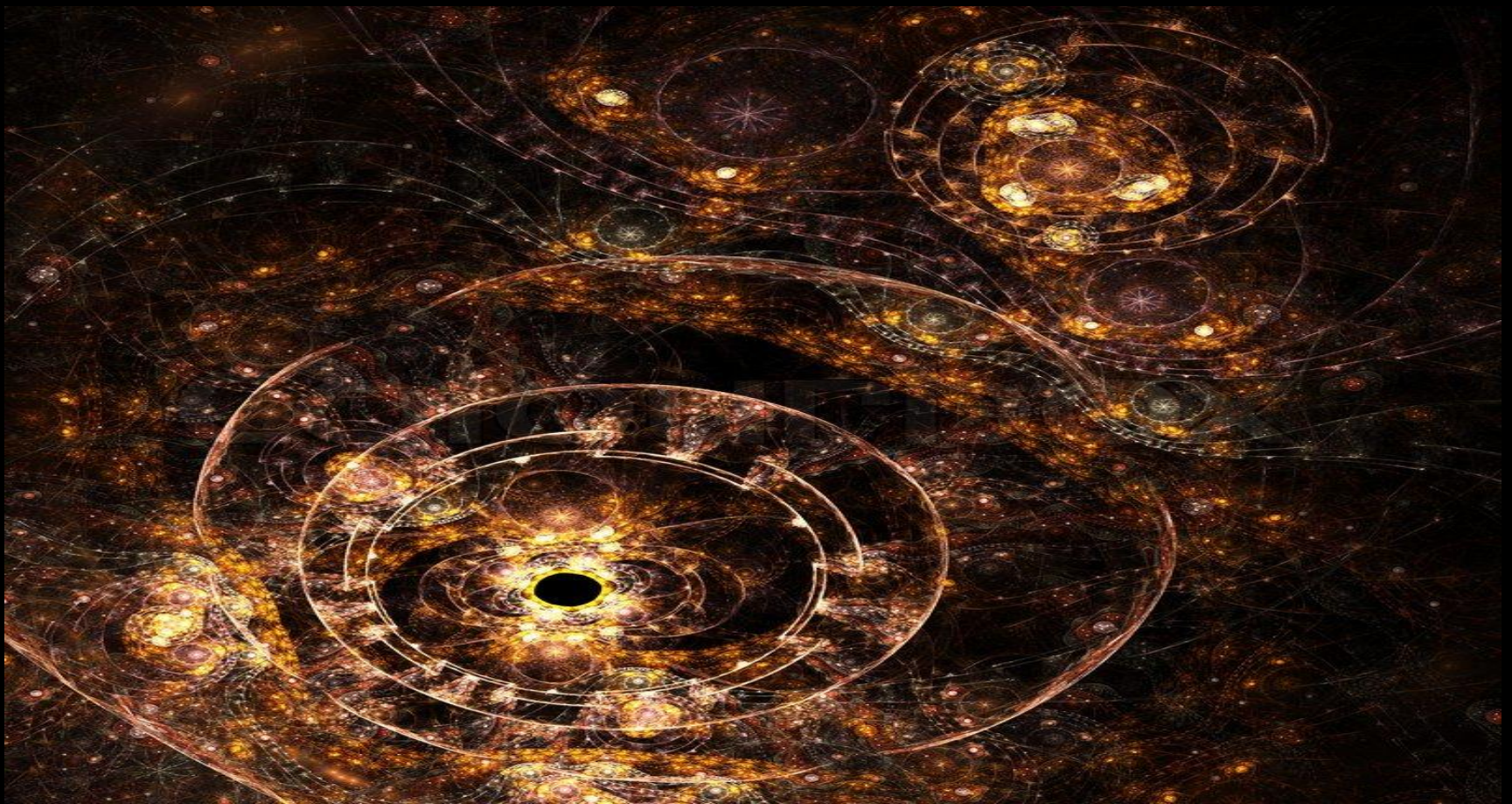


# REFLECTIONS ON THE NATURE AND DIRECTION OF TIME



# TALK STRUCTURE

- Caveat
- 10 minutes reflections on reality
- 12 minutes reflections on time
- 8 minutes concluding reflections

# NATURE OF REALITY

**We need to reflect on what our reality is**

- Whether time was born with this universe?
- Or is time embedded in the fabric of “reality”?
- Or is it emergent from more fundamental stuff?
- And in what direction does it move?

