Workshop XII Nova Física no Espaço
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First measurements of σ_8 using SN data only

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Using the closest 732 supernovae of the recent JLA catalog and the method of moments we show that a simple treatment of intrinsic non-Gaussianities with a couple of nuisance parameters is enough for make the first measurement σ_8 of using only SN data.

ArXiv:1403.monday

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The road up until now :

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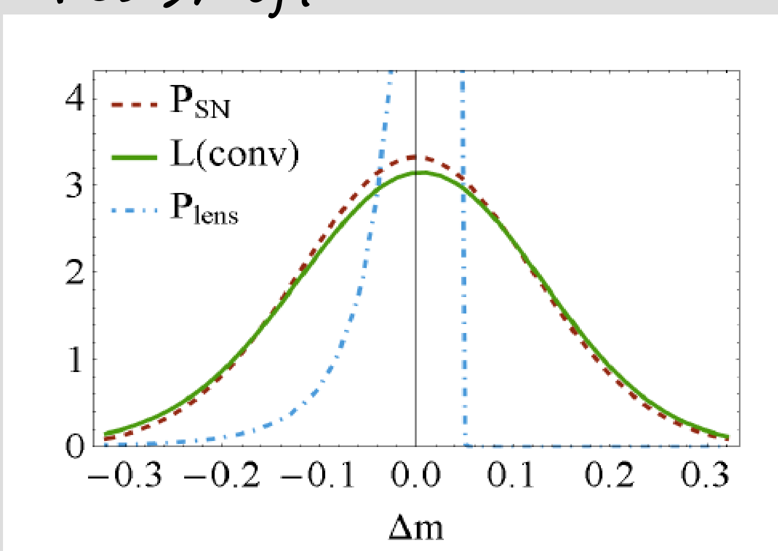
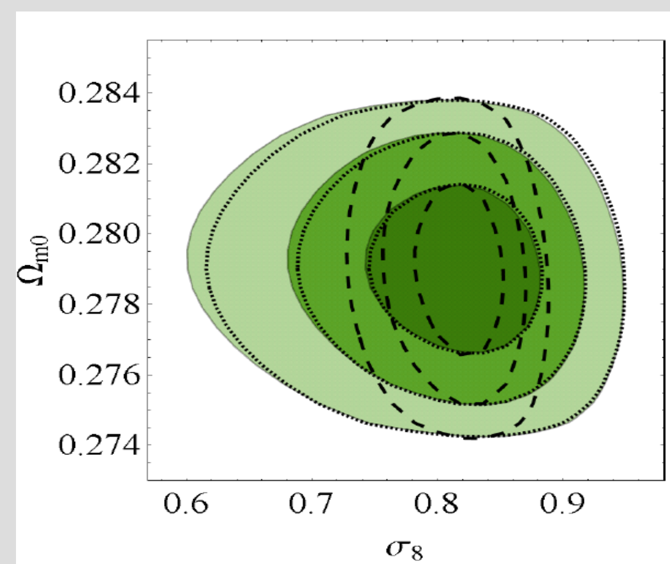
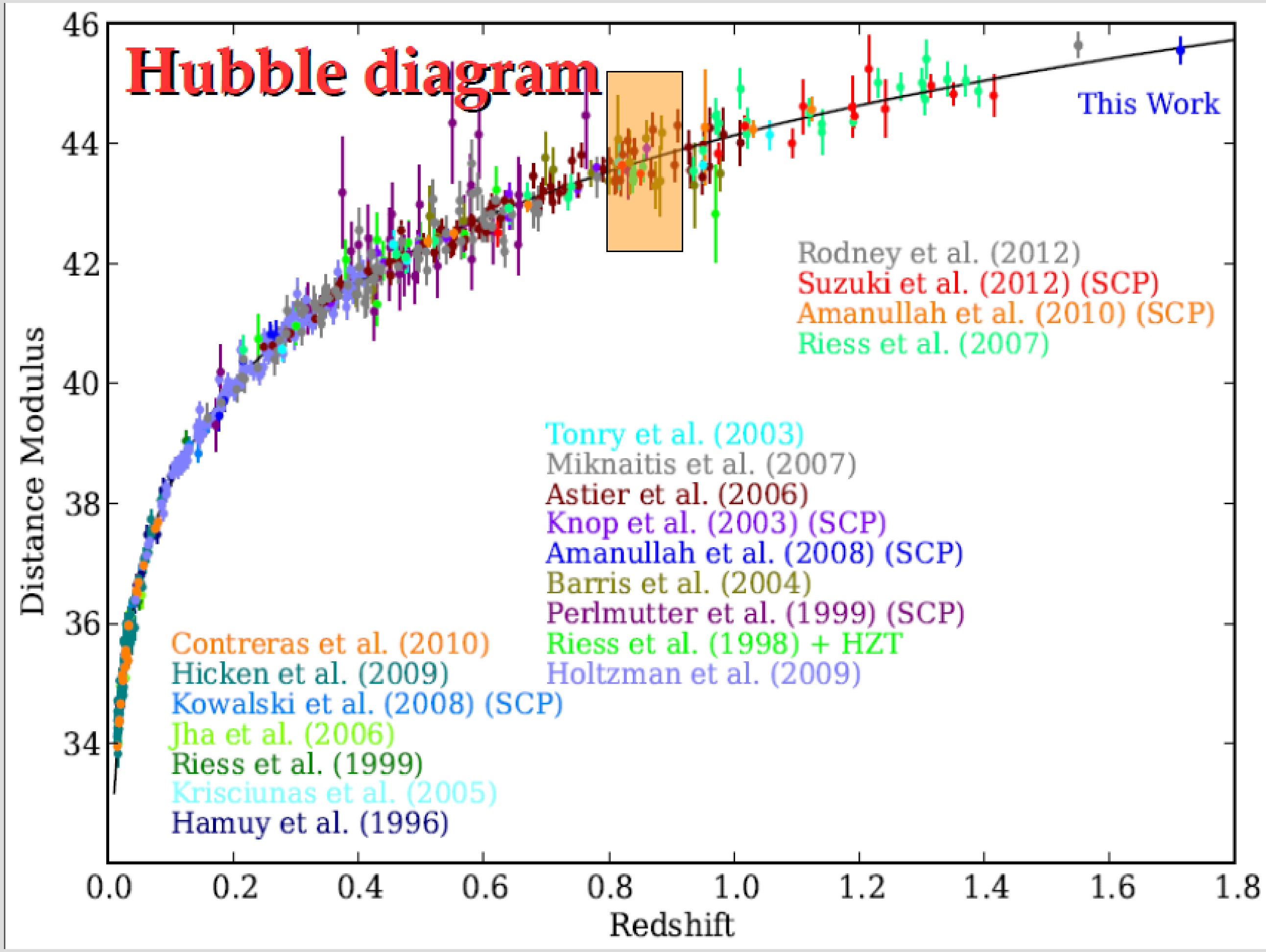




