

Title: Neil Turok: The Astonishing Simplicity of Everything

Date: Oct 07, 2015 07:00 PM

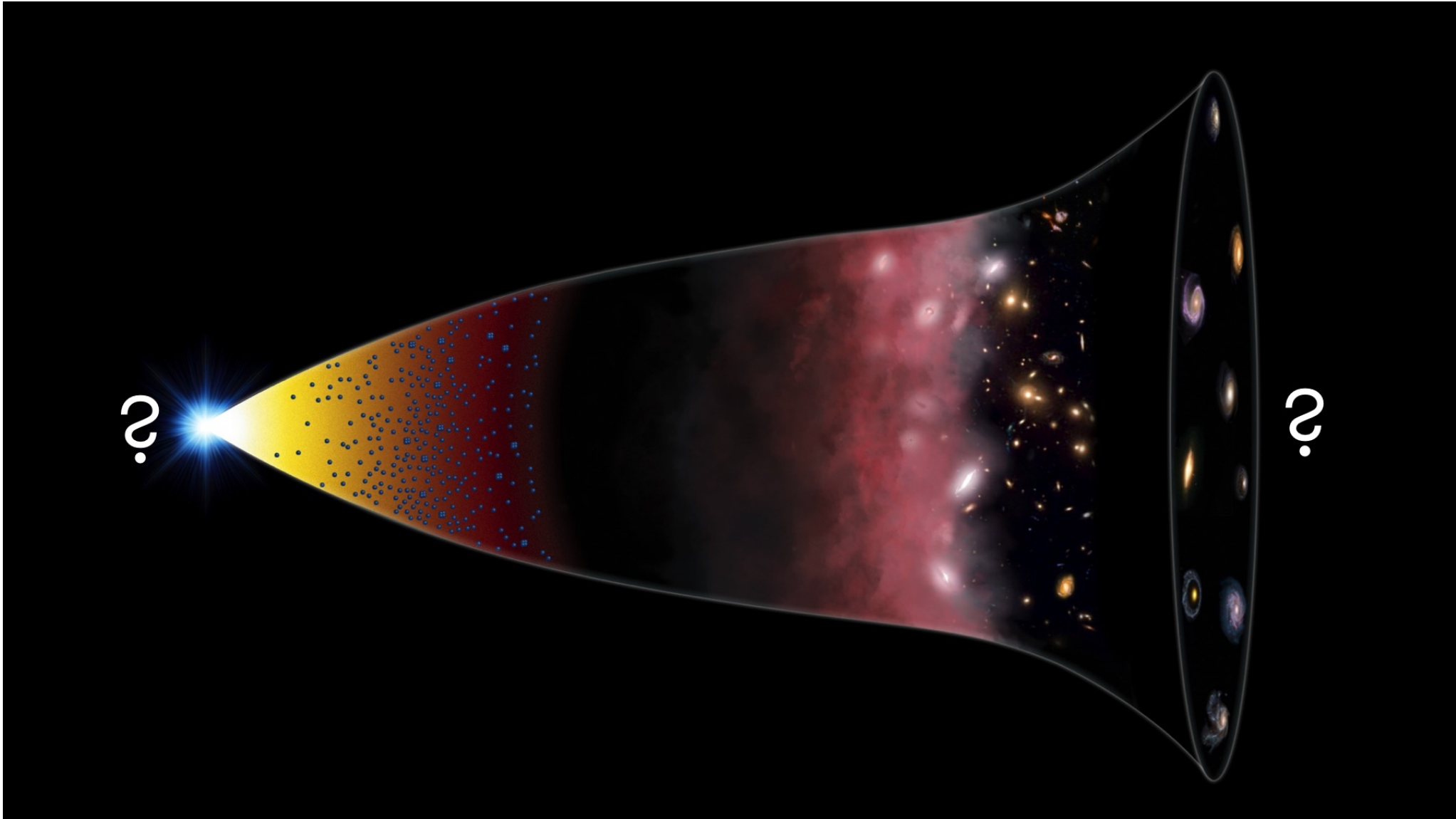
URL: <http://pirsa.org/15100070>

Abstract: <p>Fundamental physics has reached a turning point. The most powerful experiments ever devised are revealing the structure of the universe with unprecedented clarity. On the largest scales “ the whole visible universe ” and the tiniest, we are discovering remarkable simplicity, which our theories do not yet explain. In between, things are complex. But here too, new technologies are allowing us to access the quantum frontier, opening up new high-precision probes of the fundamental laws of nature and revolutionary new technologies. We stand on the threshold of breakthroughs, both theoretical and experimental, which could change our picture of the world and the development of our society.</p>

