

# ***THE NATURE OF TIME & QUANTUM MECHANICS***

**John Ashmead**

# ***POSITRONIC BRAINS BAFFLED!***

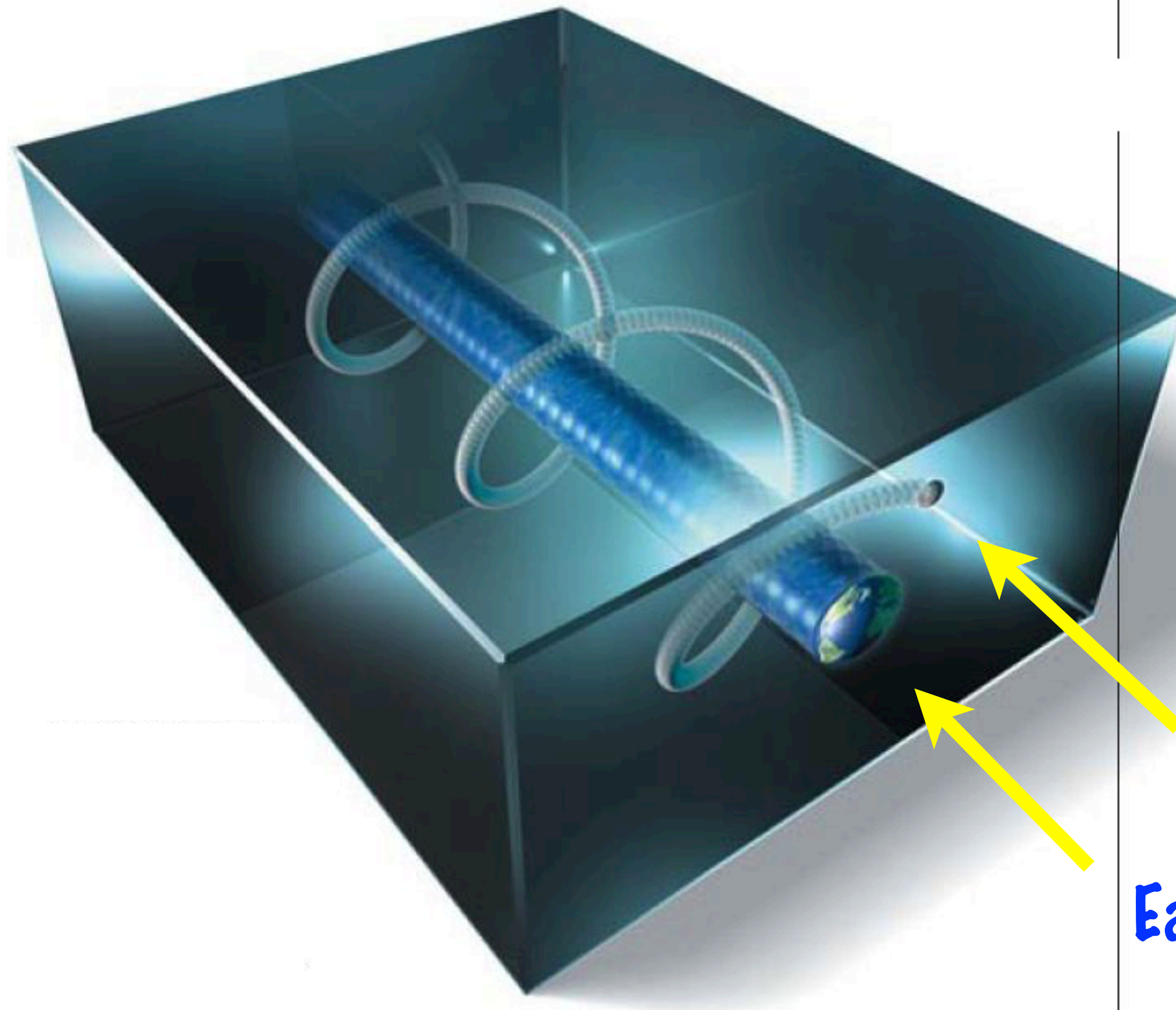


# ***OF TIME AND THE RIVER***





# ***BLOCK UNIVERSE***

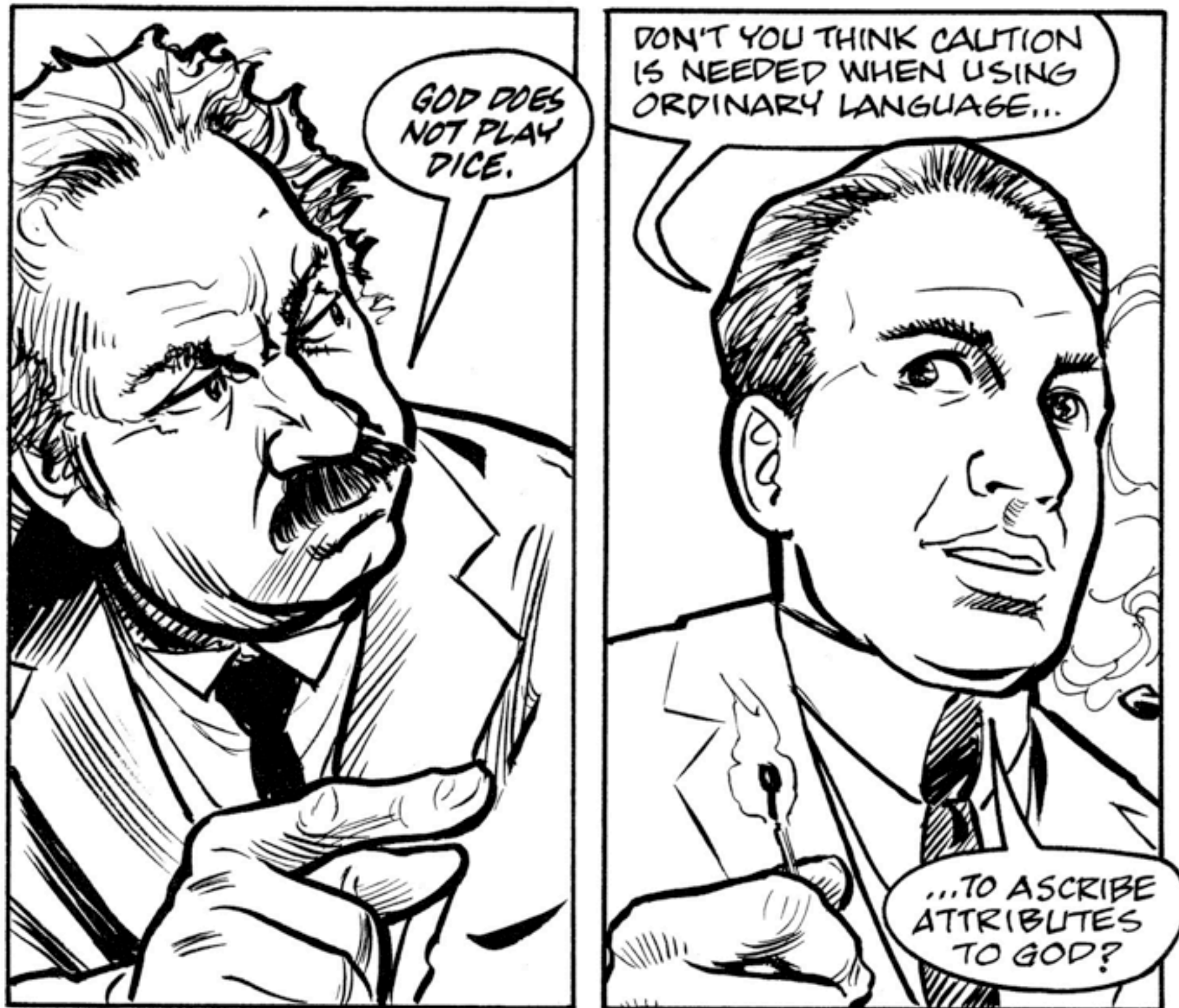


***The plane of  
the present***

***Moon***

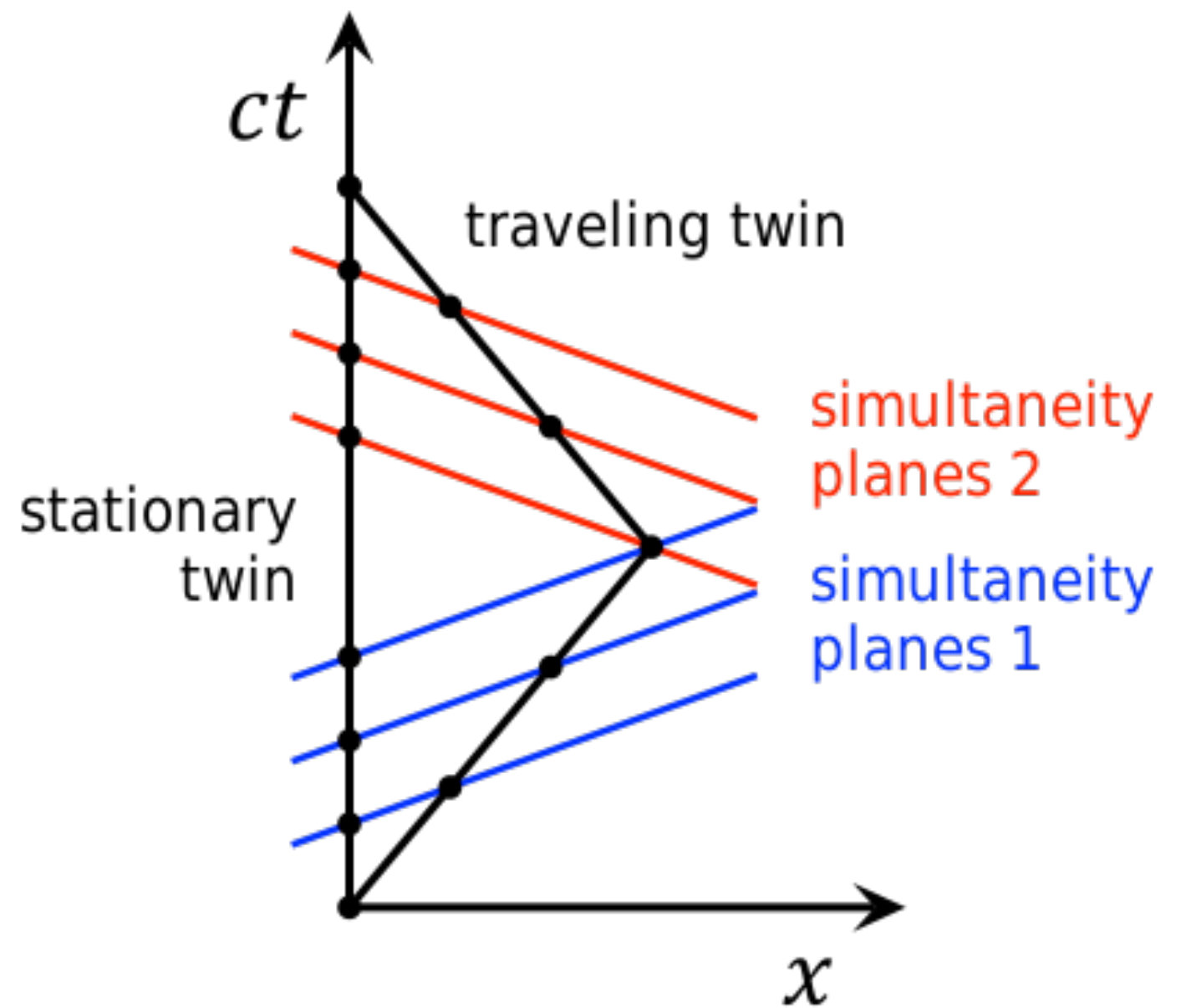
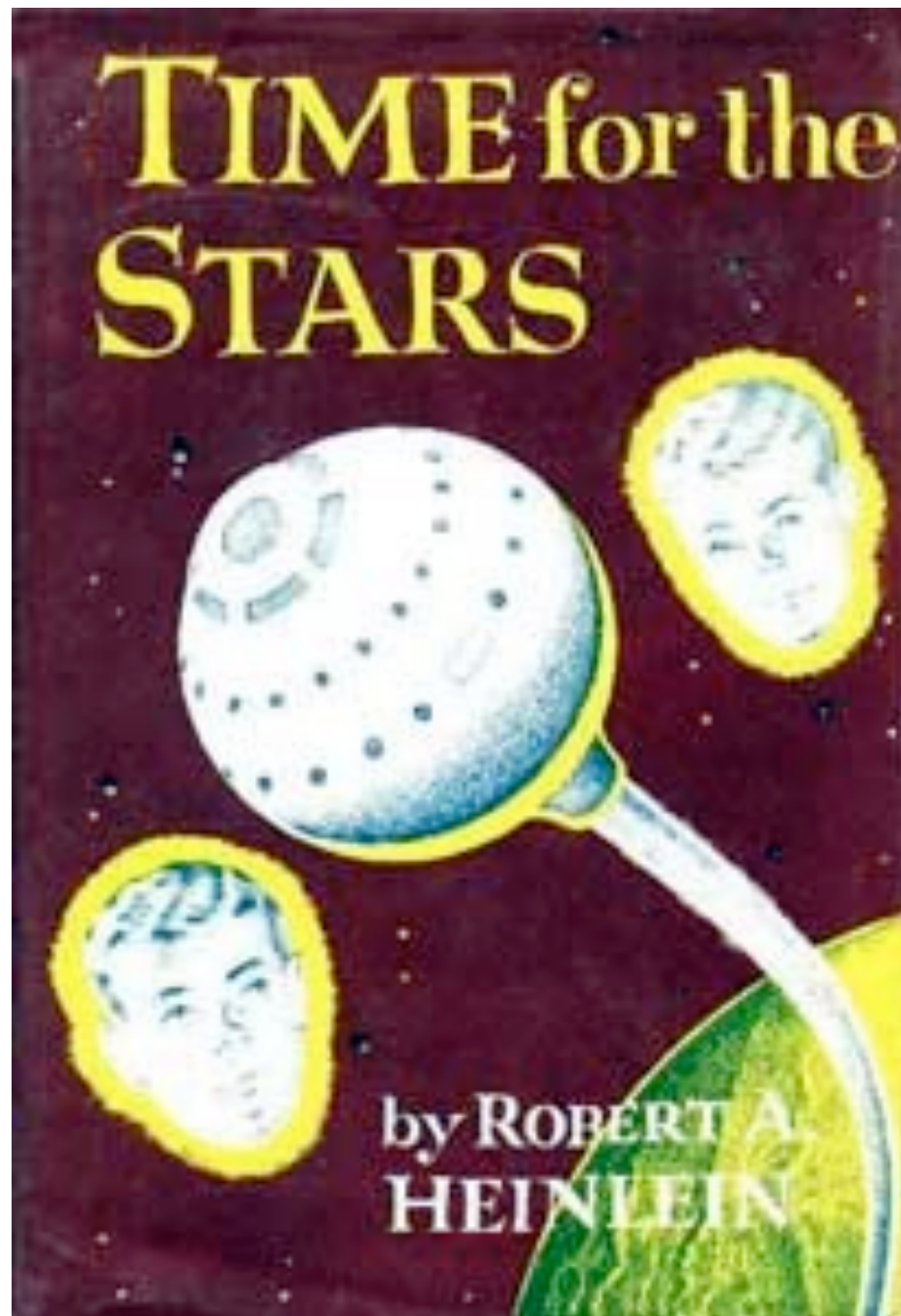
***Earth***

# RELATIVITY VS THE QUANTUM





# TWIN PARADOX





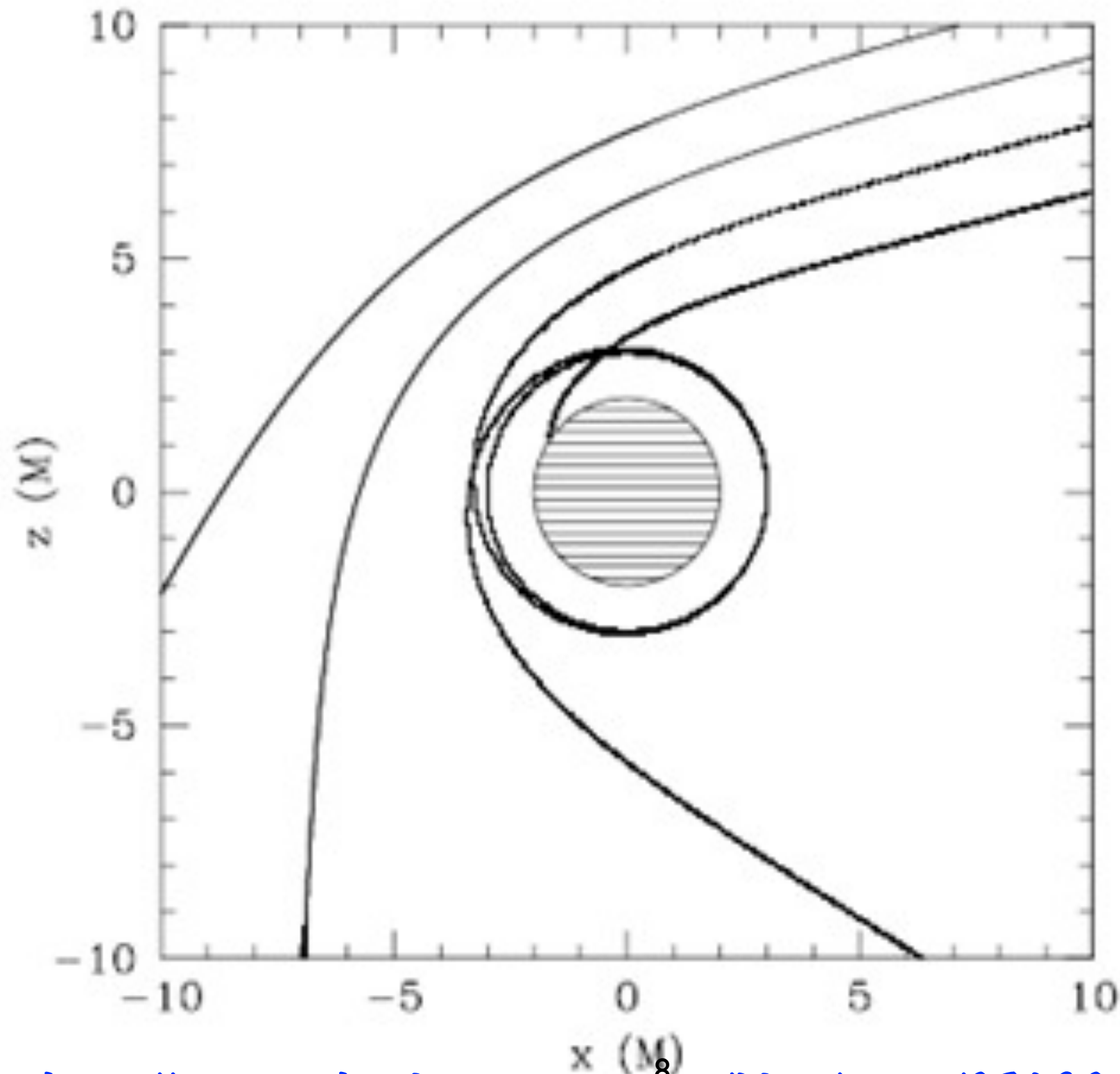
# ***TIME SERIOUSLY TWISTED***



<http://www.youtube.com/watch?v=f0VOn9r4dq8>



# ***BLACK HOLES SHOULD GENERATE RING OF LIGHT***



<http://www.technologyreview.com/blog/arxiv/25182/>



**How wonderful that we have met  
with a paradox. Now we have  
some hope of making progress.  
– Niels Bohr**



“...there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns – the ones we don't know we don't know.”