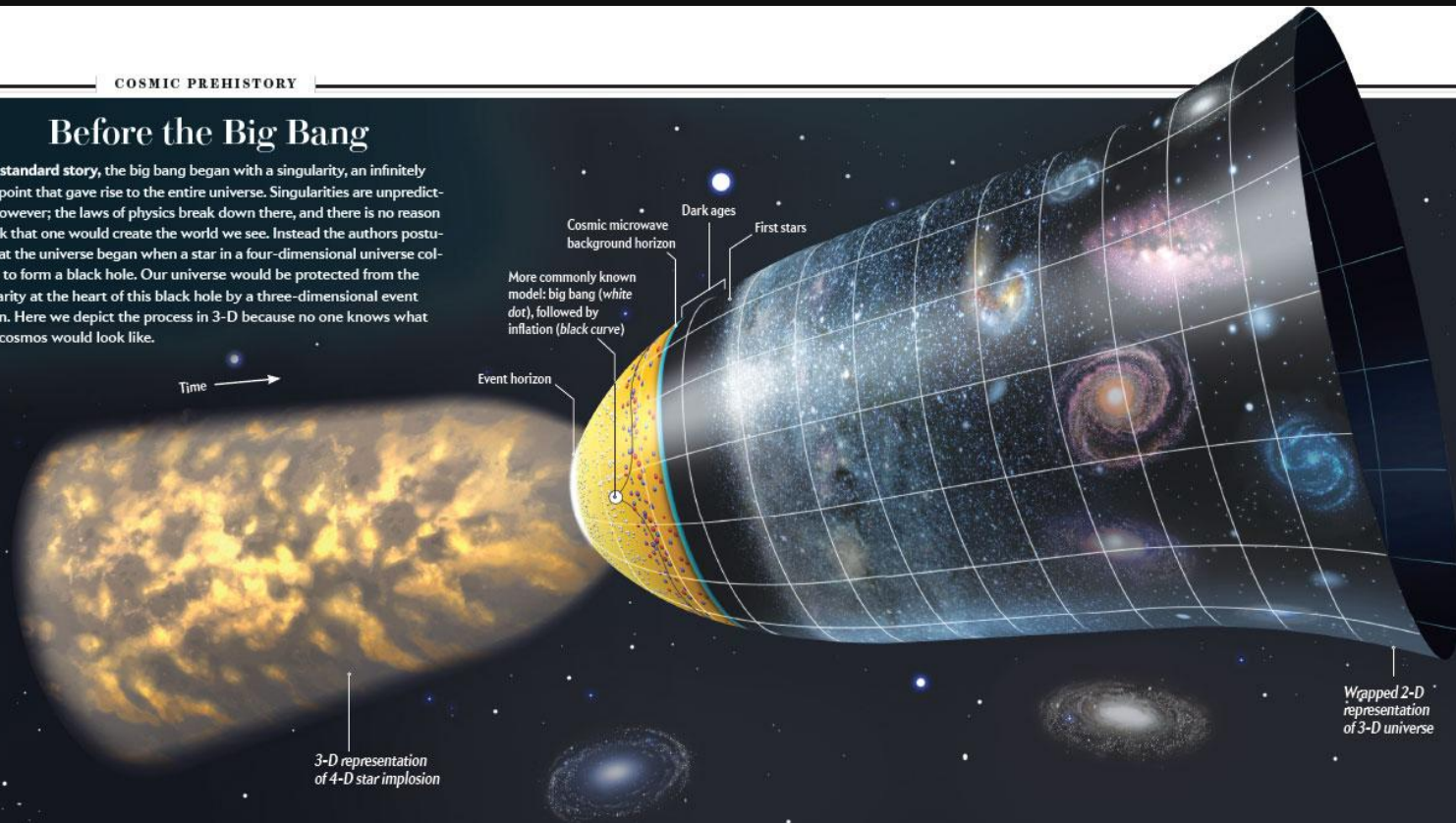


# BIG CRUNCH TO BIG BANG

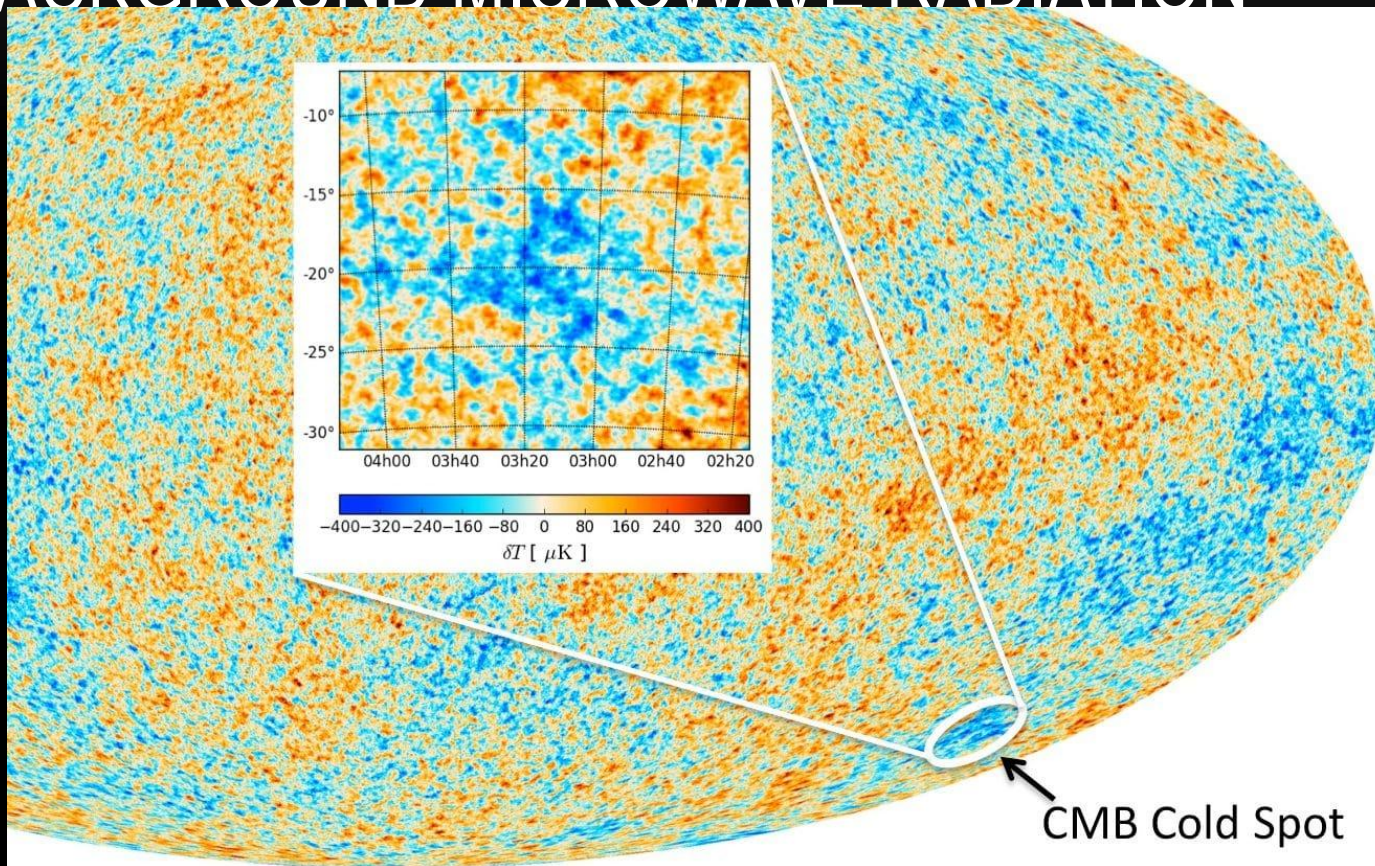
## COSMIC PREHISTORY

### Before the Big Bang

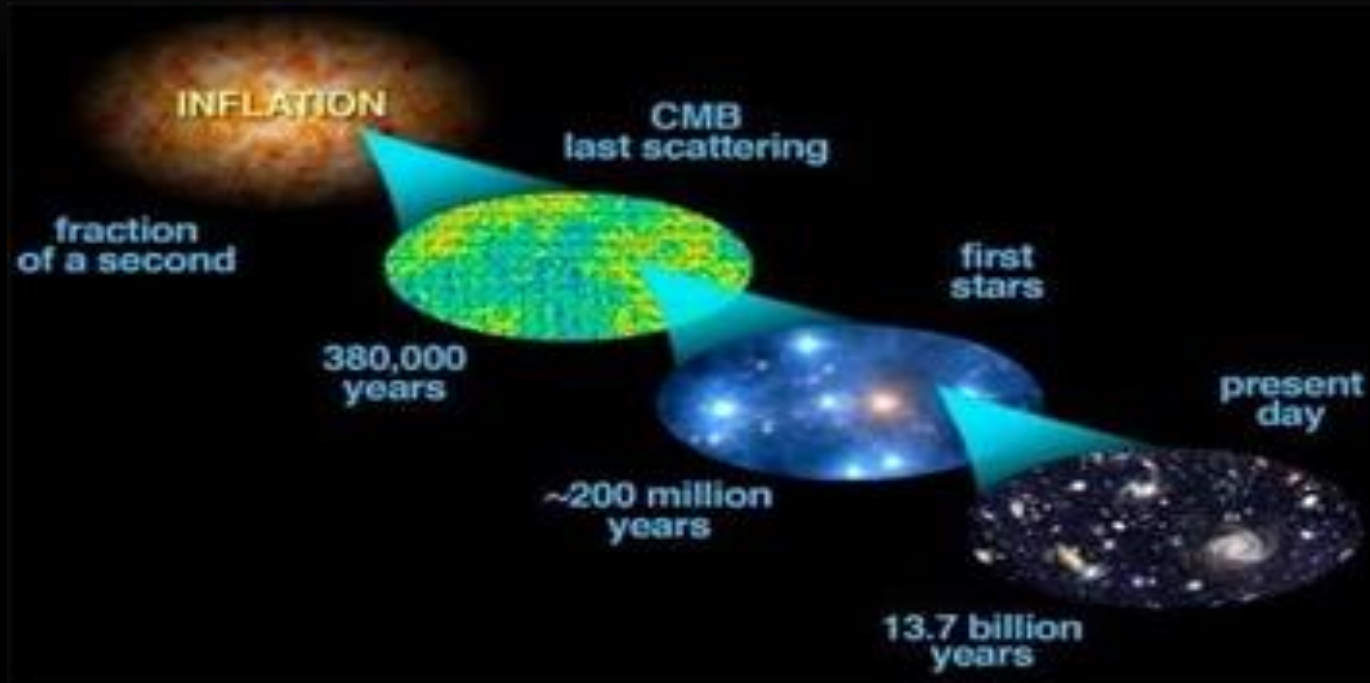
In the standard story, the big bang began with a singularity, an infinitely dense point that gave rise to the entire universe. Singularities are unpredictable, however; the laws of physics break down there, and there is no reason to think that one would create the world we see. Instead the authors postulate that the universe began when a star in a four-dimensional universe collapsed to form a black hole. Our universe would be protected from the singularity at the heart of this black hole by a three-dimensional event horizon. Here we depict the process in 3-D because no one knows what a 4-D cosmos would look like.