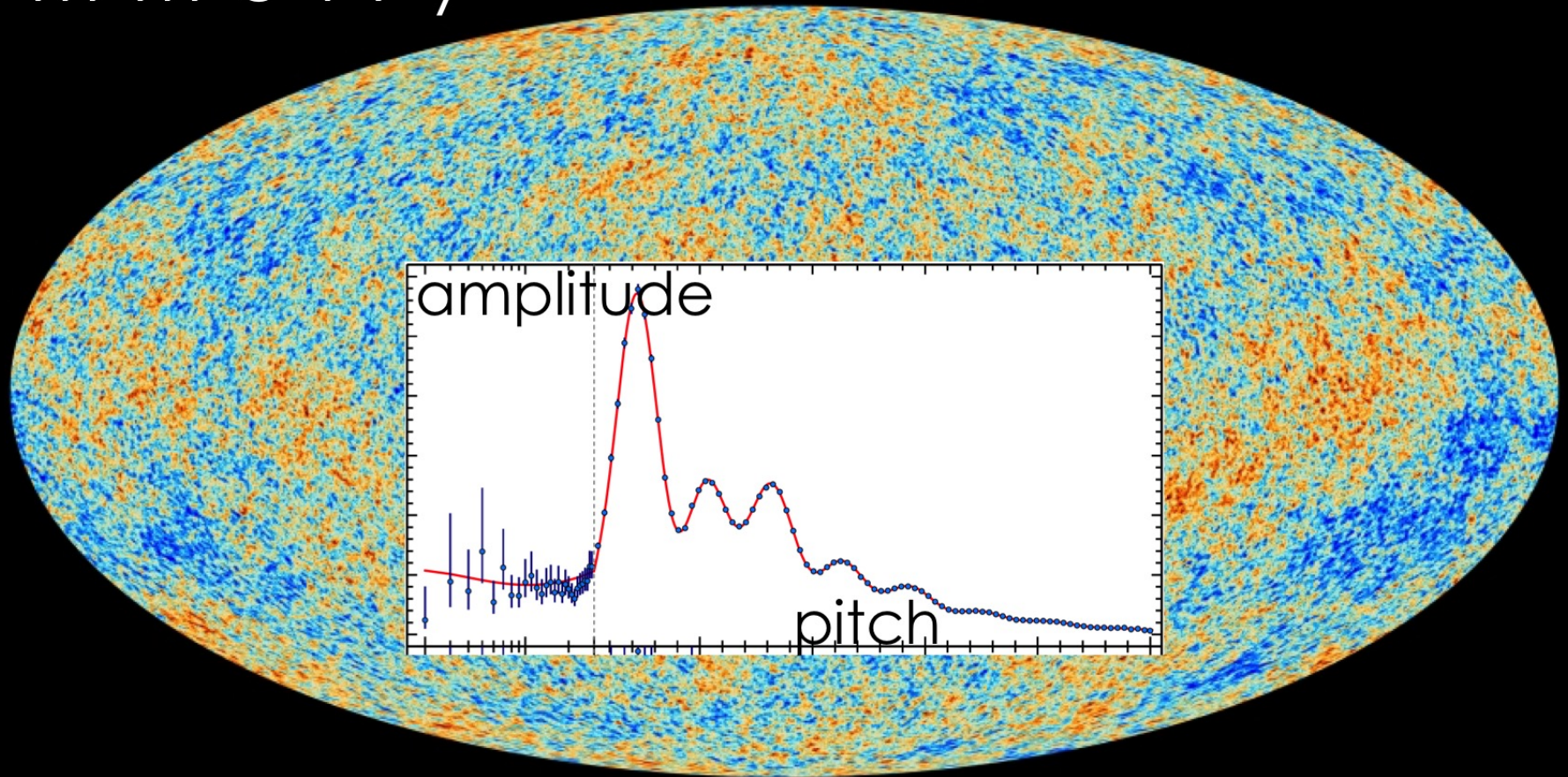
s i m p l i c i t y



Credit: Pablo Carlos Budassi



s y m m e t r y



