On clustering analyses with flux magnification

Christopher Duncan
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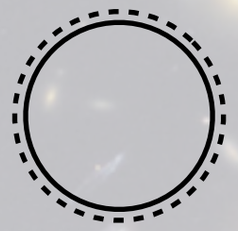
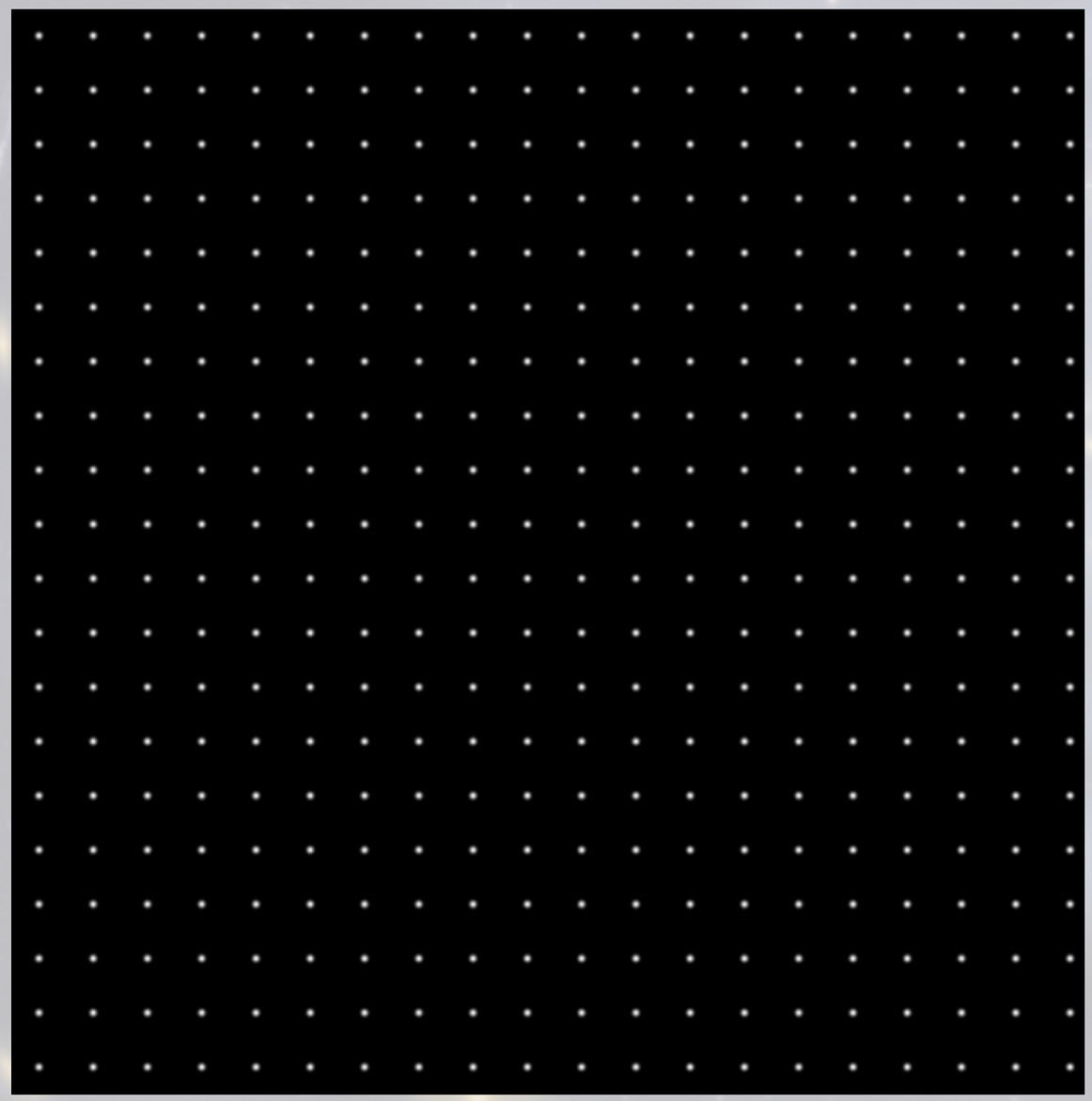
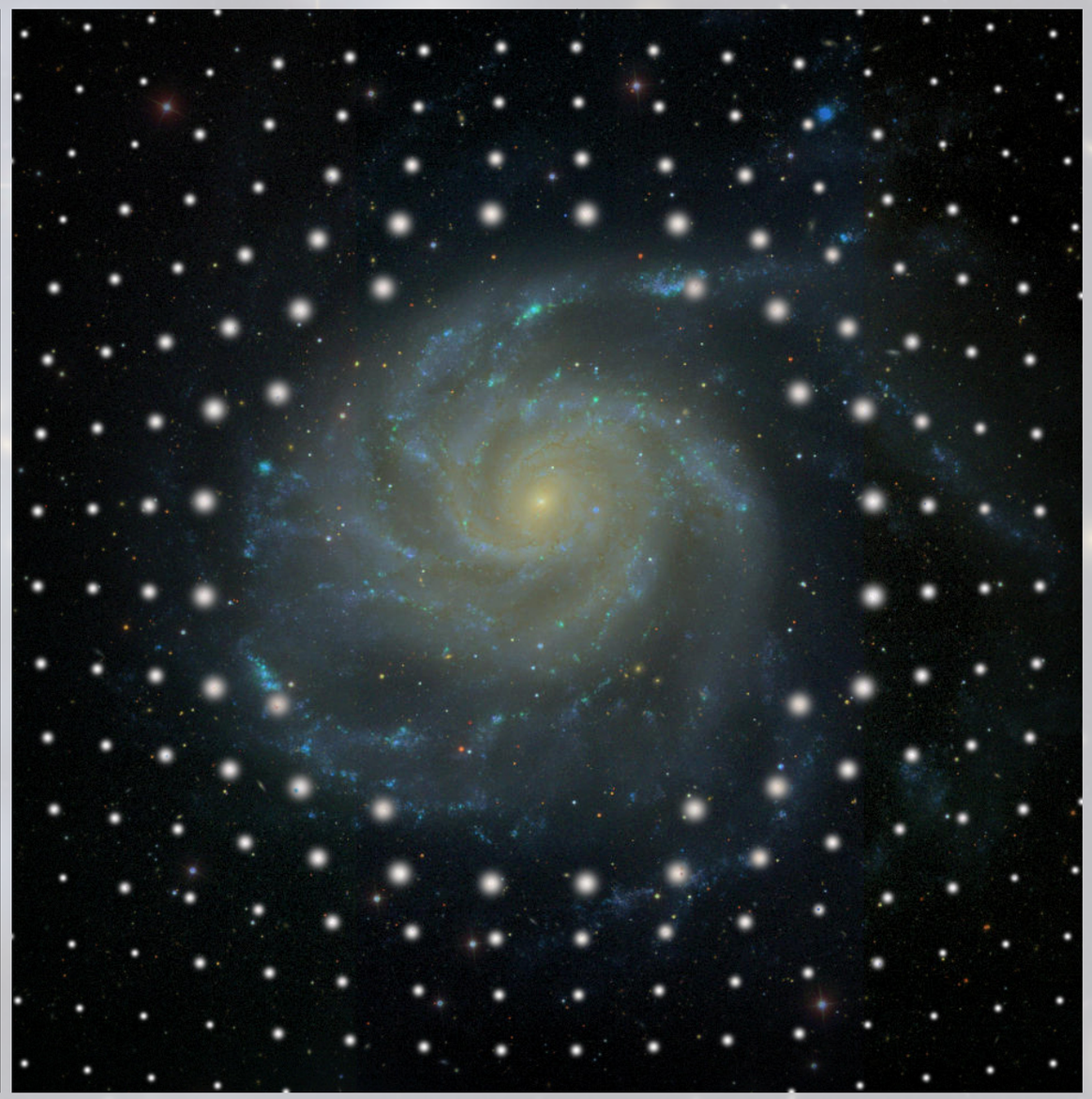


