

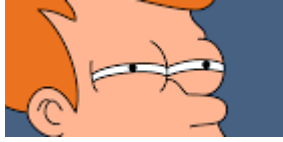
An introduction to
Inflation

Zach Meisel

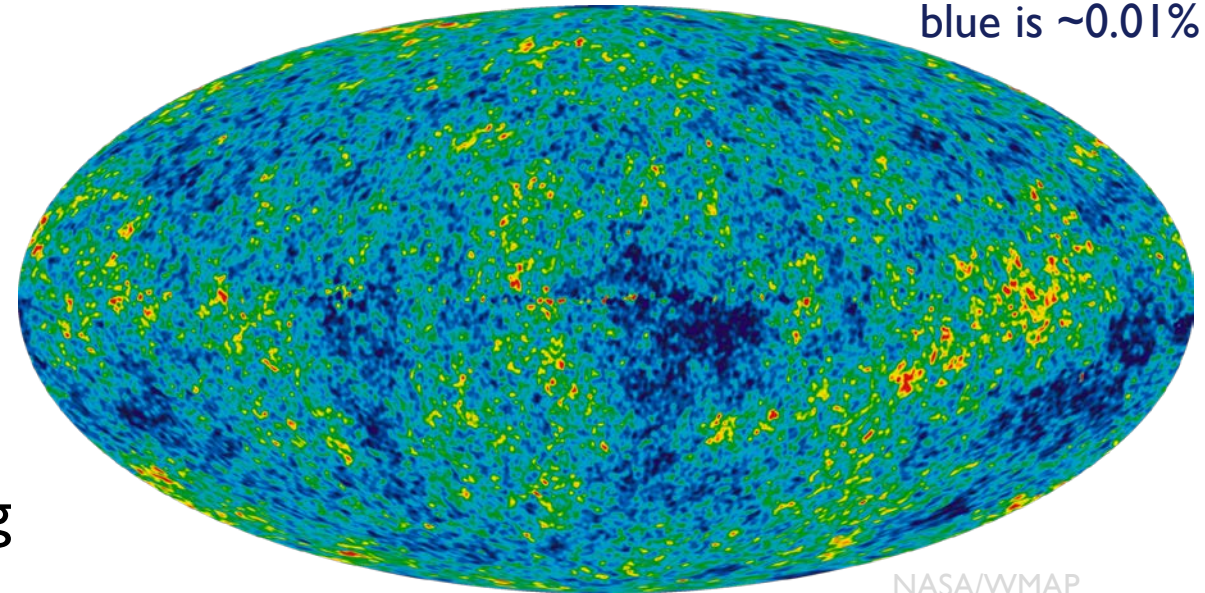
Ohio University - ASTR 1000

The Cosmic Microwave Background nearly uniform

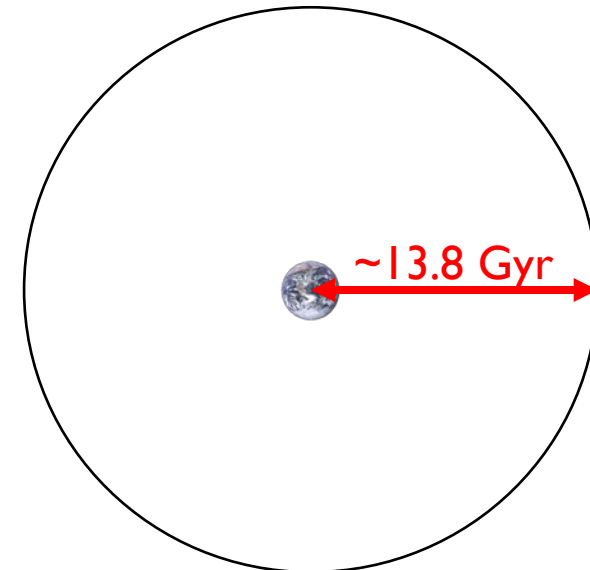
- ...too uniform



- The observable universe in two opposite directions from Earth couldn't have been in contact, because photons couldn't have traveled the distance in the time since the Big Bang
- If these regions didn't communicate, how are they so similar?
- Maybe everything was essentially in roughly the same location at one point in time and this region expanded *extremely* rapidly for a brief time.
This *possibility* is known as “inflation”