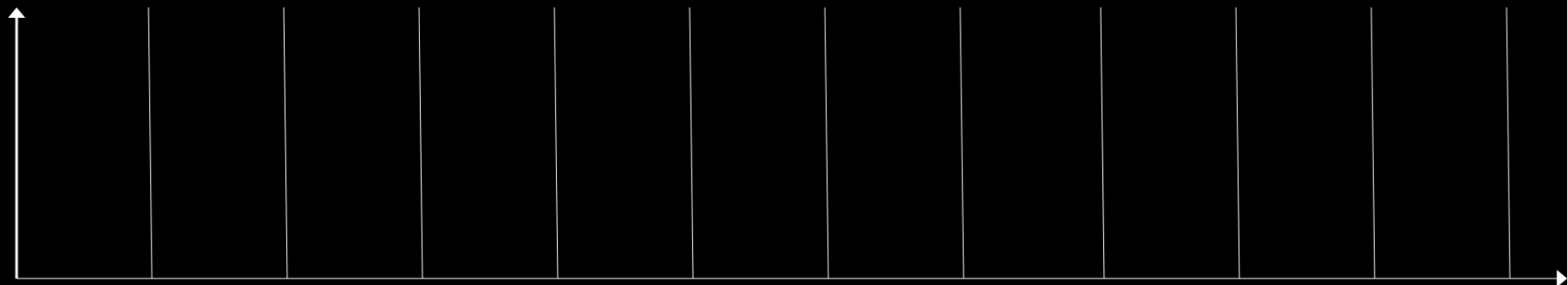
s y n c h r o n i c i t y

Credit: ESA Planck satellite

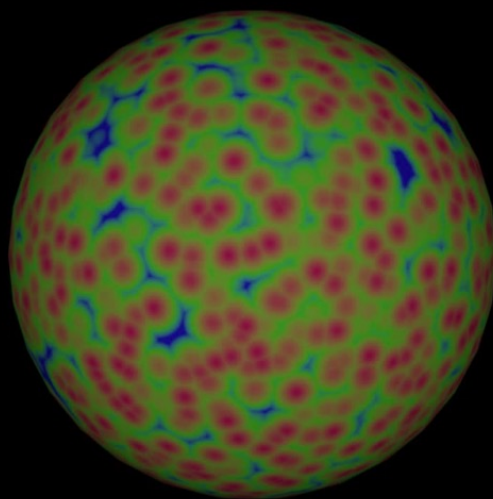
