Science Case Working Group

Section 3: Inflation & Fundamental Physics

Section 4: Gravity Waves from Inflation and the B-mode Polarization

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Inflation

- Model defined by V(Φ) or V(Φ,Ψ,…)
- Scalar and tensor perturbations

$$\epsilon \equiv \frac{M_{Pl}^2}{2}\left(\frac{V'}{V}\right)^2 \ll 1$$

$$\eta \equiv M_{Pl}^2\frac{V''}{V} \ll 1$$

$$r \equiv 16\frac{A_T^2}{A_S^2} \simeq 16\epsilon$$

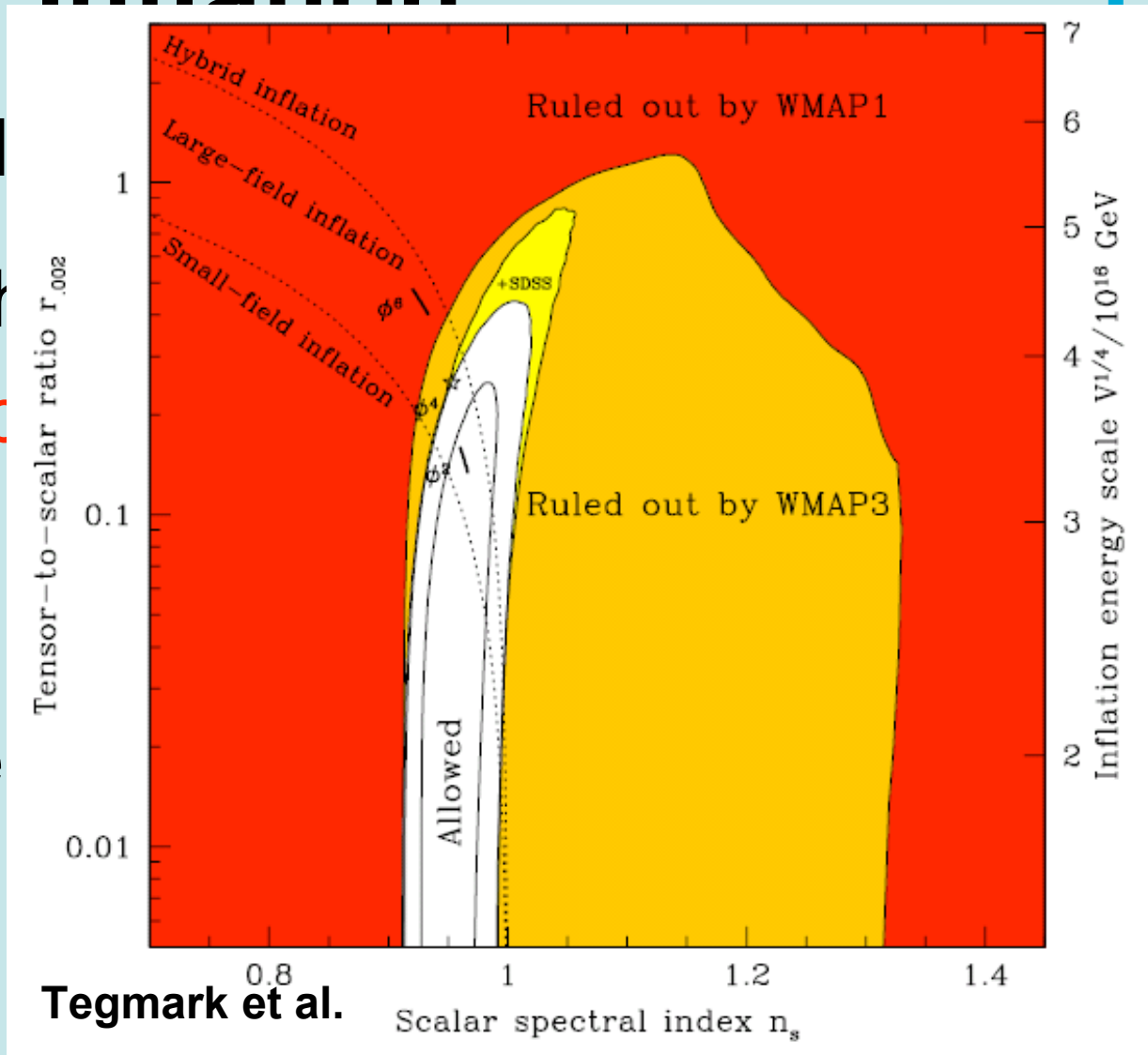
$$n_T \equiv \frac{d\ln A_T^2(k)}{d\ln k} \simeq -2\epsilon$$

$$n_S \equiv 1 + \frac{d\ln A_S^2(k)}{d\ln k} \simeq 1 + 2\eta - 6\epsilon$$

Inflation

Classes of mod

- Large field (ch
  $(\Phi/\mu)^p$, exp
- Small field
  $(1 - (\Phi/\mu)^p)$
- Hybrid (2+ fie
  $(1+ (\Phi/\mu)^p)$



Tegmark et al.

Fundamental Physics

Want to know the physics behind inflation

- The New Cosmology (Strings/M-theory/Branes) making predictions

(scalar fields, potential between branes,…)

- Alternatives exist

(pre-big bang, cyclic, ekpyrotic, …)

We want to do more than constrain V

How reliable are these predictions?