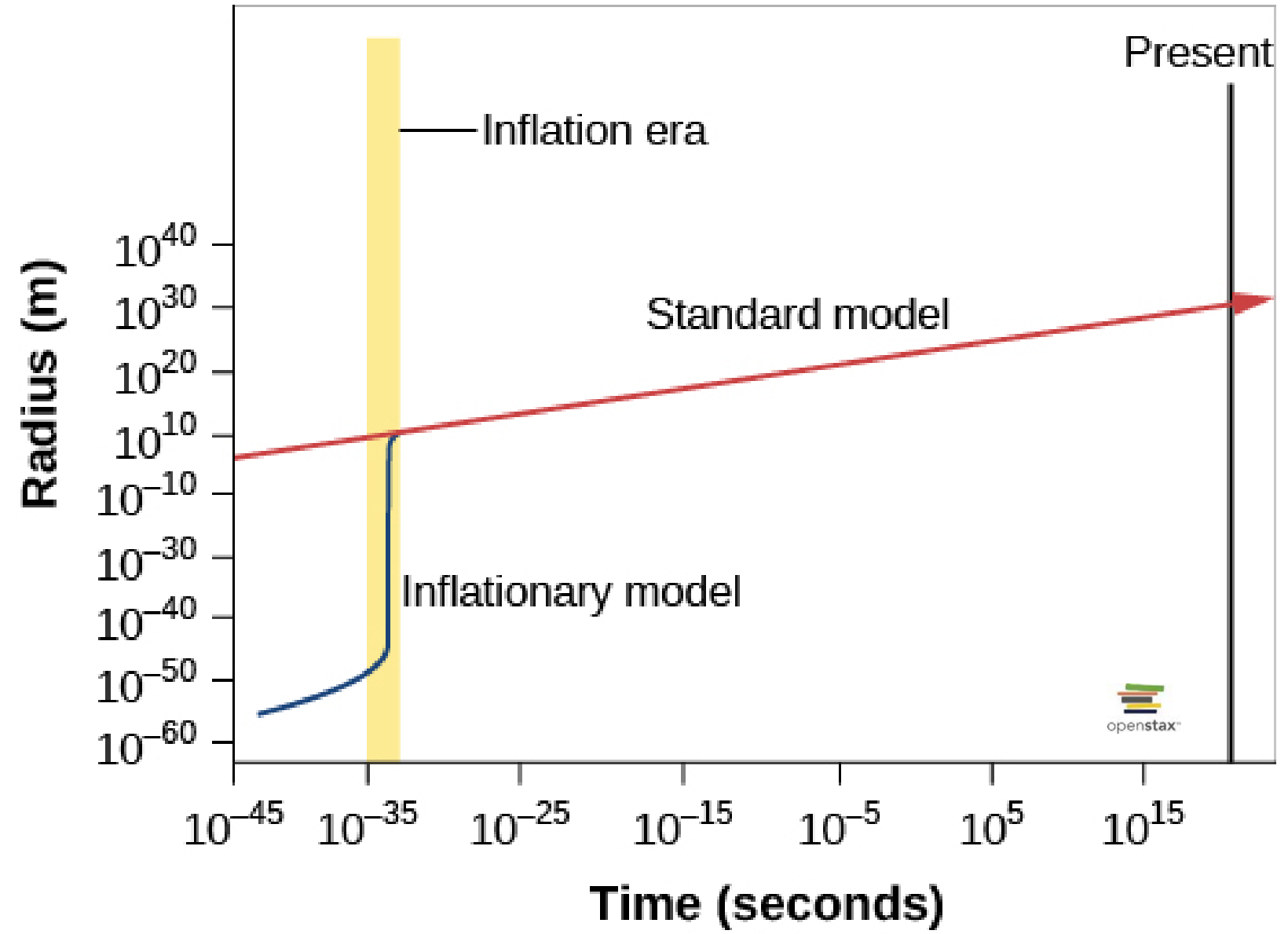


NASA/WMAP



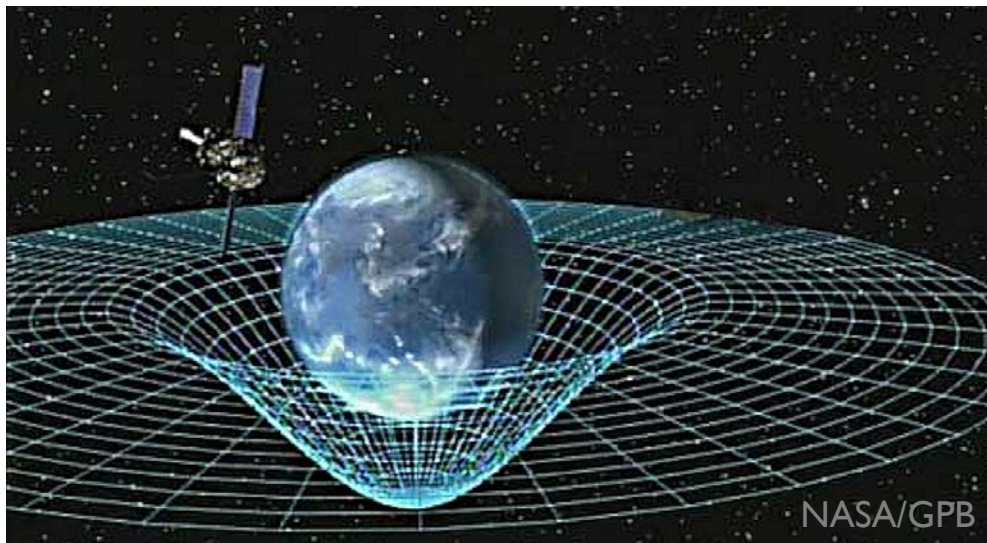
horizon of the observable universe

Inflation: *ultra-rapid expansion from a tiny point*

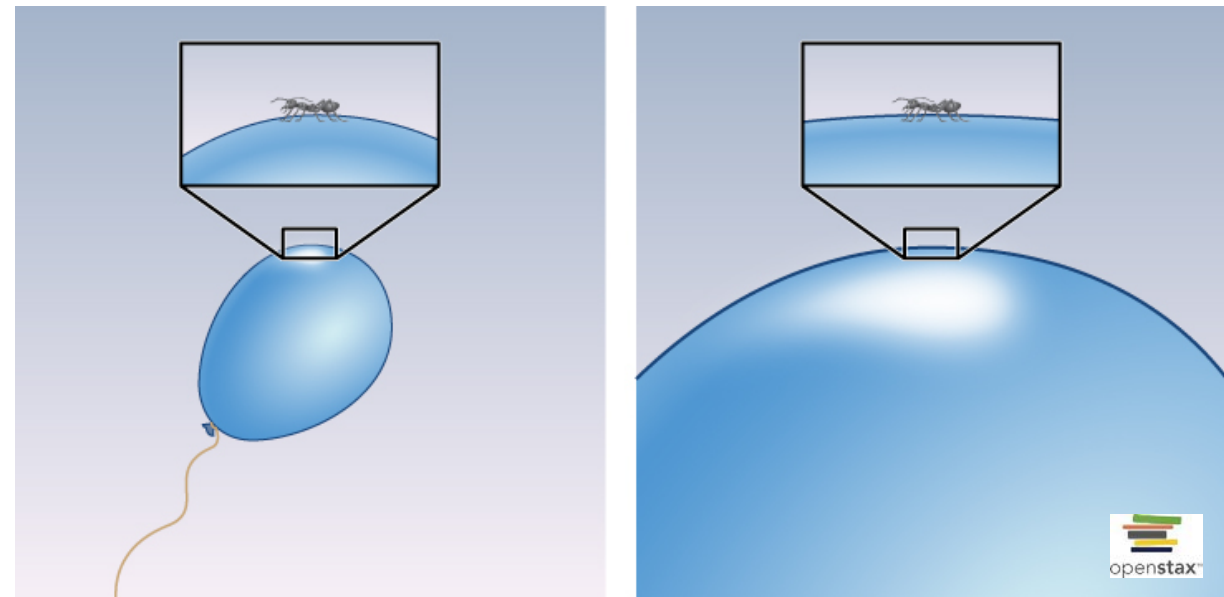


No curvature: *another bonus of inflation*