scale-free



amplitude



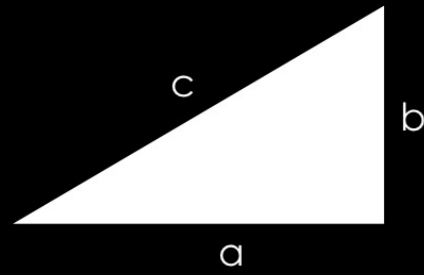
pitch

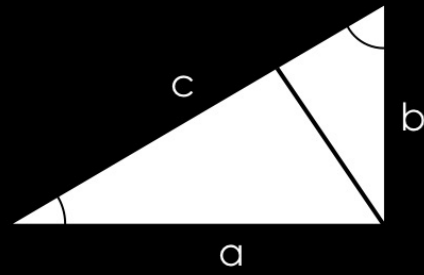


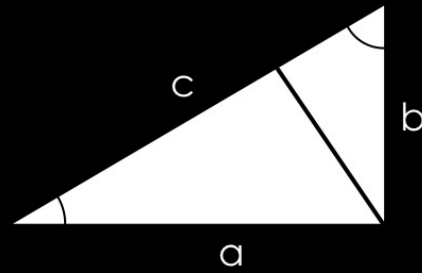


Credit: Ue-Li Pen



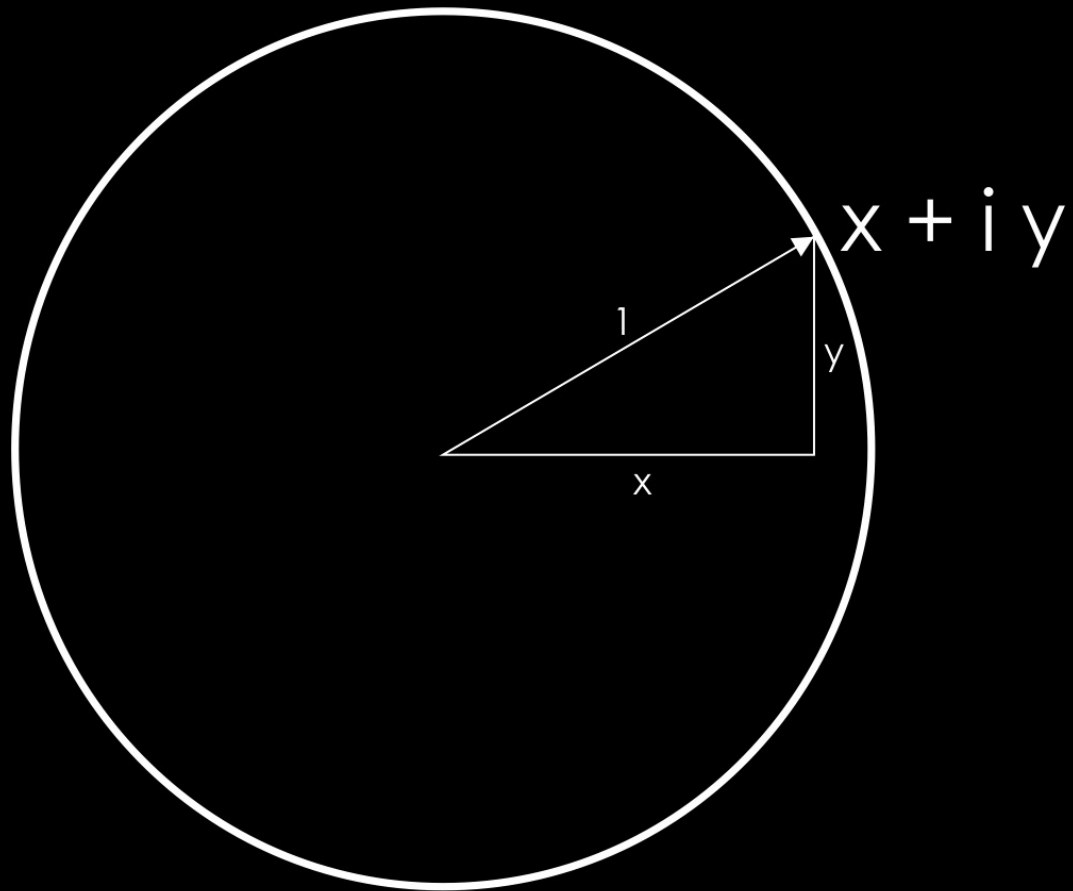