# BACKGROUND MICROWAVE RADIATION

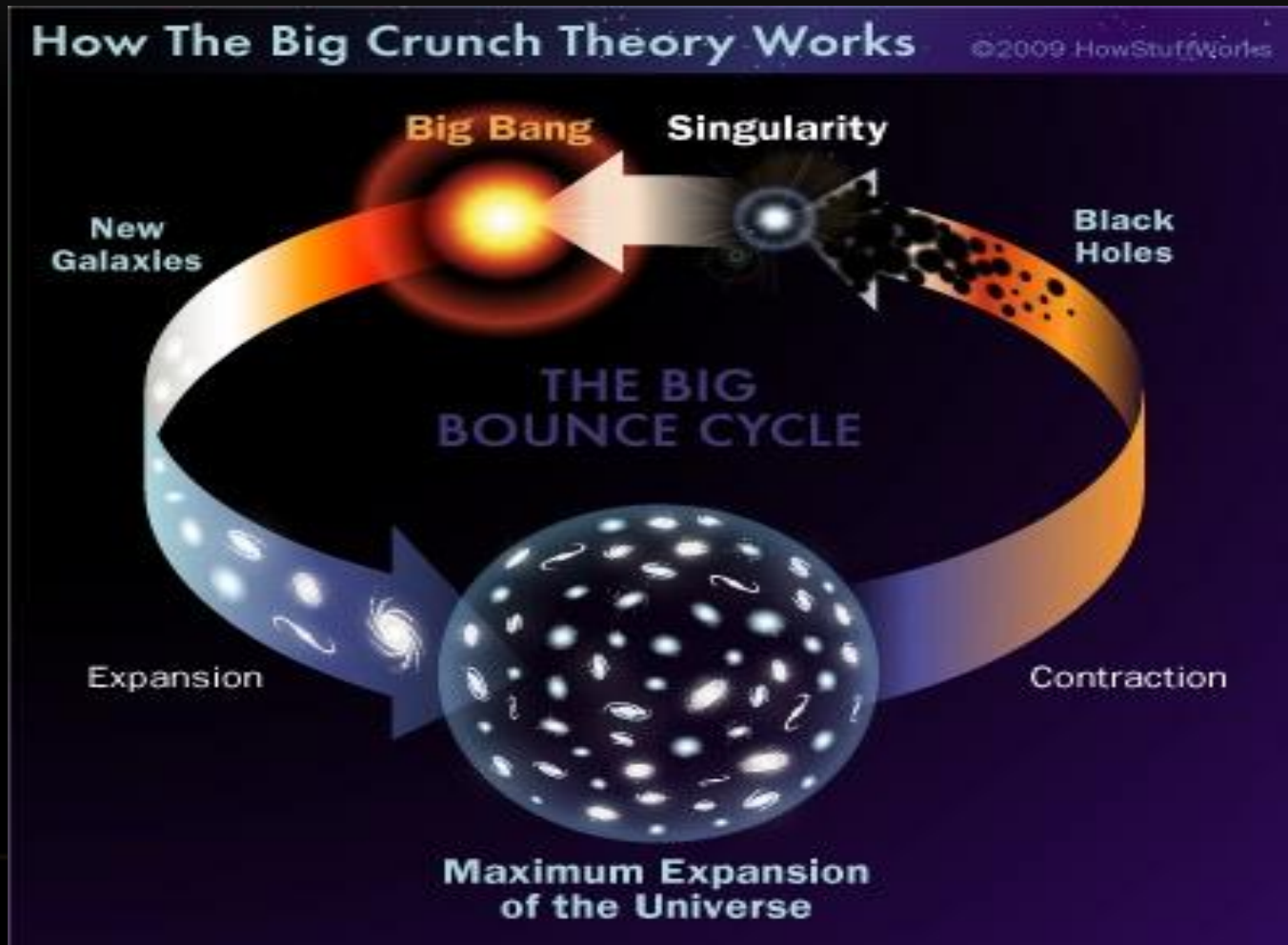


# INFLATION





# BIG BOUNCE

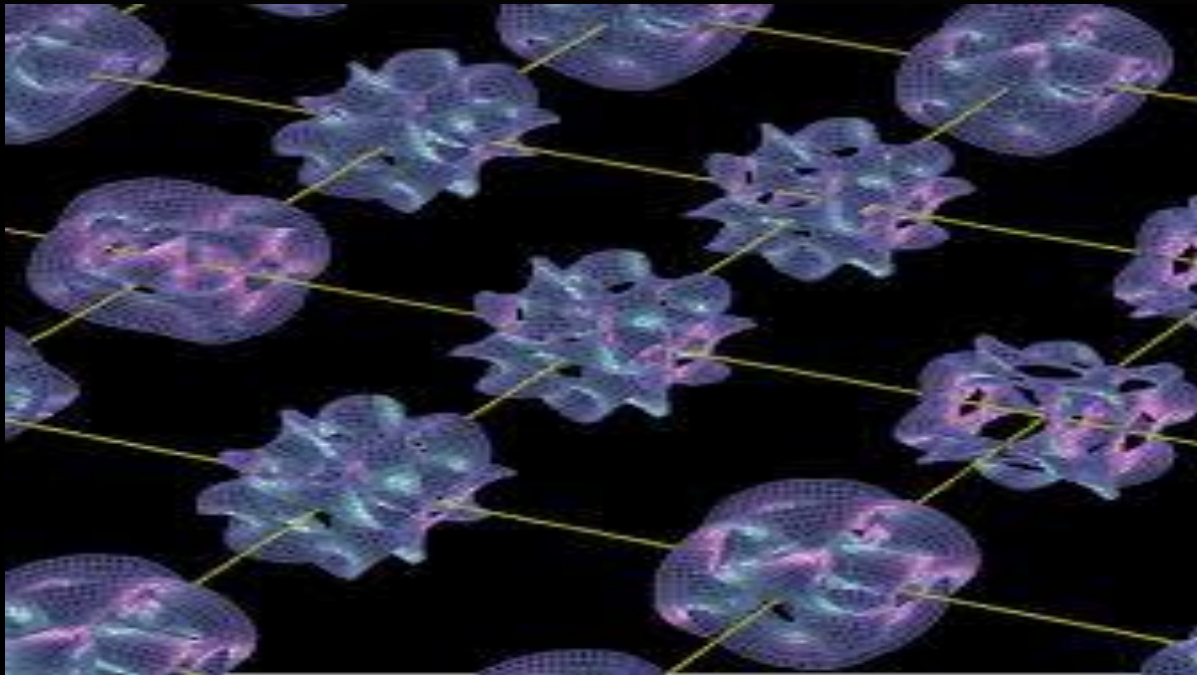