MeMo (Method of Moments) idea :

- Parametrize and distinguish different PDF through their statistical moments



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  - Too many parameters ✔
  - Simplistic choice of one nuisance parameter ✔ for each central moment ✔

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  - Too many parameters ✓
  - Simplistic choice of one nuisance parameter ✓ for each central moment ✓
- Low Statistic problems(*) ✓

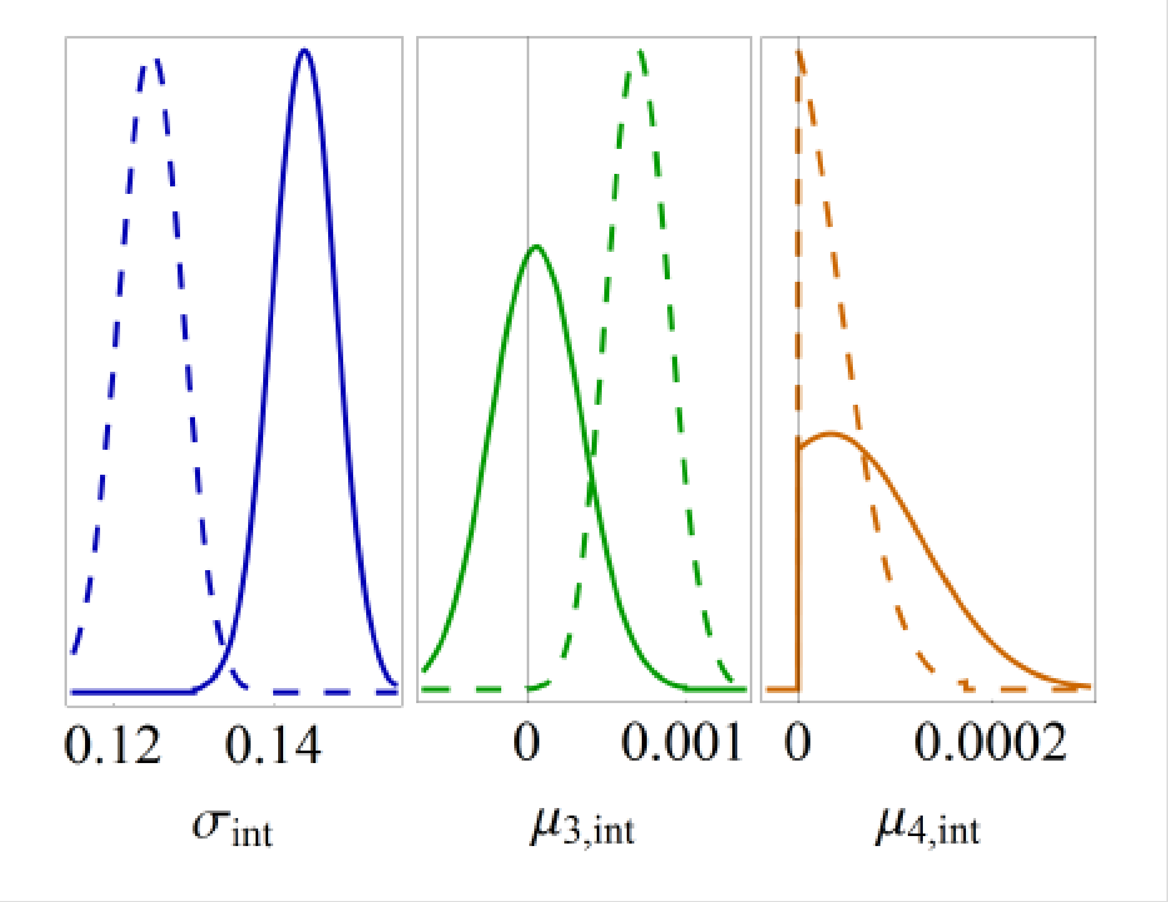
Low statistics and Biased Estimators:

The low statistic problems that come up with current data are two-fold :

- In original incarnation MeMo used the limit of infinity SN in each bin to build the covariance matrix
- The usual amostral estimator of moments of a distribution is biased
  - H-statistics gives the less dispersive unbiased estimator of central moments

Selecting the SN PDF Model : Goodness of fit

Both SNLS and JLA provided good fits showing no need for an intrinsic curtosis . . .