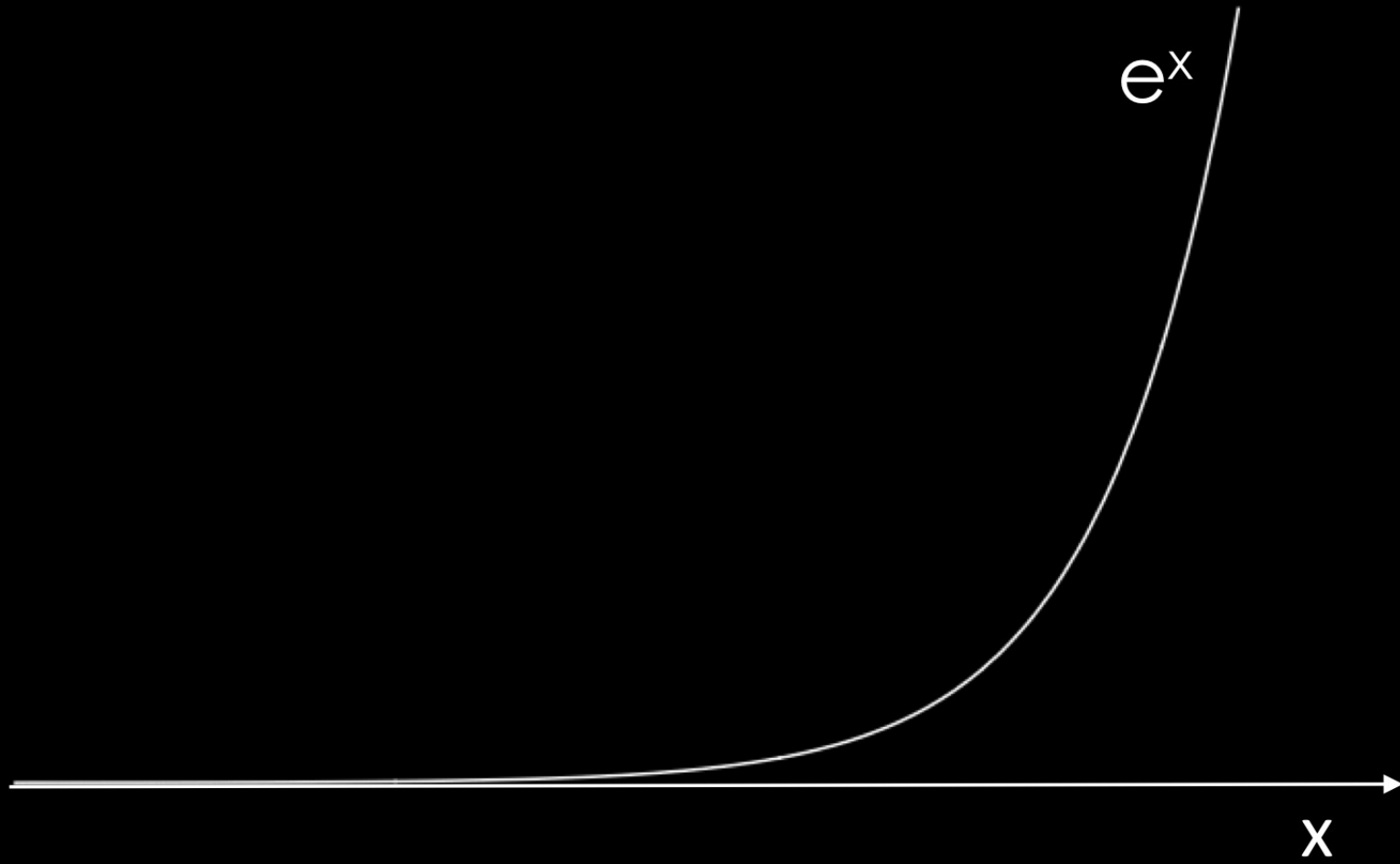


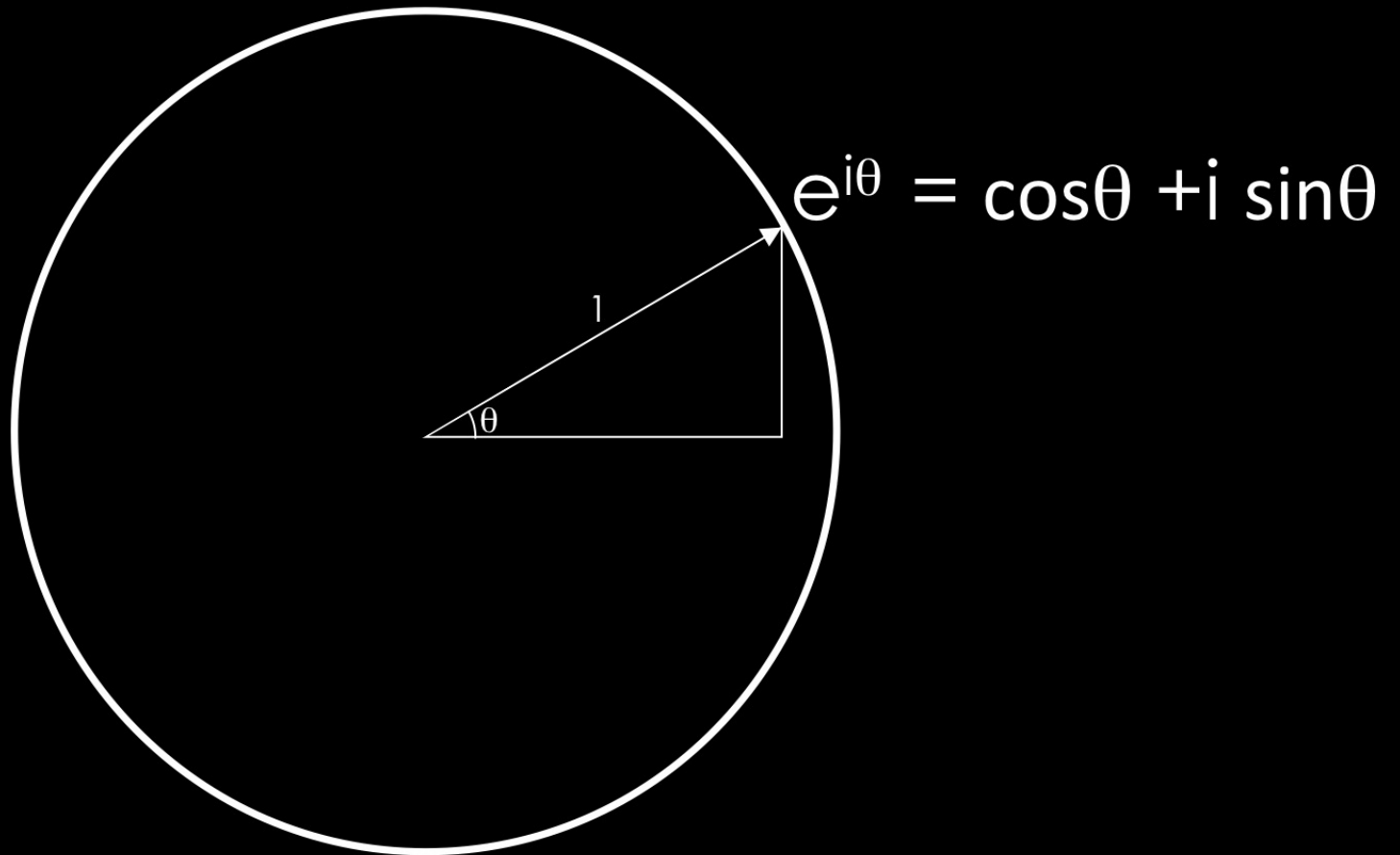


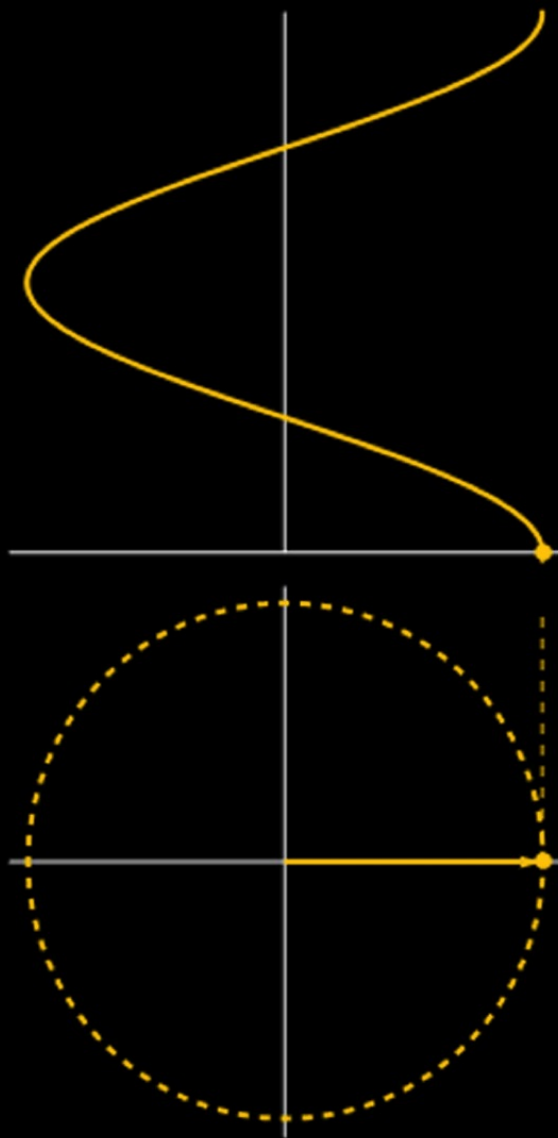