— Donald of Rumfeld



# ***THREE TOPICS***

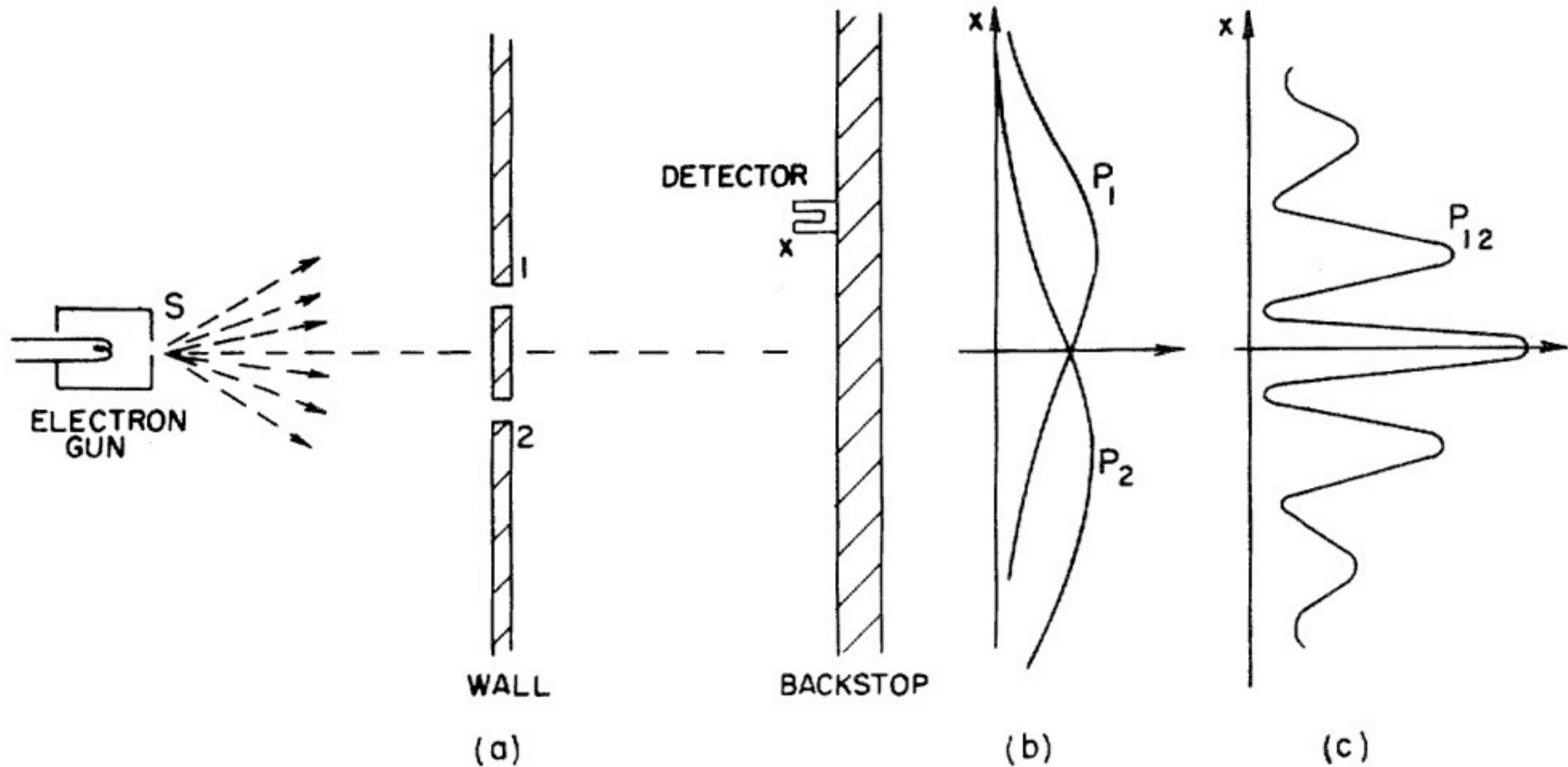
- **Delayed choice quantum eraser**
- **Time symmetric quantum mechanics**
- **The inflationary vs the endless universe**

# ***DELAYED CHOICE QUANTUM ERASER***

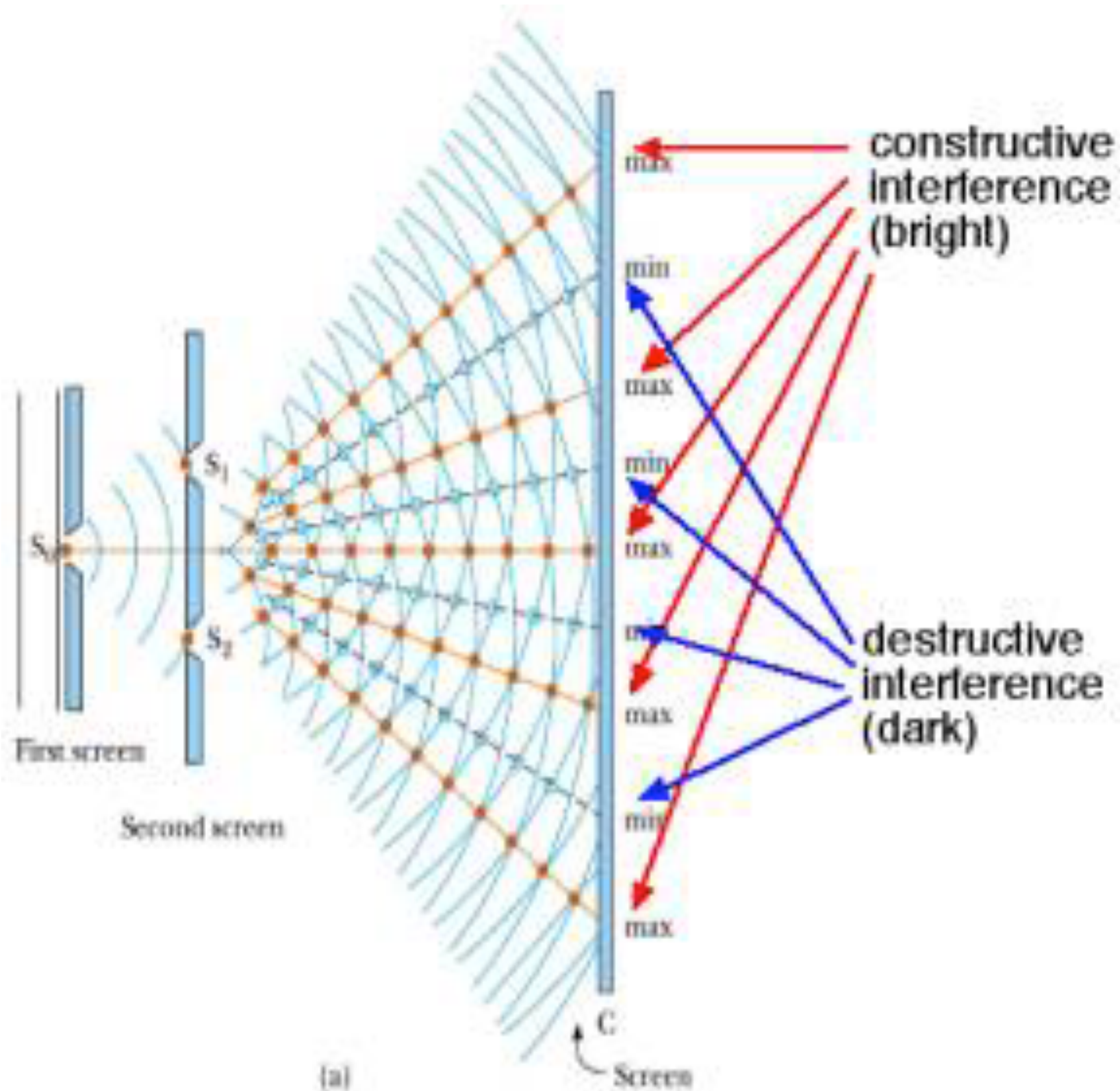
- Double slit experiment
- Single slit
- No peeking
- Quantum eraser
- Delayed choice quantum eraser
- Great smoky dragon