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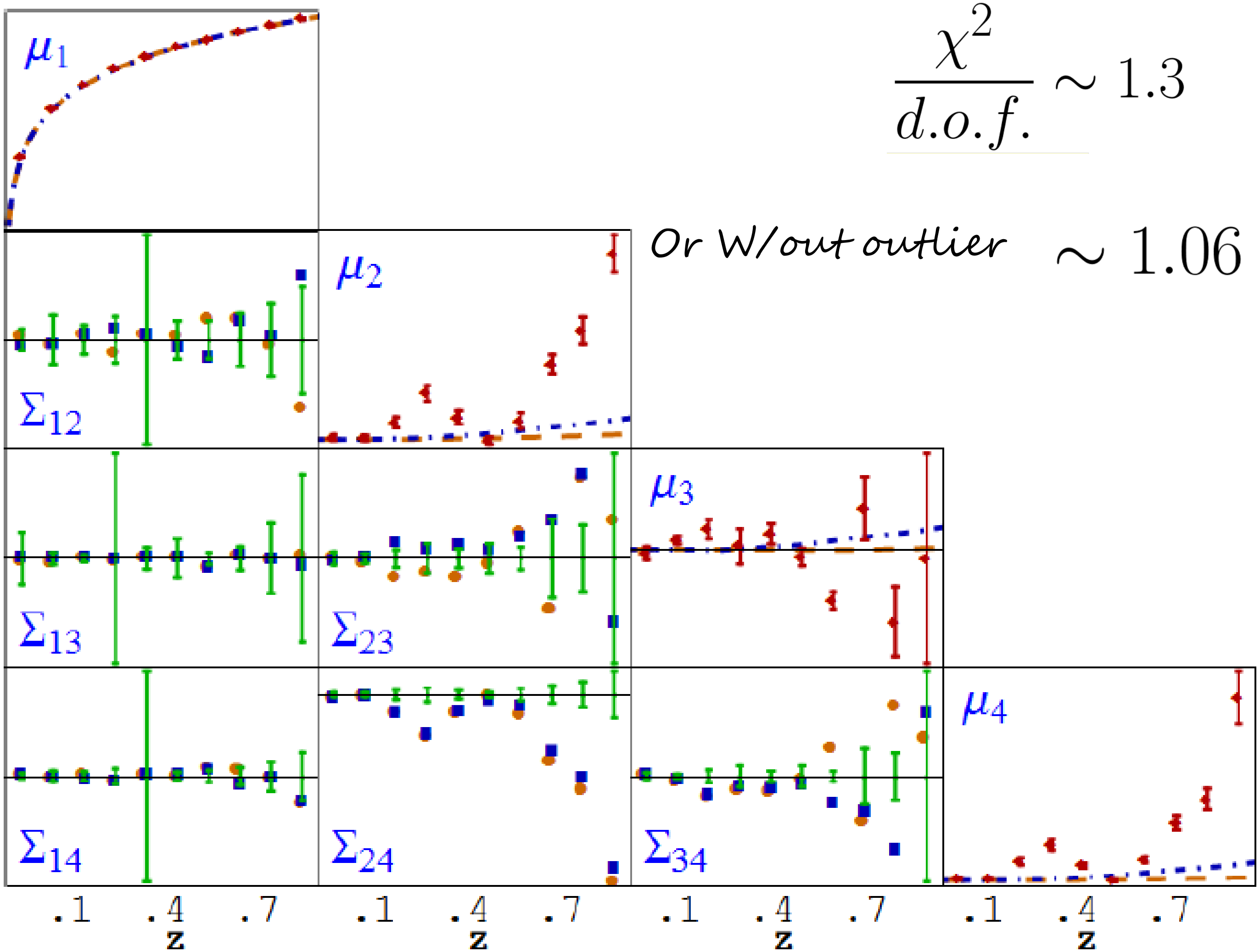

$$\frac{\chi^2}{d.o.f.} \sim 1.3$$

Or W/out outlier ~ 1.06

Bayesian Selection Model :

In a nutshell :

- BSM is ruled by the Bayes Factor B_{01} (ratio of the evidences) and the Jeffrey's Scale

Evidence :

- From Bayes Theorem :

$$P(M|D) = \frac{P(D|M)P(M)}{P(D)}$$

- Evidence is the constant of normalization P(D)
- Does depend only on data, and carry the information about the predictivity and fit of the Model