- Spacetime, the spatial and time coordinates of the universe, can be warped
- For instance, explaining how a satellite orbits the Earth by riding around in the sort of gravitational funnel formed by Earth

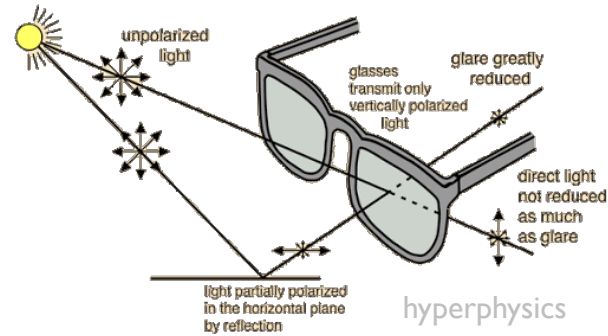
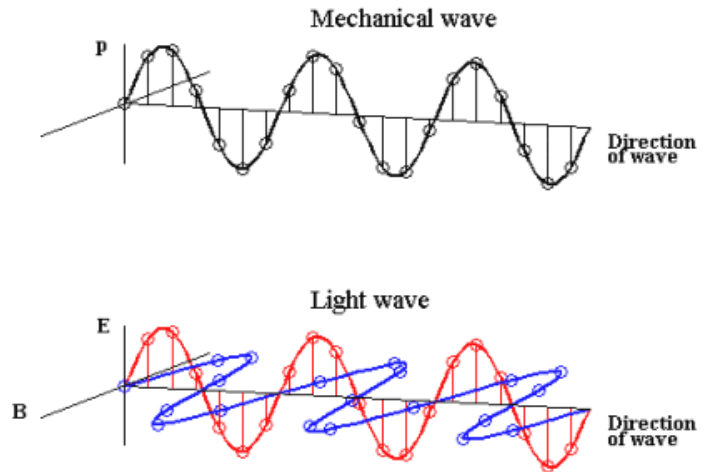


- In principle, the local universe could be warped, or “curved”, in a similar way...but it isn’t
- Inflation would be a neat explanation. Essentially, if you’re close enough to a curved surface and you’re really tiny, then everything looks flat



