Can Loop Quantum Cosmology describe an unified and consistent scenario since bounce until the end of inflation?

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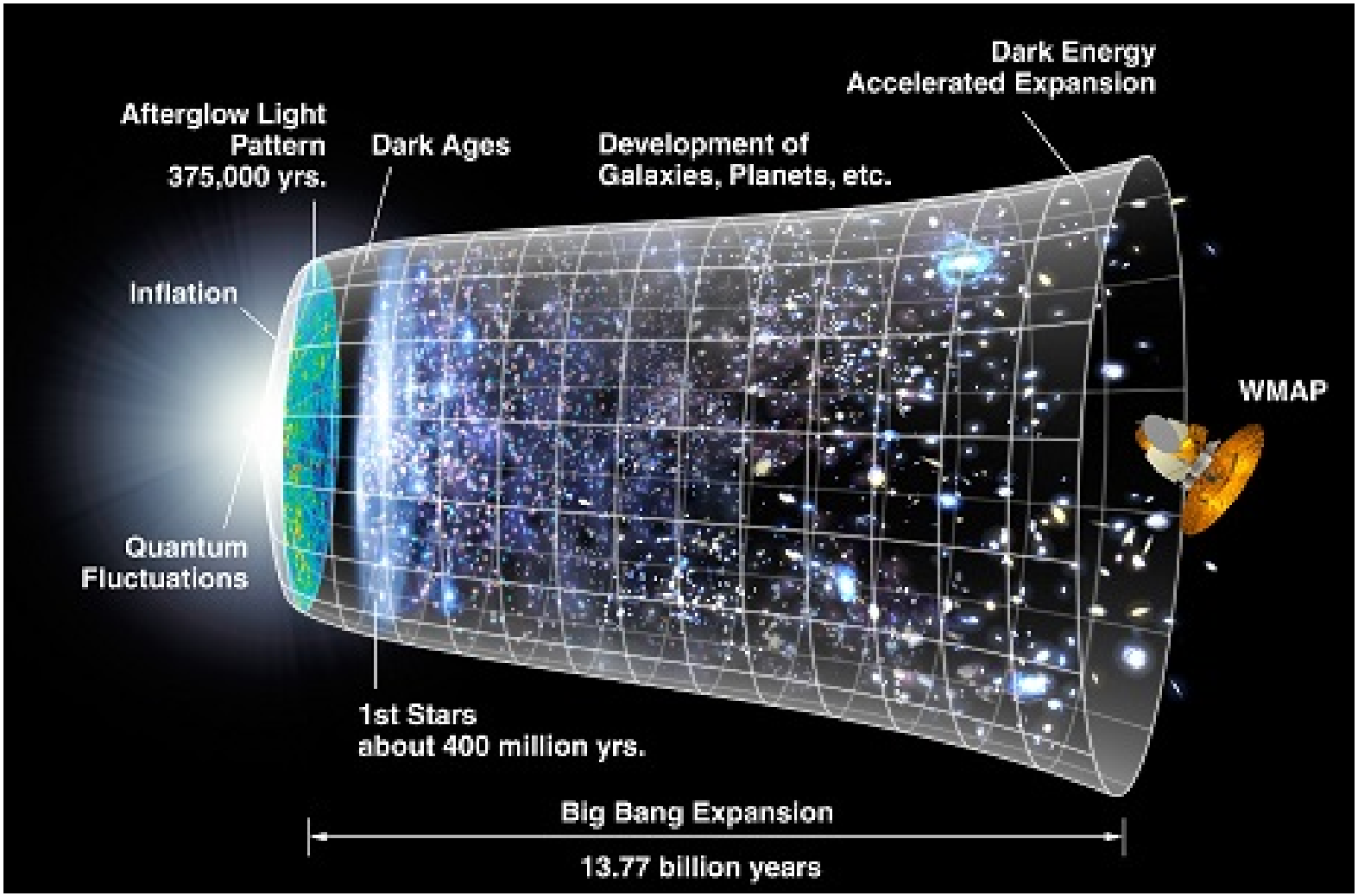
Introduction

Very Early Universe

- Planck scale;
- Standard Cosmology (from Big Bang until the end of inflation);
- Inflationary Universe;



Credit: NASA/WMAP

Open Problems

- Big Bang singularity;
- Inflaton nature;

- Quantum theory of gravity;

Loop Quantum Cosmology

- Loop Quantum Gravity (LQG);
- Quantization of cosmological space-times through techniques and variables from LQG;
- The Big Bang initial singularity is replaced by a Big Bounce:

$$H^2 = \frac{8\pi G}{3}\rho\left(1 - \frac{\rho}{\rho_c}\right); \tag{1}$$

- It allows the existence of a previous version of our universe;
- Mimetic gravity description of LQC;