1. Change in solid angle behind lens

2. Change in flux of the source





Credit: Joerg Colberg, Ryan Scranton, Robert Lupton, SDSS

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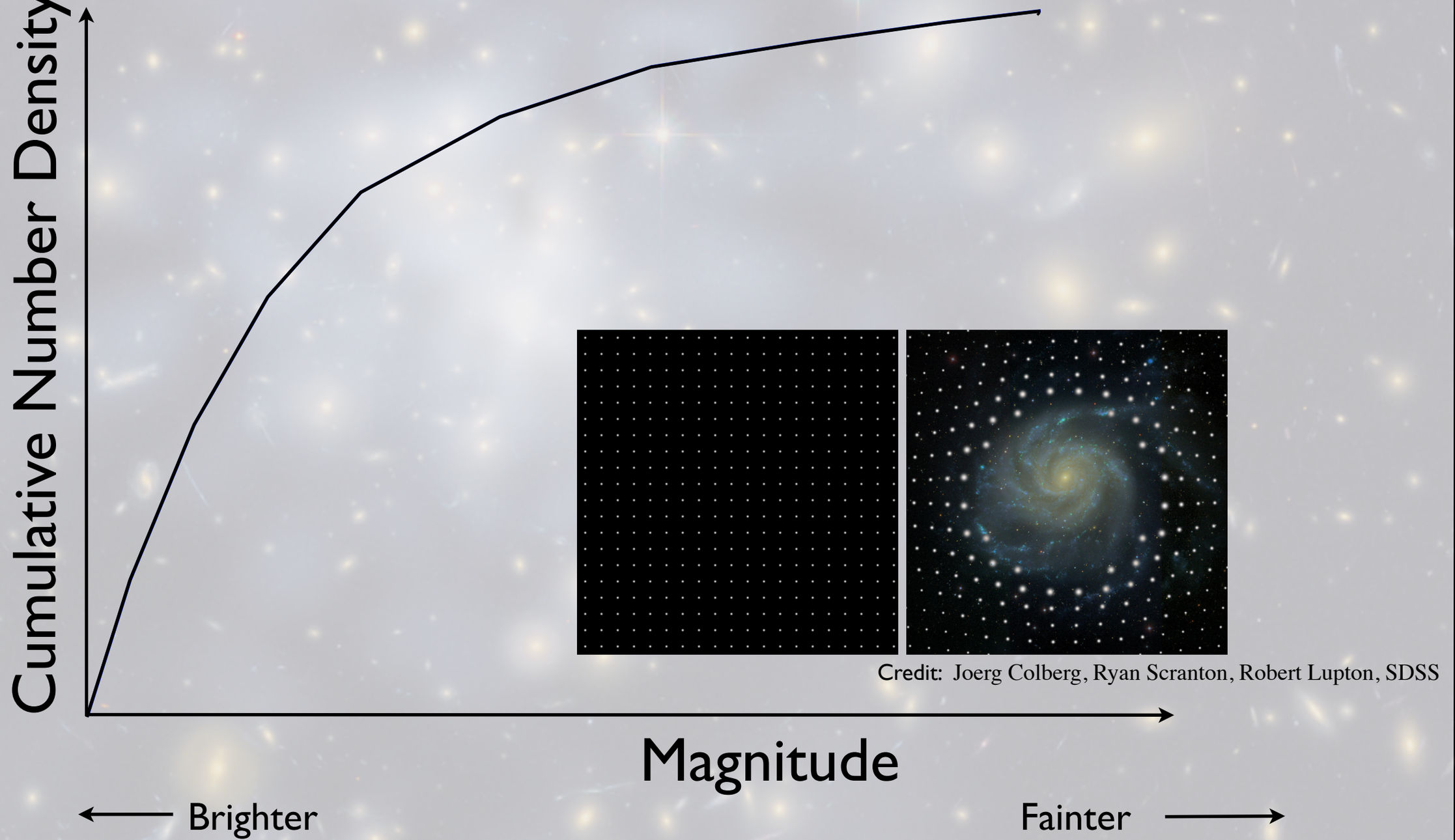

