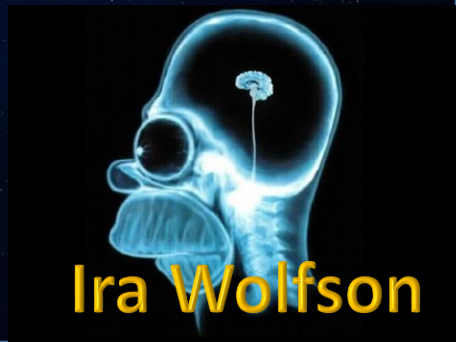
Small field models with Significant GW signal

Ben-Gurion University of the Negev



Ira Wolfson

Motivation

The hunt for Primordial Gravitational Waves

- Alternatives to large field models.

- Fundamental Physics?

Ben-Dayan, Brustein JCAP 1009, 007 (2010)
Cabass et. al. PRD 94.023523 (2016)

Outline

I. Recent Results
   - The model
   - Covering the plane of interest
   - Finding the most probable member

II. Discrepancy between predictions and exact calculation

III. Summary and outlook

IW, Brustein arXiv:1607.03740(2016)
And ongoing work

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Results

5 Degree polynomial model

$$V(\phi) = V_0 \left(1 + \sum_{p=1}^{5} a_p \phi^p\right)$$

$$\Downarrow$$

$$V(\phi) = V_0 \left(1 - \sqrt{\frac{r_0}{8}}\phi + \frac{\eta_0}{2}\phi^2 + \frac{\alpha_0}{3\sqrt{2r_0}}\phi^3 + a_4\phi^4 + a_5\phi^5\right)$$

Ben-Dayan & Brustein JCAP 1009, 007 (2010)
Hotchkiss, Mazumdar, Nadathur JCAP 1202, 008 (2012)

Results

Why look at these models?

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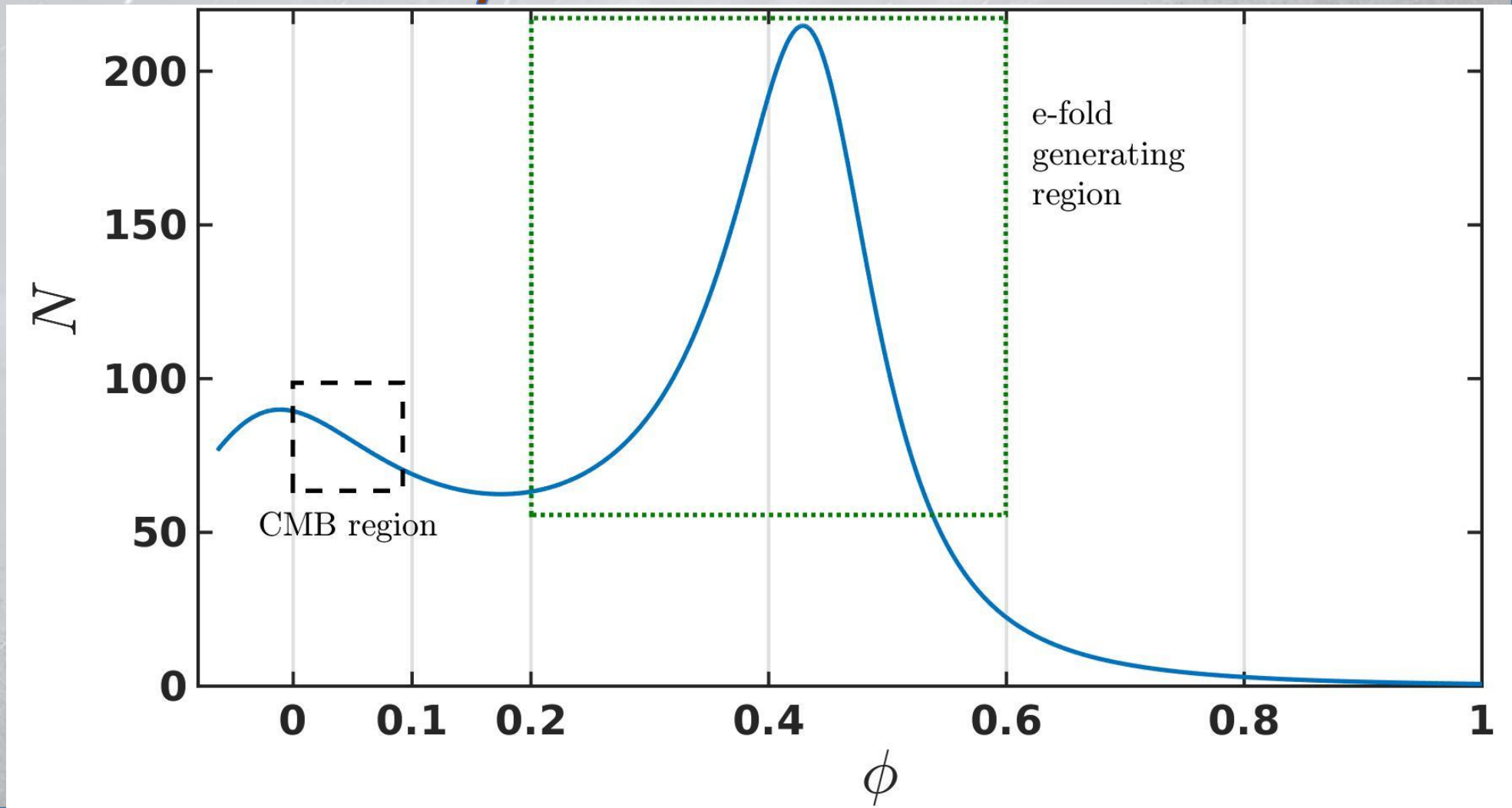