# MULTIVERSE?





# THE STRING THEORY LANDSCAPE



# THE BULK



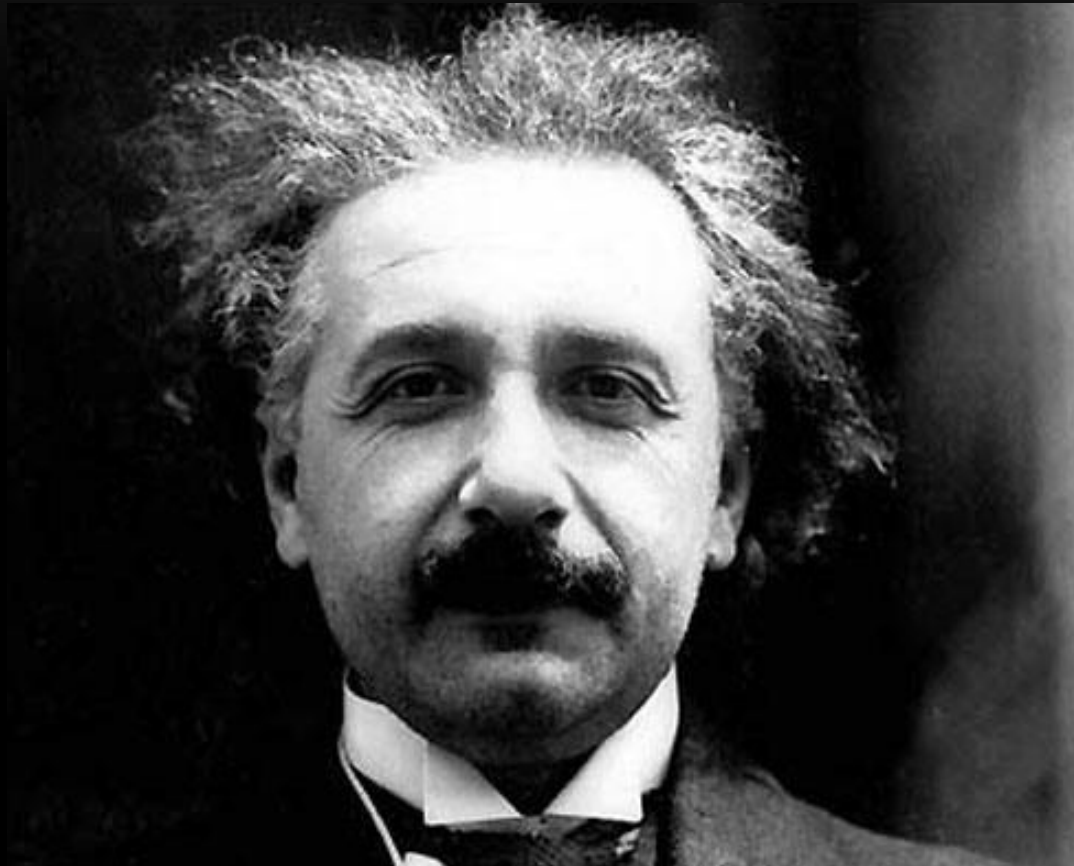
**TIME – “..A BIG BALL OF WIBBLY-WOBBLY,**