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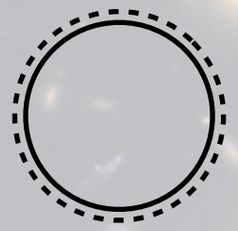

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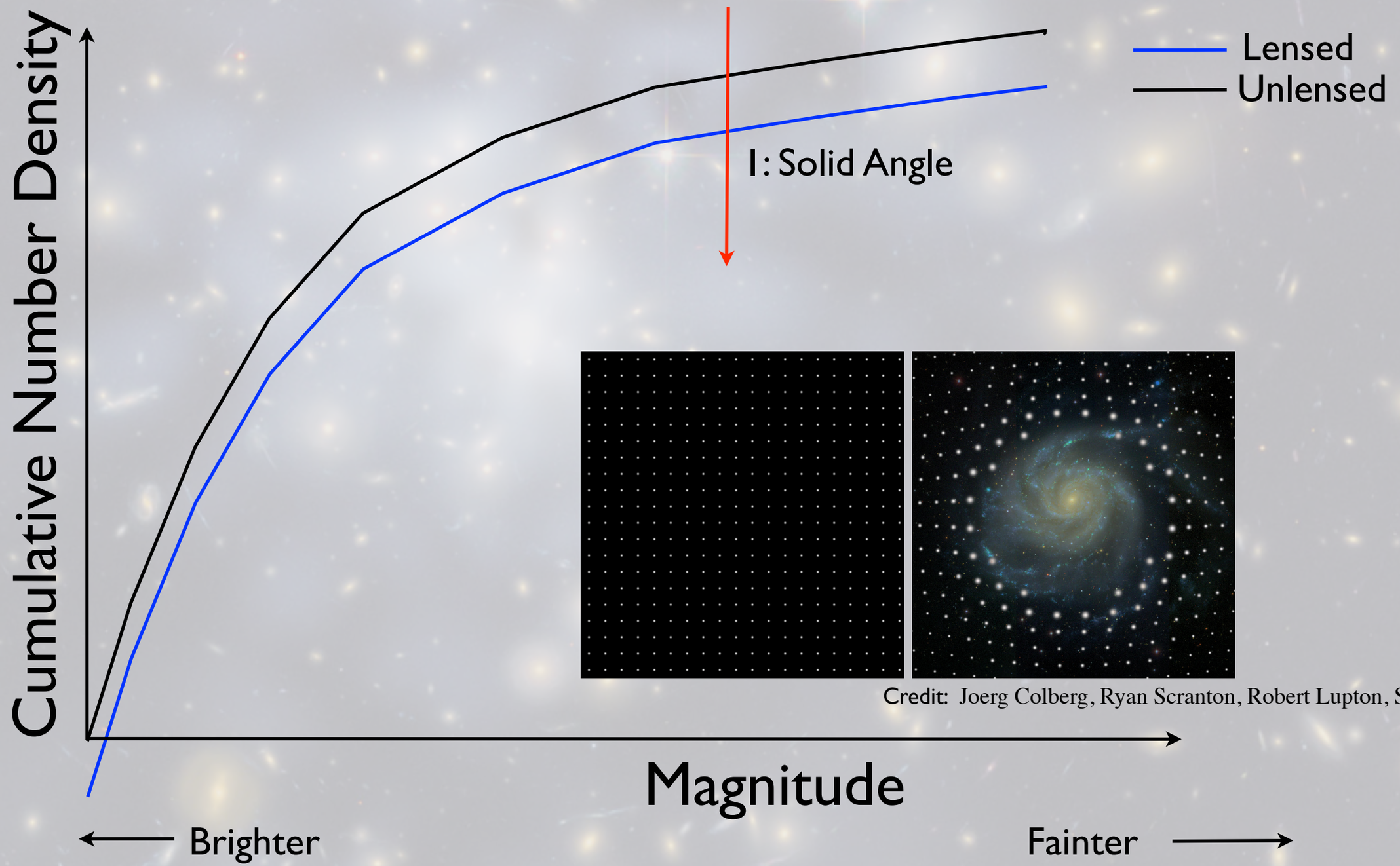

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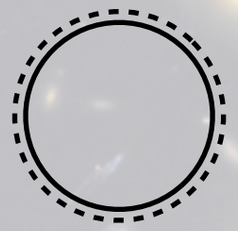