Direct proof for inflation

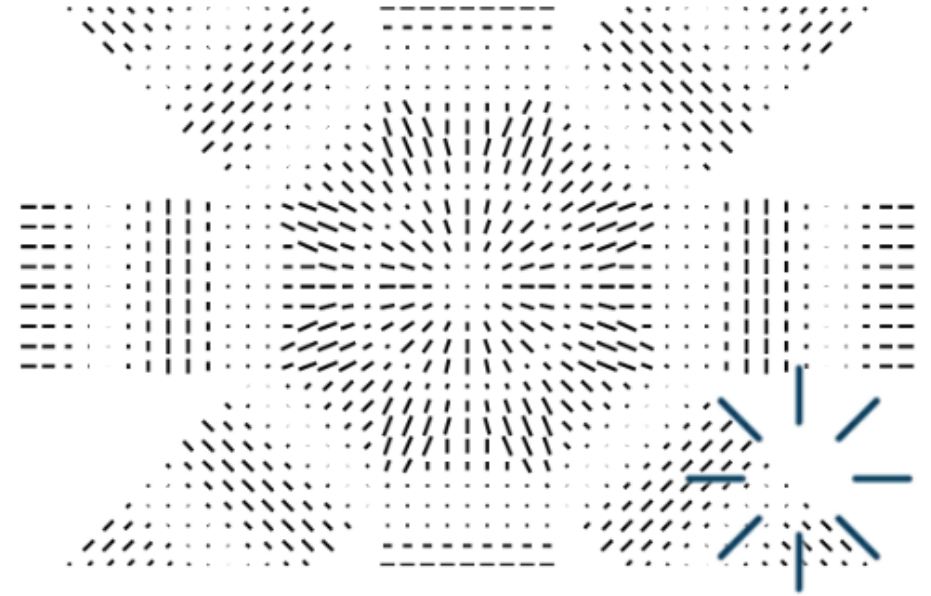
- **There isn't any!**
- Inflation is just the best of bad options, supported by circumstantial evidence
- However, there are testable predictions ...the tests are just really hard
- A *potentially* observable signature is the pattern of light polarization in the CMB