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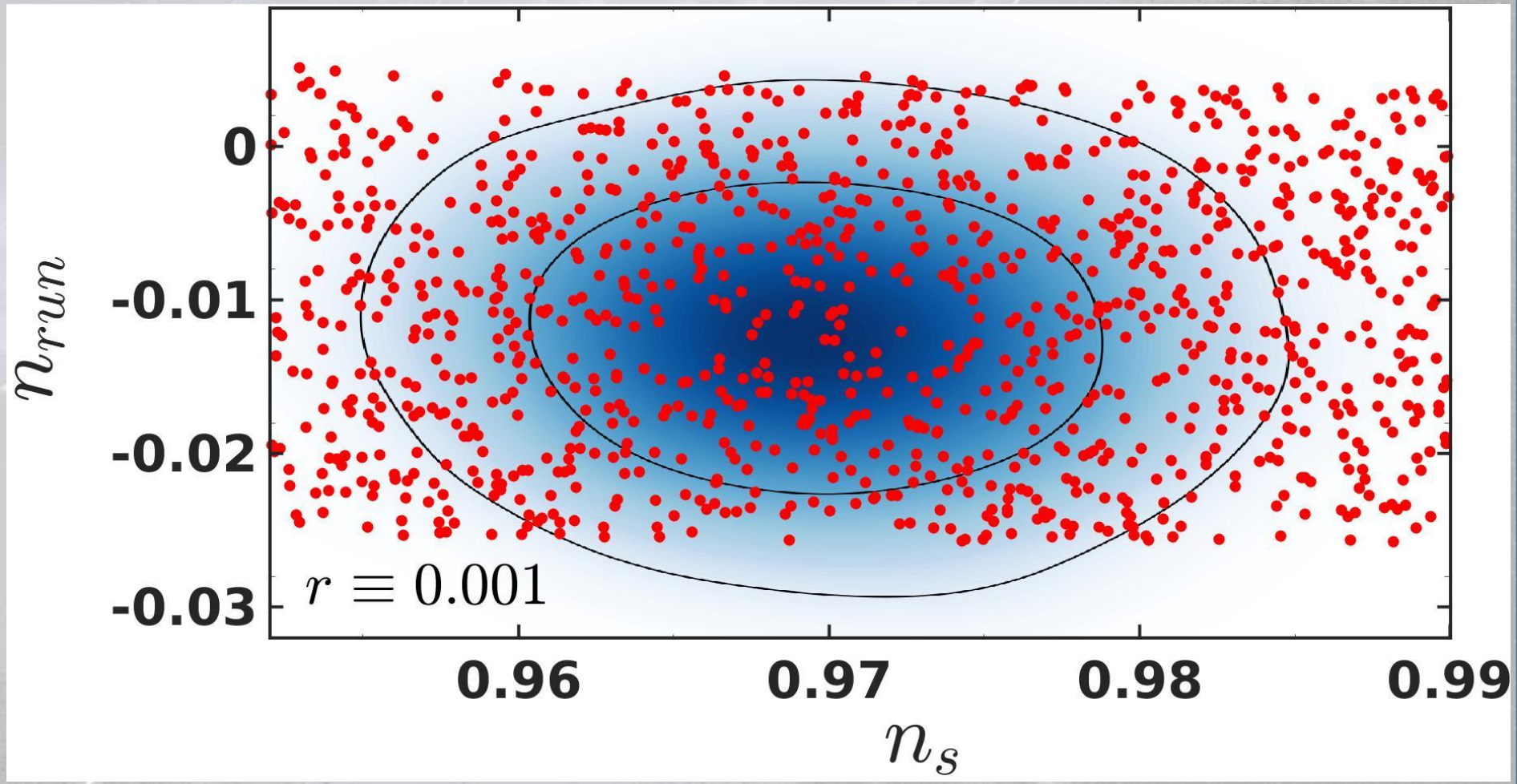
6 Degree polynomial model