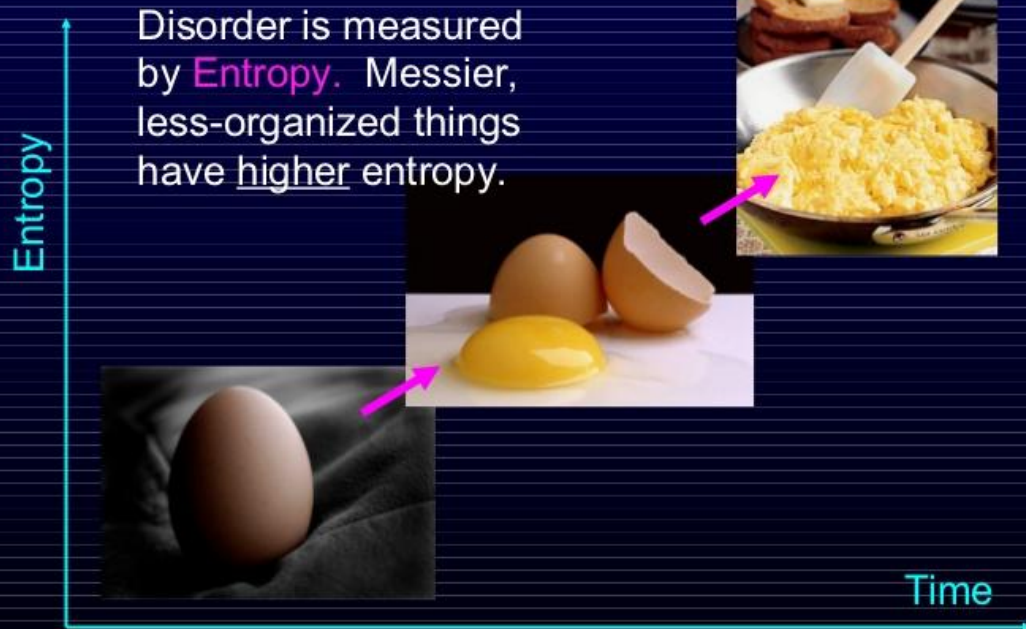
**Scientists insist that the most successful theories in physics prove that time does not exist**