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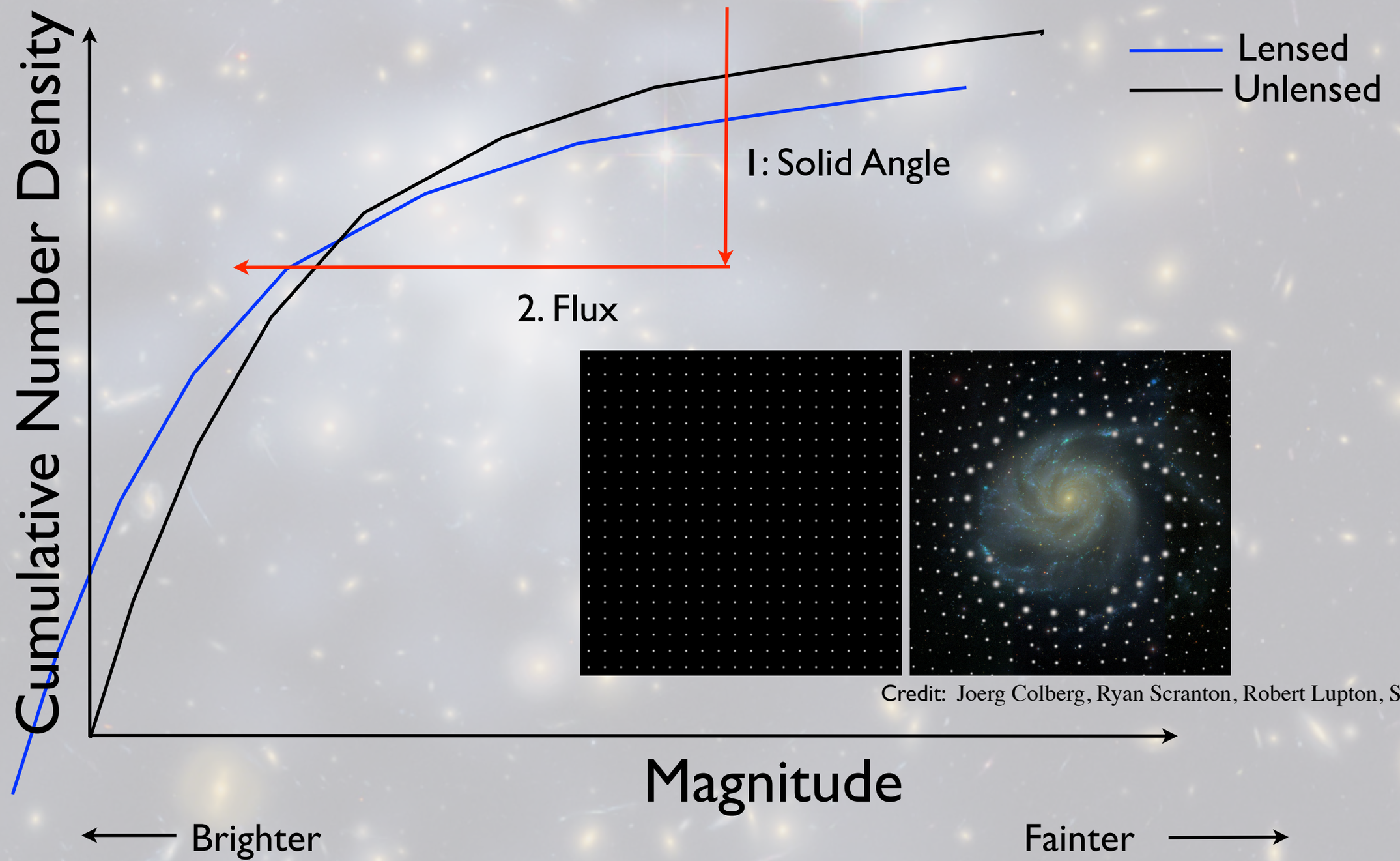

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1. Change in solid angle behind lens

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Observed Number Density

Unlensed Number Density

$$n(>S) = \frac{1}{\mu} n_0 \left(> \frac{S}{\mu} \right)$$

+ Weak Lensing Approx.

$$+\ n(>S) \propto S^{-\alpha}$$

g - Intrinsic
m - Flux Magnification

$$\delta n = \delta n_g + \delta n_m$$
$$= b\delta_m + 2(\alpha - 1)\kappa$$

Linear Bias

Related to faint end of Schechter Luminosity Function

Photometric Clustering:

$$P_{\delta n \delta n}(l) = P_{mm}(l) + P_{gg}(l) + P_{gm}(l) + P_{mg}(l)$$ + Shot Noise

Observed Clustering

Magnification only

$\propto (\alpha - 1)^2$

Intrinsic Clustering only

$\propto b^2$

Cross Terms

$\propto b(\alpha - 1)$

Photometric Clustering:

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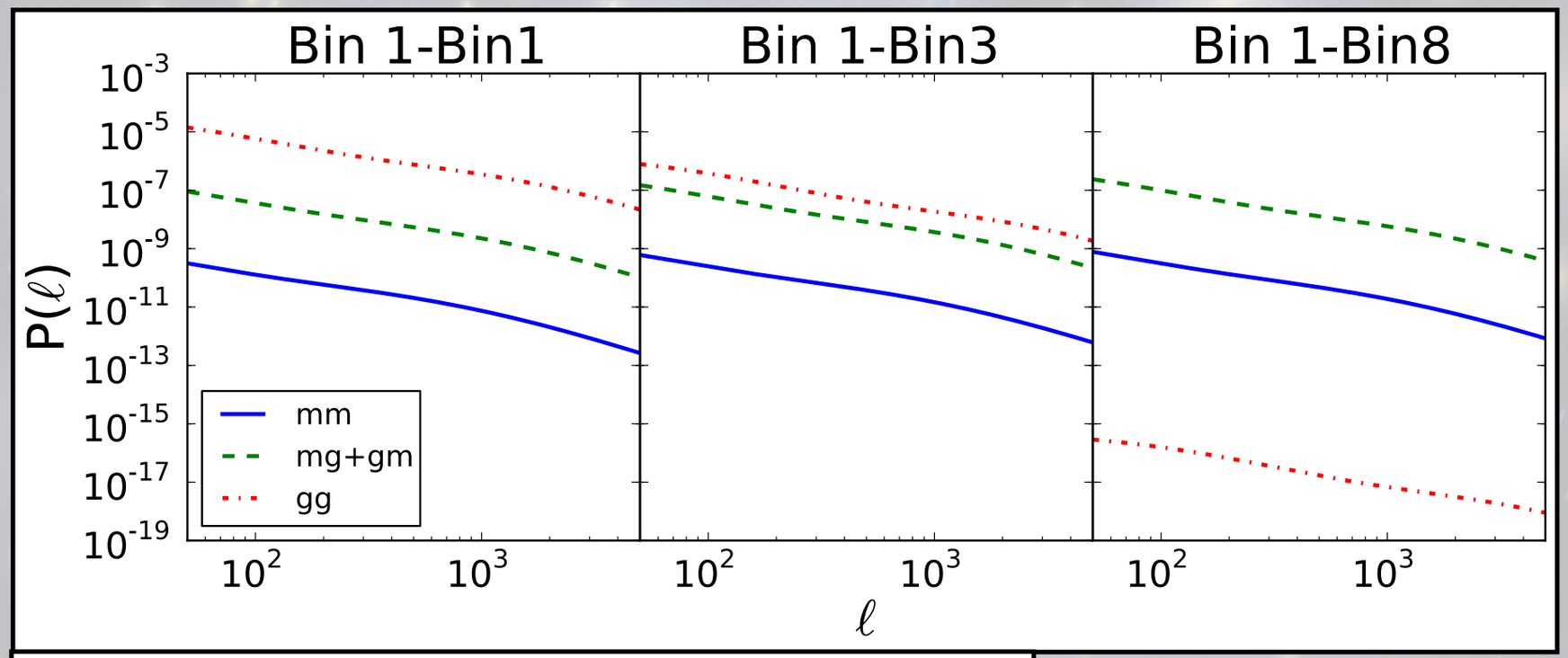