Inflation - what we know so far

Crude constraints on dynamics of inflation

- WMAP3 consistent with adiabatic, Gaussian fluctuations
- Tensor mode has not been detected
- There could be some other contributions (cosmic strings, isocurvature, …)
- $n_s \approx 0.96$ (< 1 at 95% CI)
- Exclude quartic potentials, disfavour Hybrid
- $r \leq 0.38$

Inflation - what we could know

Amplitude of tensor mode fixes energy scale of inflation

$$V^{1/4} = 3.3 \times 10^{16} \; r^{1/4} \text{ GeV}$$

(current constraint $V^{1/4} < 2.6 \times 10^{16}$ GeV)

Detection of tensor modes would:

- Confirm that inflation took place
- Determine energy scale
- Constrain dynamics

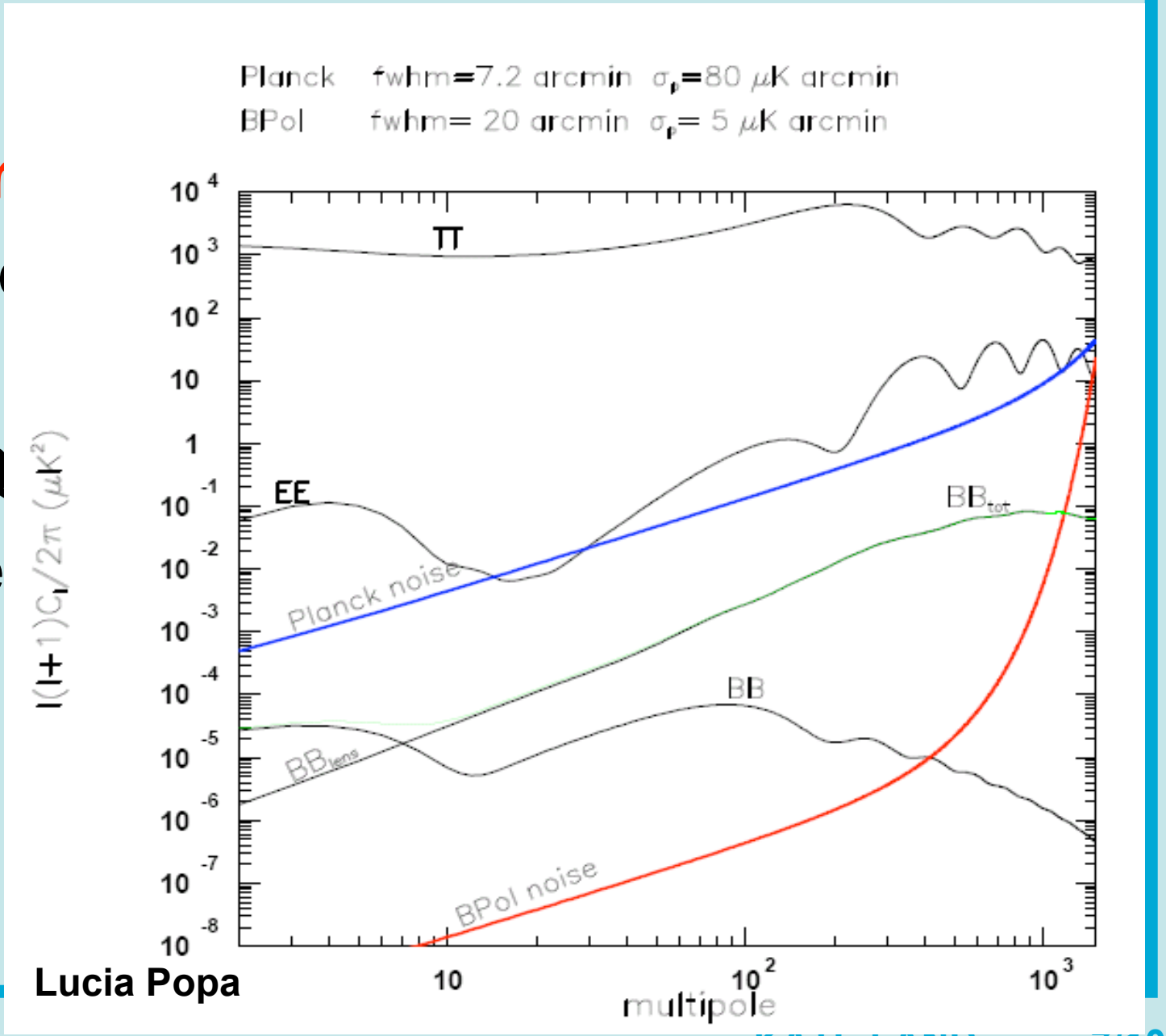
Planck: r

Should d

Clover/Q

Can dete

Bpol: r >



Lucia Popa

Predictions

- **Large-field** $r > 0.01$

High-field values → probing new territory beyond Planck scale.

- **Other** r could be 10^{-10}

No guarantee of r detectable

If Clover/Quiet find r<0.01, do we expect Bpol to do better?

Bpol after Clover/QUIET

- Models with $0.001 < r < 0.01$ ➔

  $6 \times 10^{15} < V^{1/4} < 10^{16}$ GeV

- Fine tuning arguments ➔ $r > 0.01$?

- **Impact of a null detection? $r < 0.001$**

What does this tell us about fundamental physics? Inflation < GUT scale, impact on model building…

Discussion

Section 3: Inflation and Fundamental Physics

Section 4: Gravity Waves, Polarization & Inflation

1. Overall tone & aim
2. How many branes?
3. Party line on expectation of r
4. Level of detail
5. Notation, etc.