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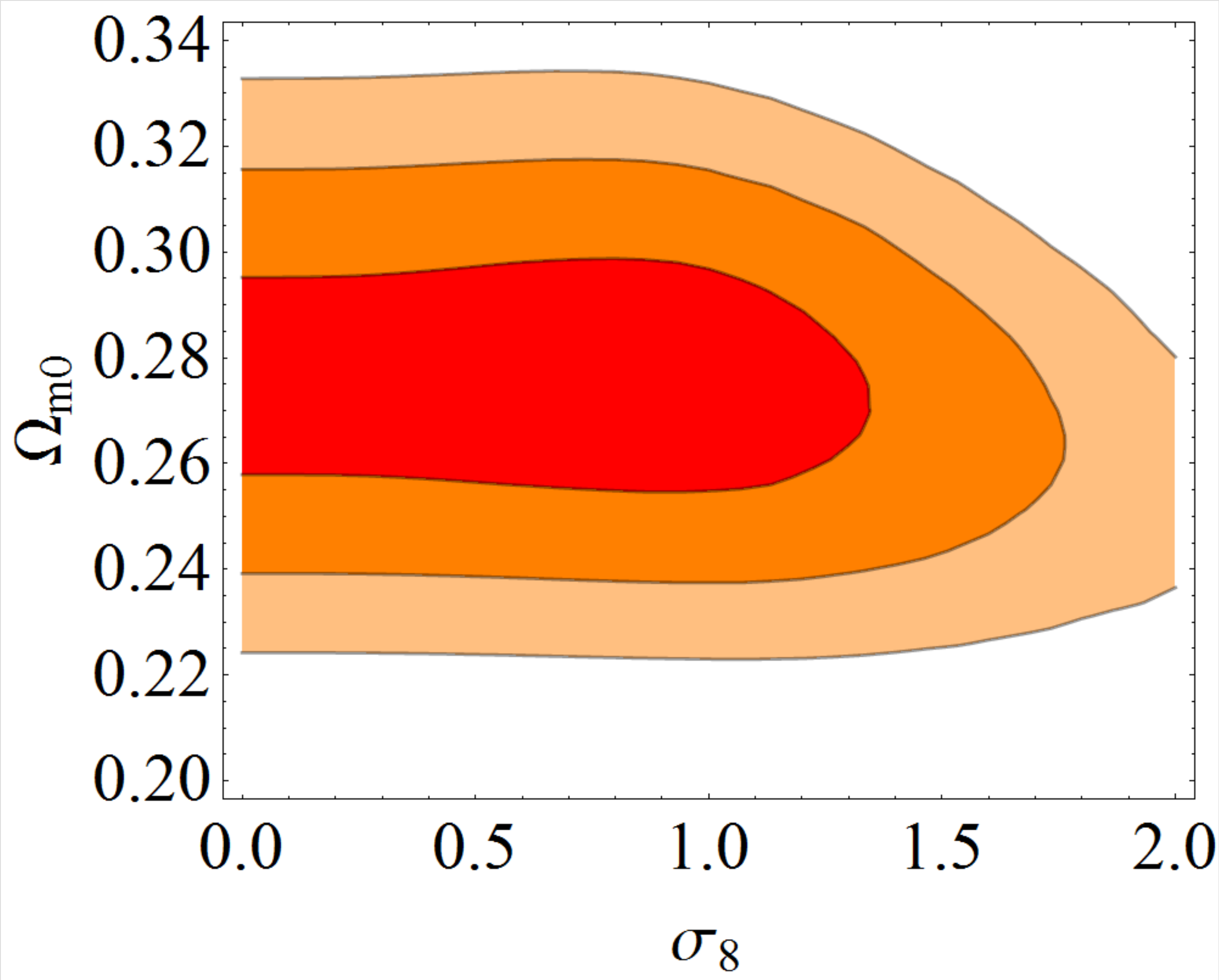
$\lvert \ln B_{01} \rvert$	Odds	Probability	Strength of evidence
< 1.0	$\lesssim 3:1$	< 0.750	Inconclusive
1.0	$\sim 3:1$	0.750	Weak evidence
2.5	$\sim 12:1$	0.923	Moderate evidence
5.0	$\sim 150:1$	0.993	Strong evidence

Selecting the SN PDF Model : Bayesian Selection Model

And, aside of the first case, the choise of $\mu_{n,intr}(z)$ are discarded by Occam's Razor via BSM

	Hypothesis				
Data	Model 1	Model 2	$\ln B_{12}$	Probabilities	σ–level
μ_{1-2} (JLA)	const.	$\sigma_{\text{int}}(z)$	−90	$1 - 10^{-41}$	13.5
μ_{1-4} (JLA)	const.	$\sigma_{\text{int}}(z)$ & $\mu_{3,\text{int}}(z)$	60	$1 - 3 \times 10^{-16}$	8.1
μ_{1-4} (JLA)	fixed in best fit	const.	10.9	$1 - 4 \times 10^{-5}$	4.1
μ_{1-4} (DES)	const.	$\sigma_{\text{int}}(z)$ & $\mu_{3,\text{int}}(z)$	190	$1 - 3 \times 10^{-83}$	19