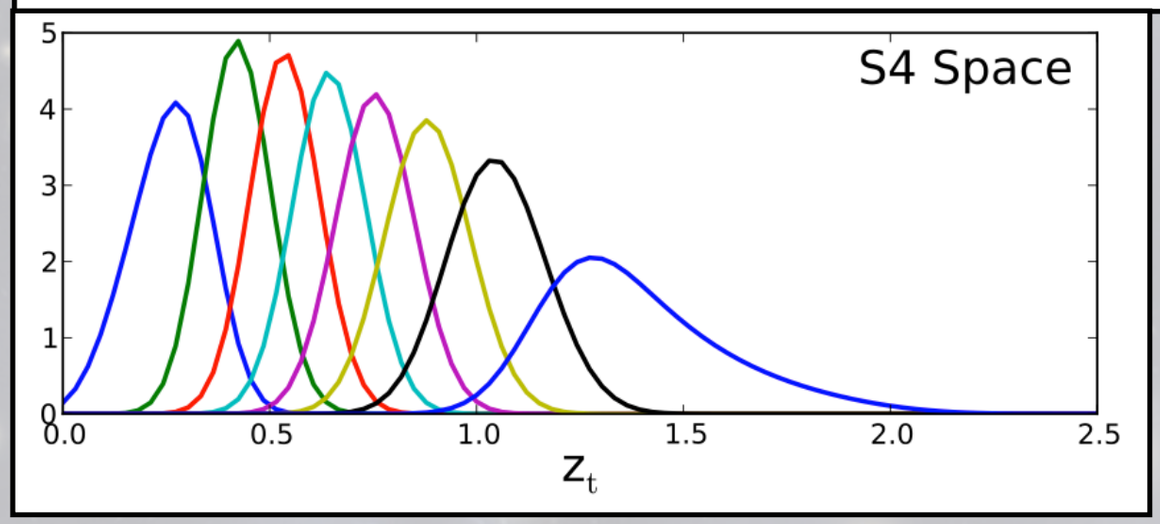

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Magnification only

Intrinsic Clustering only

Cross Terms

$\propto (\alpha - 1)^2$

$\propto b^2$

$\propto b(\alpha - 1)$

Cosmic Shear:

$$P_{\epsilon\epsilon}(\ell) = P_{\kappa\kappa}(\ell)$$ + Shot Noise

ϵ	Ellipticity Measure
δn	Number density fluctuation
κ	Lensing Convergence
g	Intrinsic Clustering
m	Flux Magnification

Galaxy-Galaxy Lensing:

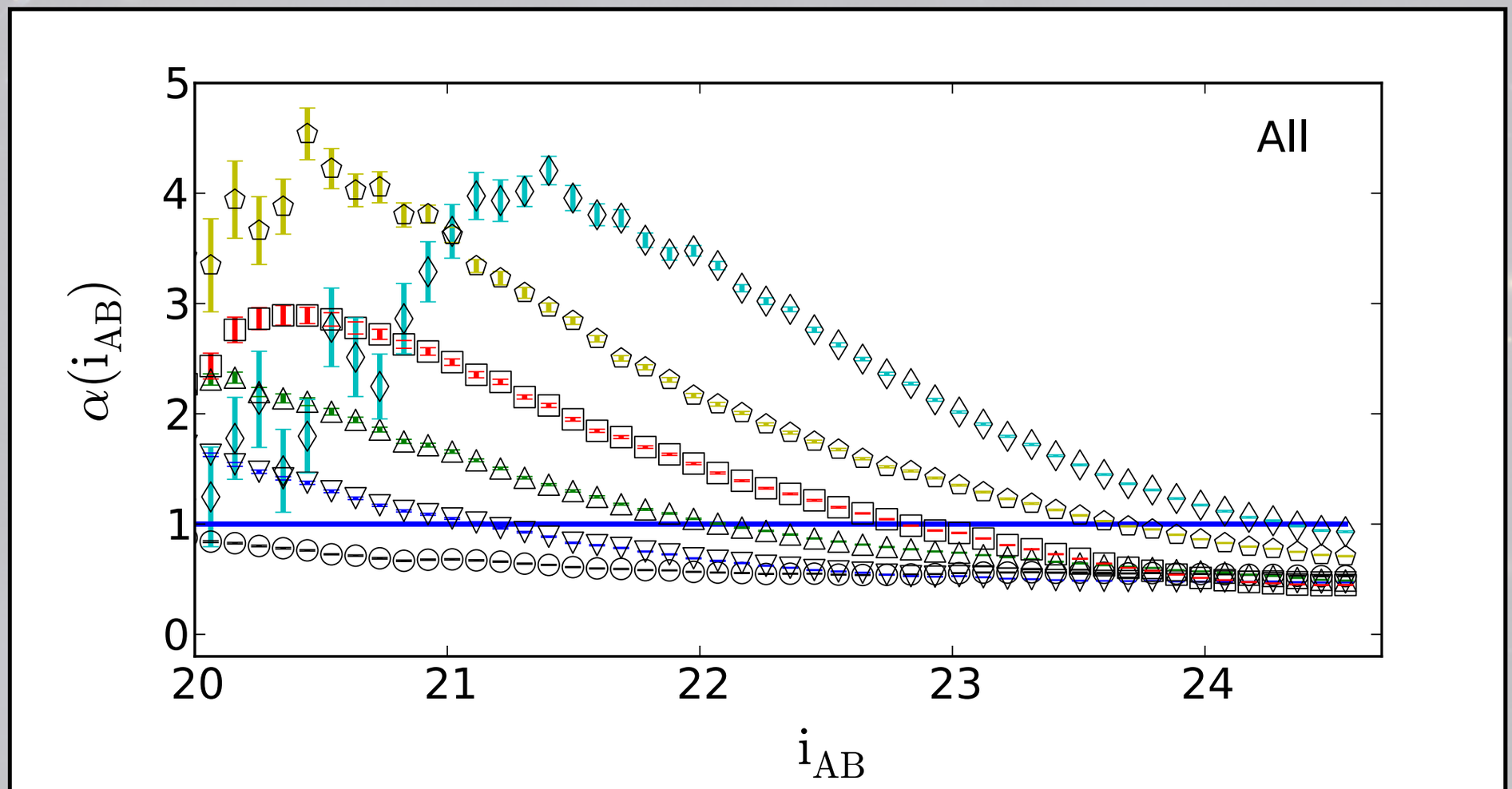
$$P_{\epsilon \delta n}(\ell) = P_{\kappa g}(\ell) + P_{\kappa m}(\ell)$$

