Test Gravity

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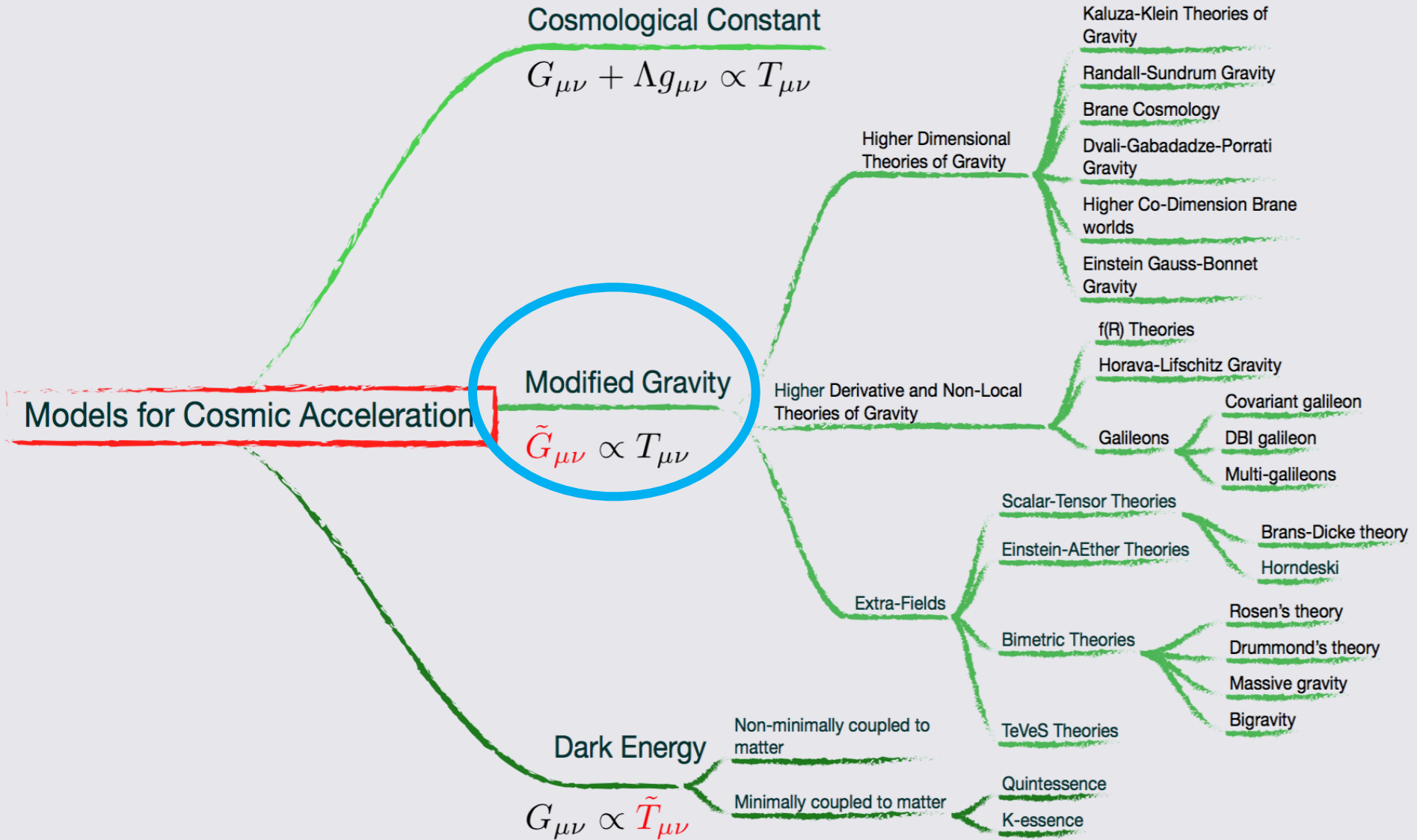