# DOUBLE SLIT EXPERIMENT

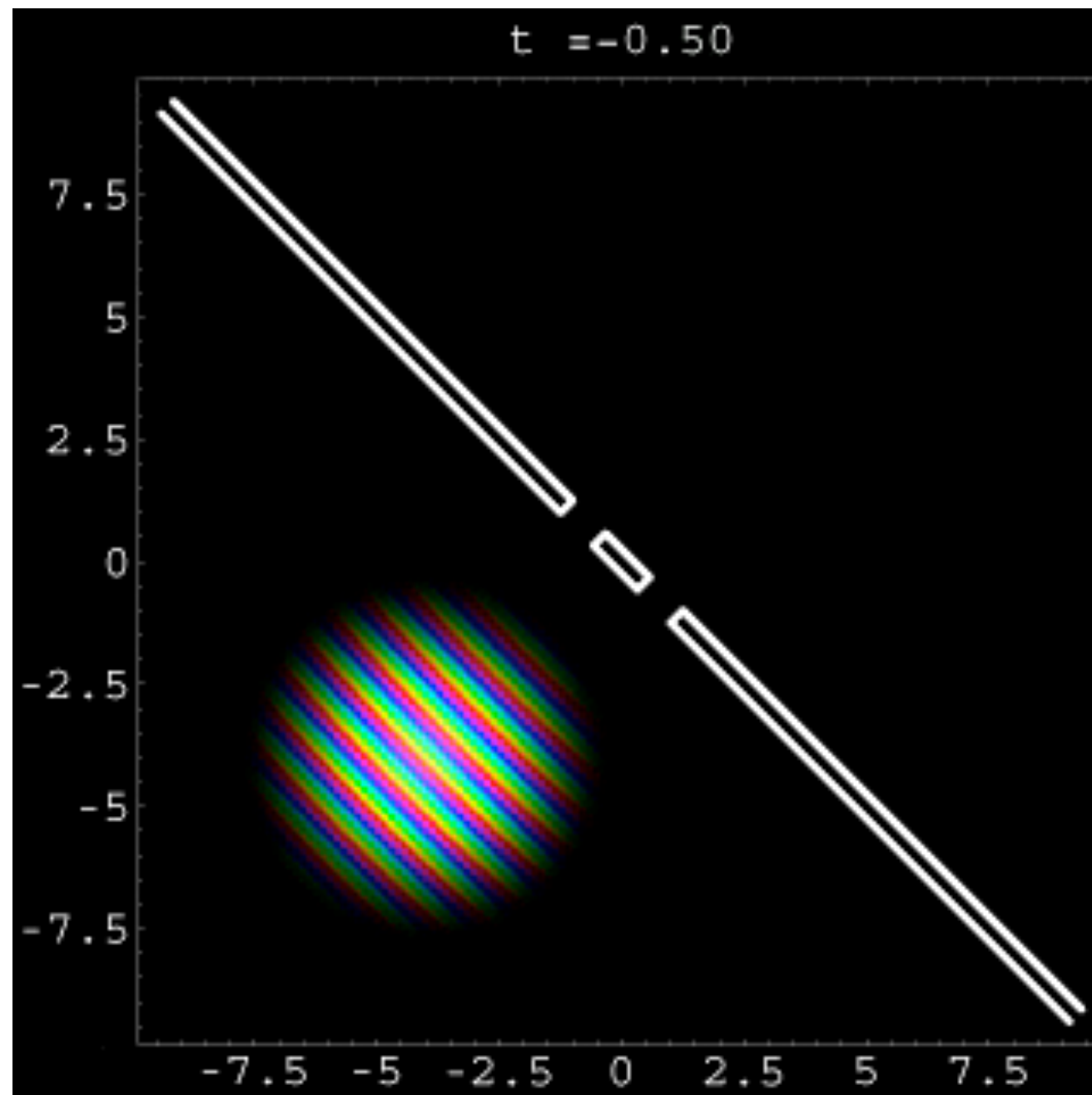


# DOUBLE SLIT EXPERIMENT

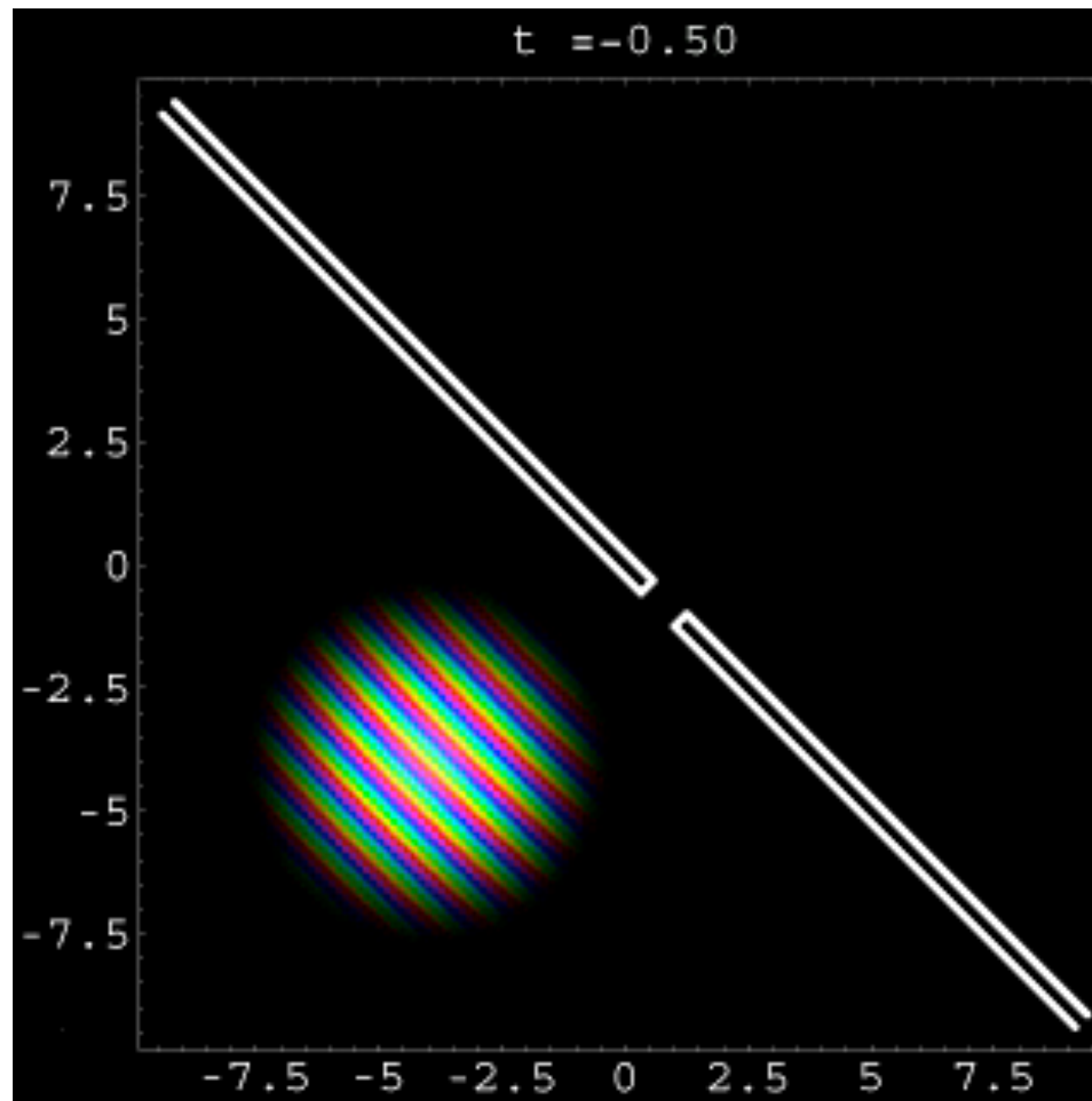




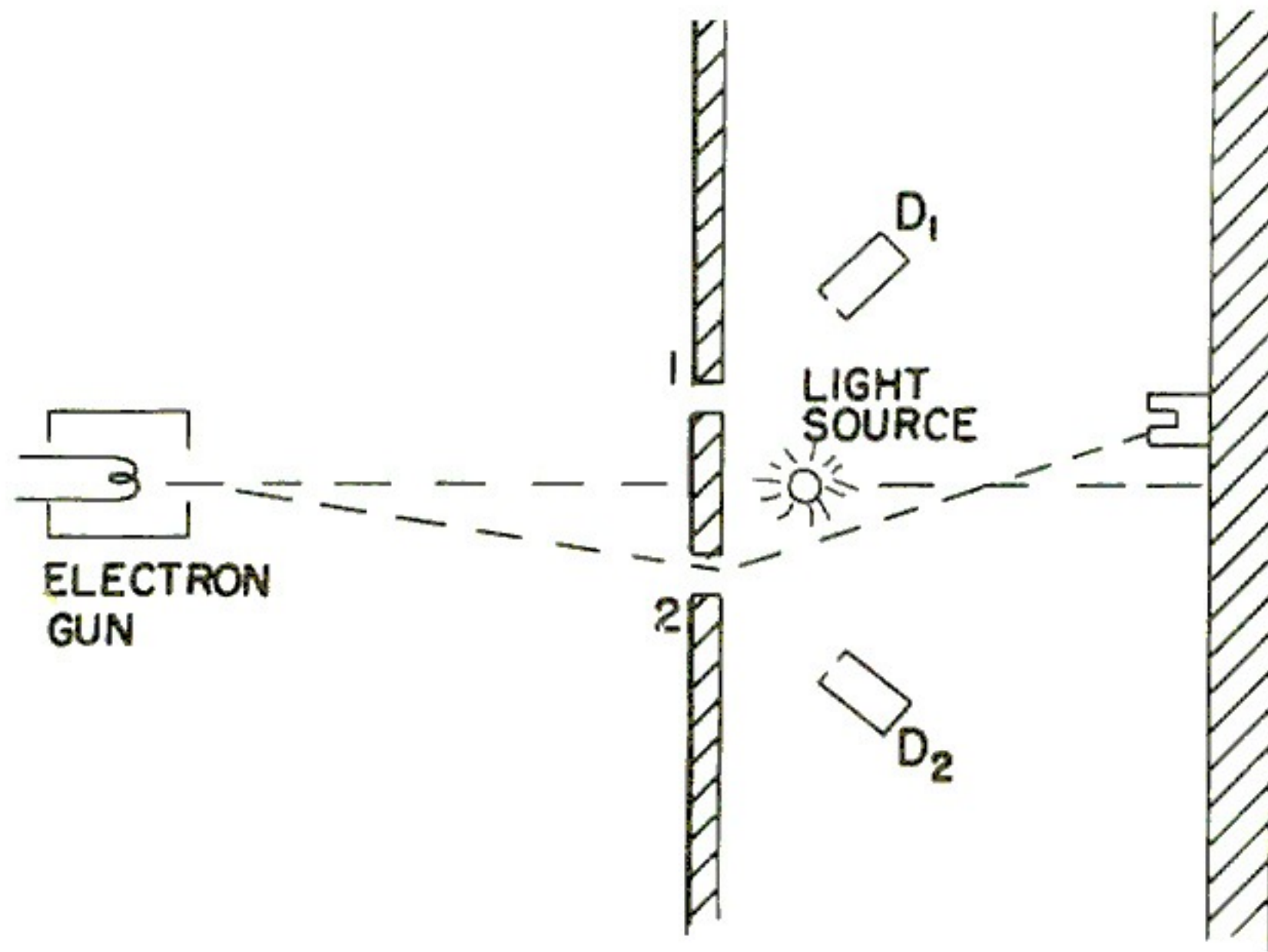
# ***DOUBLE SLIT, IN MOTION***



# ***SINGLE SLIT, IN MOTION***

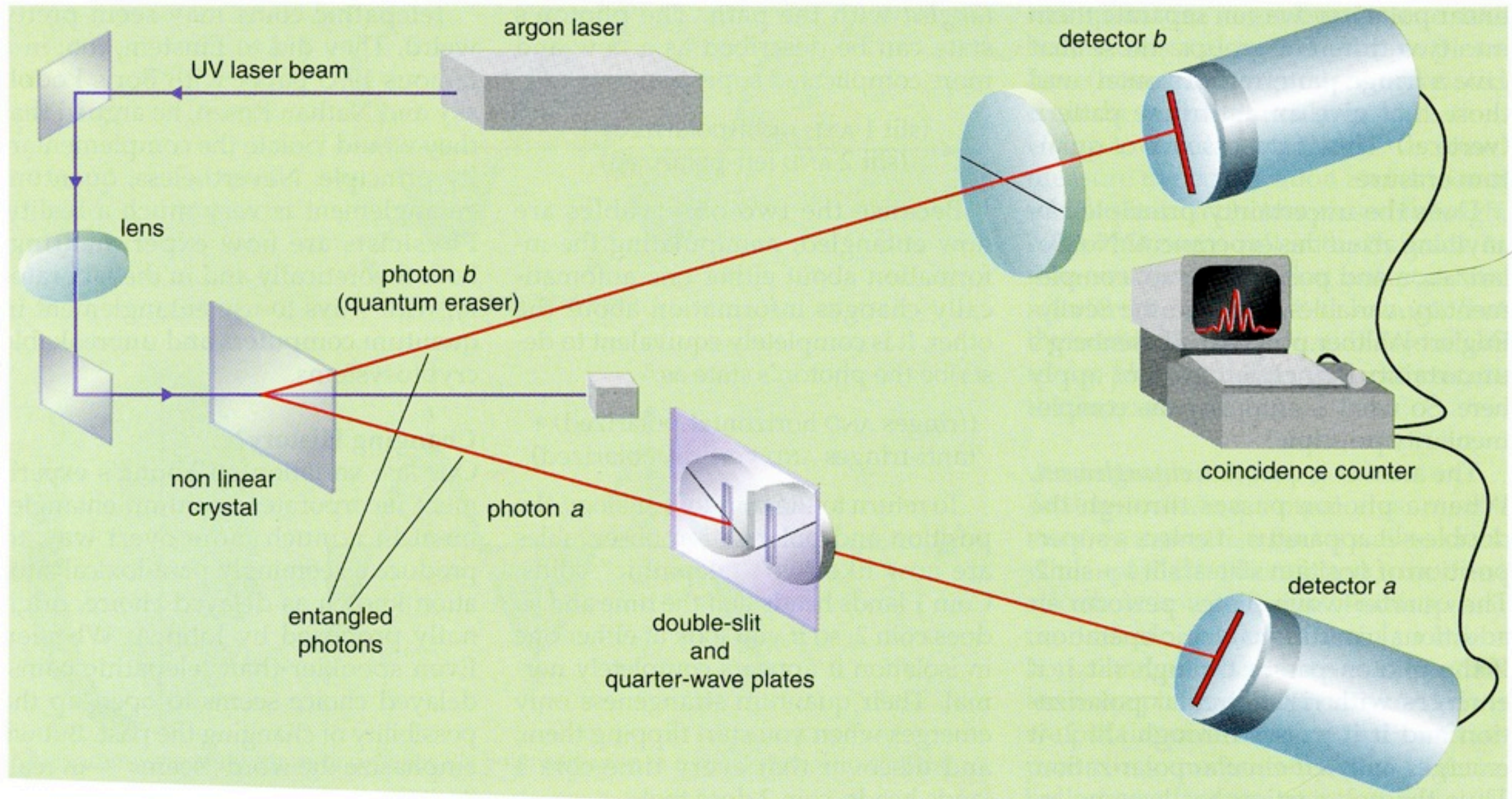


# ***IF YOU LOOK, YOU DESTROY THE INTERFERENCE***



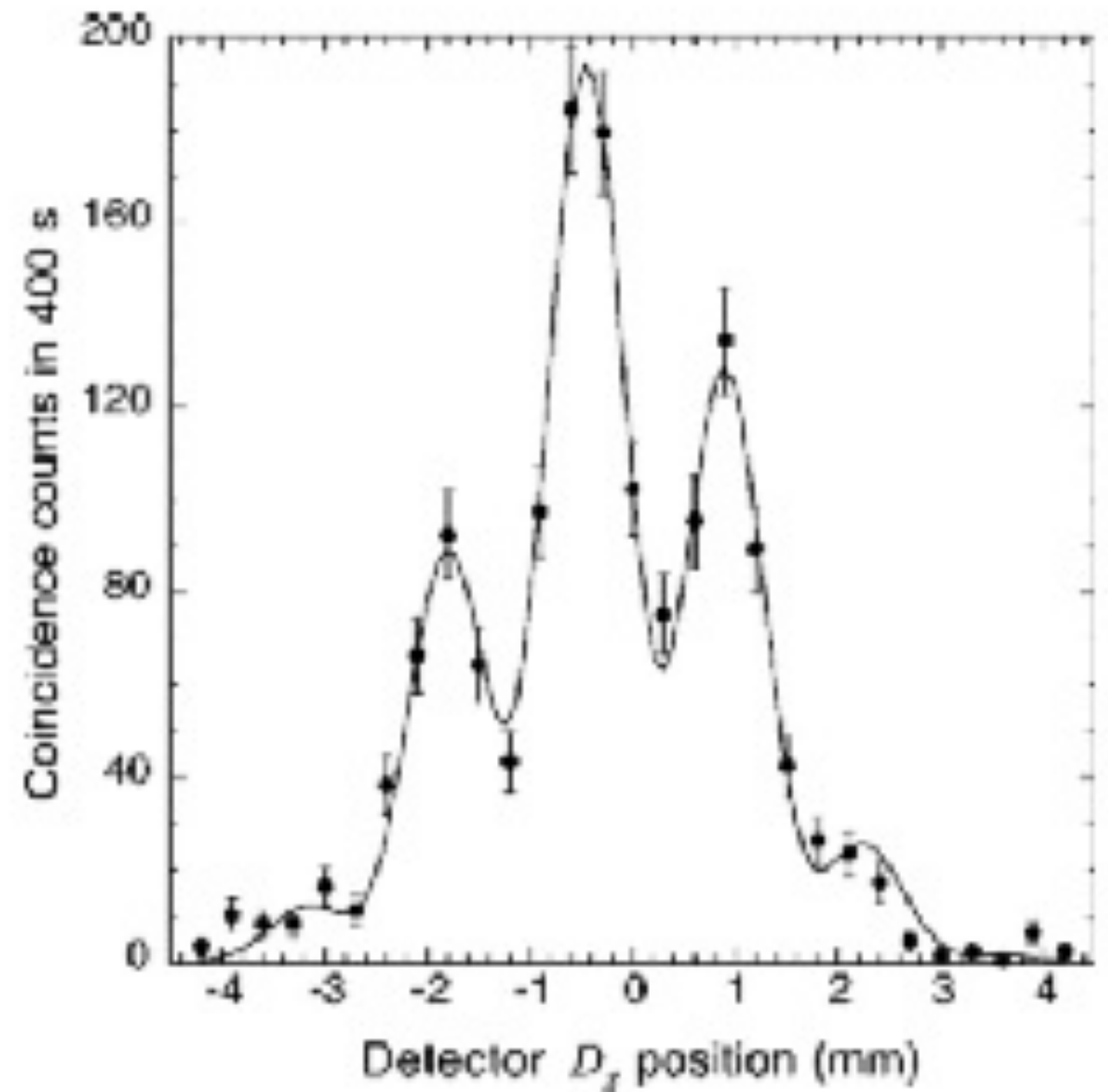
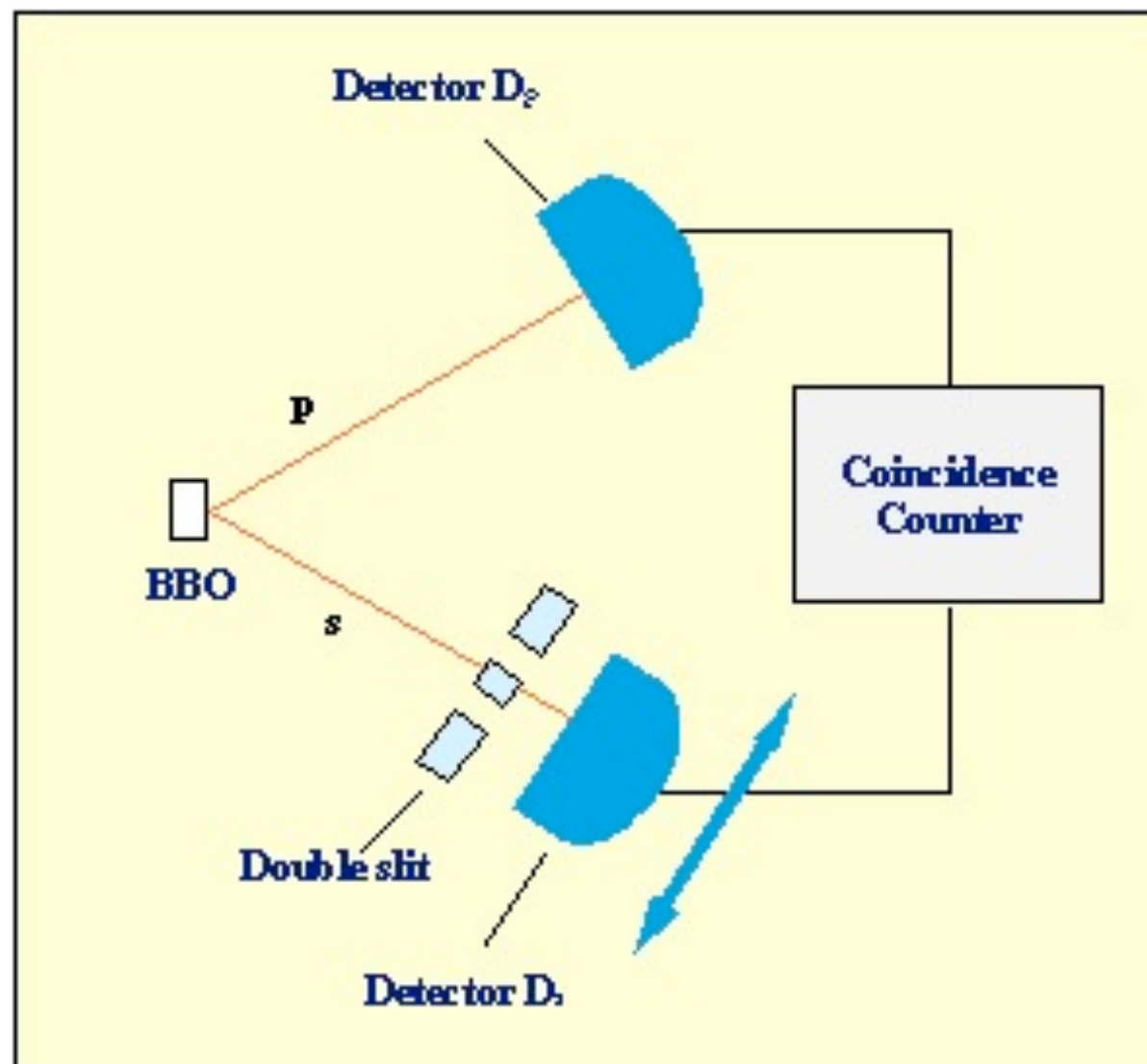


# QUANTUM ERASER SETUP



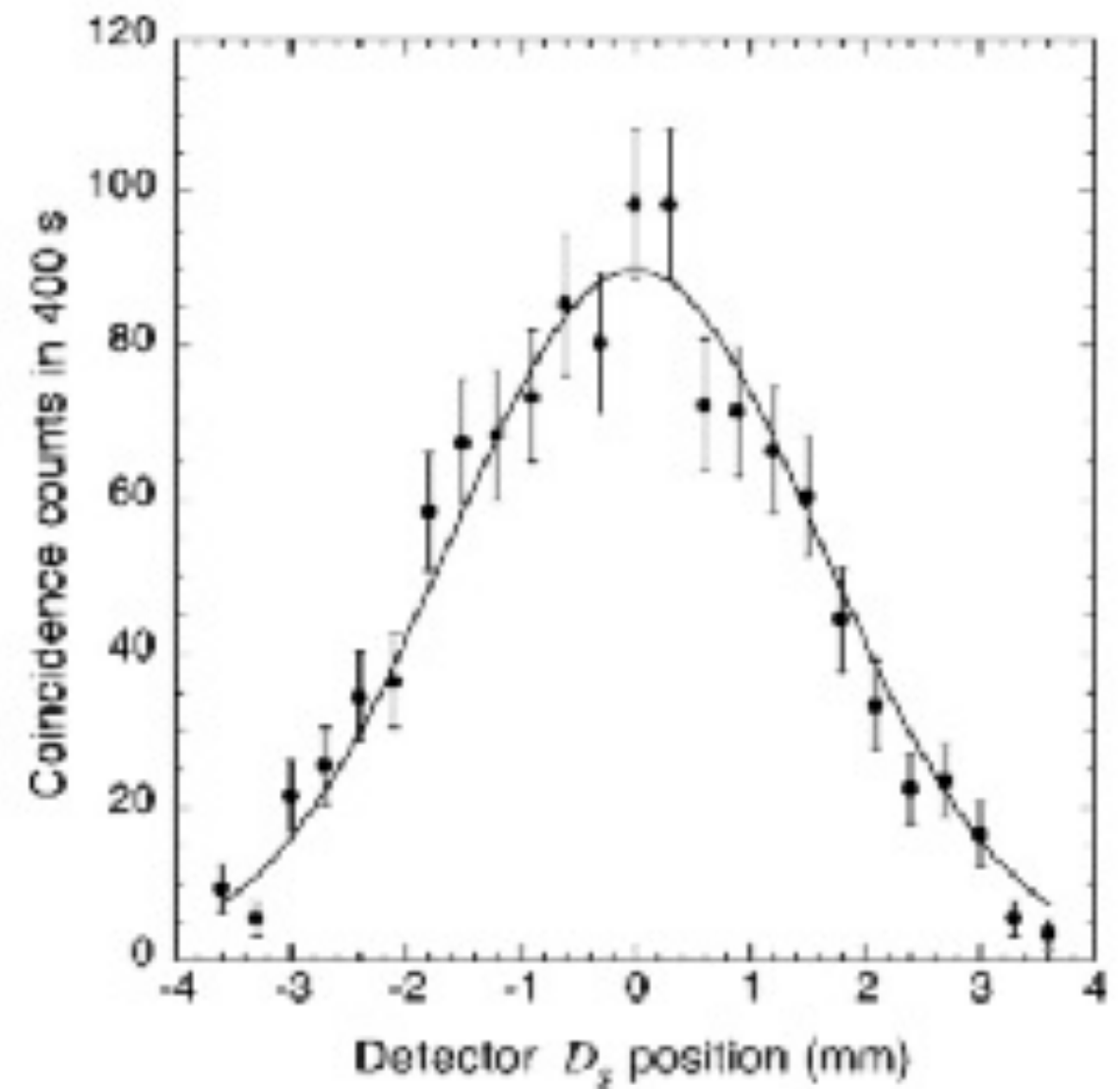
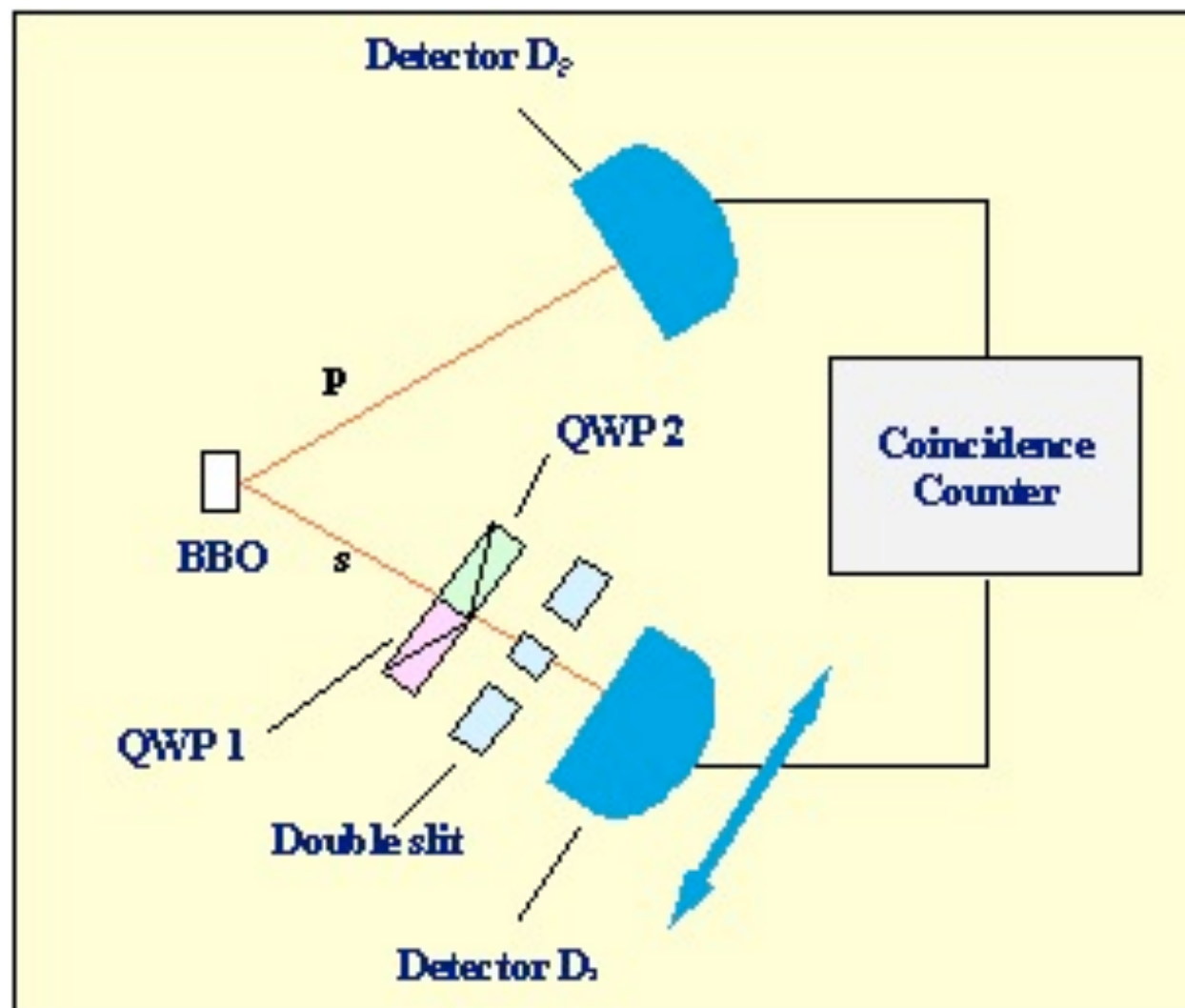