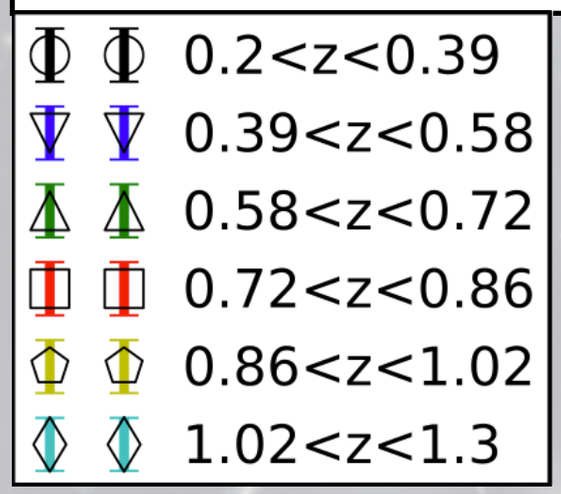
$\propto b$ Shear-IC

Shear-Mag $\propto (\alpha - 1)$

Setting the strength of magnification:

From public CFHTLenS catalogues:





$$0 \leq \alpha \leq 4$$

$$\alpha = 0.7$$

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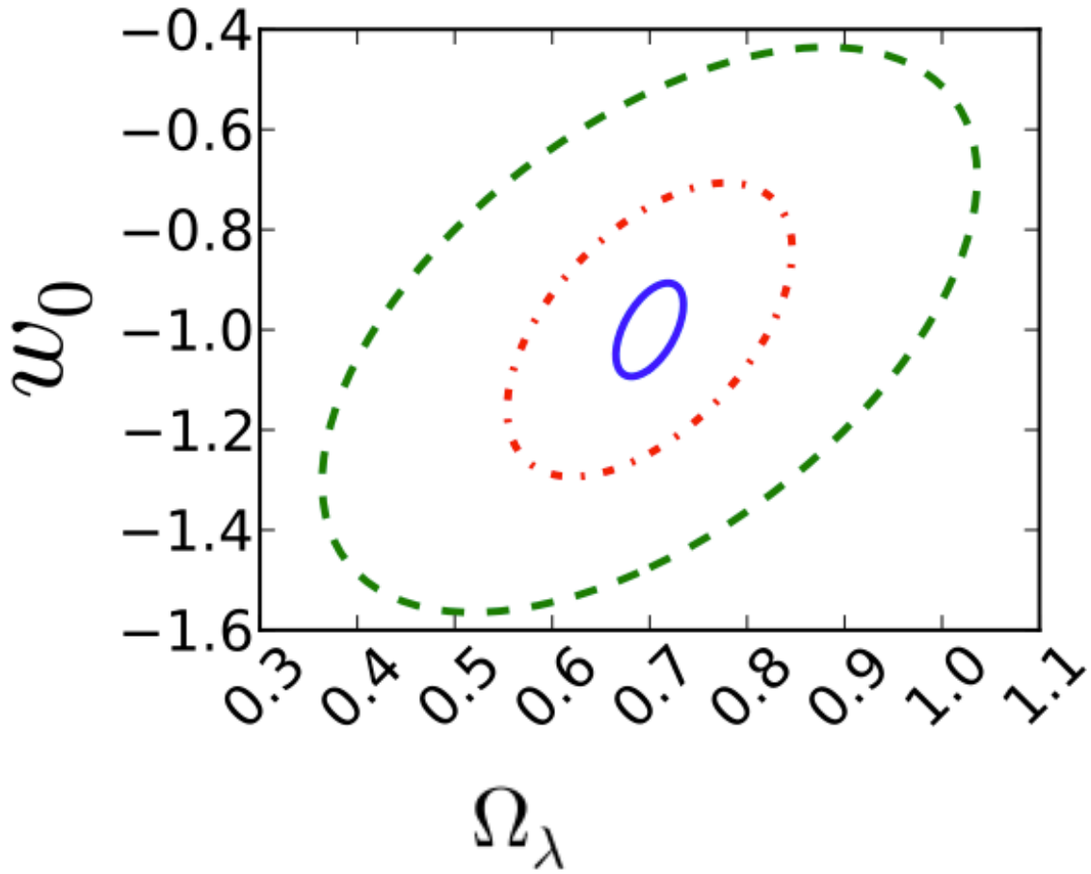
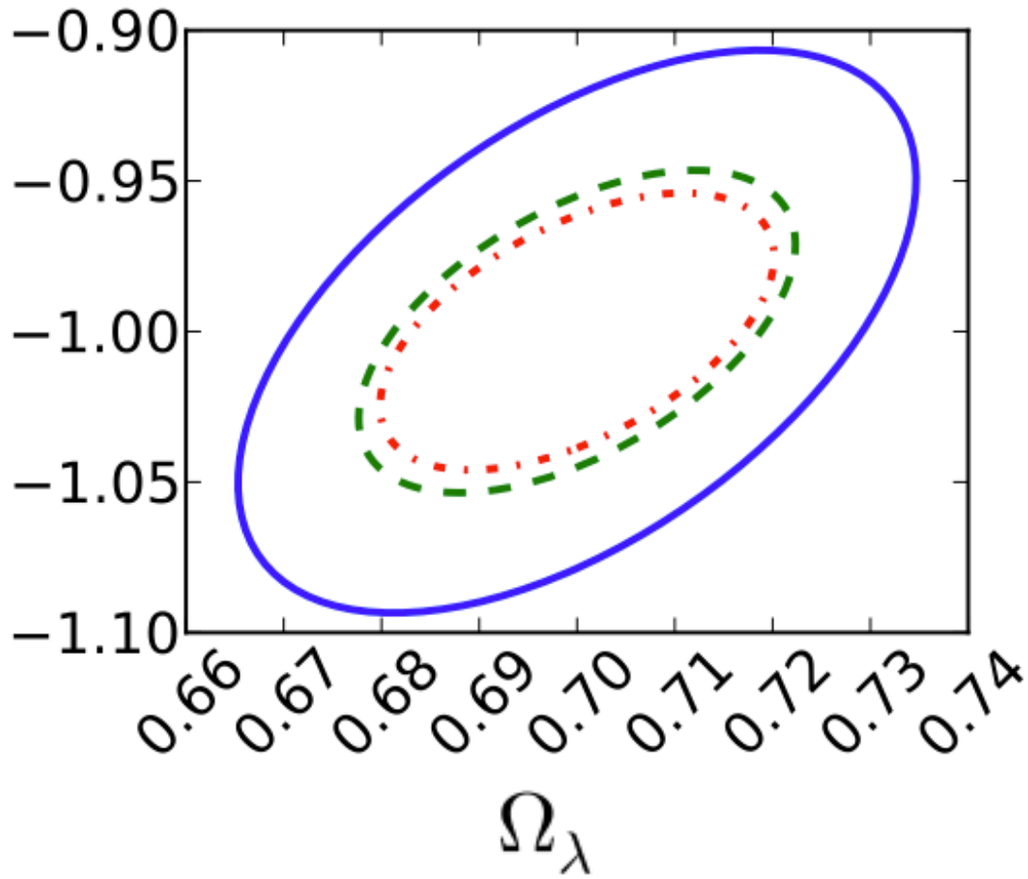




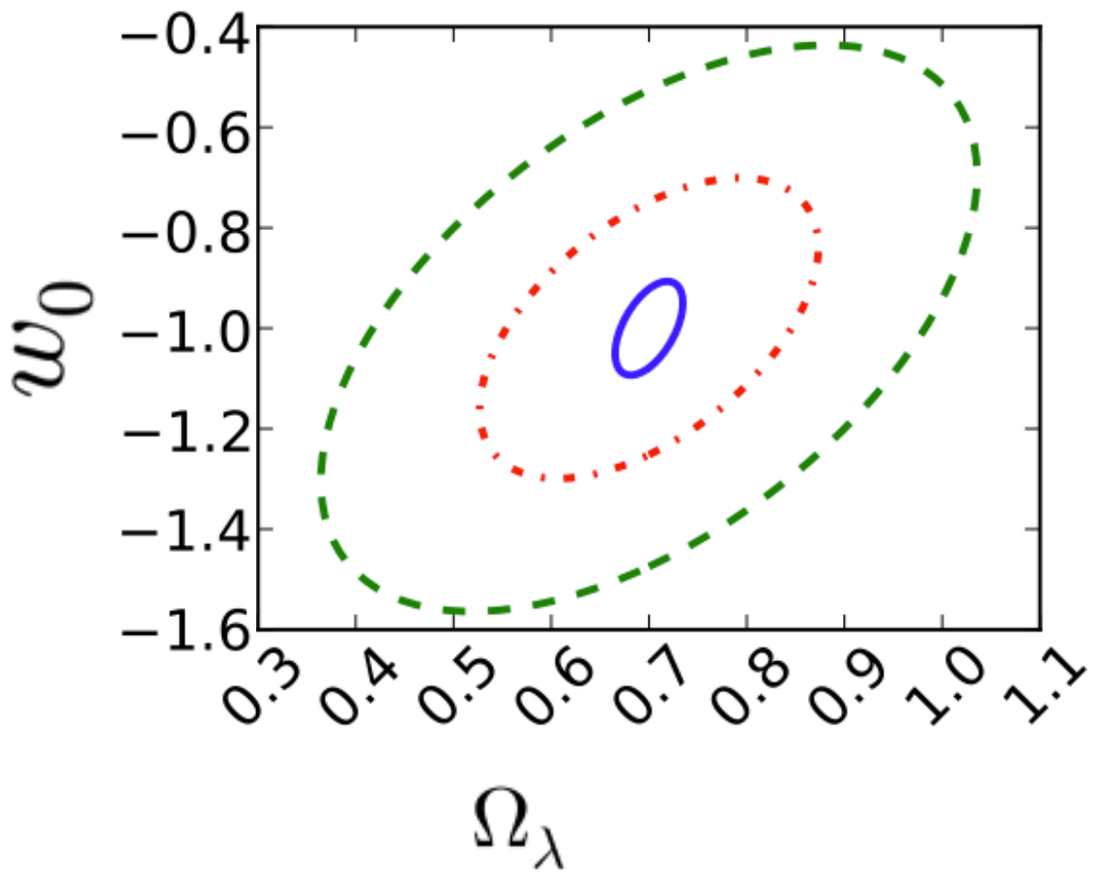
Shear Only
Auto Clustering
All Clustering