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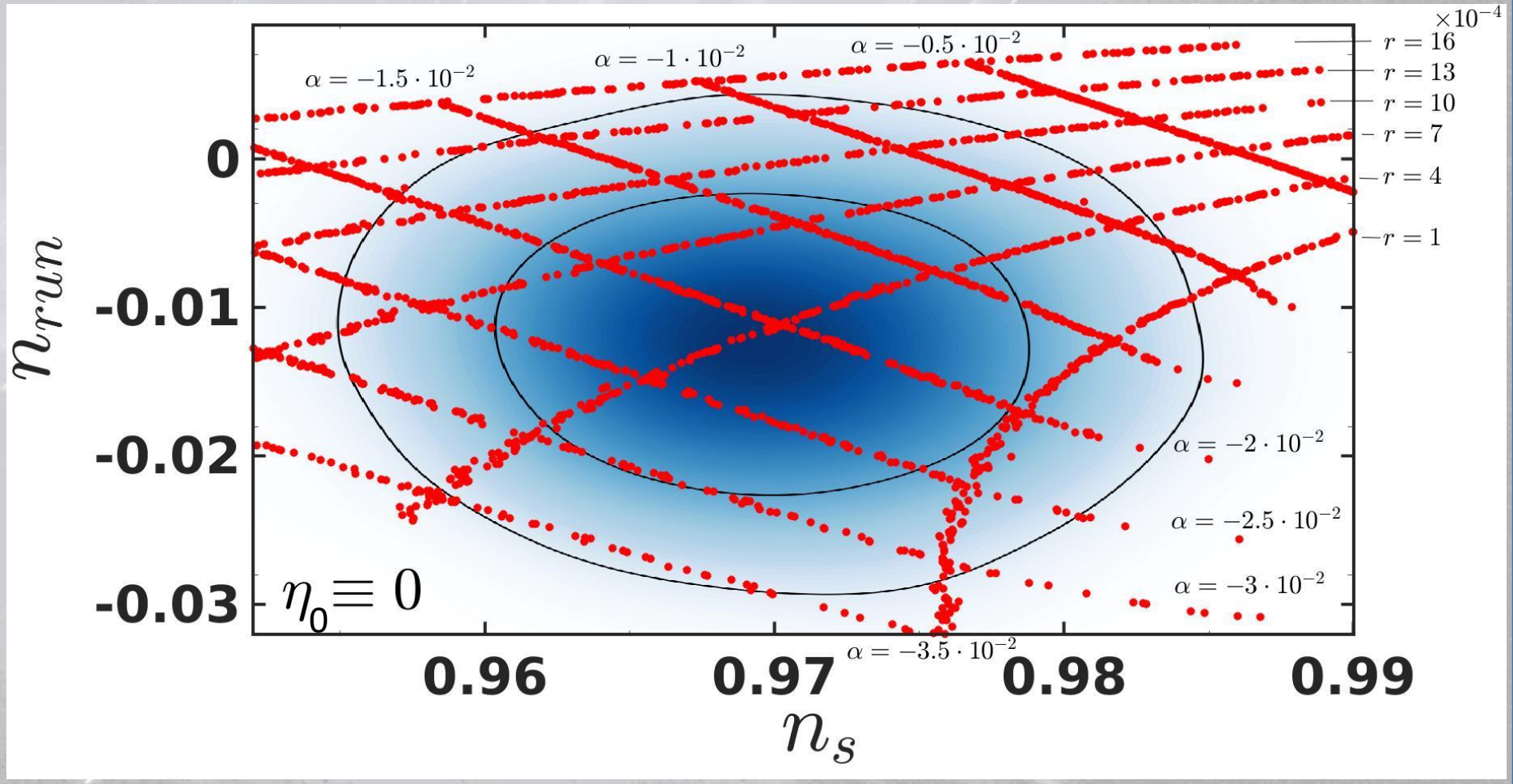