# QUANTUM ERASER, ACT I



<http://grad.physics.sunysb.edu/~amarch/>

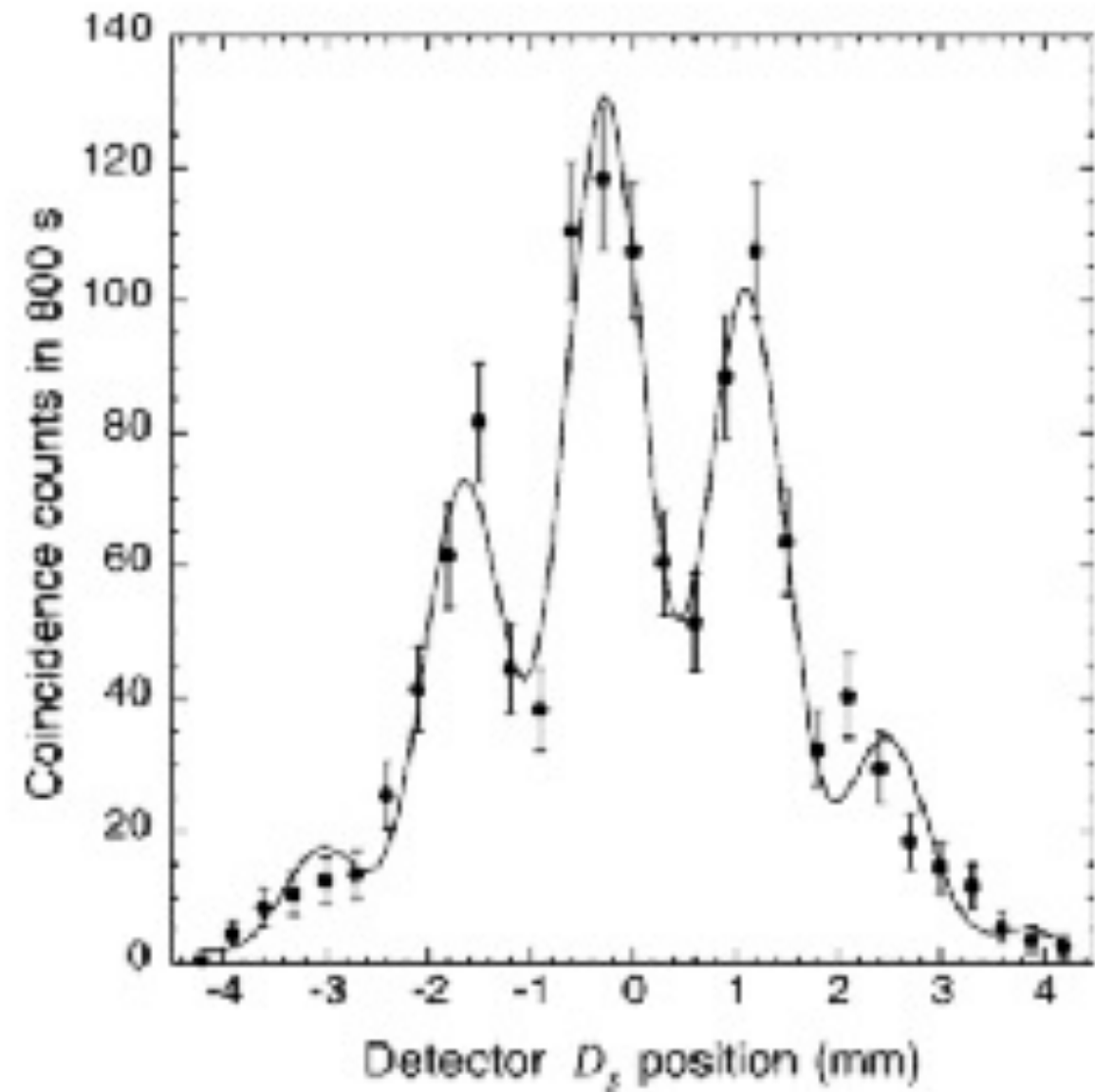
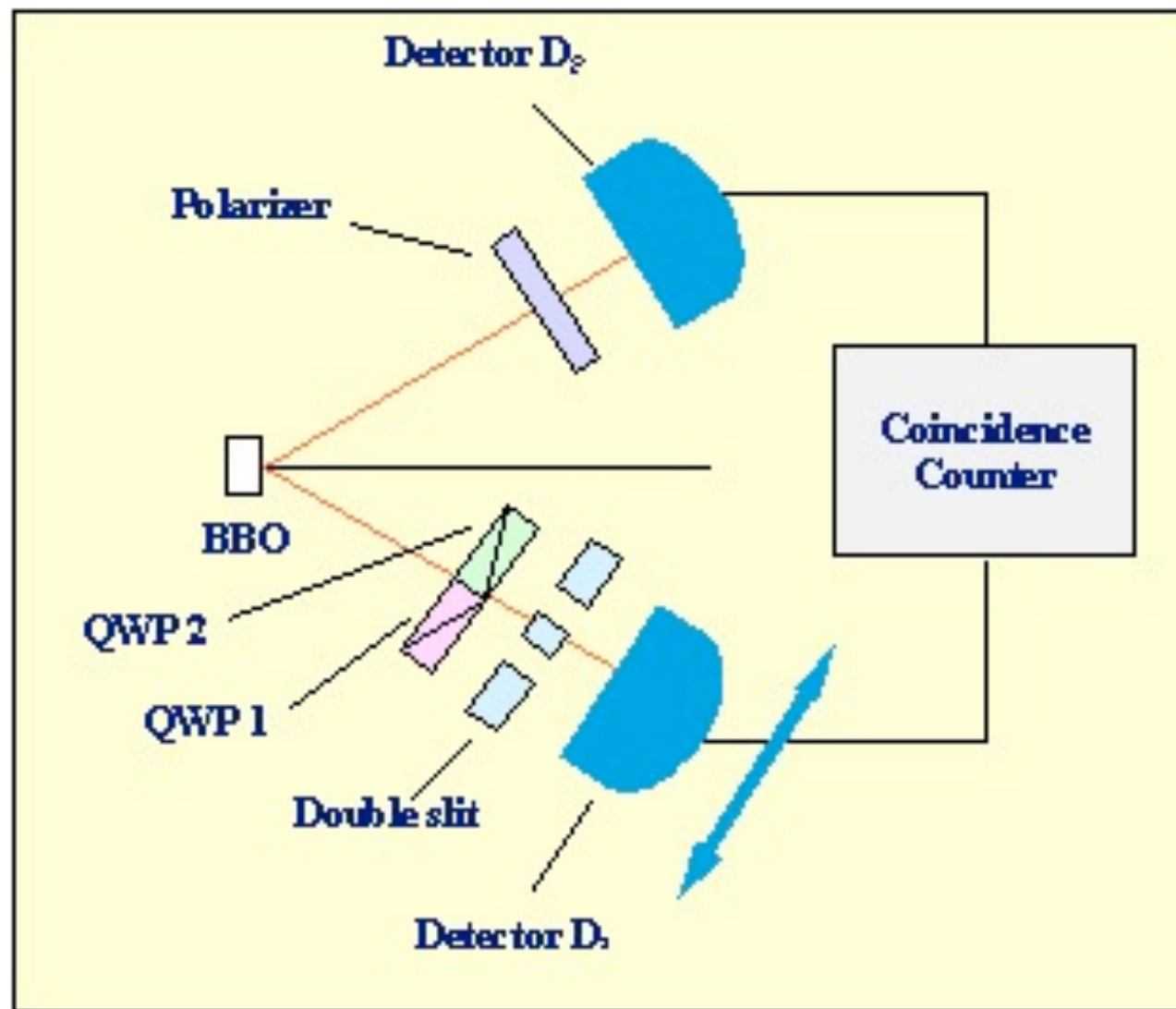
# QUANTUM ERASER, ACT II



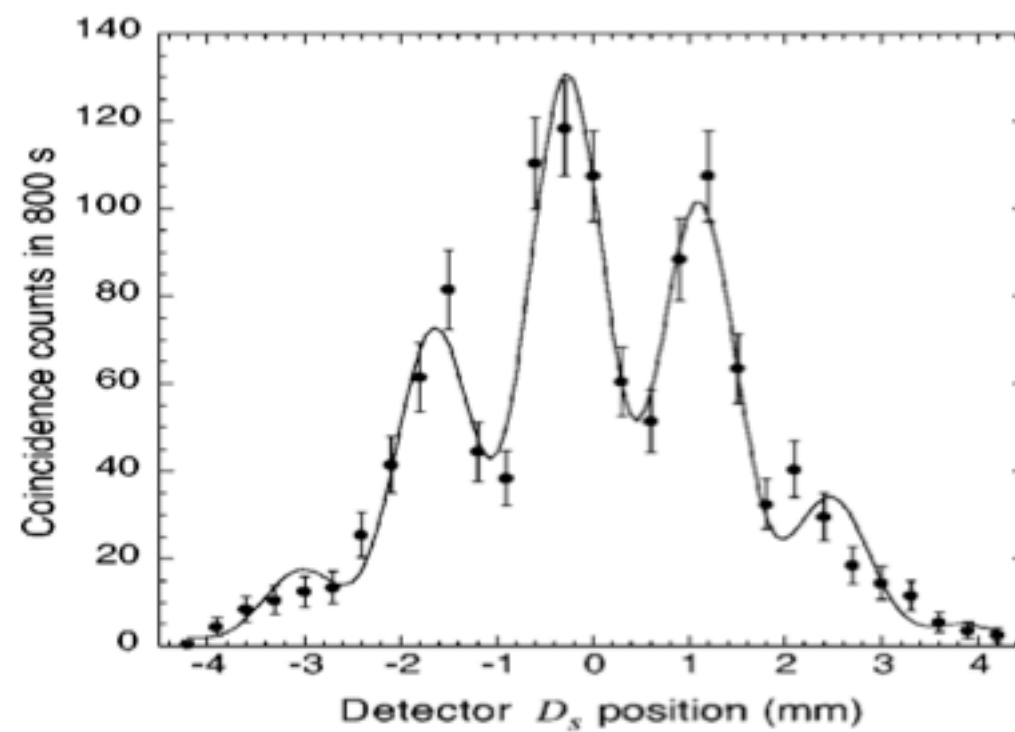
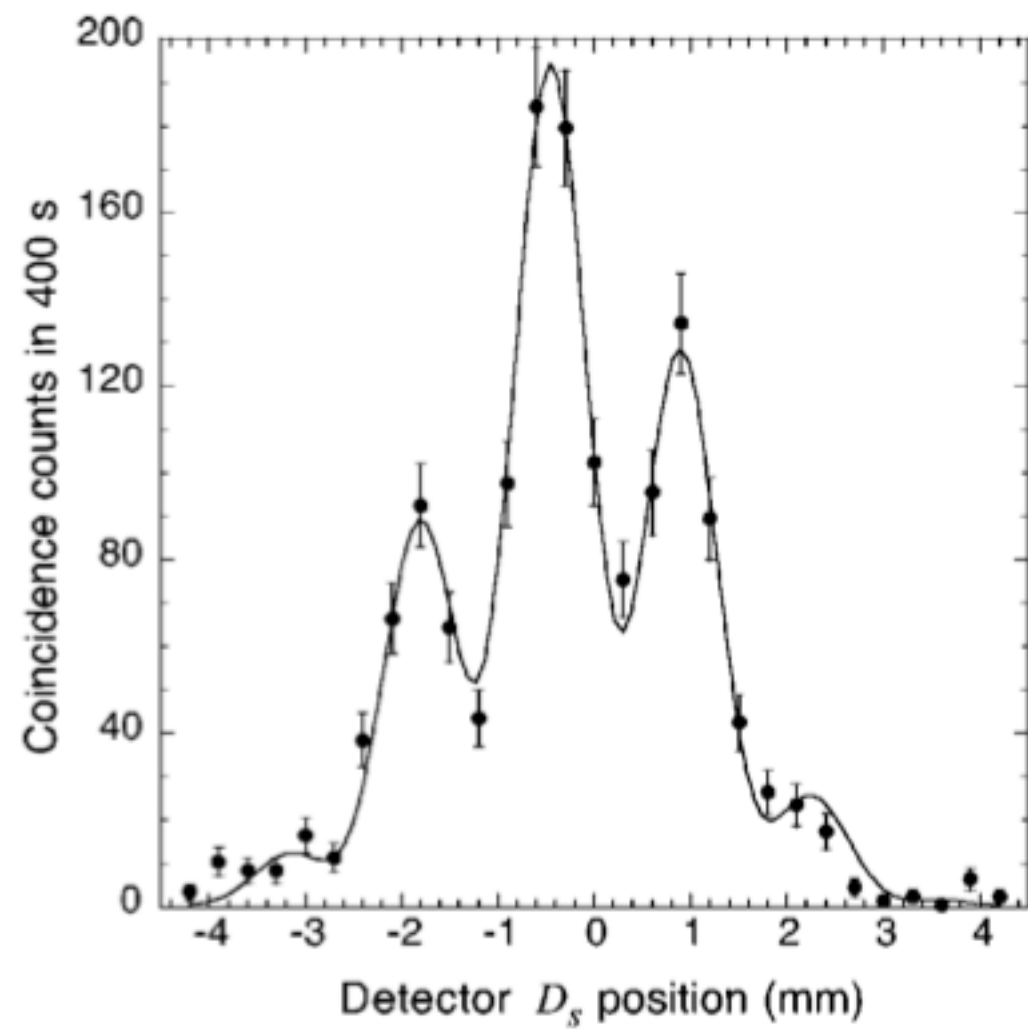
P	S	S after slit 1	S after slit 2
X	Y	R	L
Y	X	L	R