$$a^2 + b^2 = c^2$$

$$i^2 = -1$$

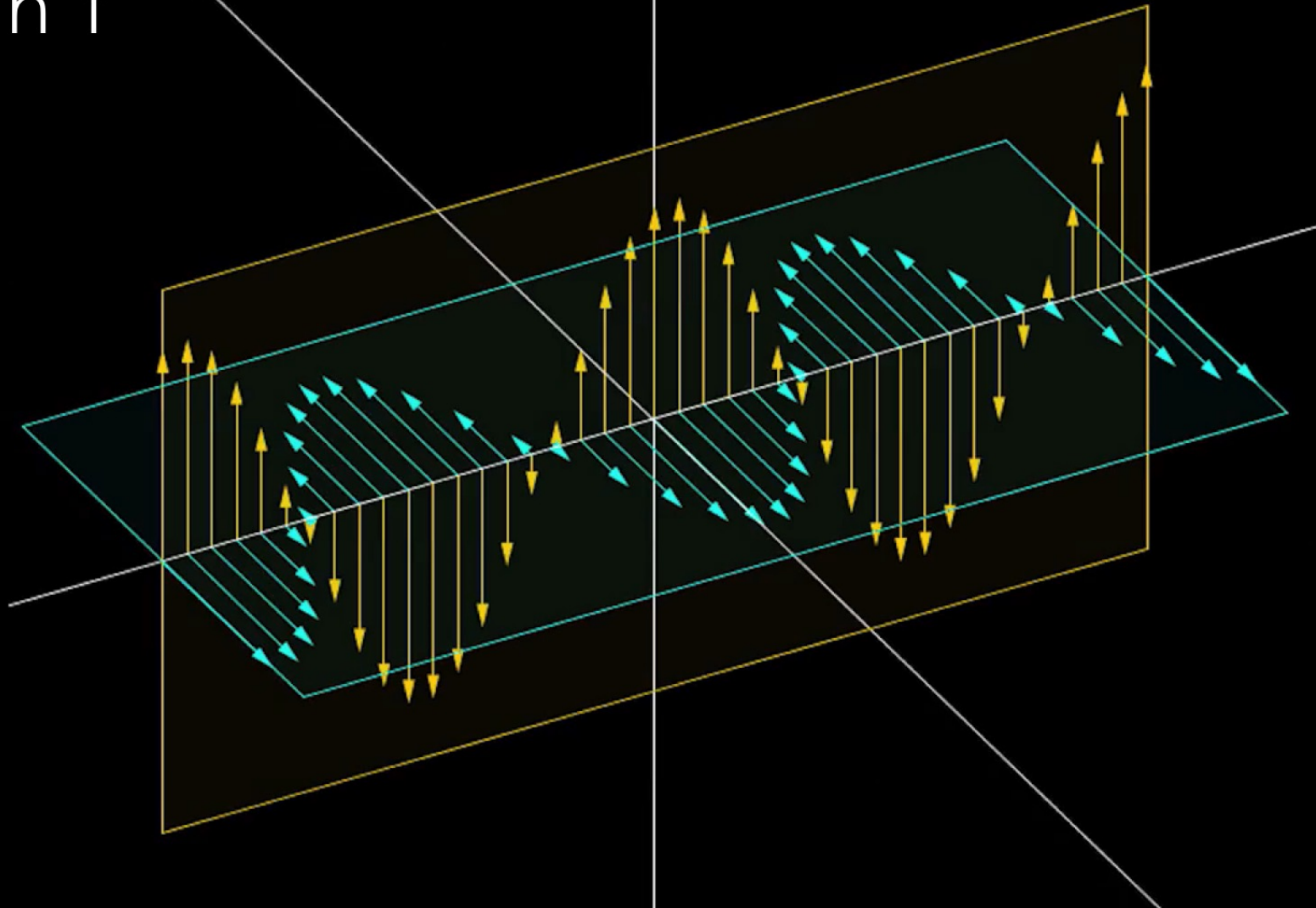








light



all is waves