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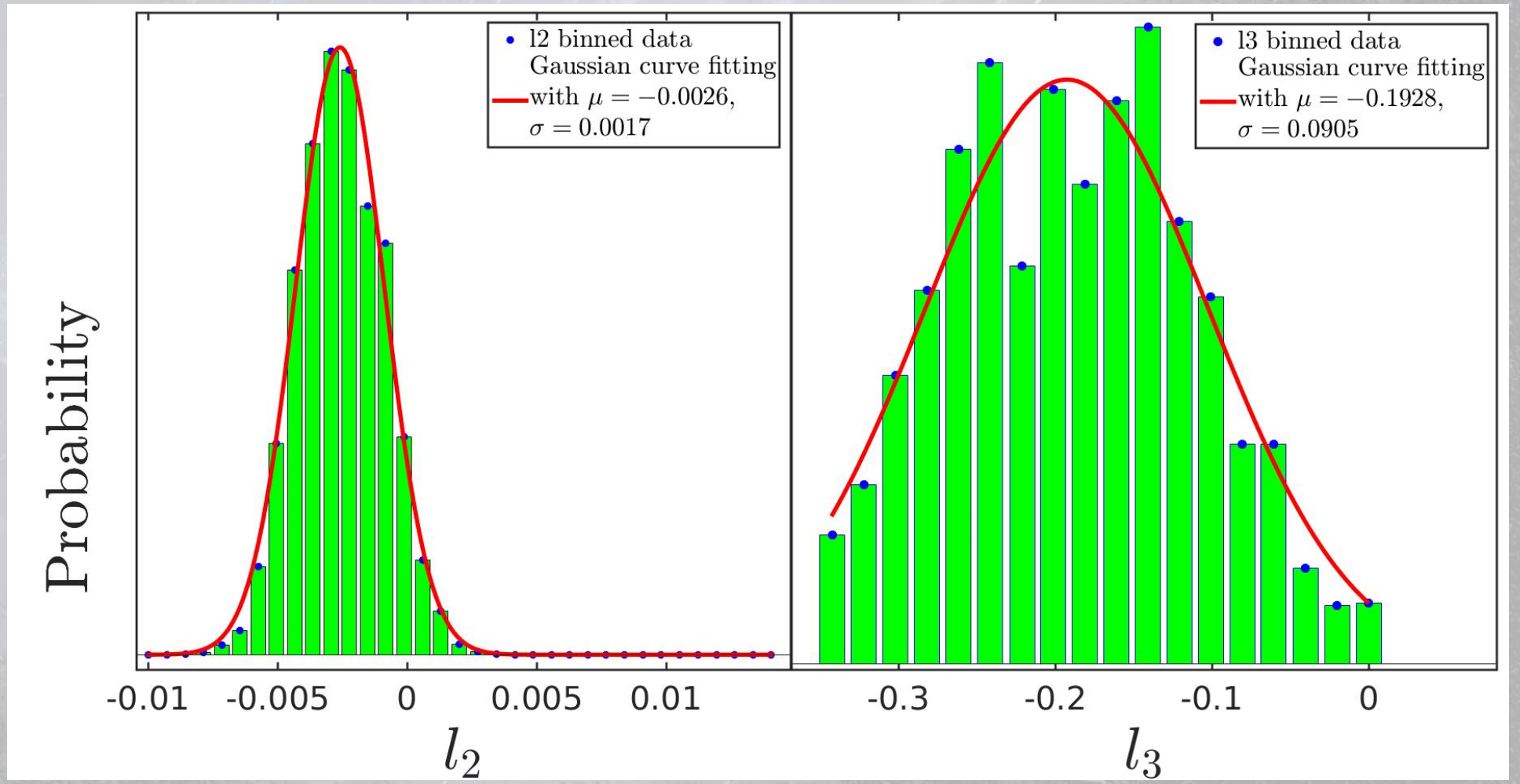

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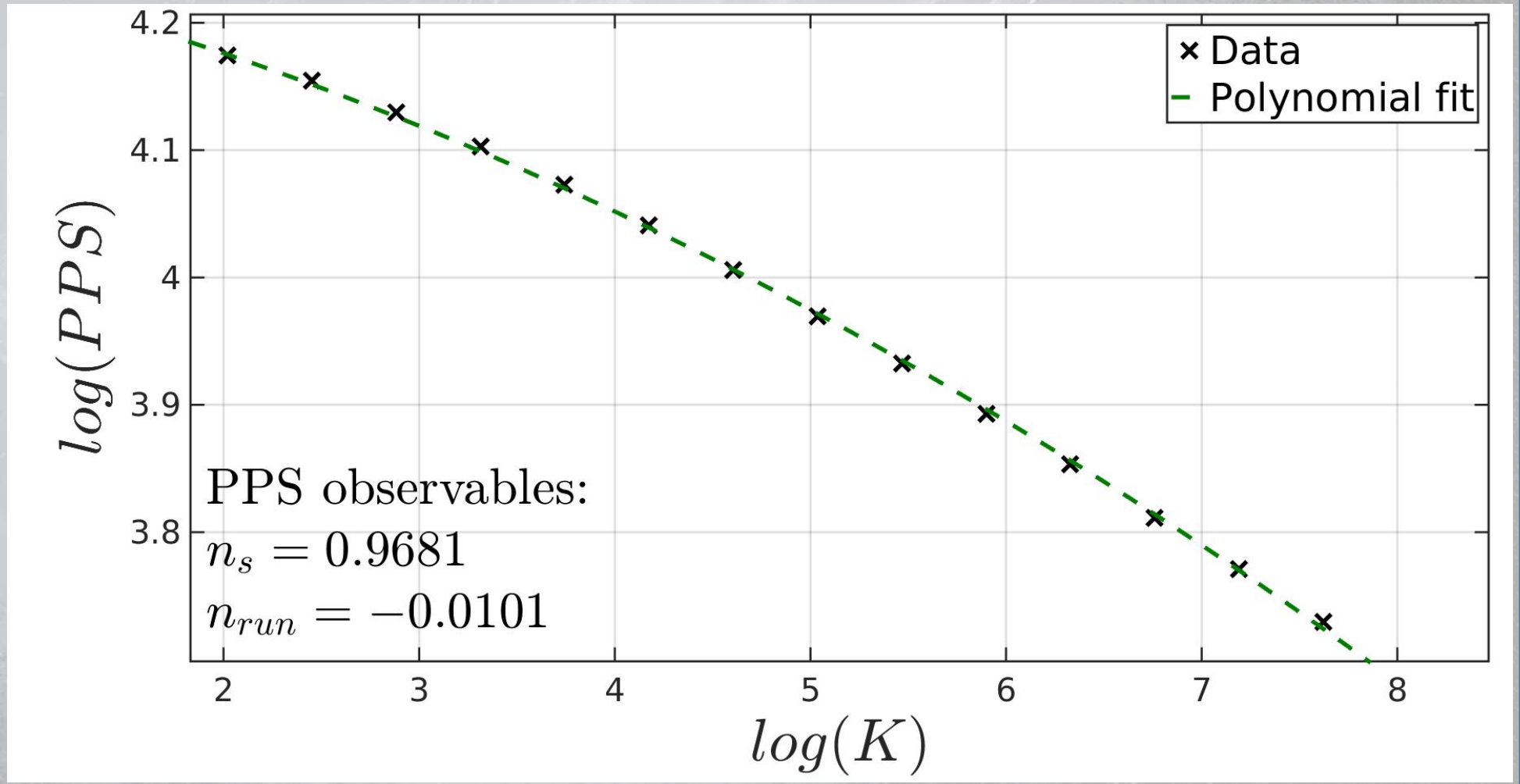