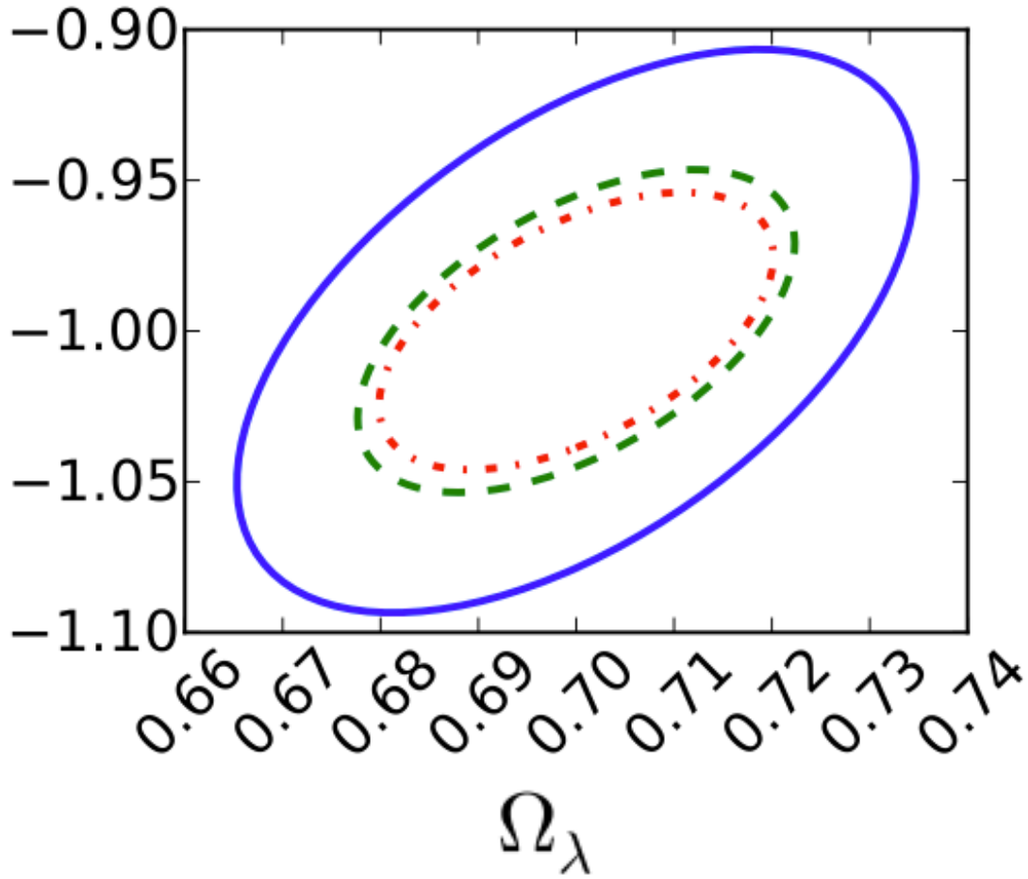
Shear Only
Shear + Auto Clustering + GGL
Shear + All Clustering + GGL

Forecasts

Combining Ellipticity and Position measurements gives significant gain in constraints

$\alpha = 1.0$





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Auto Clustering
All Clustering

Shear Only
Shear + Auto Clustering + GGL
Shear + All Clustering + GGL

Forecasts

Combining Ellipticity and Position measurements gives significant gain in constraints

Figure of merits

	$\alpha = 1$	$\alpha = 0.7$
Auto-Clustering	12.4	12.4
All-Clustering	30.1	39.5
Gal-Gal Lensing	49.0	84.0
Shear	685	685
Shear+All-Clustering	1032	1040
Shear+All-Clustering+GGL	2468	2505

320%

With unknown galaxy bias, and cuts on non-linear modes
More probes at 1306.6870

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152%

With unknown galaxy bias, and cuts on non-linear modes
More probes at 1306.6870

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1.5%

With unknown galaxy bias, and cuts on non-linear modes
More probes at 1306.6870

Can we safely ignore magnification bias?

$$\alpha_{\rm true} = 0.7$$

$$\alpha_{\rm Modelled} = 1.0$$

No Mag Bias!

Auto Clustering

	Bias	$\frac{\text{Bias}}{\text{Error}}$
Ω_Λ	0.026	0.08
w_0	0.045	0.08

All Clustering

	Bias	$\frac{\text{Bias}}{\text{Error}}$
Ω_Λ	0.69	4.6
w_0	0.77	2.66

But flux magnification MUST be measured and modelled when using cross-correlations in redshift.

Can we safely ignore magnification bias?

No Mag Bias!

$\alpha_{\rm true} = 0.7$ $\alpha_{\rm Modelled} = 1.0$

Shear + All Clustering + GGL (Everything)

	Bias	$\frac{\text{Bias}}{\text{Error}}$
Ω_Λ	0.11	5.5
w_0	0.13	2.8

- 3.6 improvement to constraints on DE parameters...
- But flux magnification MUST be measured and modelled

Summary

The addition of position information (Clustering + GGL) to shear gives significant improvement to cosmological constraints (360% to dark energy parameters)

Flux Magnification MUST be measured and modelled to avoid biasing inferred parameter values.

Questions?

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ArXiv: 1306.6870