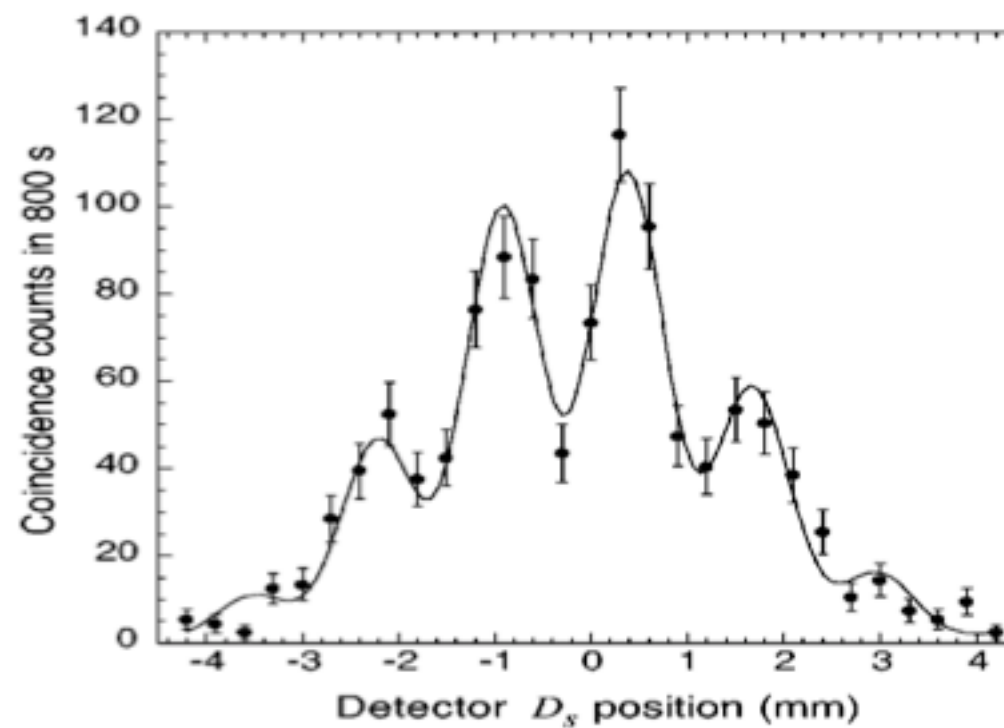
# QUANTUM ERASER, ACT III



Double slit quantum eraser - Walborn, Cunha, Pádúa, Monken

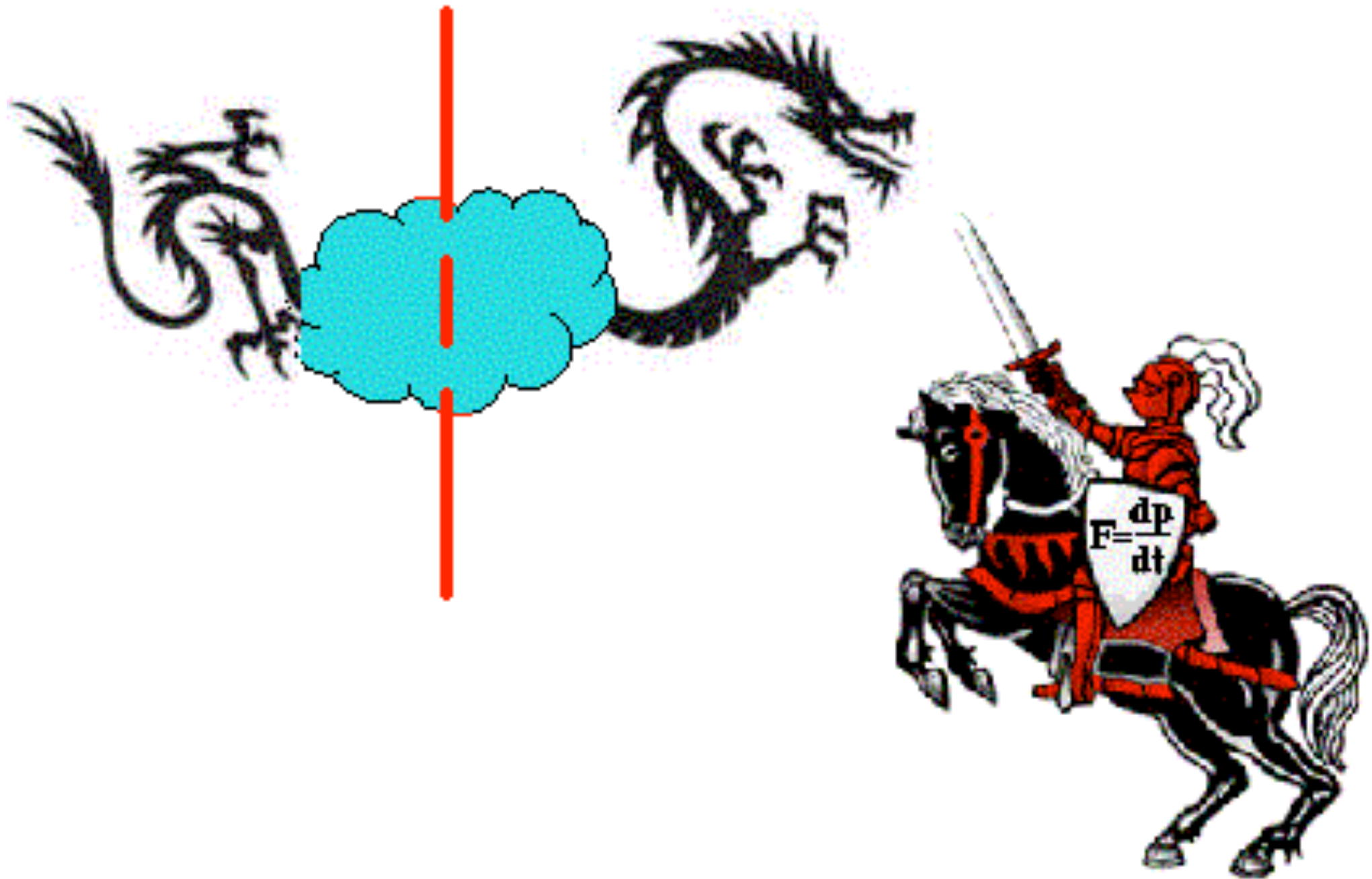


$$\theta = 45^\circ$$



$$\theta = -45^\circ$$

# ***GREAT SMOKEY DRAGON***



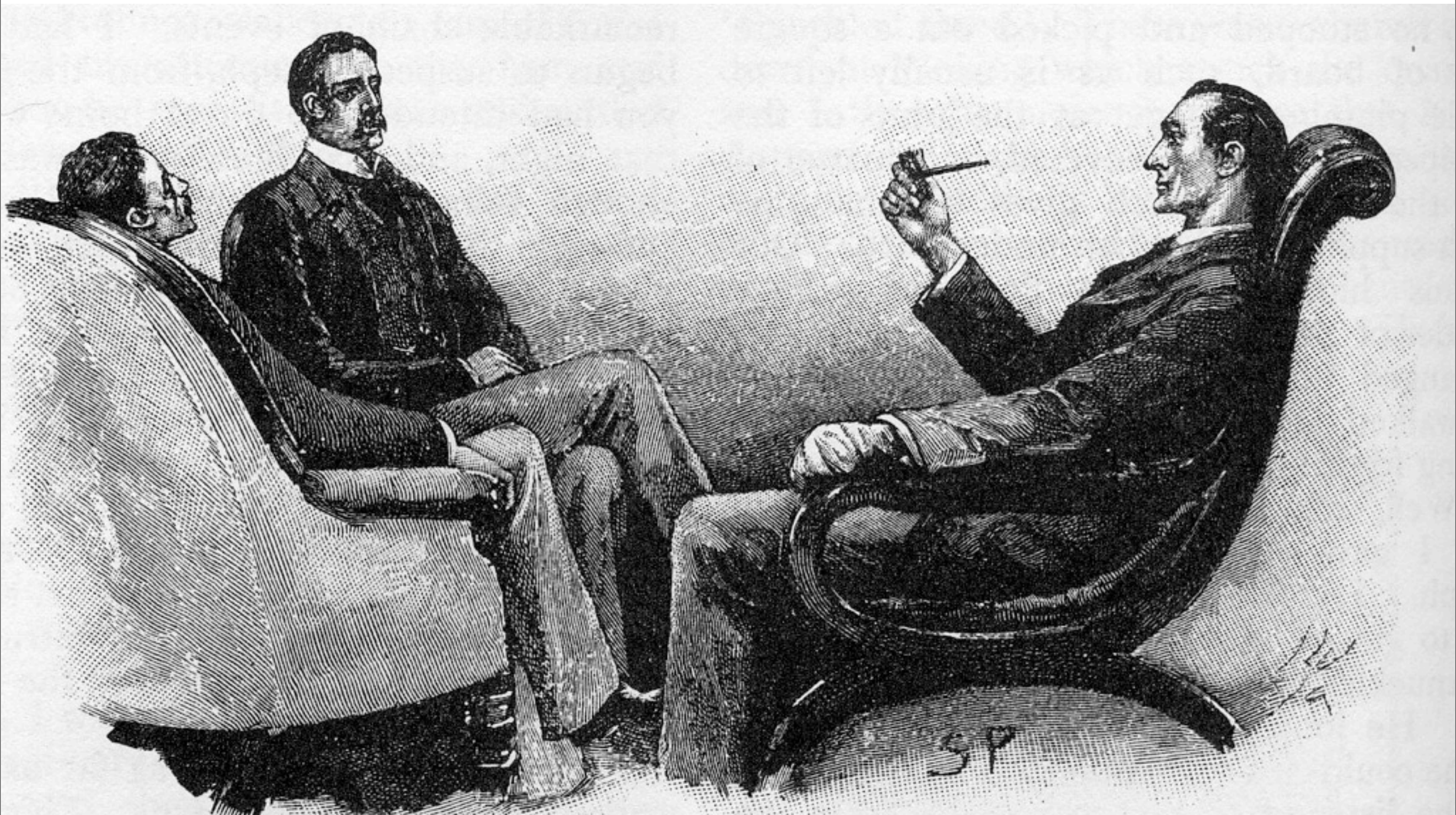


# ***TIME SYMMETRIC QUANTUM MECHANICS***

- Reasoning backwards
- Two state formalism
- Weak measurements
- Two experiments
- Backwards in time?

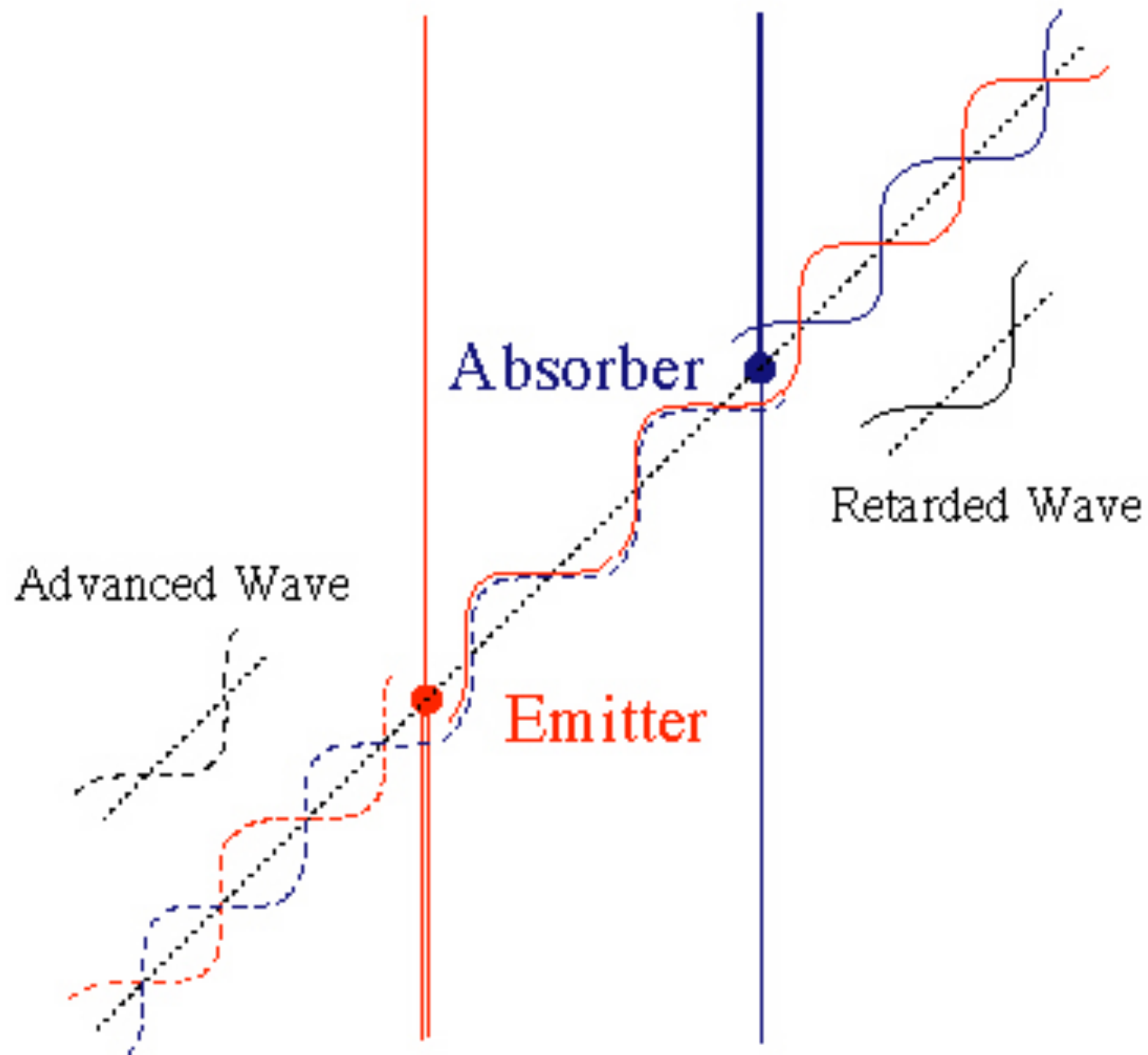


*In solving a problem of this sort, the grand thing is  
to be able to reason backward.*





# JOHN CRAMER'S



# TRANSACTIONAL INTERPRETATION

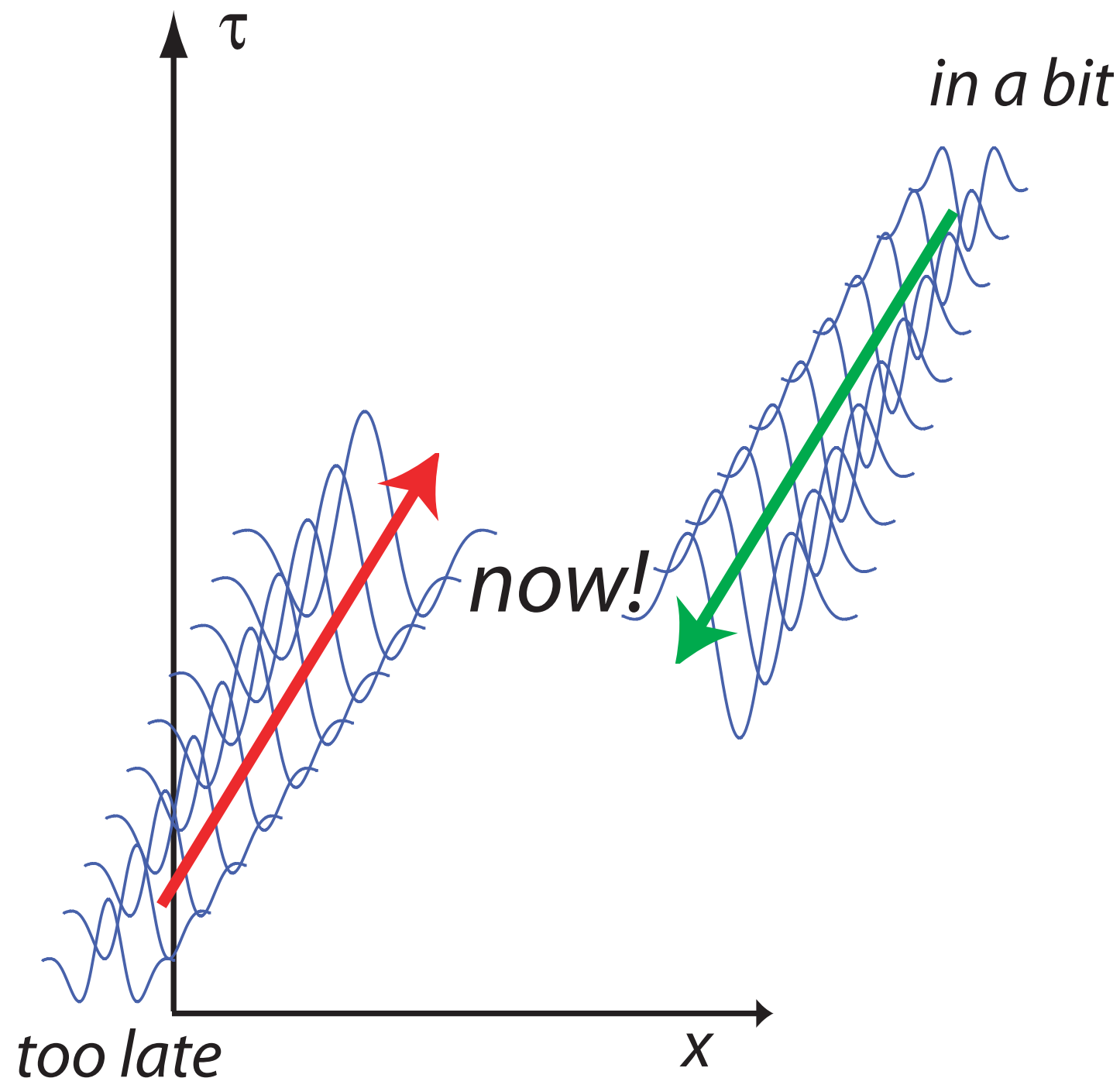


# ***TIME SYMMETRY IN THE QUANTUM PROCESS OF MEASUREMENT***

As for the microscopically determined aspects of quantum measurements, we believe that they can be fairly summarized by the statement that in time-symmetrically constructed ensembles the laws of probability are also time symmetric; further, that to the extent that retrodiction situations may be said to exist, they obey the same laws as the corresponding prediction situations.