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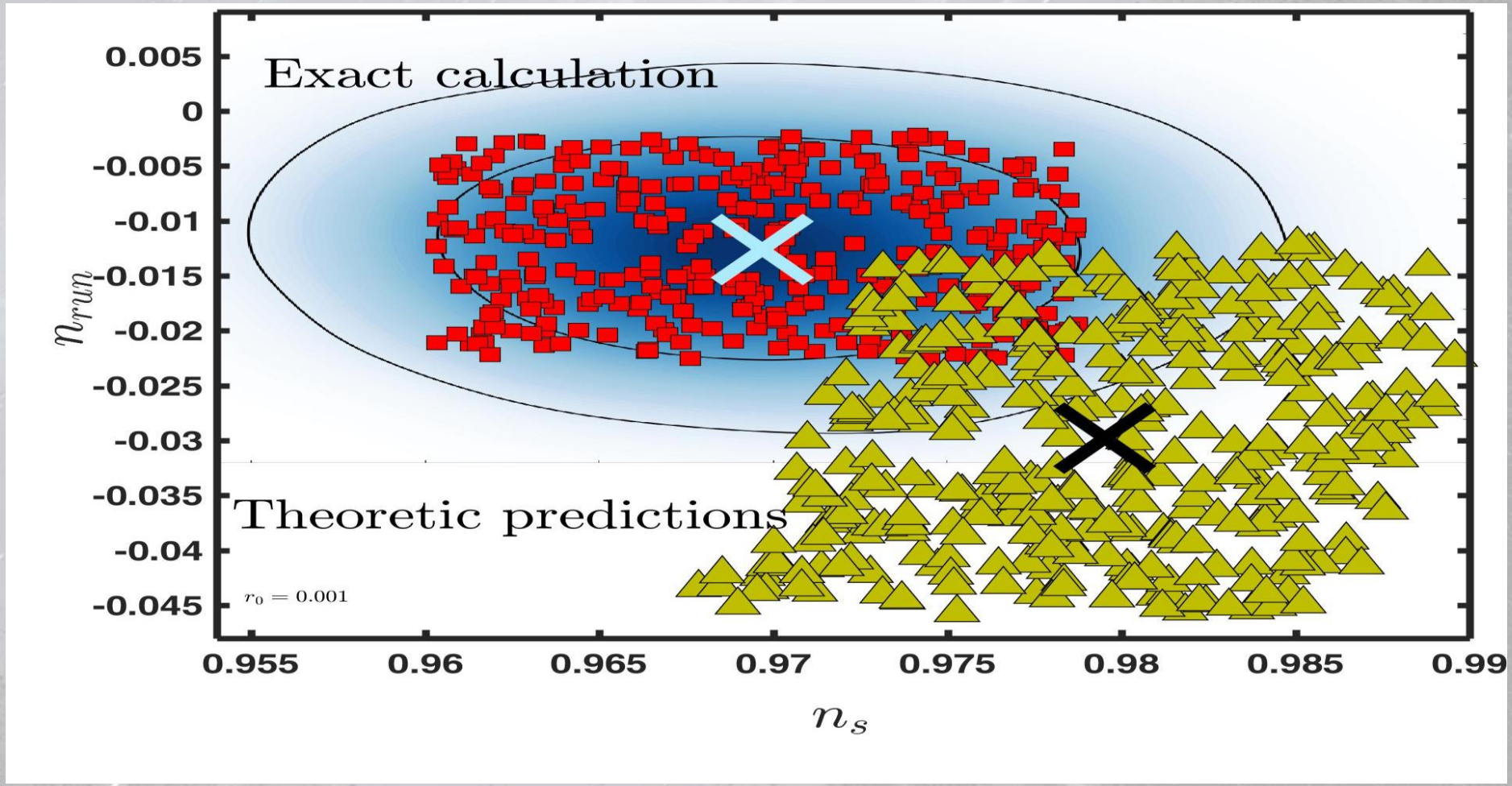
Discrepancy between predictions and calculations