TIME IS NOT ABSOLUTE

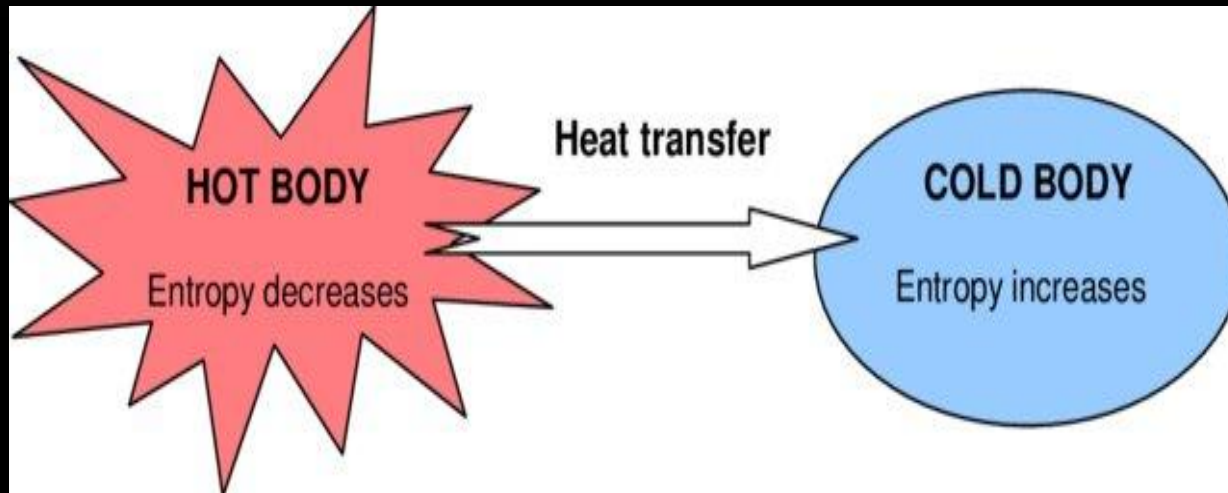


# THE ARROW OF TIME



**The Second Law of Thermodynamics:**  
entropy increases with time (in closed systems).

# THERMODYNAMIC ARROW OF TIME

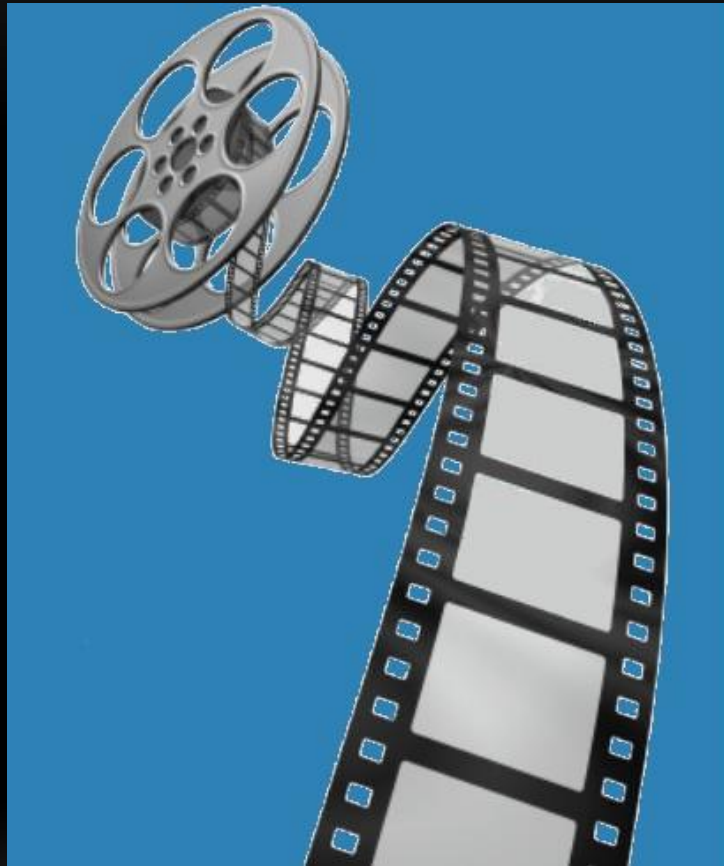




# IS THE ARROW OF TIME AN ILLUSION?

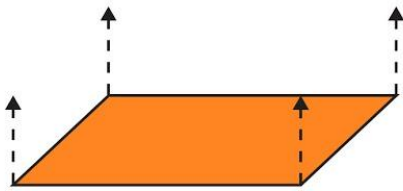


# TIME A SUCCESSION OF FRAMES?



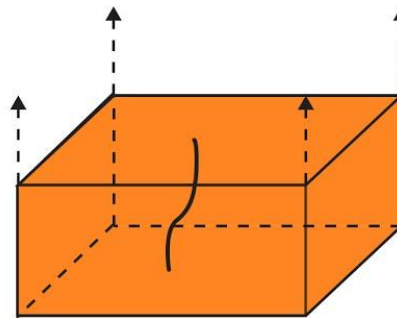