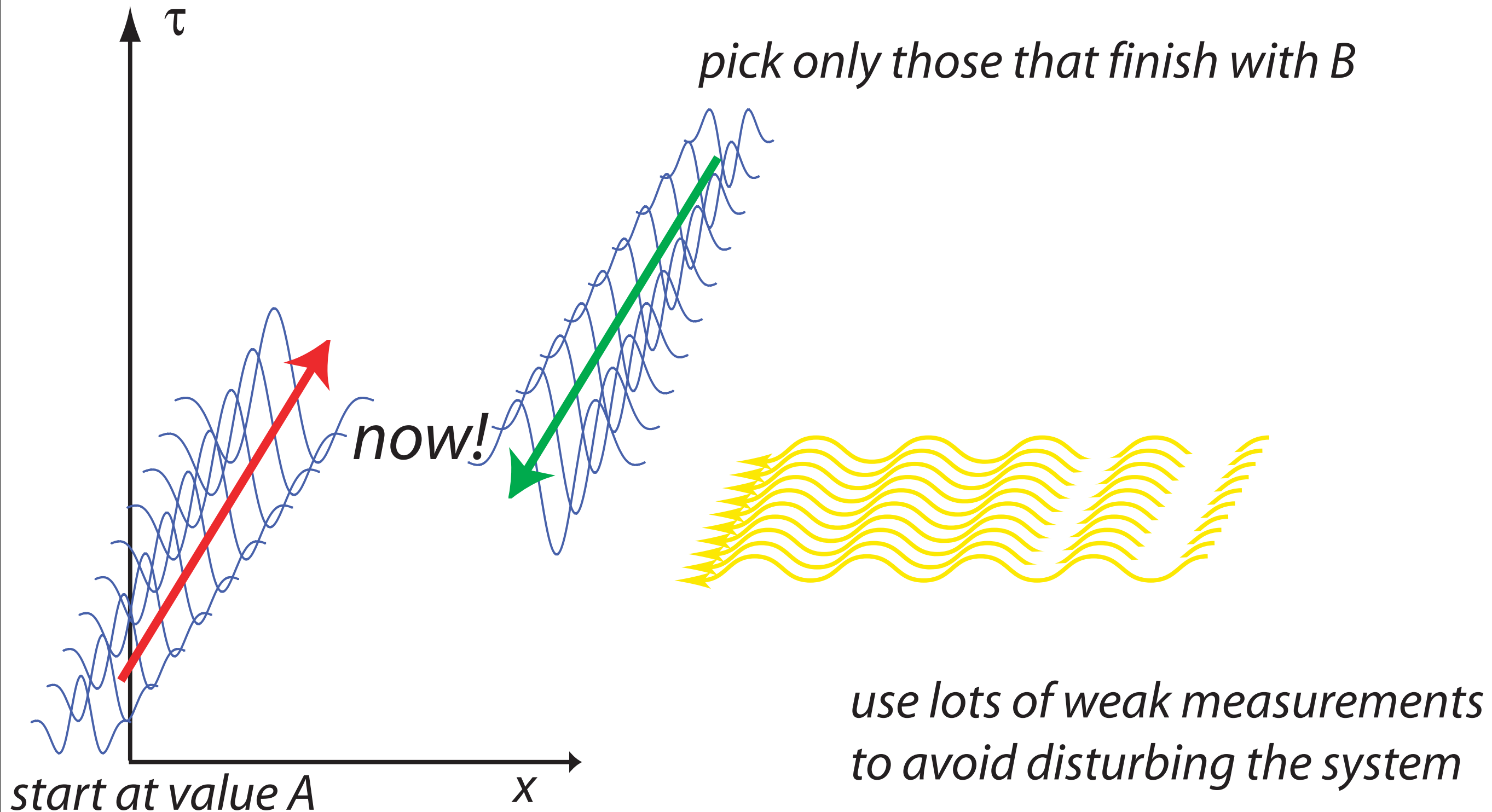
***AHARONOV, BERGMAN, LEBOWITZ***

# TWO-STATE FORMALISM



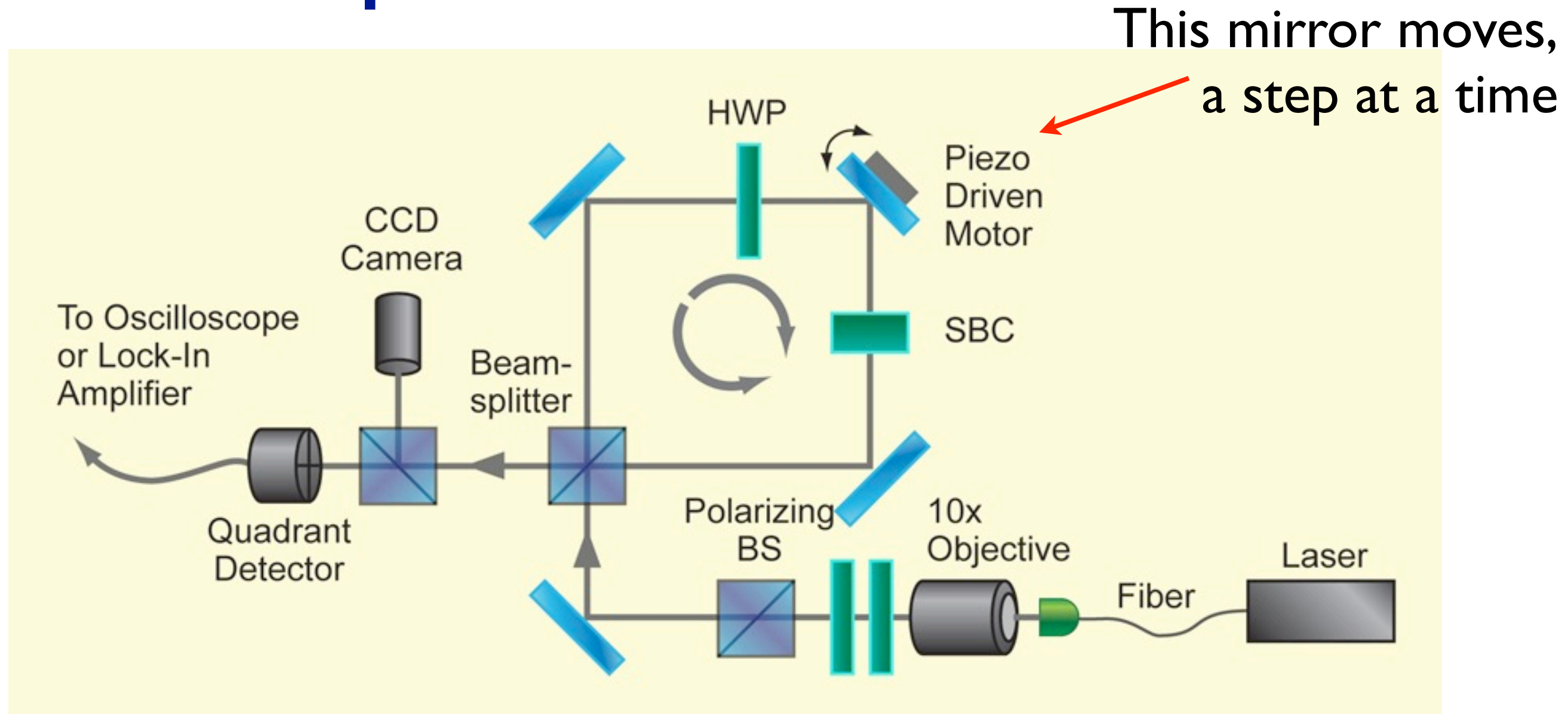
- Represent wave function by a state from past & a state from the future
- Looks a lot like the usual rules, just from a different angle

# ***WEAK MEASUREMENTS***



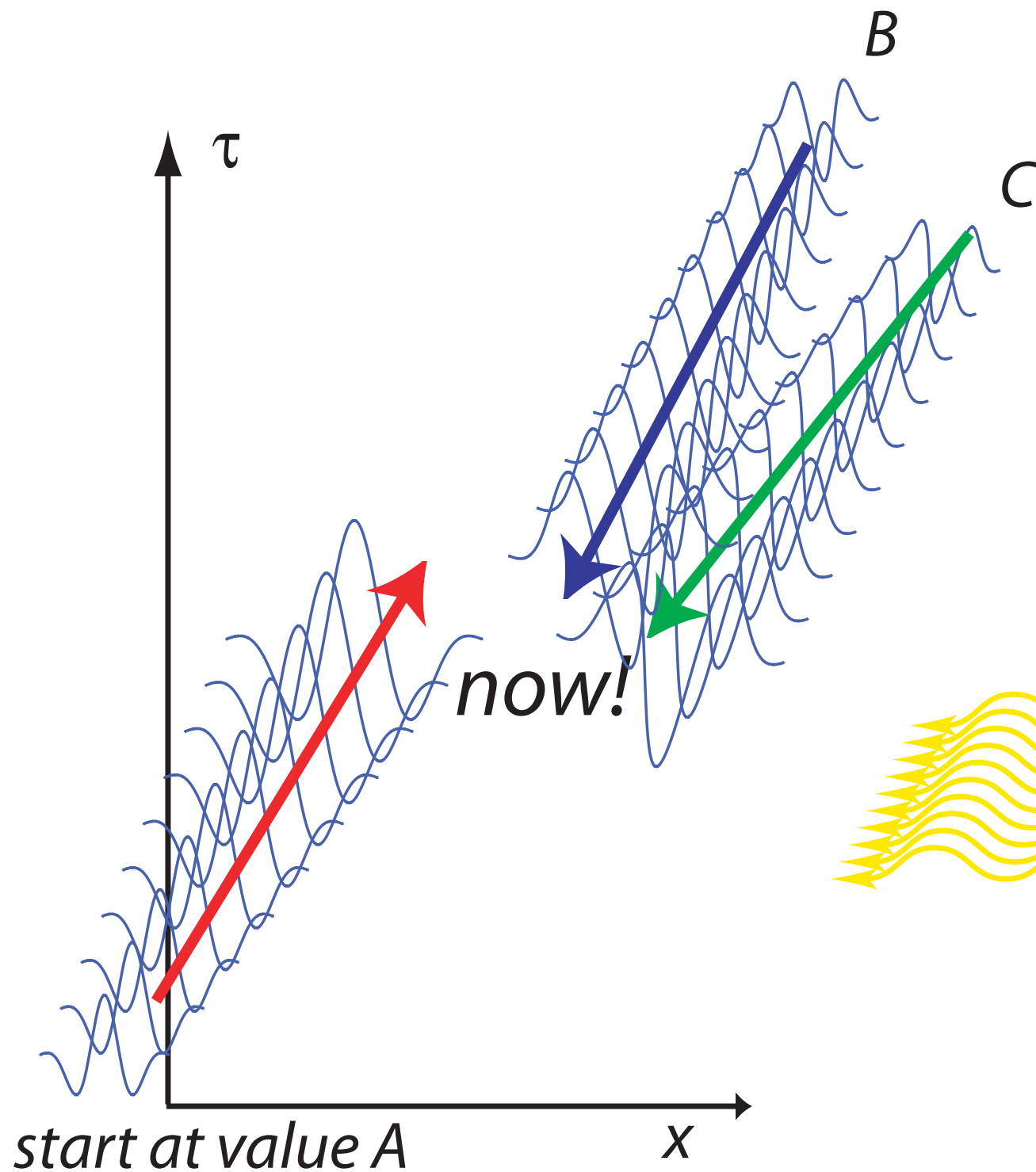


# Ultrasensitive Beam Deflection Measurement via Interferometric Weak Value Amplification

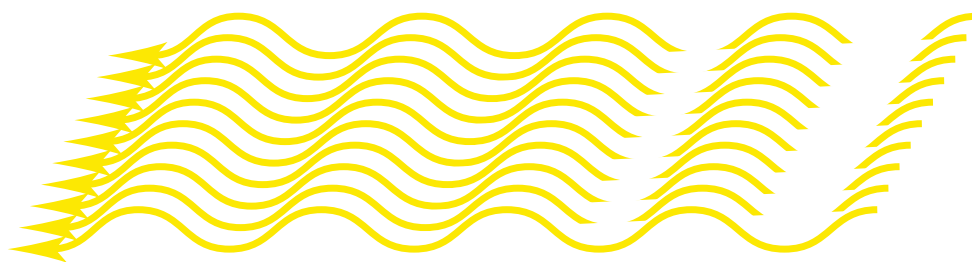


Dixon, Starling, Jordan, & Howell

# BACKWARDS IN TIME?



*If you measure B or C,  
will the results of the  
weak measurement  
change?*



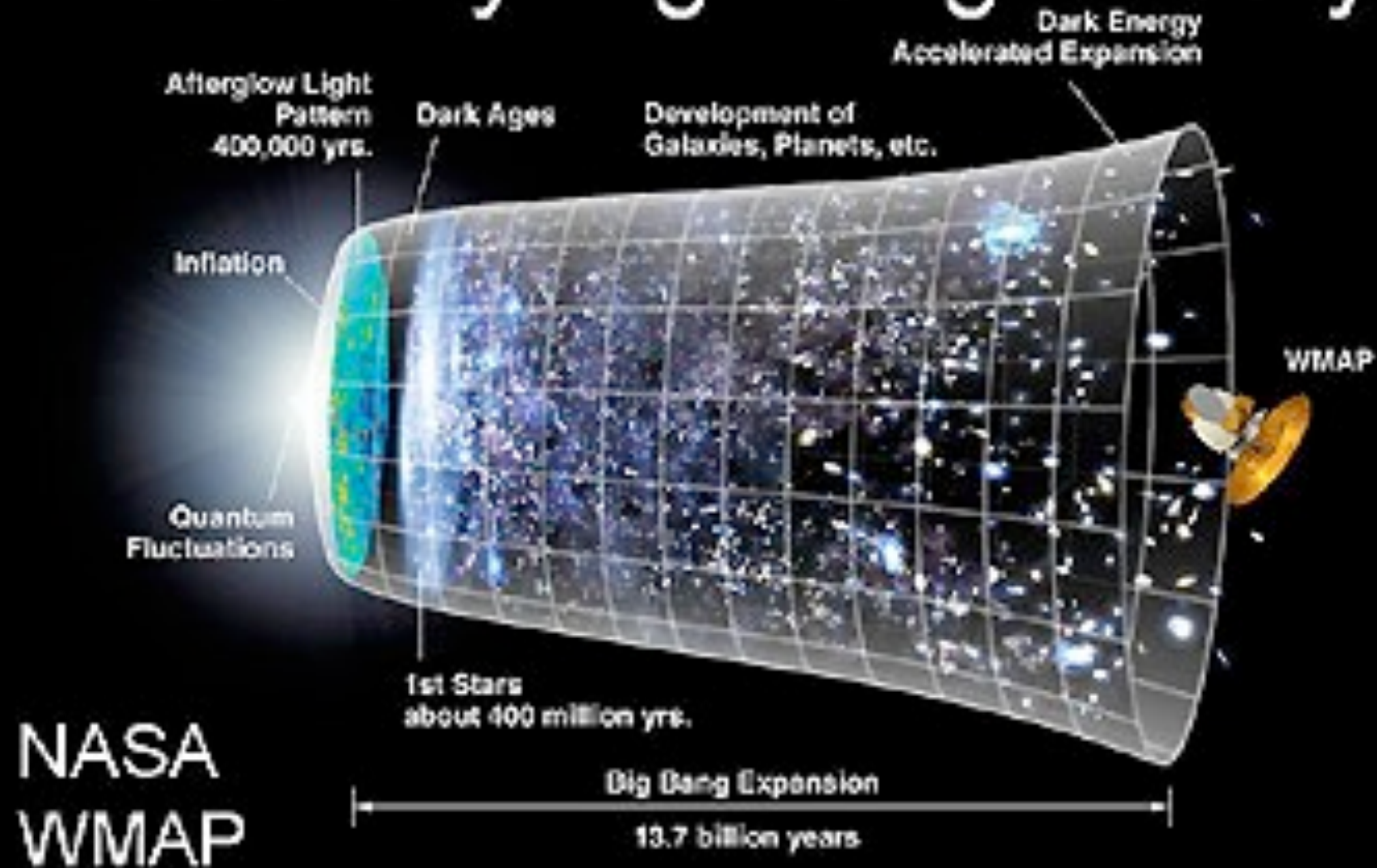
*use lots of weak measurements  
to avoid disturbing the system*

# ***INFLATION VS THE ENDLESS UNIVERSE***

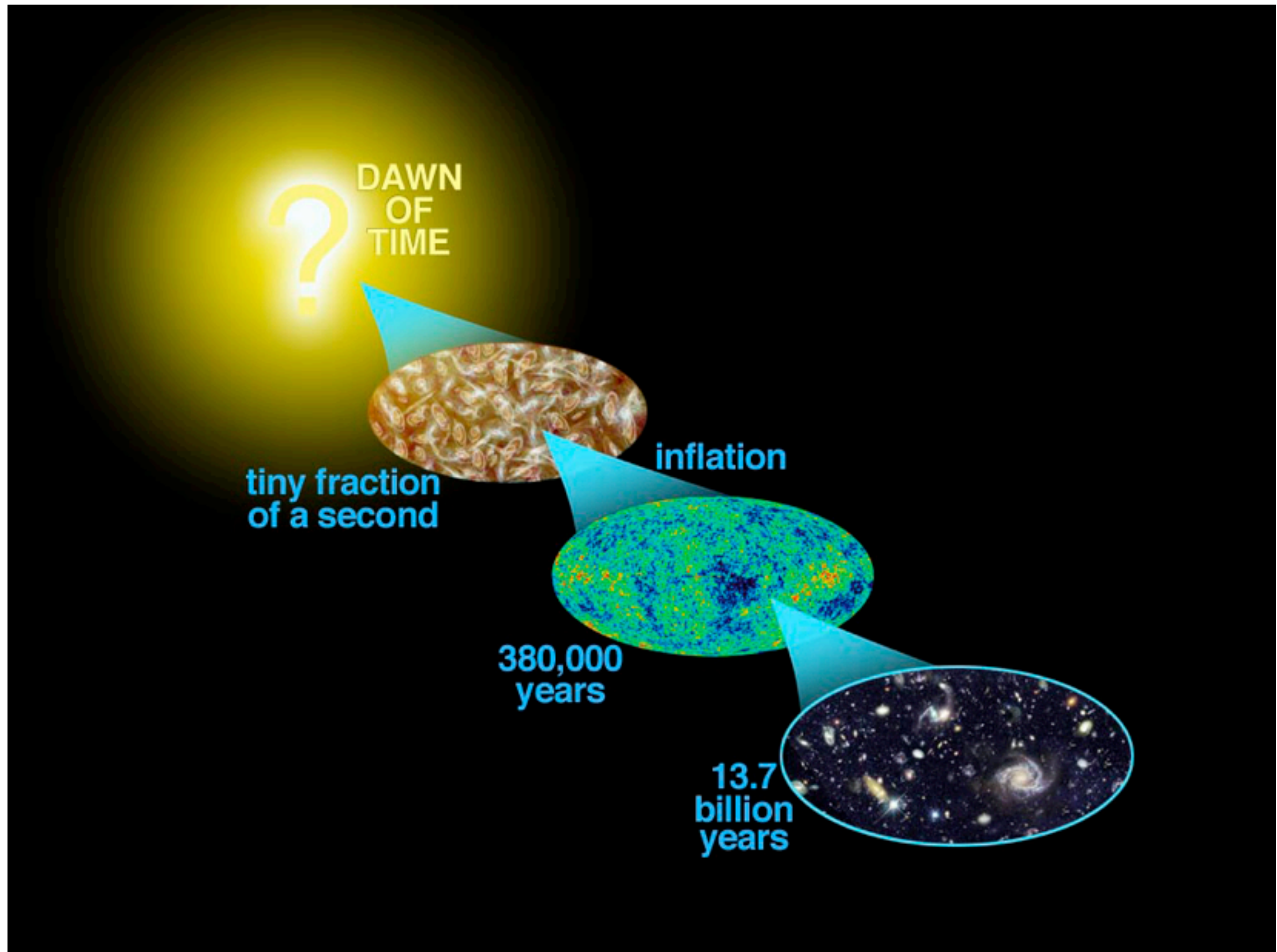
- Inflation
- From Eternity to Here, Carroll
- Problems
- Endless universe, Steinhardt & Turok
- Stuff they agree on
- And how to disambiguate!