Higgs Inflation

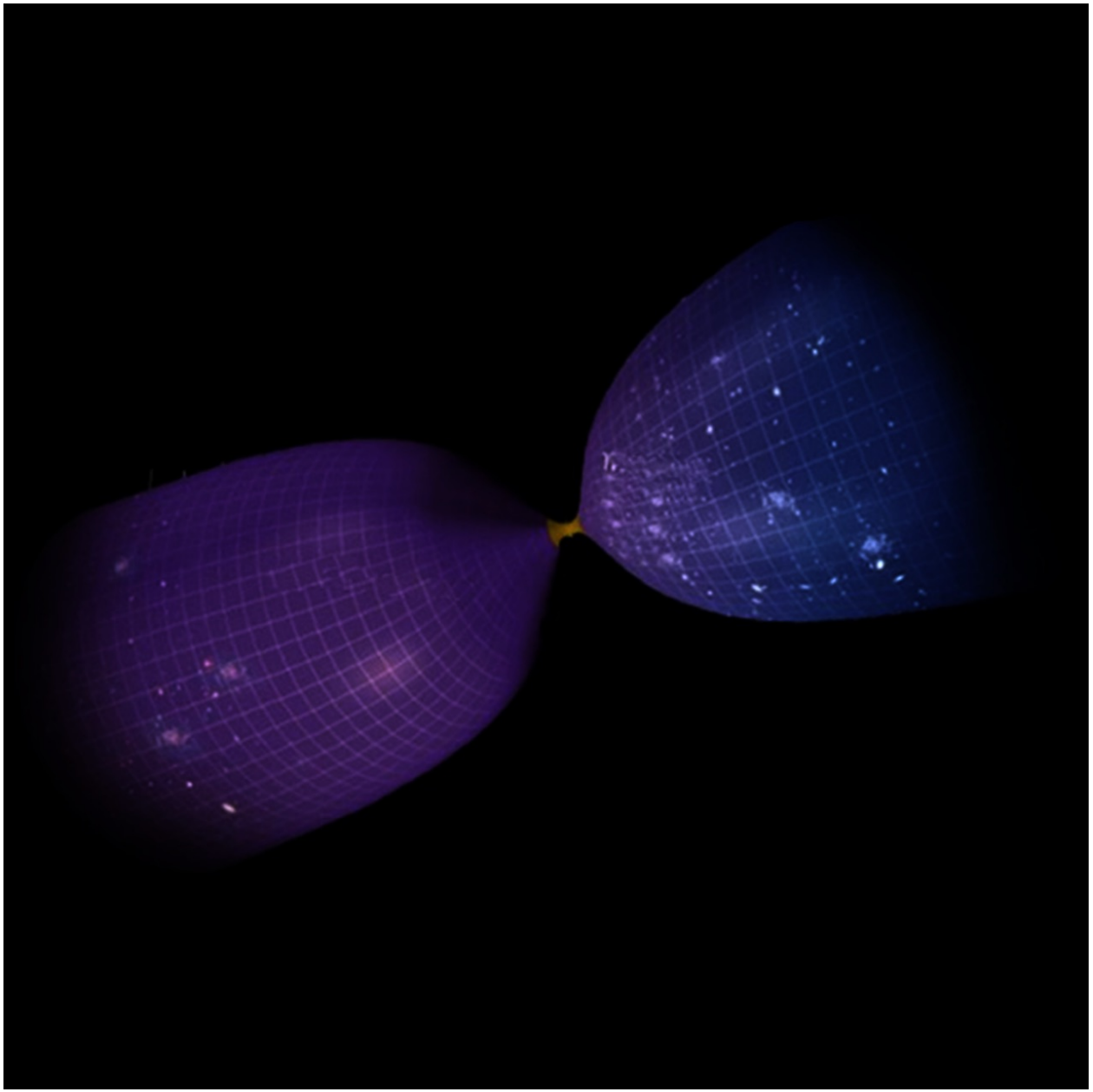
- The Higgs field is the only scalar field currently observed;
- Primordial version of Higgs field;
- Non-minimal coupling between gravity and matter;

How it can be implemented?

- Mimetic Gravity description of LQC + like-Higgs Inflation;

Evolutionary Phases of Primordial Universe

- Contracting;
- Bounce;
- Expanding;



Source: http://www.physics.princeton.edu/

Effective Friedmann Equation

- Reinterpreting the effective Friedmann equation obtained in Langlois *et al.*(2017)

$$H^2 = \frac{1}{3M_{Pl}^2}\left[\rho + 3M_{Pl}^2\left(V_k(h) - \frac{k}{a^2}\right)\right] \times$$

$$\times\left\{1 - \frac{1}{\rho_c}\left[\rho + 3M_{Pl}^2\left(V_k(h) - \frac{k}{a^2}\right)\right]\right\}; \qquad (2)$$

- Effective energy density

$$\rho_{\rm eff} = \rho + 3M_{Pl}^2\left[V_k(h) - \frac{k}{a^2}\right] \text{ where } \rho = \frac{\pi_h^2}{2a^6}; \qquad (3)$$

- Recovering the effective Friedmann equation

$$H^2 = \frac{\rho_{\rm eff}}{3M_{Pl}^2}\left(1 - \frac{\rho_{\rm eff}}{\rho_c}\right); \tag{4}$$

- Bounce

$$H^2 = \frac{8\pi G}{3}\rho\left(1 - \frac{\rho}{\rho_c}\right); \tag{5}$$

- Outset of Inflation

$$H^2 = \left[V_k(h) - \frac{k}{a^2}\right]\left\{1 - \frac{3M_{Pl}^2}{\rho_c}\left[V_k(h) - \frac{k}{a^2}\right]\right\}; \tag{6}$$

- End of inflation

$$H^2 \approx \frac{1}{3M_{Pl}^2}\left[\rho + 3M_{Pl}^2 V_k(h)\right]; \tag{7}$$

Final remarks

- Origin of current universe;
- Higgs field;
- Regarding curvature;
- Pair Higgs field and gravity;
- Recovering of both standard models;

Thank you!

Questions?