

Cyclic cosmology

An alternative theory to inflation

by Steinhardt and Turok

Basic concepts:

1. Big bang is not the beginning of time, but rather a transition to an earlier phase of evolution.
2. The evolution of universe is cyclic.
3. Large scale structure is originated from a phase of slow contraction before the bang, rather than inflation after the bang.

(Events a cycle ago shape our universe today.)

Essential ingredient:

Branes in higher dimensional picture or a scalar field in 4D effective theory.

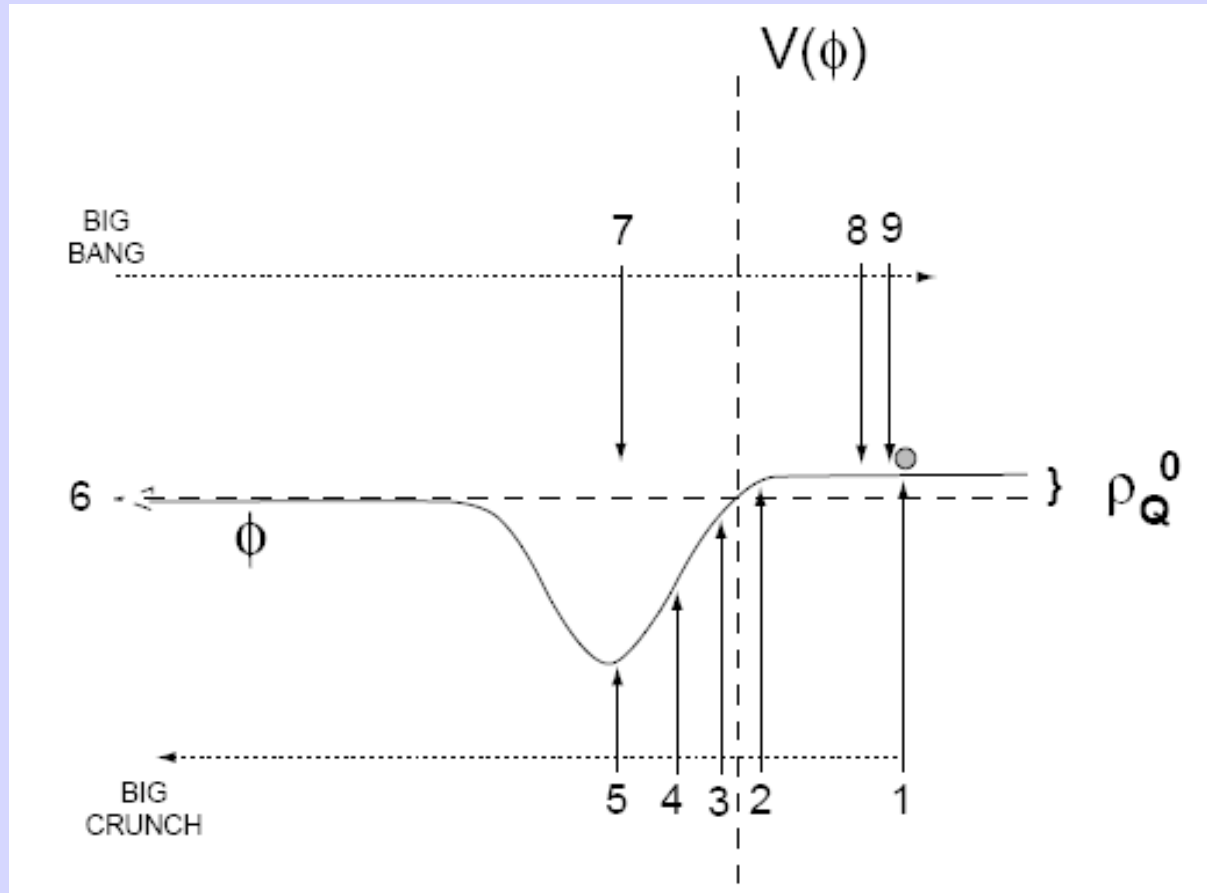
Explanation on DM:

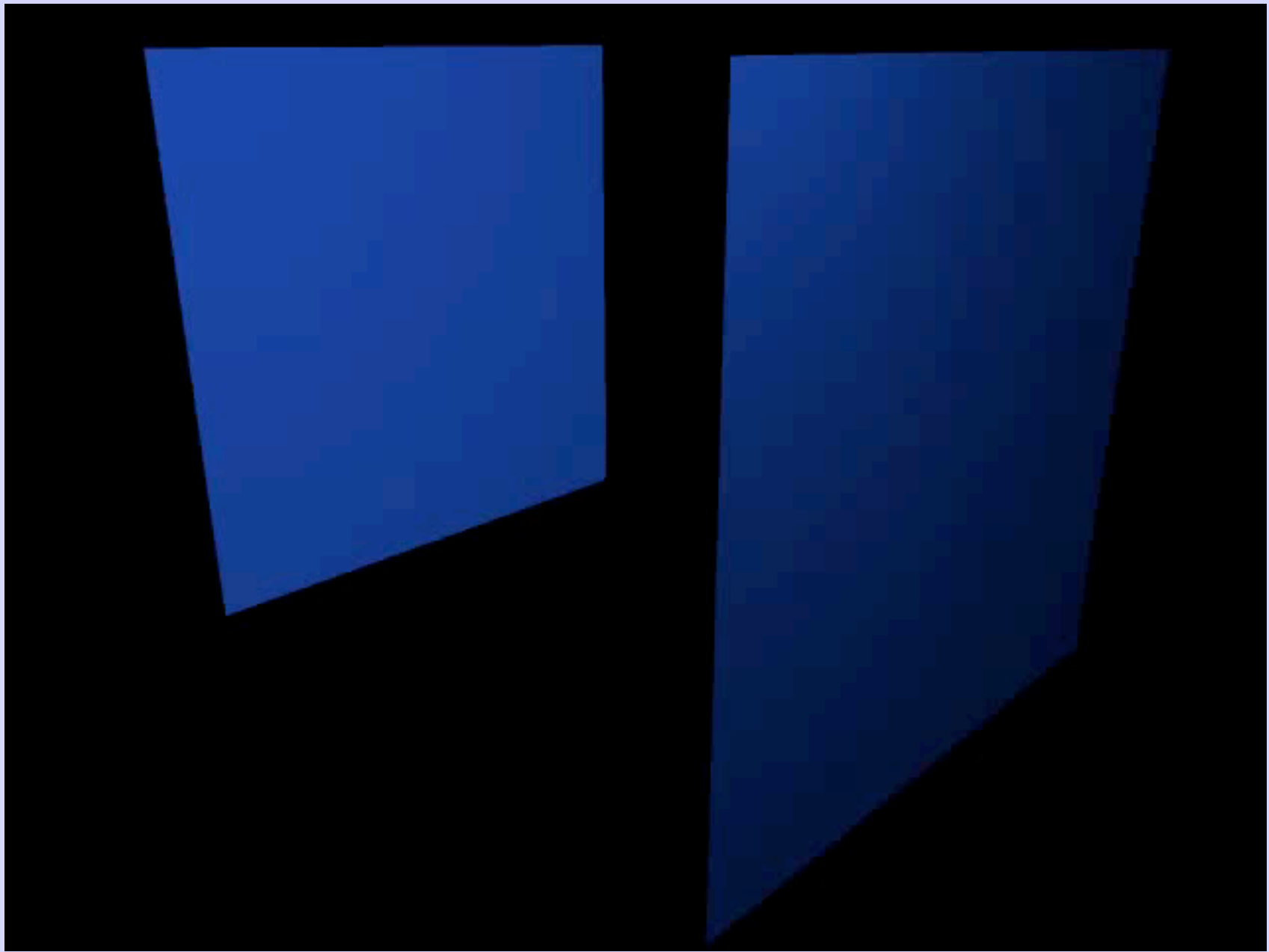
Particles in other brane can interact with particles in our brane by gravity, but not by other ordinary interactions.

Thus they seem to be invisible matters which provides gravity to our universe.

Then dark matter cannot be detected in labs looking for weakly interacting particles.

Introduce a potential to describe the attractive force.