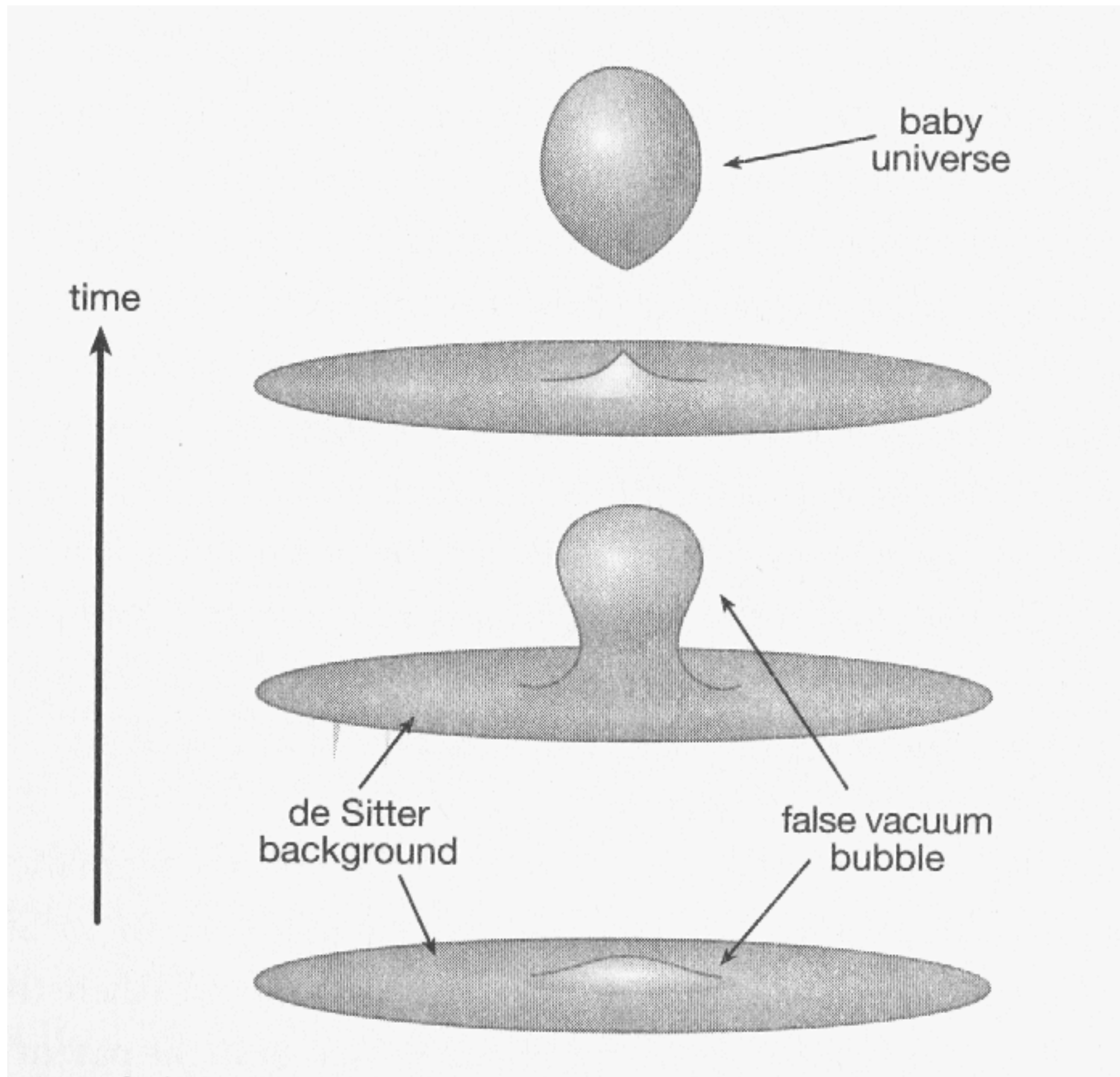
# Inflationary Big Bang Theory



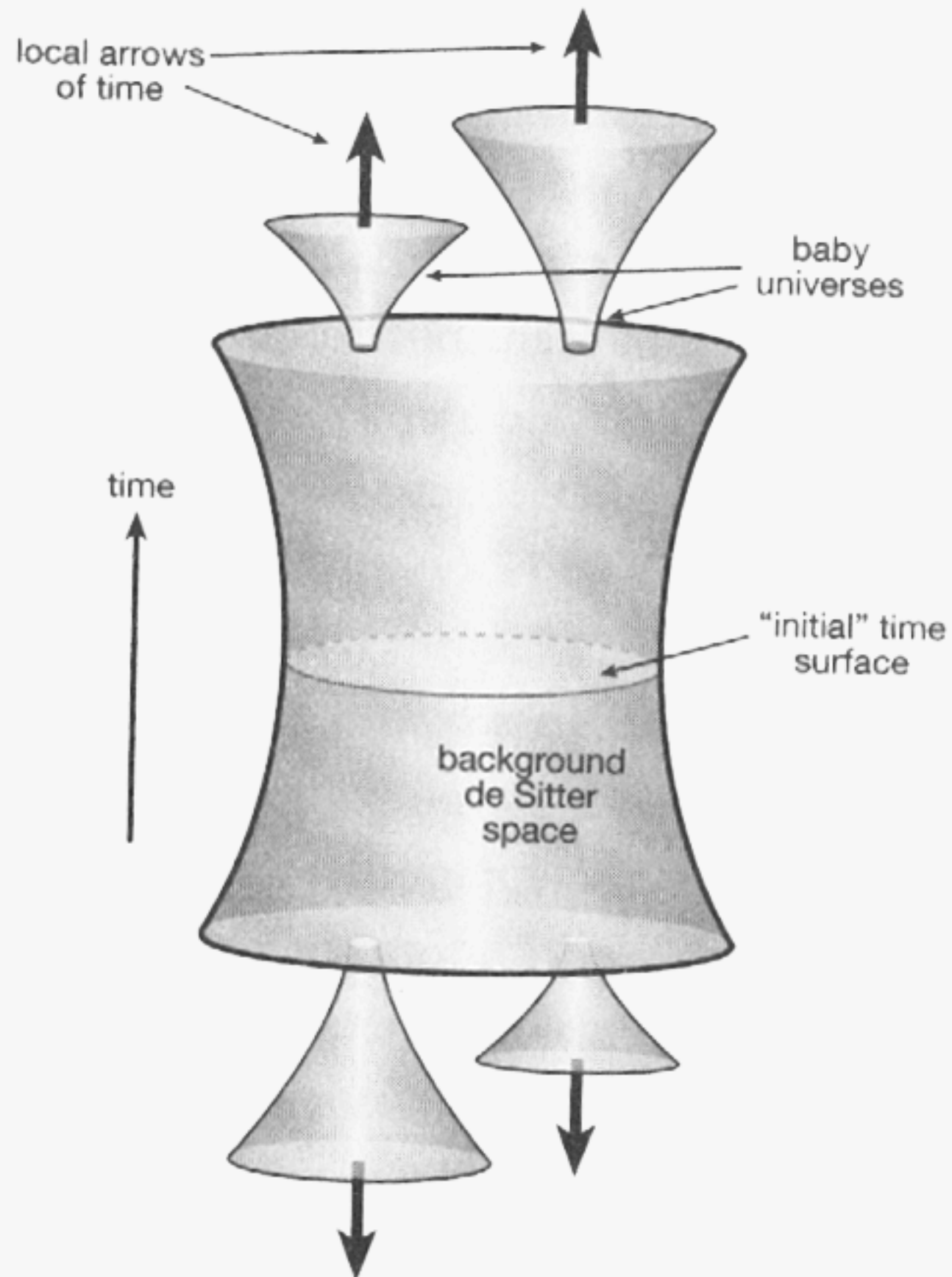
# ***INFLATE, THEN SLOW DOWN***



# A UNIVERSE IS BORN

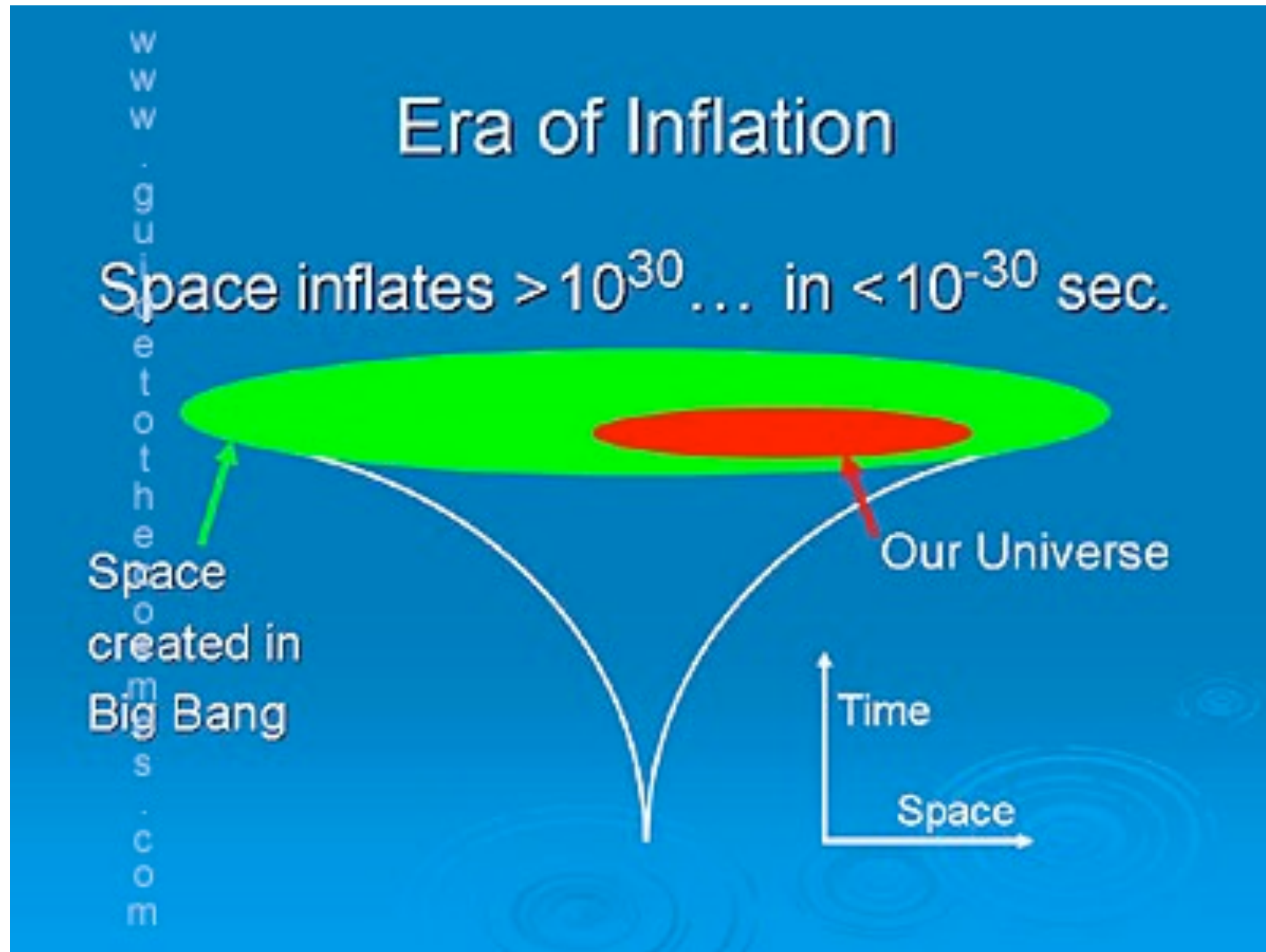






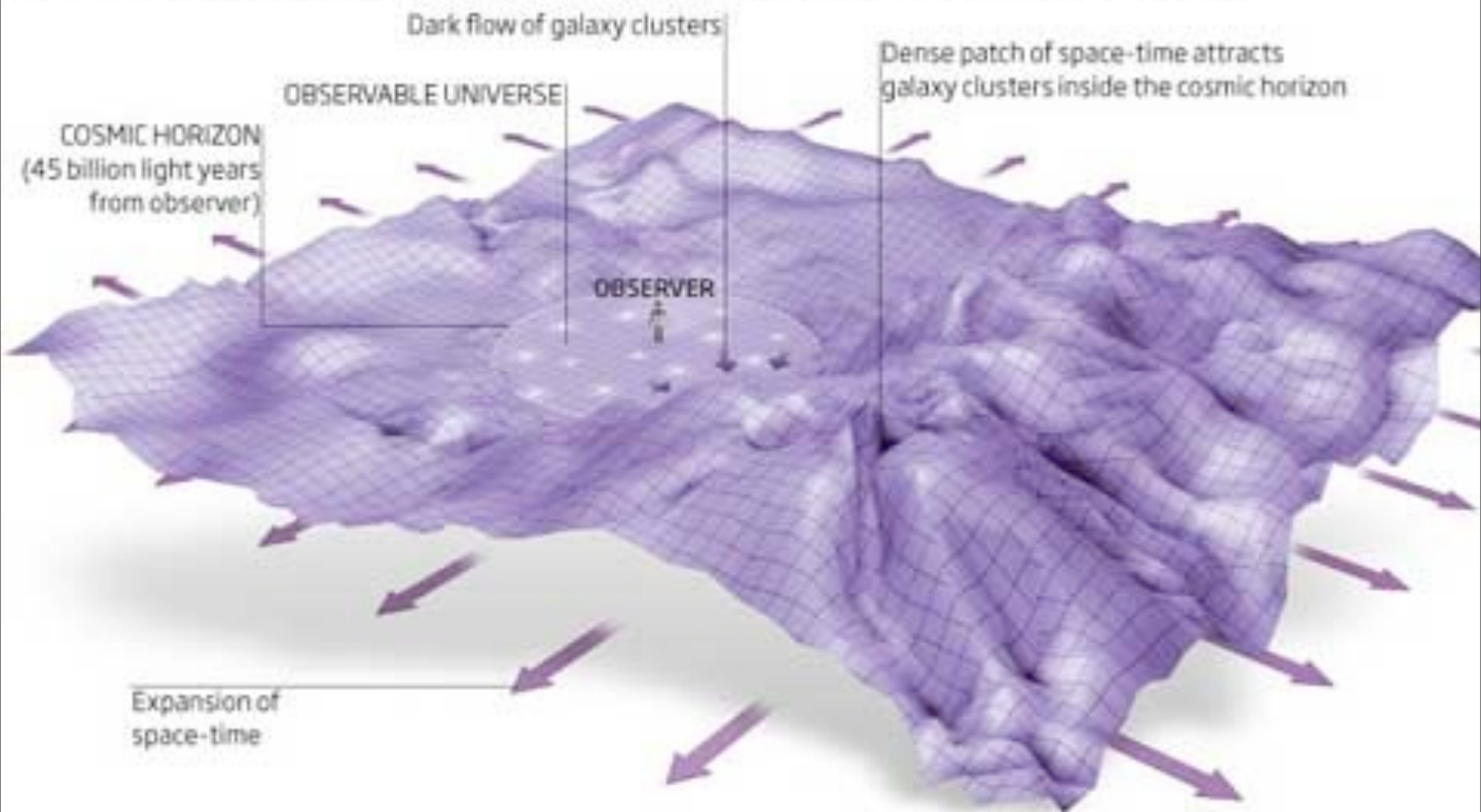
# ***TIME SYMMETRIC BIRTHS OF UNIVERSES***

# VERY RAPID INFLATION



# Edge of the universe

The "dark flow" of wayward galaxy clusters that appear to be pulled in one direction could give us our first hint of something beyond the cosmic horizon, which normally marks the limit of the observable universe



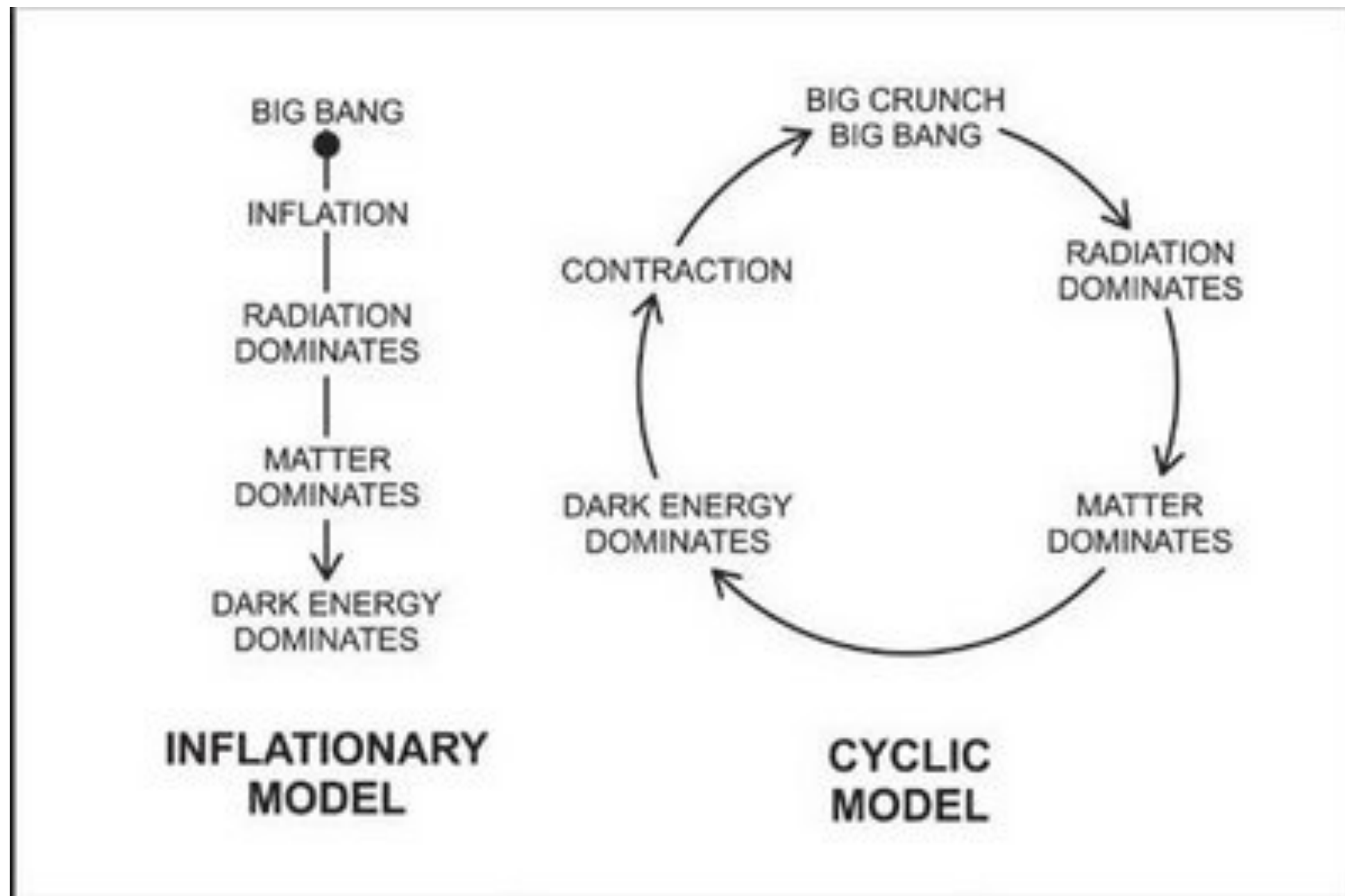


# ***FLAWS OF INFLATION***

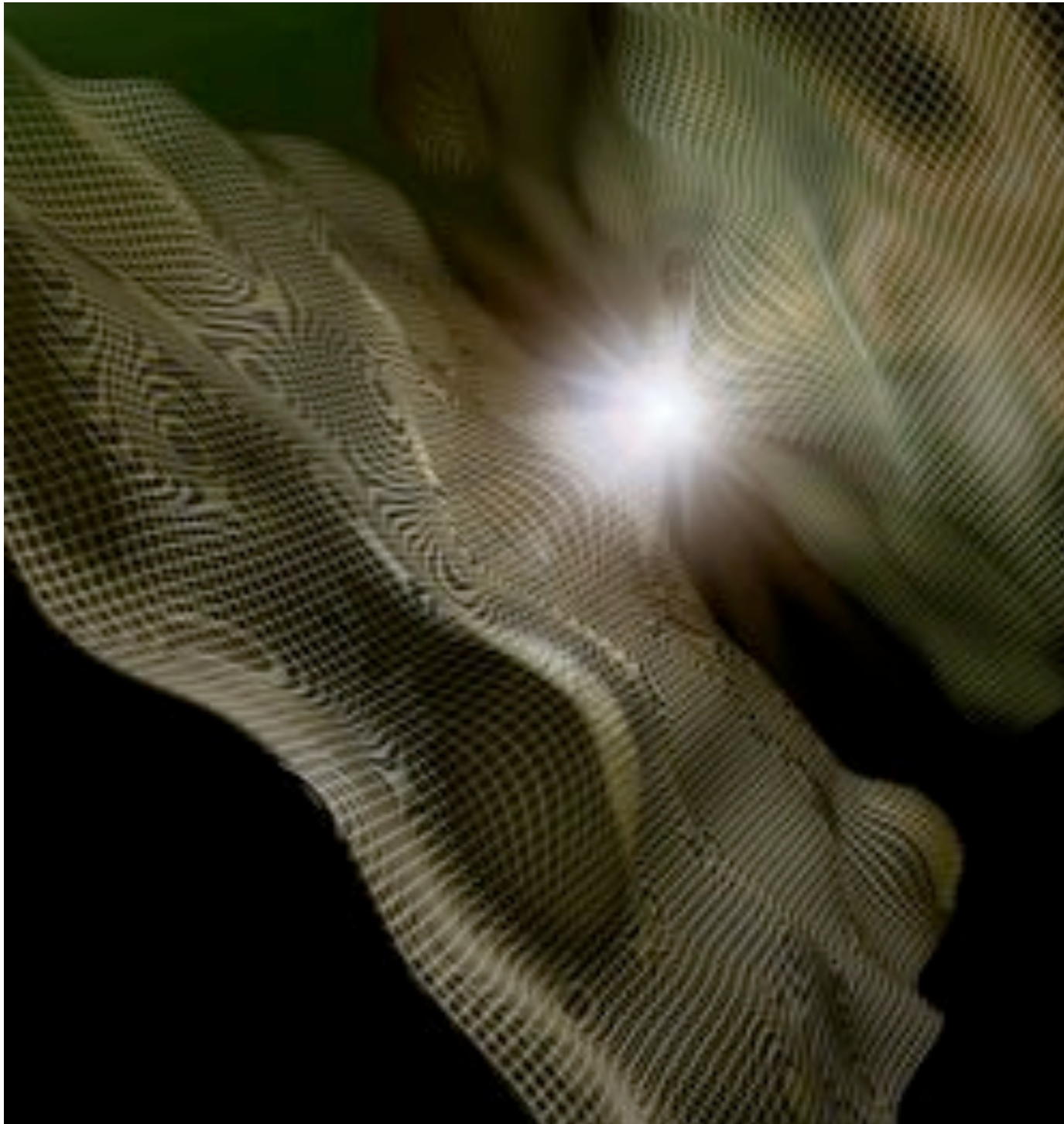
- Source of inflationary energy?
- How did space & time begin?
- Why did big bang lead to inflation?
- Why don't we see runaway inflation?

