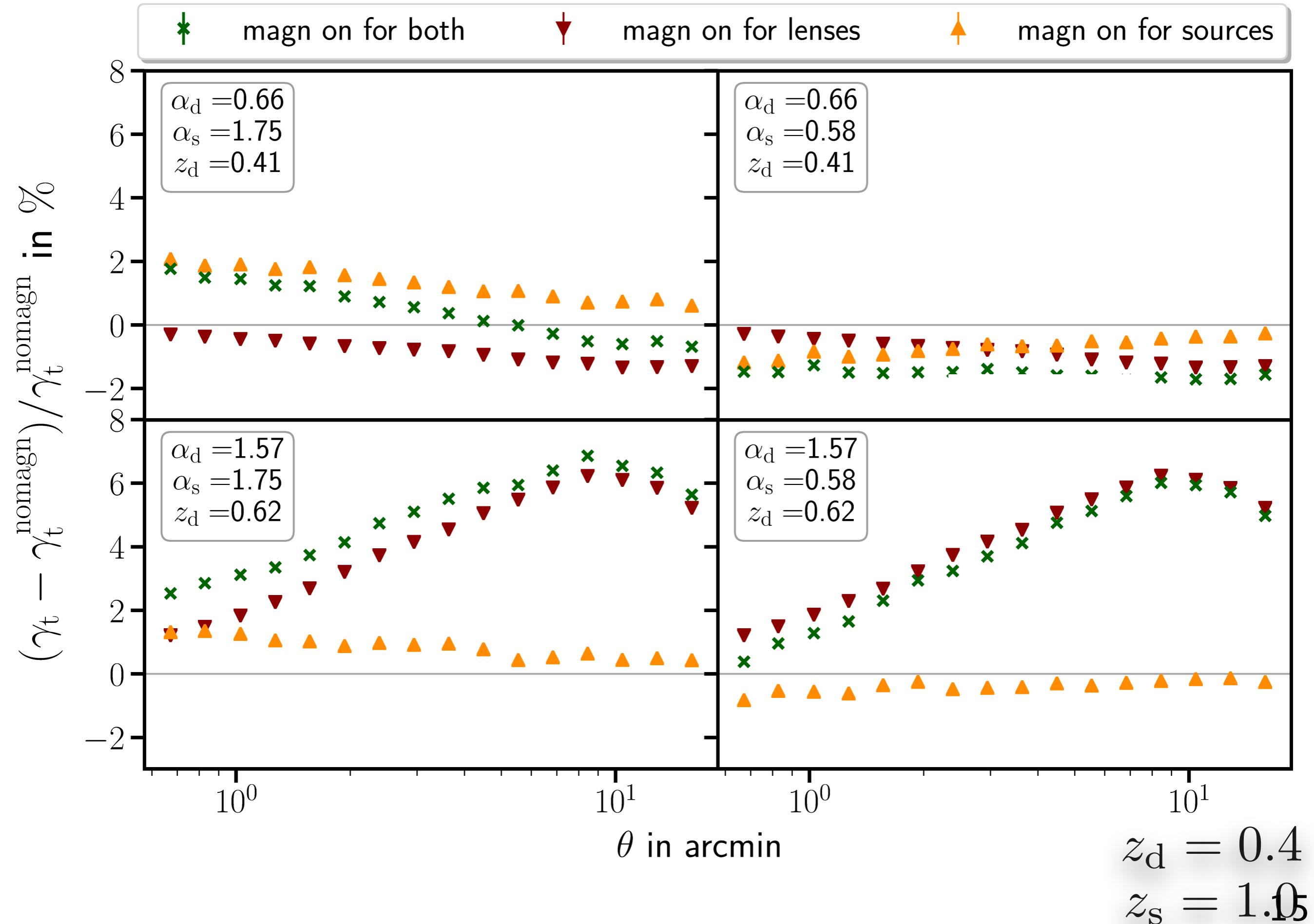


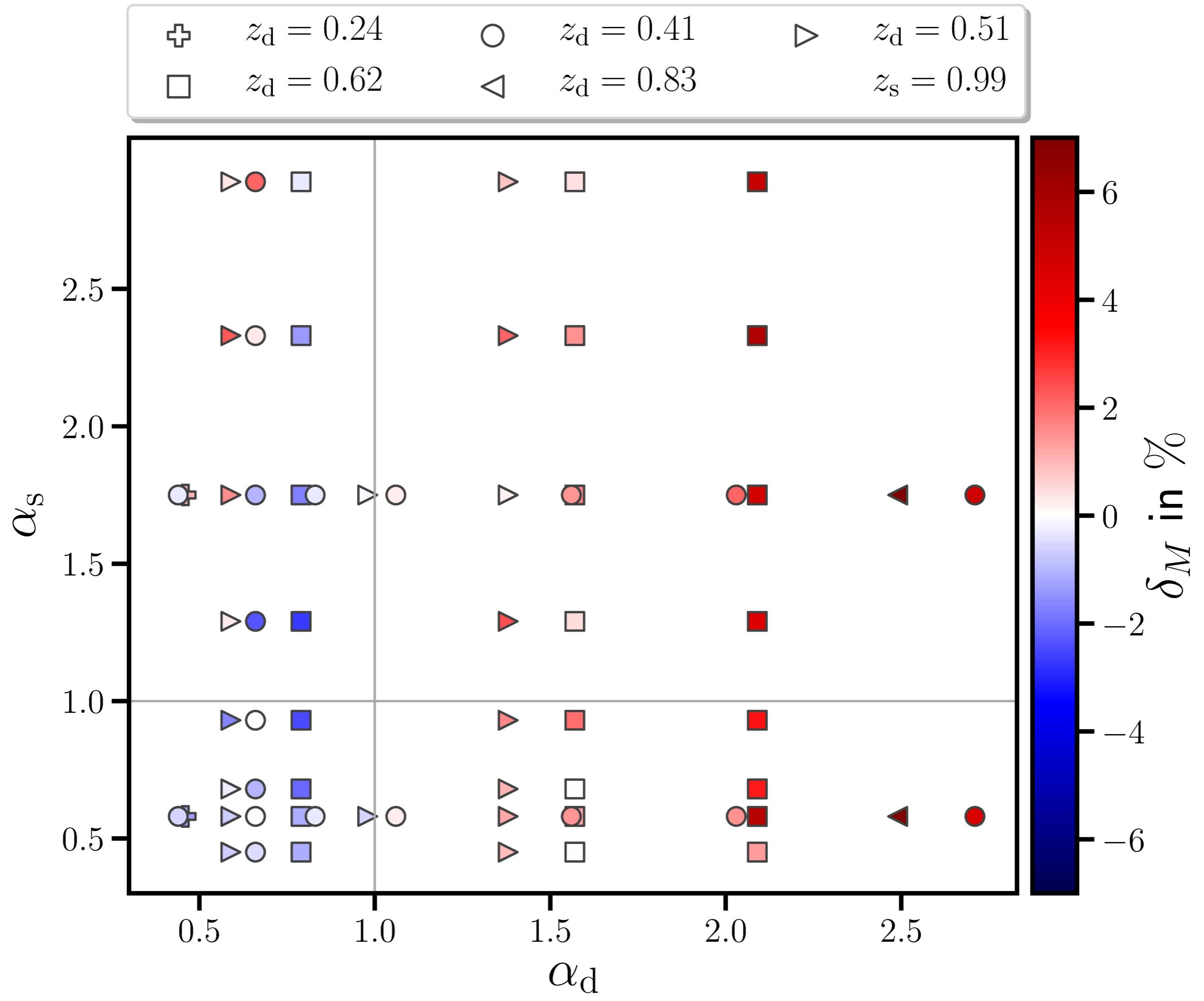
# Magnification effect as a function of lim. magnitude





# Magnification effects on galaxy-galaxy lensing





# Conclusions

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- impact depends on redshifts, limiting magnitudes and angle on the sky
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# Thank you for your attention

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