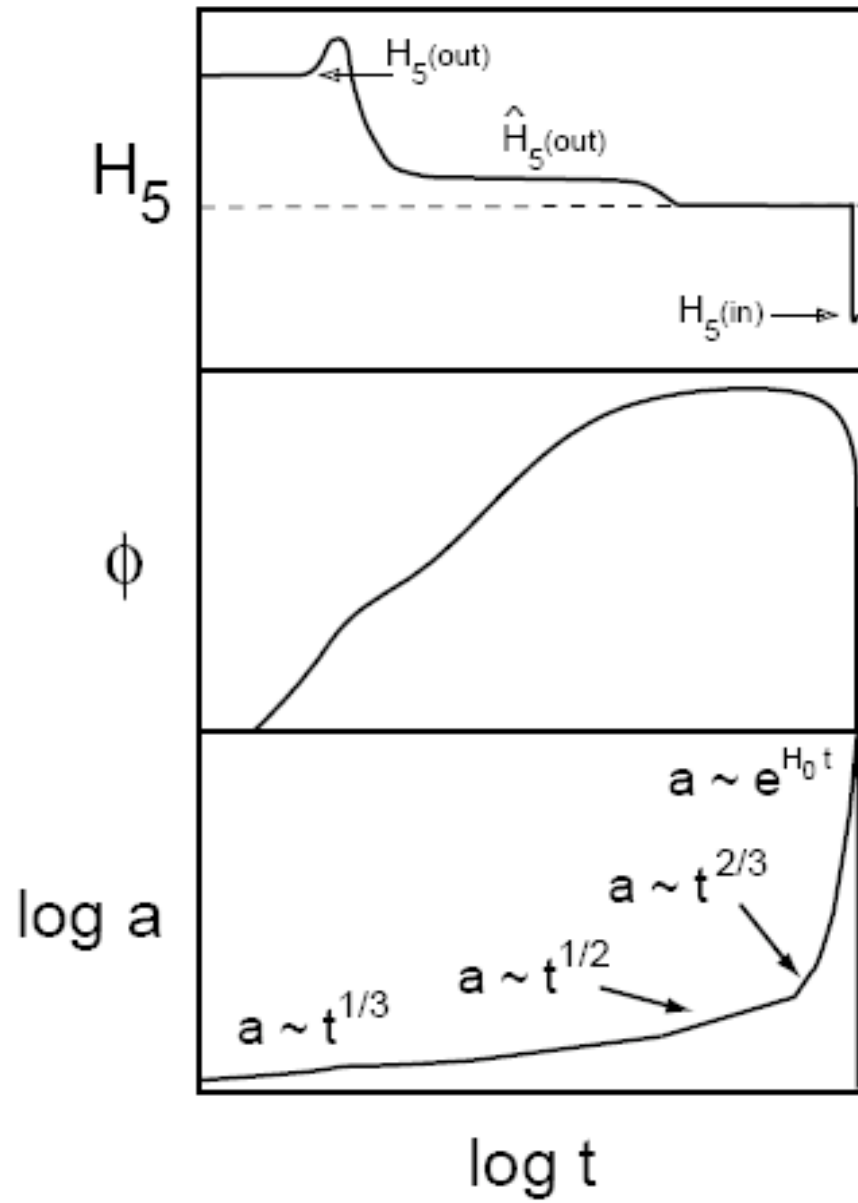


During DE dominated phase, branes are stretched to flat and parallel.

During the contraction phase, branes stop stretching and quantum fluctuations cause branes to wrinkle.

Collisions on branes are in different times, which cause slightly inhomogeneous after collision.

The spectrum of temperature fluctuations is nearly scale invariant.



$$H_5 \equiv \frac{2}{3} d(\exp(\sqrt{3/2}\phi))/dt$$

H_5 is proportional to the proper (5D) speed of contraction of the fifth dimension.

$H_5(\text{out})$ is for big bang,
 $H_5(\text{in})$ is for big crunch.

$$w \equiv \frac{\frac{1}{2}\dot{\phi}^2 - V}{\frac{1}{2}\dot{\phi}^2 + V} > 1$$

during the contraction phase

The collisions can continue indefinitely.

Gravity can provide extra energy during each contraction phase.

Consider a system for coupled gravity, scalar field and radiation, the evolution equations have a cyclic solution which is stable under small perturbation.