# ***ENDLESS UNIVERSE***

## ***STEINHARDT & TUROK***

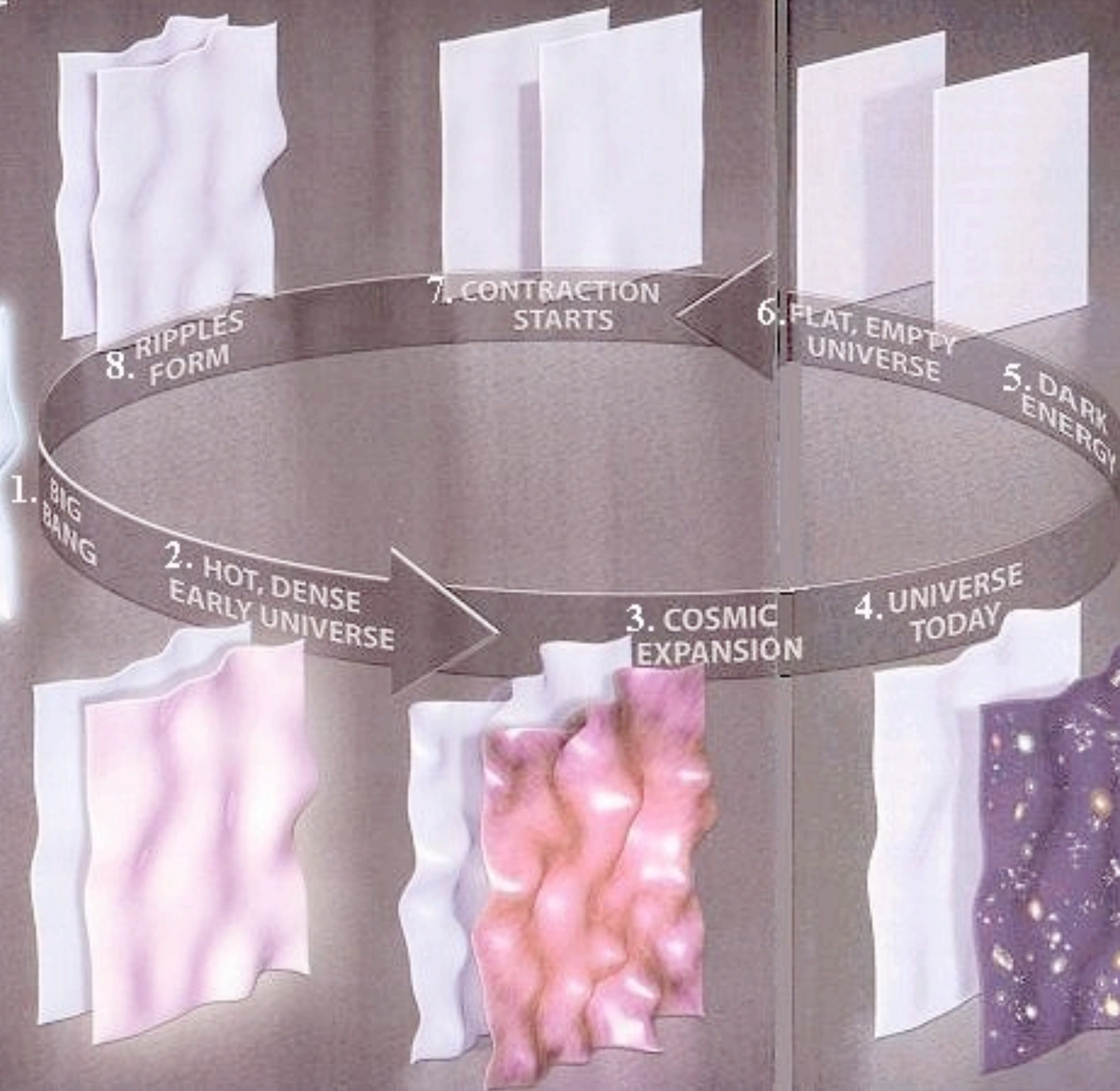


# ***WHEN BRANES COLLIDE***



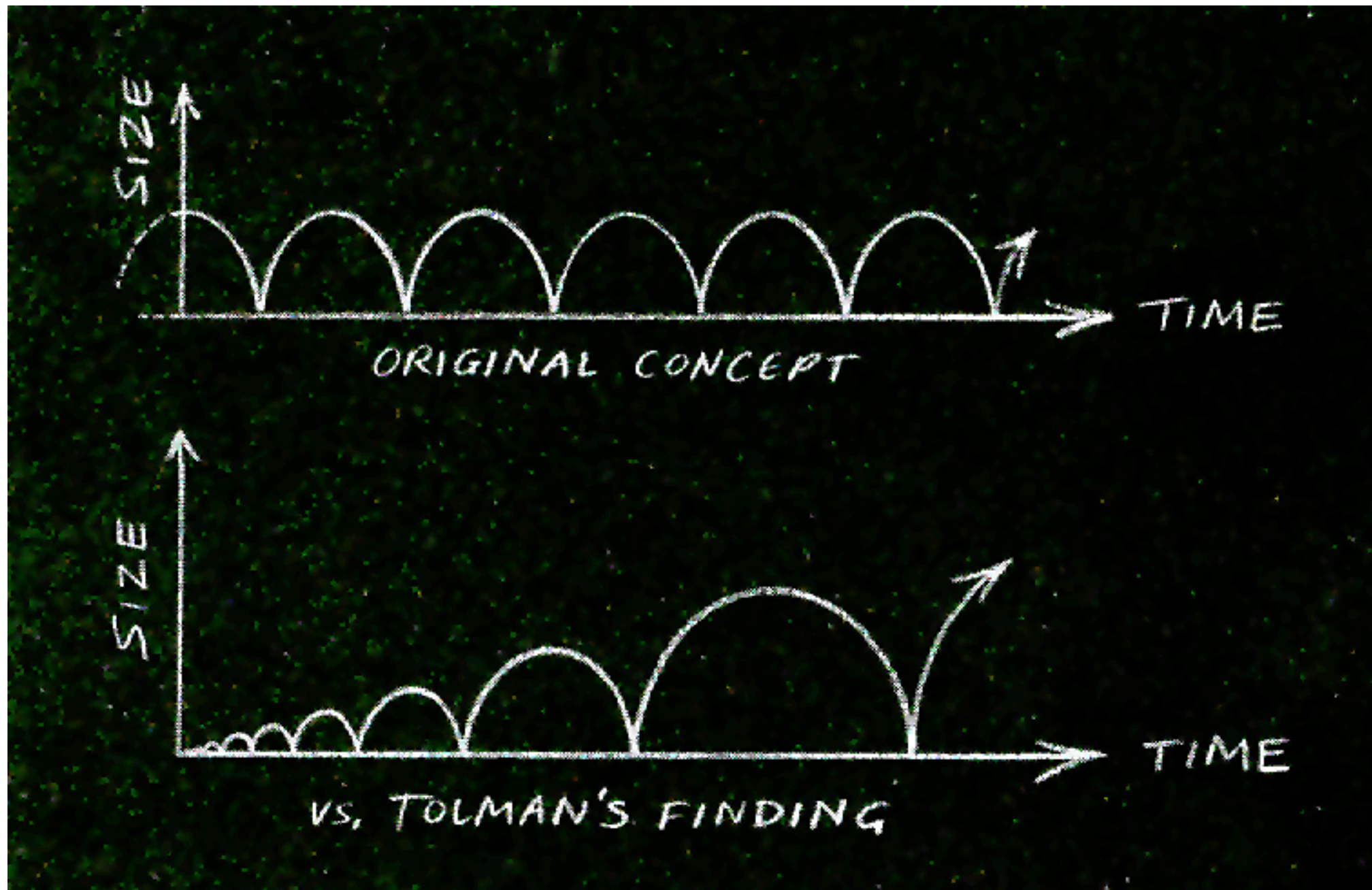


# cyclic universe





# ENTROPY IN THE ENDLESS UNIVERSE



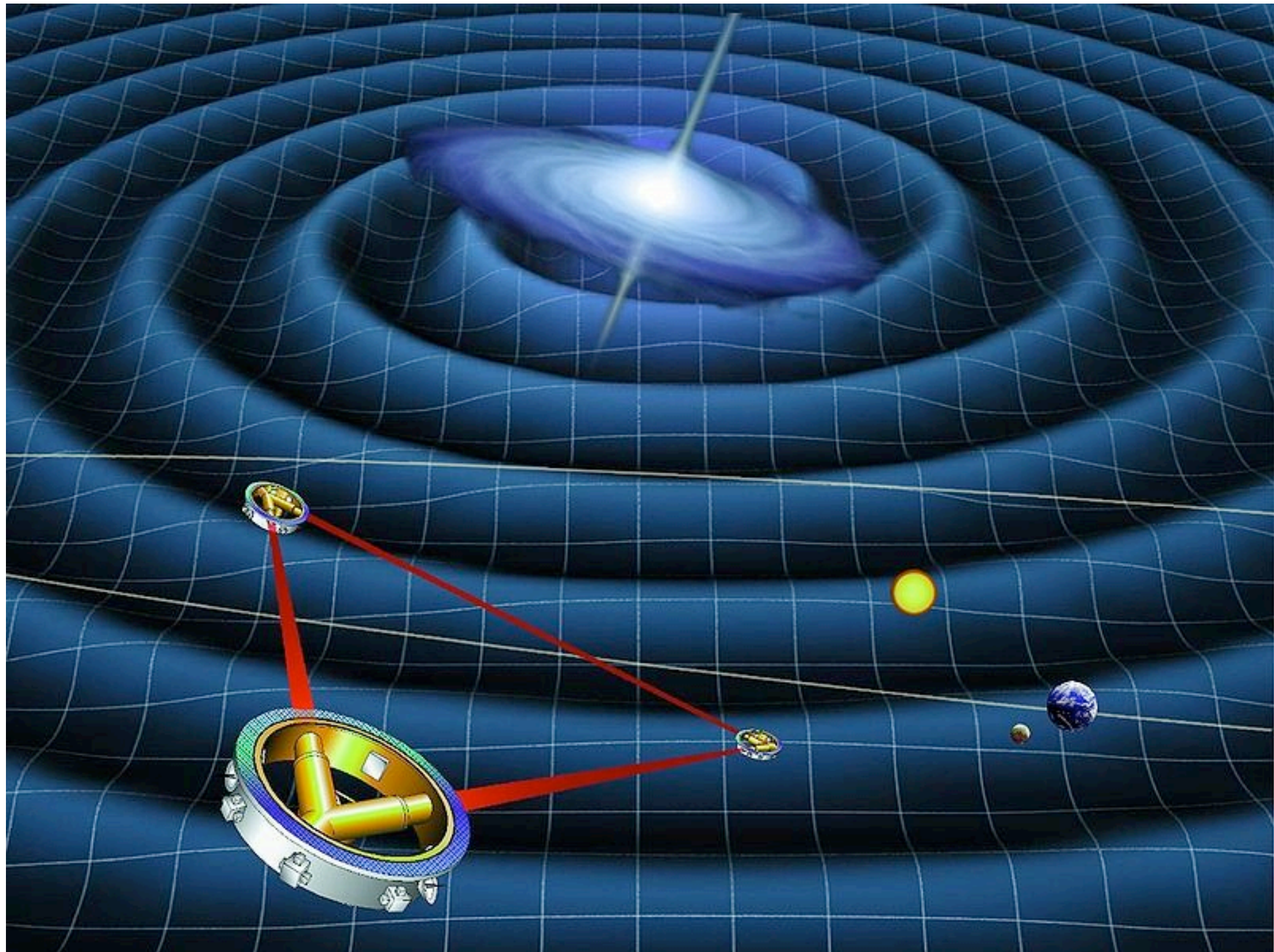
# ***FIVE TESTS SURVIVED***

- Nearly scale invariant background
- Space flat, not curved
- Matter, dark matter, & radiation have same distribution
- Distribution is random in right way
- Slight tilt towards red end of spectrum

44 ... ***BY INFLATIONARY & CYCLIC!***

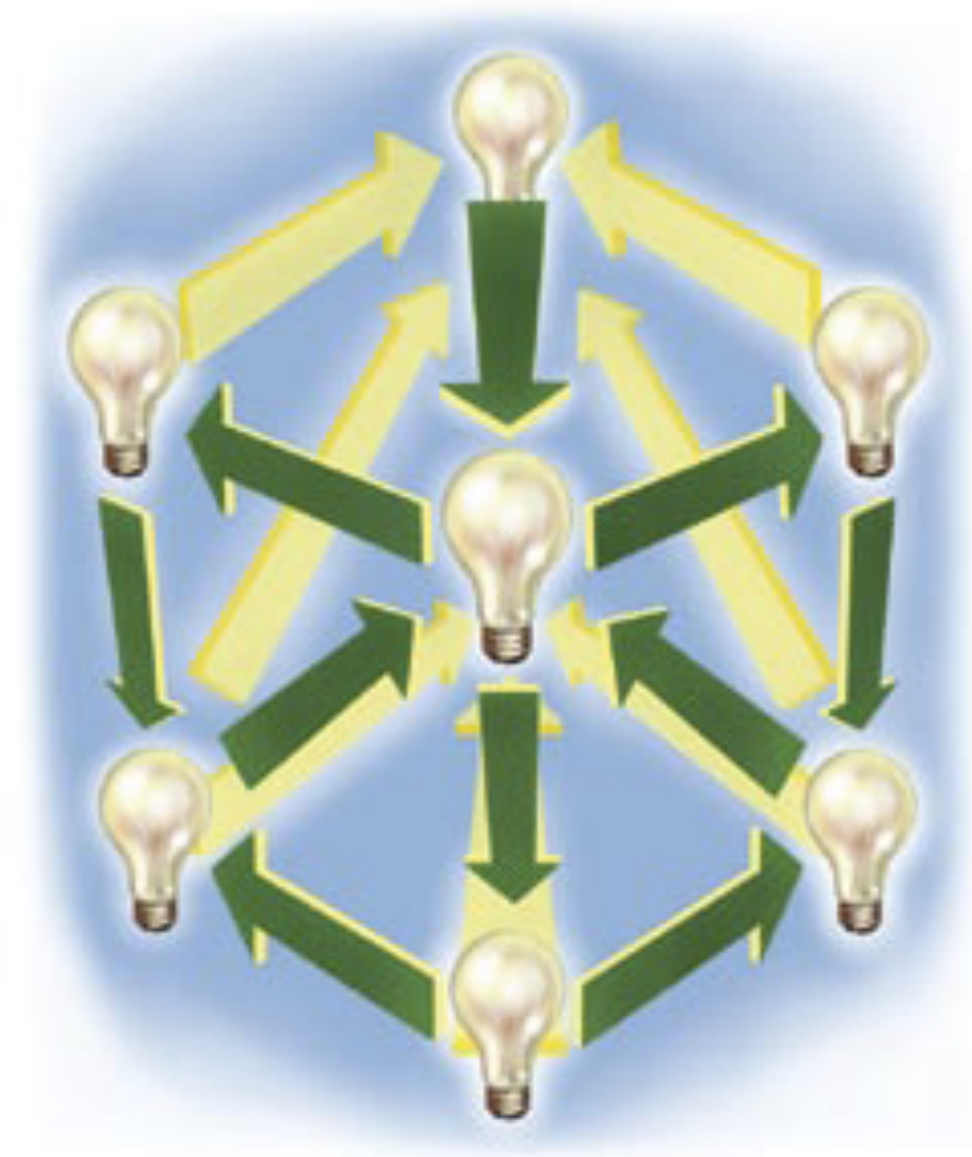


# ***GRAVITATIONAL RADIATION***





# ***WHEN IDEAS HAVE SEX***



**In other words, our ancestors had sex with people they knew, but their ideas had sex with strangers, and this form of trade led to trust and prosperity.**

**- Michael Shermer, June 2010 Scientific American**

# ***REFERENCES***

- From eternity to here, Sean Carroll
- Endless Universe, Steinhardt & Turok
- The New Time Travelers, Toomey
- Physics of the Impossible, Kaku
- New Theories of Everything, Barrows





**What does that mean? Huh?**  
**"Time & quantum  
mechanics."**  
**I don't even know what the  
hell that means.**  
**– Old Jack Burton, on a dark  
& stormy night**

**[www.timeandquantummechanics.com](http://www.timeandquantummechanics.com)**