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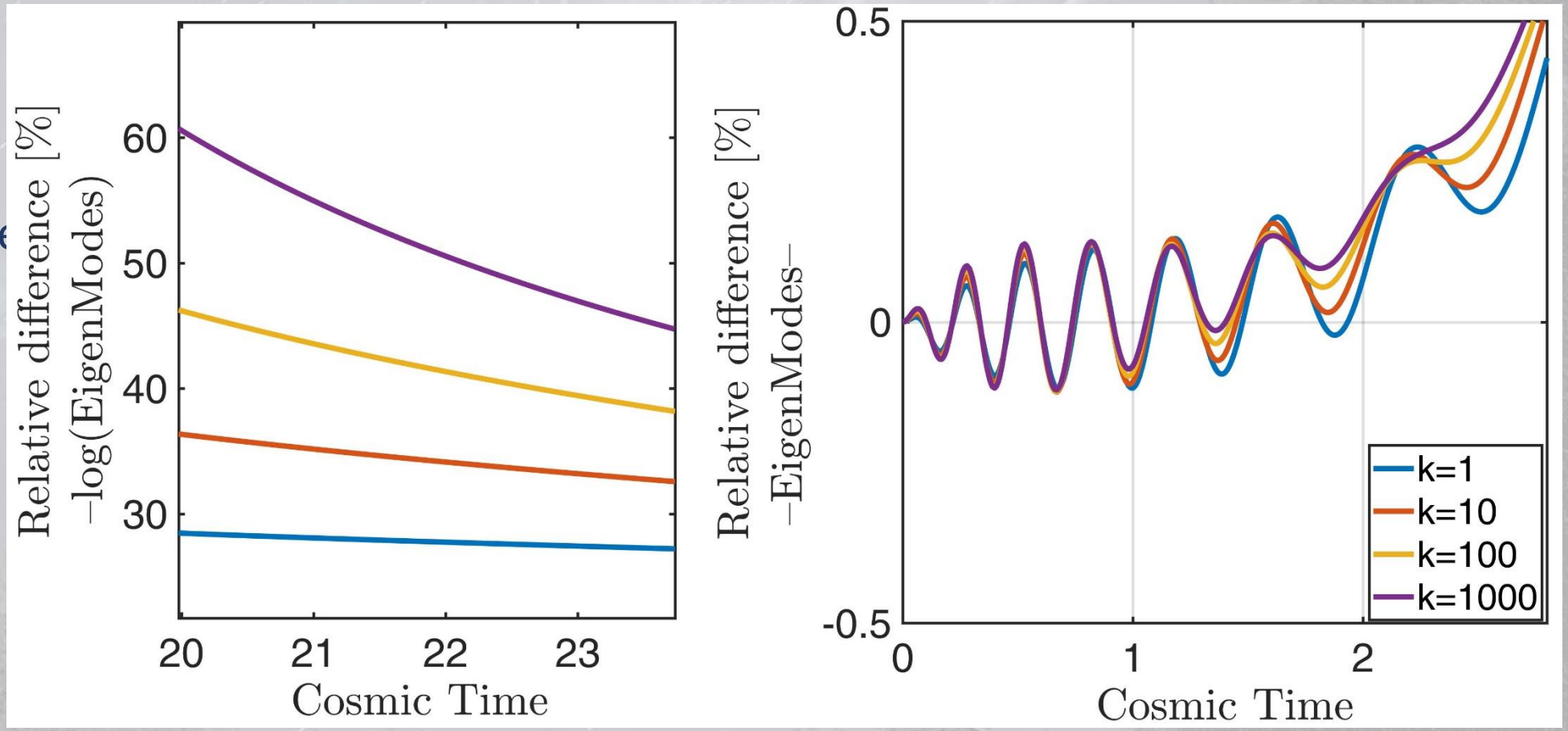


Dodelson & Stewart PRD 65(2002)

IW, Brustein arXiv:1607.03740 (2016)

Summary and outlook

What to take away from all of this?

- Small field models can produce GW.
- There is much more in a potential than the first derivative.
- It ain't over 'till it's over.