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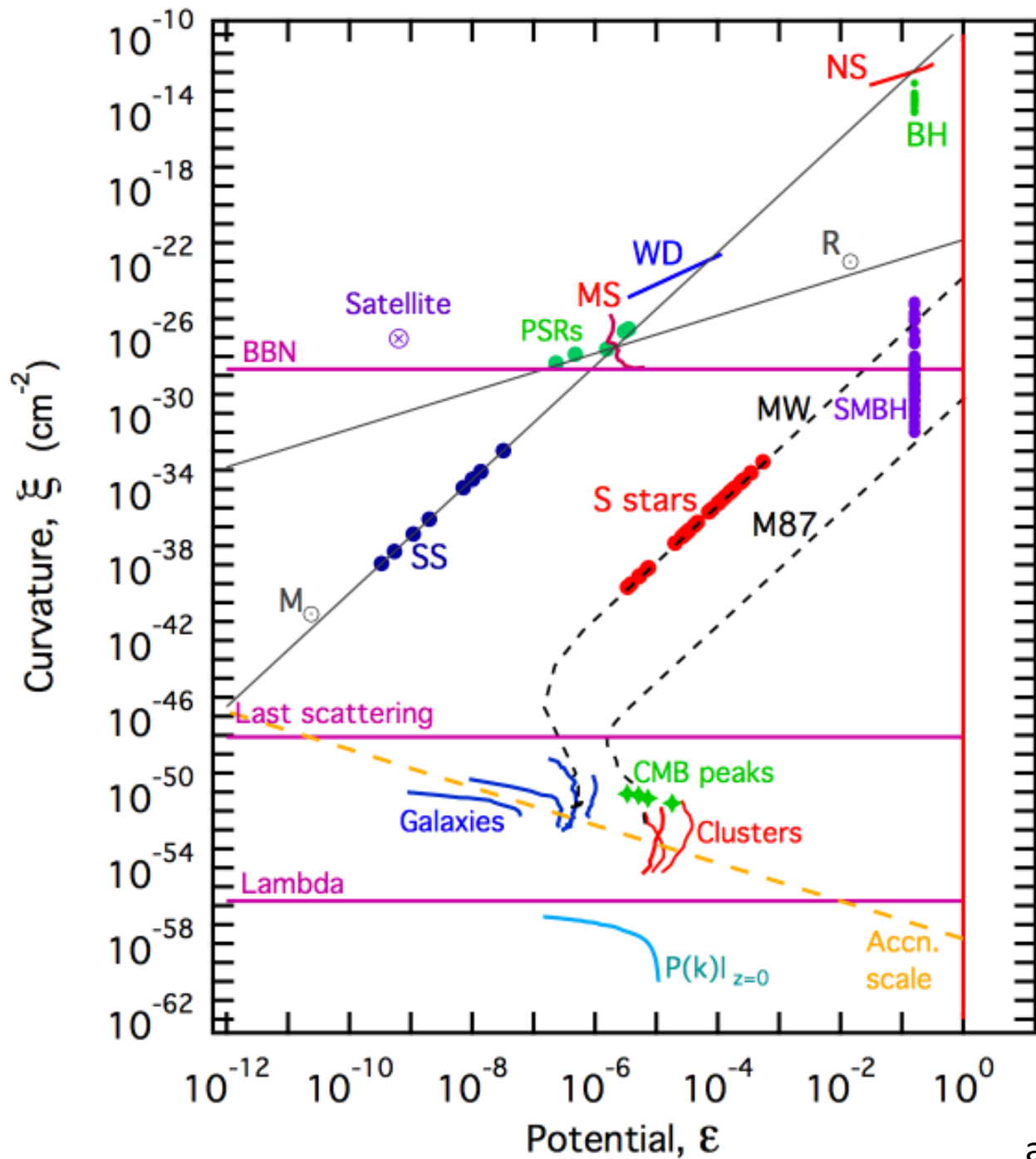
What is the Problem?