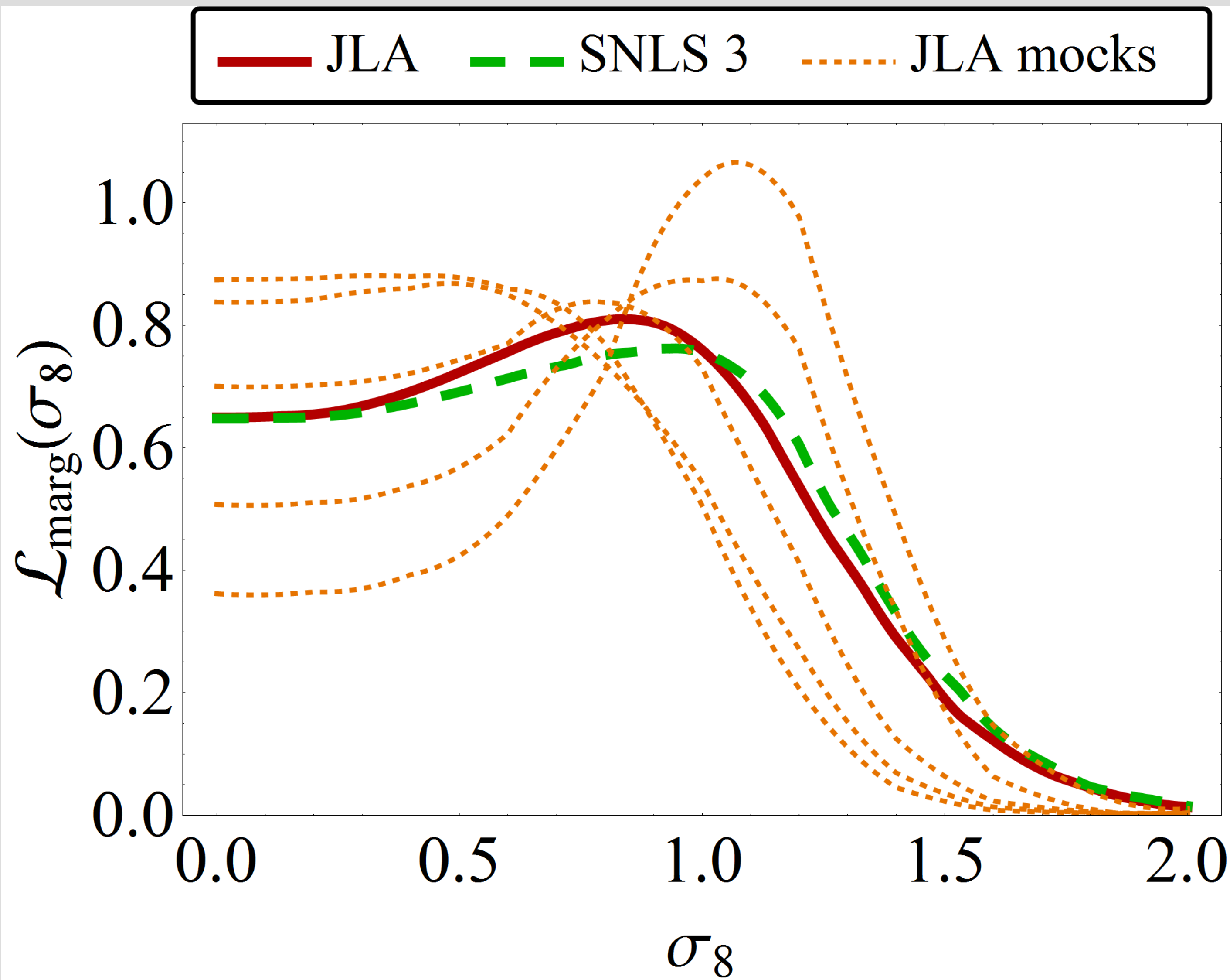
Results (1): Contours on Cosmological Parameters



Results (2): Power of detecting Lensing Signal of future and current data

	Hypothesis				
Data	$\sigma_{\rm int}$	$\mu_{3,\rm int}$	$\mu_{4,\rm int}$	$\ln B_{12}$	$\sigma-$lev.
μ_{1-2} (JLA)	$\sigma_{\rm int}(z)$	—	—	0.1	0.3
μ_{1-4} (JLA)	const.	const.	$\equiv 0$	0.45	0.9
μ_{1-4} (JLA)	$\sigma_{\rm int}(z)$	$\mu_{3,\rm int}(z)$	$\equiv 0$	0.17	0.7
μ_{1-2} (DES)	const.	–	–	1.4	1.3
μ_{1-3} (DES)	const.	const.	–	1.8	1.5
μ_{1-4} (DES)	const.	const.	$\equiv 0$	2.8	1.9
μ_{1-4} (DES)	$\sigma_{\rm int}(z)$	$\mu_{3,\rm int}(z)$	$\equiv 0$	0.7	1.0
μ_{1-4} (LSST100k)	const.	const.	$\equiv 0$	21	6.1

Results (3): First measure of σ_8 using just SN



1- σ

$\sigma_8 = 0.84^{+0.28}_{-065}$

2- σ

$\sigma_8 < 1.45$

Conclusions

- Using less nuisance parameters we made the method more robust
- Our hypothesis was prooved to be more suitable concerning both the goodness of fit and the BSM
- Our work represents an important proof of principle and a cross-check of theory
- First measure ever of σ_8 using just SN data

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Obrigado!