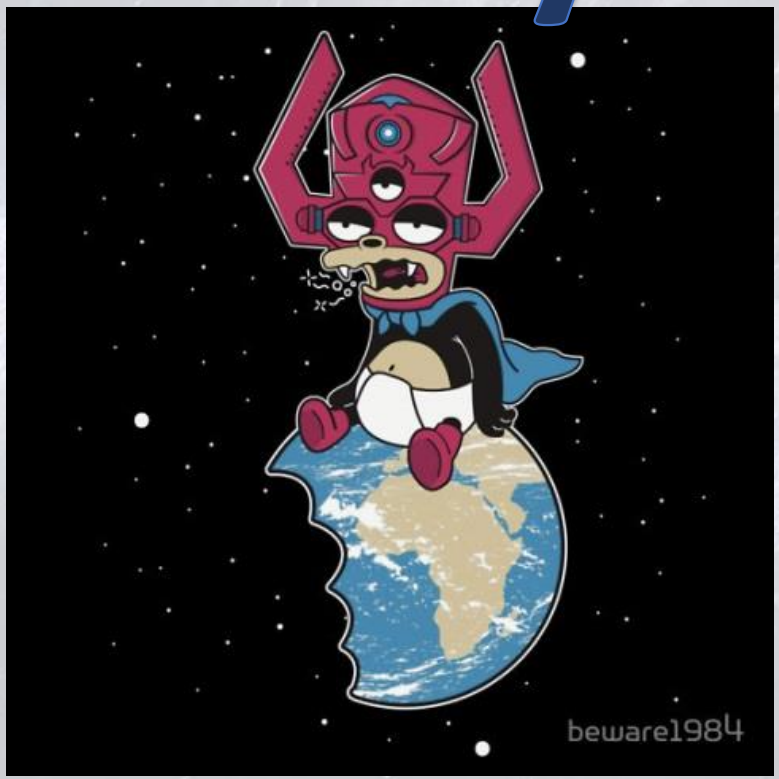
Summary and outlook

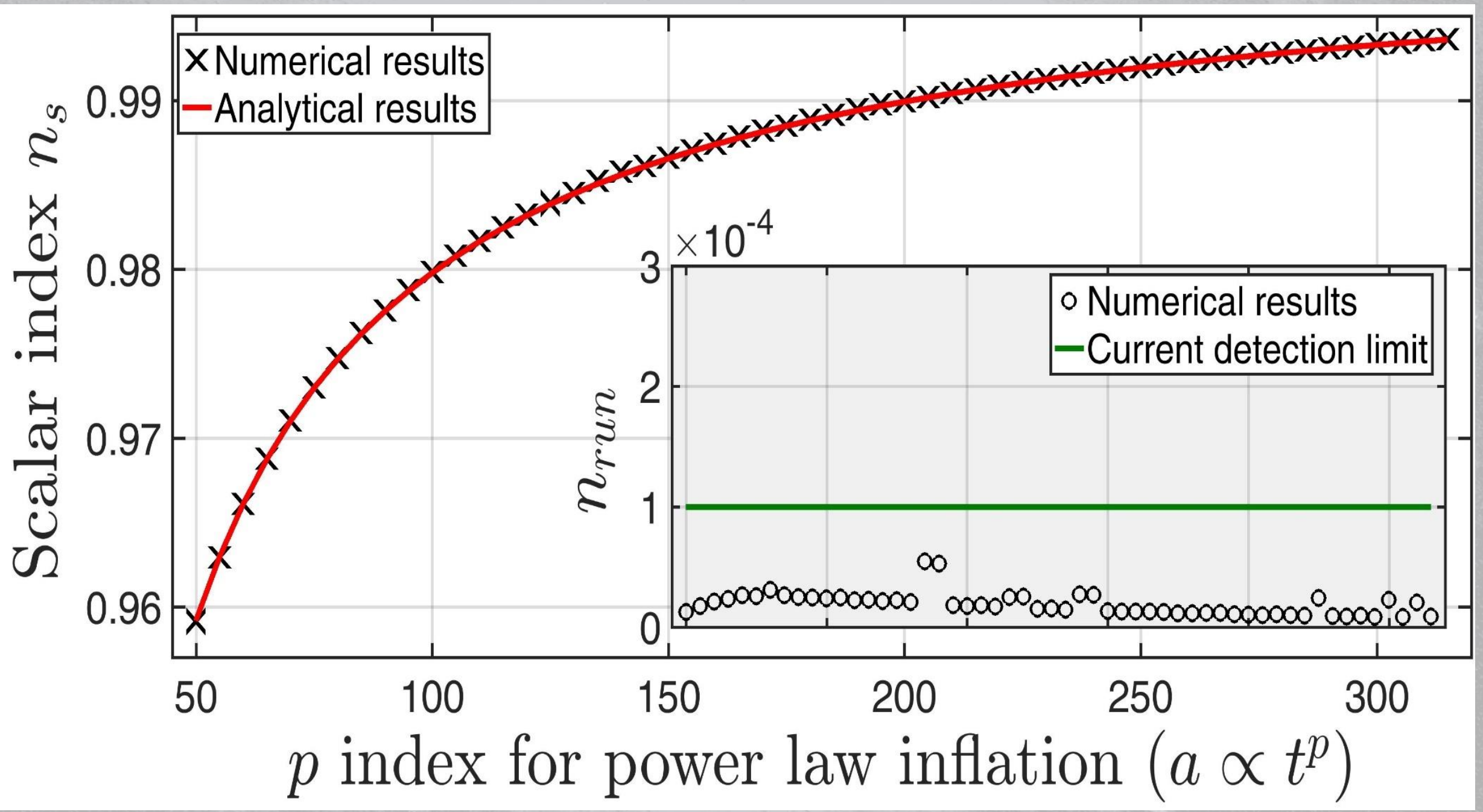
In the works

- Find a better analytic expression from first principles.
- Complete work on r=0.05 small field models.
- Other checks on small field models viability.

Questions?