hyperphysics

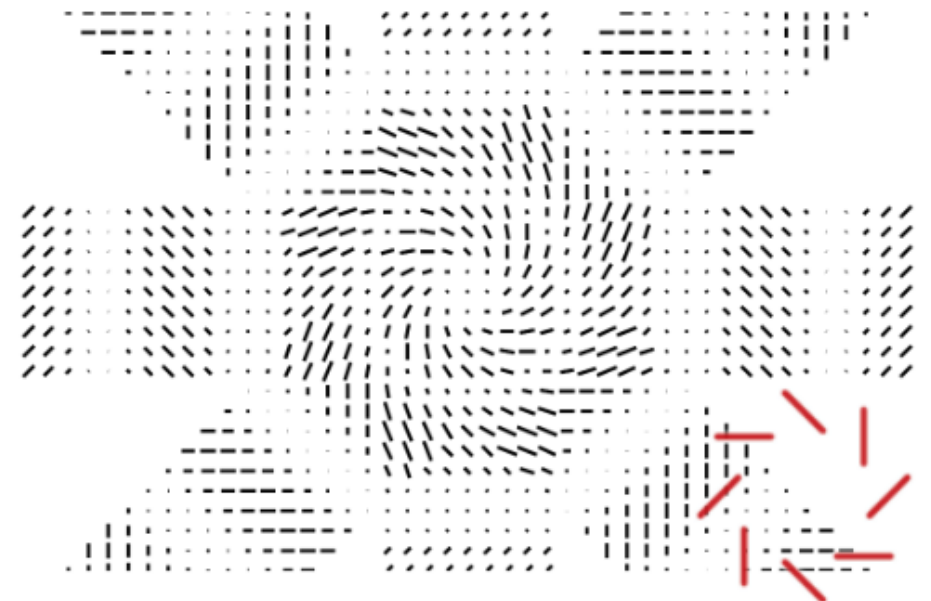
isvr

E-Mode Polarization Pattern



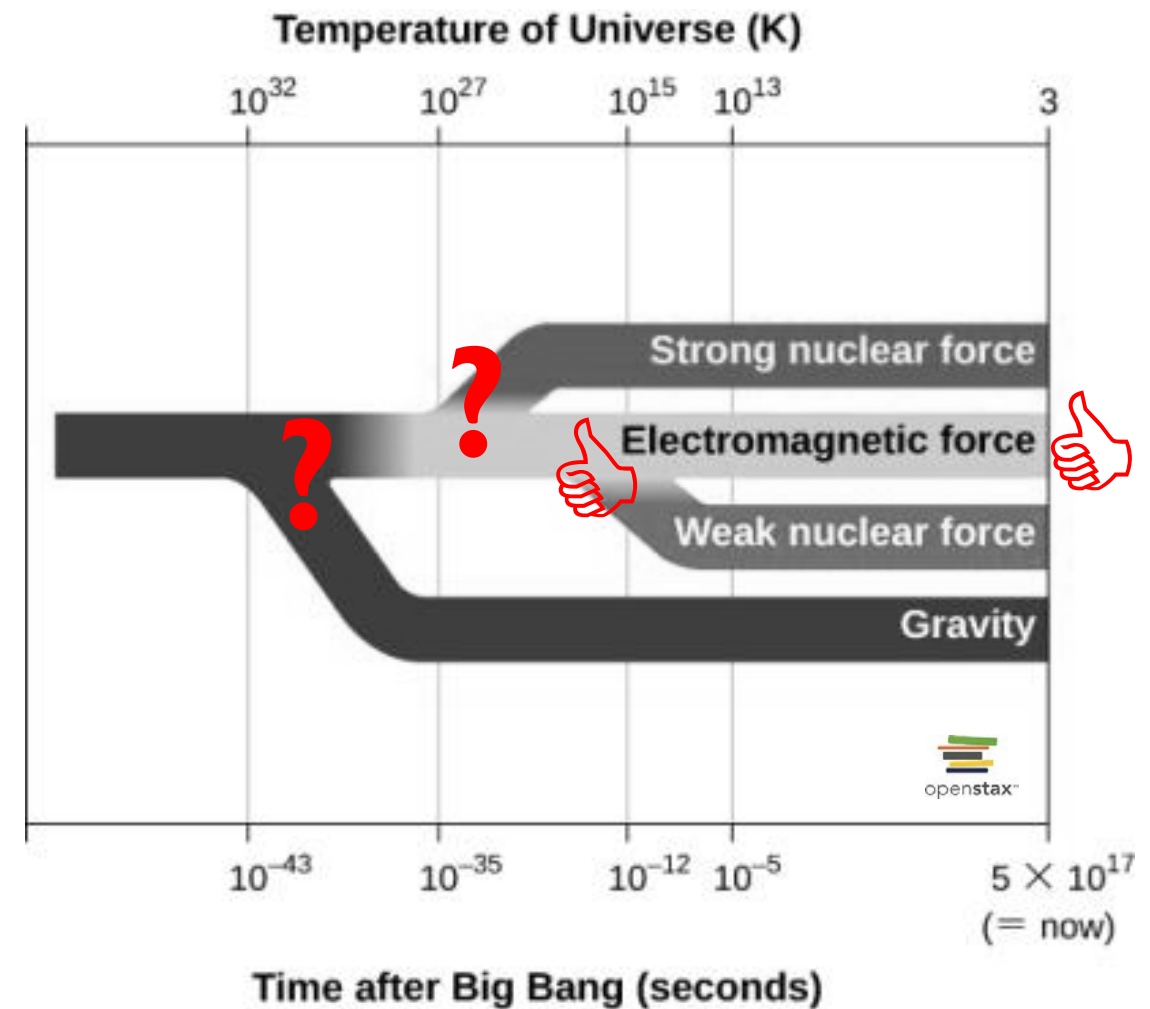
J. Kovac / BICEP2

B-Mode Polarization Pattern



Inflation: *How does it work?*

- Another good question!
- For such high densities and small scales, we need quantum mechanics and gravity...but there is as yet no unified theory linking them
- Electromagnetism unified electricity and magnetism
- Electroweak theory unified electromagnetism and the weak force
- A “Grand unified theory” is an attempt to unify the strong force and electroweak theory
- A “Theory of everything” is an attempt to unite all 4 fundamental forces
 - e.g. “superstring theory”



*“There’s small choice in rotten apples”
Shakespeare, The Taming of the Shrew*

There is zero proof for any GUTs or TOEs. A correct theory may not even exist.