- Cosmic Acceleration: DE/MG?
- Cosmological Constant problem

The situation in model space:

Cosmological Constant

$$G_{\mu\nu} + \Lambda g_{\mu\nu} \propto T_{\mu\nu}$$

Models for Cosmic Acceleration

Modified Gravity

$$\tilde{G}_{\mu\nu} \propto T_{\mu\nu}$$

Higher Dimensional Theories of Gravity
- Kaluza-Klein Theories of Gravity
- Randall-Sundrum Gravity
- Brane Cosmology
- Dvali-Gabadadze-Porrati Gravity
- Higher Co-Dimension Brane worlds
- Einstein Gauss-Bonnet Gravity

Higher Derivative and Non-Local Theories of Gravity
- f(R) Theories
- Horava-Lifschitz Gravity
- Galileons
  - Covariant galileon
  - DBI galileon
  - Multi-galileons

Extra-Fields
- Scalar-Tensor Theories
  - Brans-Dicke theory
  - Horndeski
- Einstein-AEther Theories
- Bimetric Theories
  - Rosen's theory
  - Drummond's theory
  - Massive gravity
  - Bigravity
- TeVeS Theories

Dark Energy

$$G_{\mu\nu} \propto \tilde{T}_{\mu\nu}$$

- Non-minimally coupled to matter
- Minimally coupled to matter
  - Quintessence
  - K-essence

[based on arXiv:1106.2476, by far not complete…]
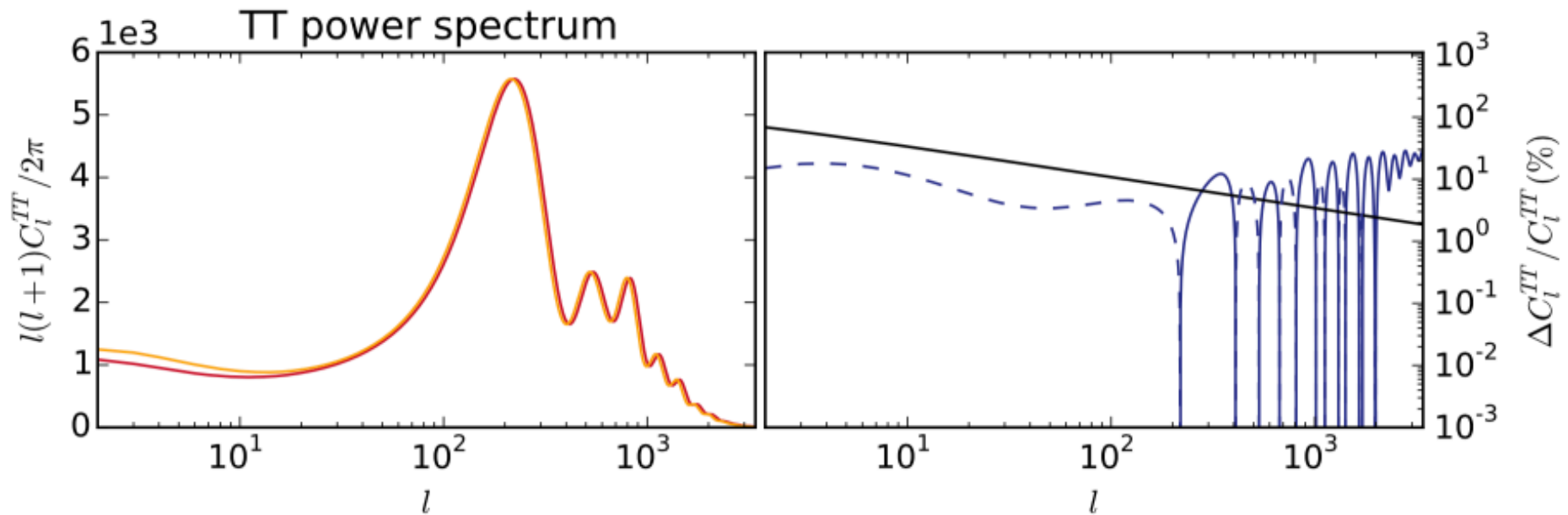
arXiv:1412.3455v3

Parameterization

- Equation of state of DE: w_{DE}

- Parameters in Einstein equations: μ, γ

- Velocity of gravitational wave: c_T

- ......

Reconstruction CAMB

- Mode 0: GR+LCDM
    - $(w_{DE} = -1, \mu = \gamma = 1, c_T = 1)$
- Mode 1: wCDM
    - $(w_{DE} \neq -1, \mu = \gamma = 1, c_T = 1)$
- Mode 2: Modified Gravity
    - $(\mu \neq 1 \ \text{ or } \ \gamma \neq 1)$
- Mode 3: $c_T \neq 1$
- ……

1_GR VS 4_constantwDE_2 comparison of lensed Cls

TT power spectrum

$w_{DE} = -0.7$

1_GR VS 3_MG_2 comparison of lensed Cls

TT power spectrum

$\mu = 1.1$

TT power spectrum

$\gamma = 1.1$