Thank you!




Numerical results
Analytical results
Scalar index n_s
0.99
0.98
0.97
0.96
$\times 10^{-4}$
3
2
1
0
n_{run}
Numerical results
Current detection limit
50
100
150
200
250
300
p index for power law inflation $(a \propto t^p)$

Some Theory

Observables – in theory

- Observables in potential derivative language

$$n_s \simeq 1 - 6\varepsilon_{V,0} + 2\eta_{V,0} + 2\left[\frac{\eta_{V,0}^2}{3} - \left(\frac{5}{3} - 12b\right)\varepsilon_{V,0}^2 - (8b+1)\,\varepsilon_{V,0}\eta_{V,0} + \left(b + \frac{1}{3}\right)\xi_{V,0}^2\right],$$

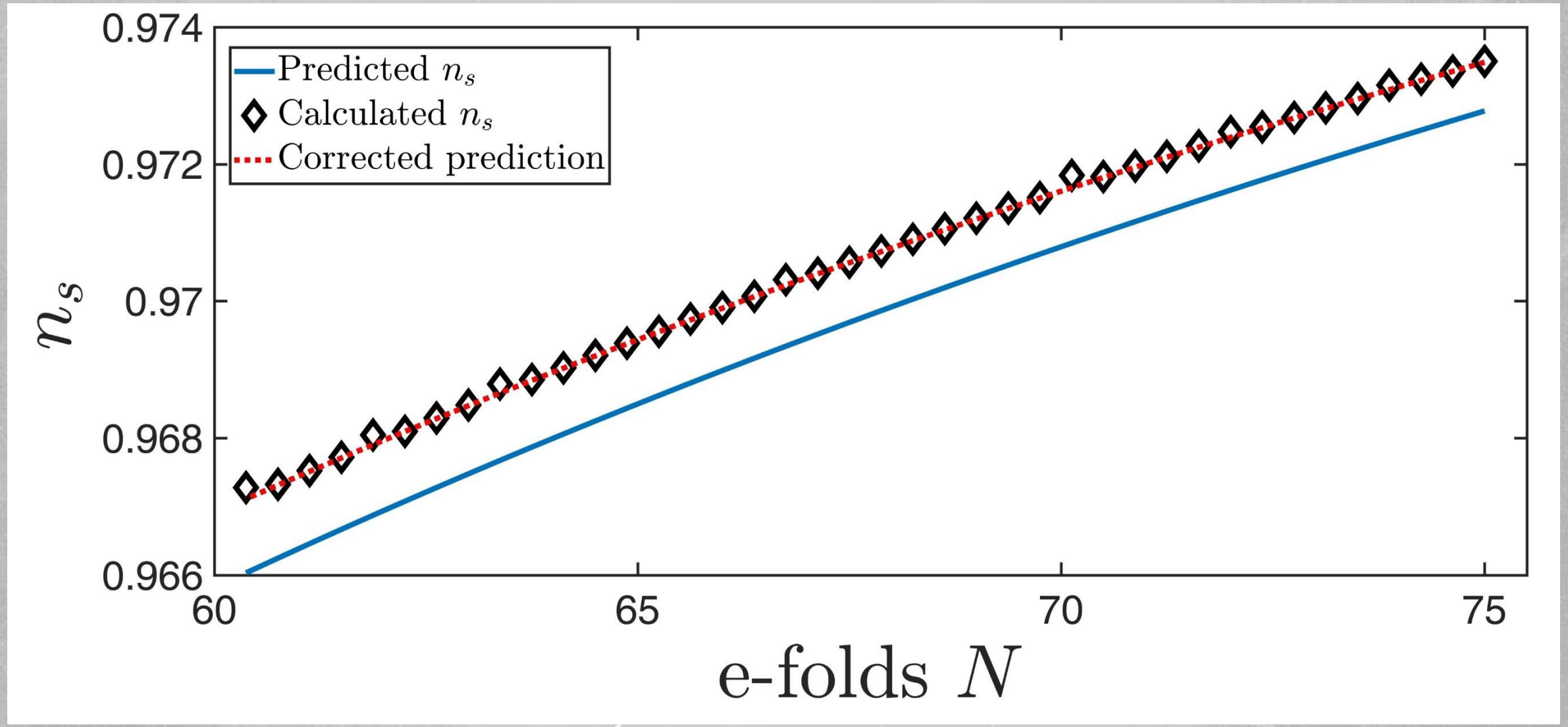
$$n_{run} \simeq 16\varepsilon_{V,0}\eta_{V,0} - 24\varepsilon_{V,0}^2 - 2\xi_{V,0}^2$$

$$\varepsilon = \frac{1}{2}\left(\frac{V'}{V}\right)^2$$

$$\eta = \frac{V''}{V}$$

$$\xi^2 = \frac{V'V'''}{V^2}$$

Stewart & Lyth: Phys. Lett.B 302, 171 (1993)


Predicted n_s
Calculated n_s
Corrected prediction
0.974
0.972
0.97
0.968
0.966
n_s
60
65
70
75
e-folds N