# THE THREE THEORIES

## Presentism



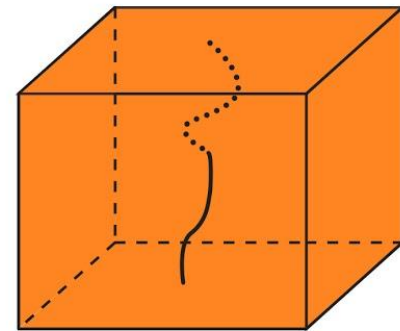
The Present

## Growing Past



Past & Present

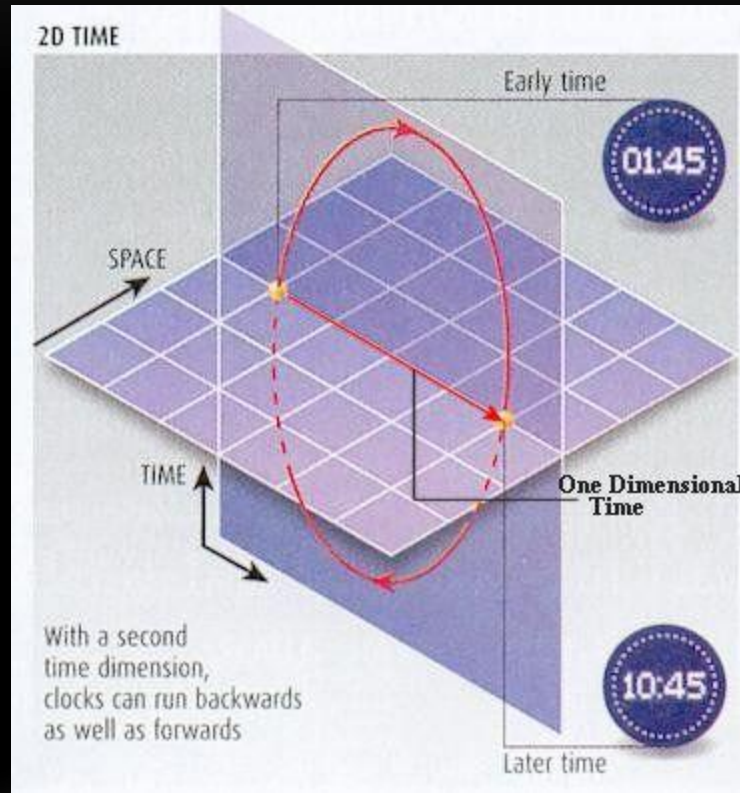
## Eternalism



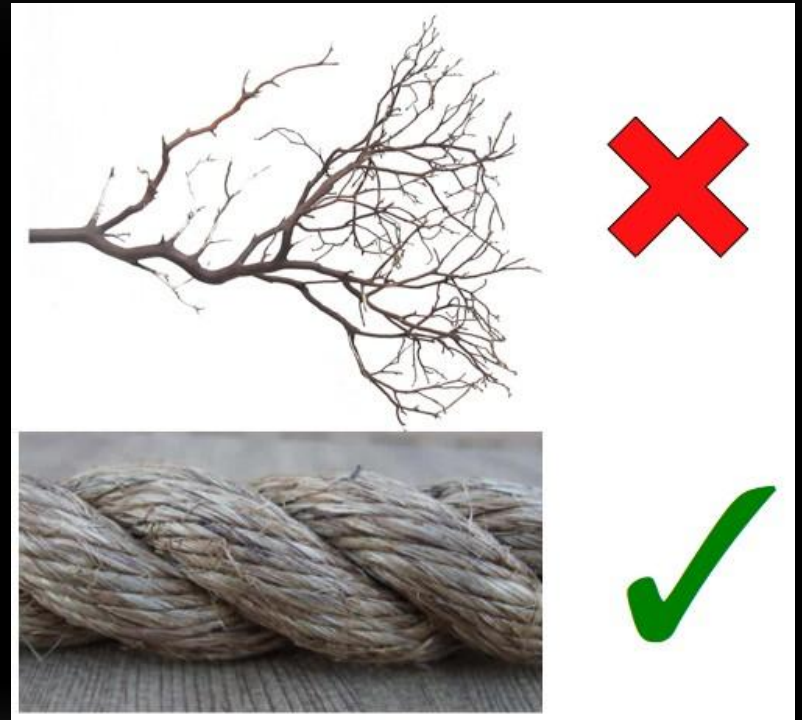
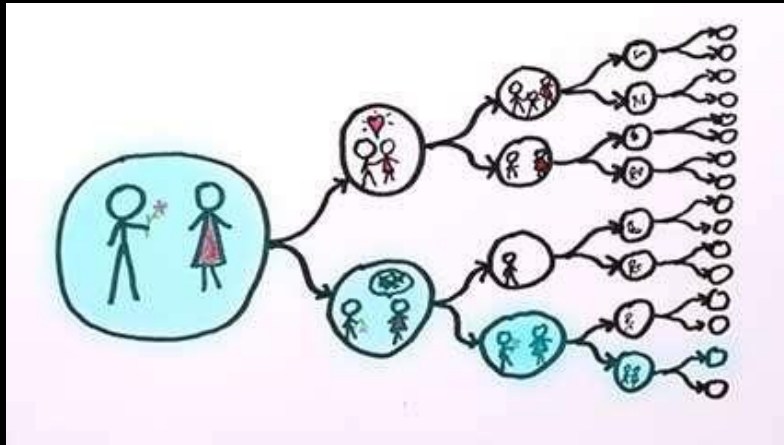
Past, Present, & Future



# MORE THAN ONE DIMENSIONAL TIME



# MANY-WORLDS INTERPRETATION OF QUANTUM MECHANICS



# ARE WE LIVING IN A SIMULATION?