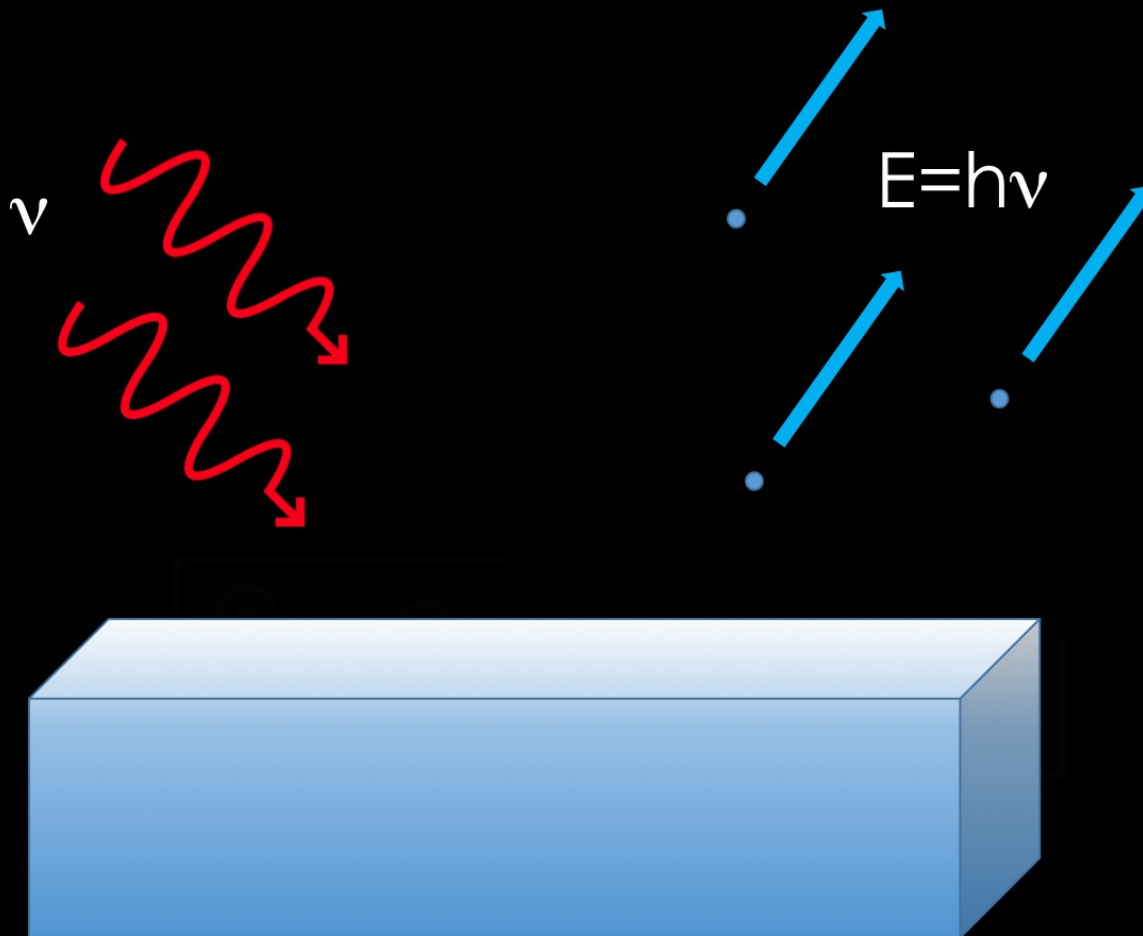
h e a t



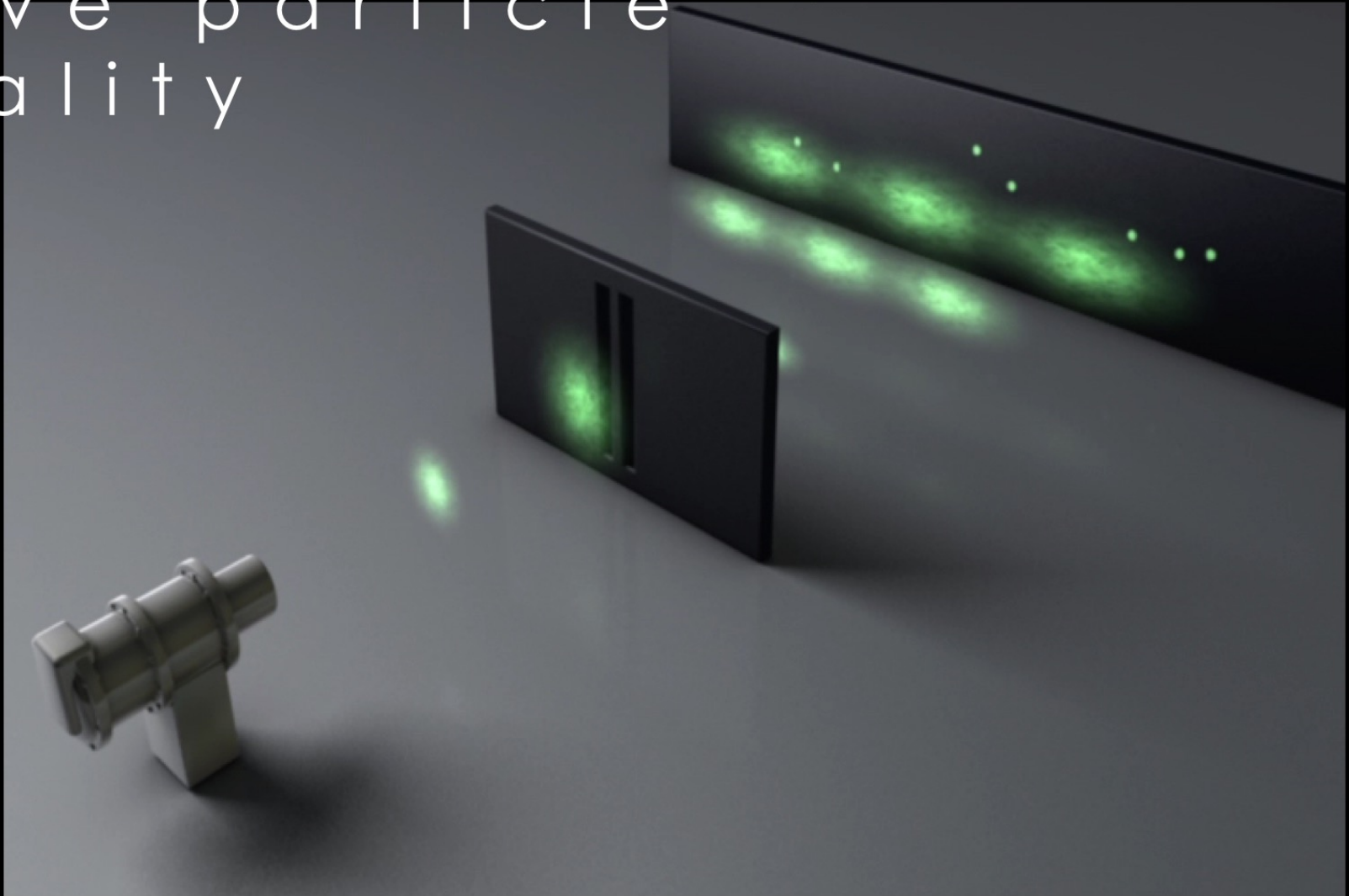
P l a n c k



q u a n t u m

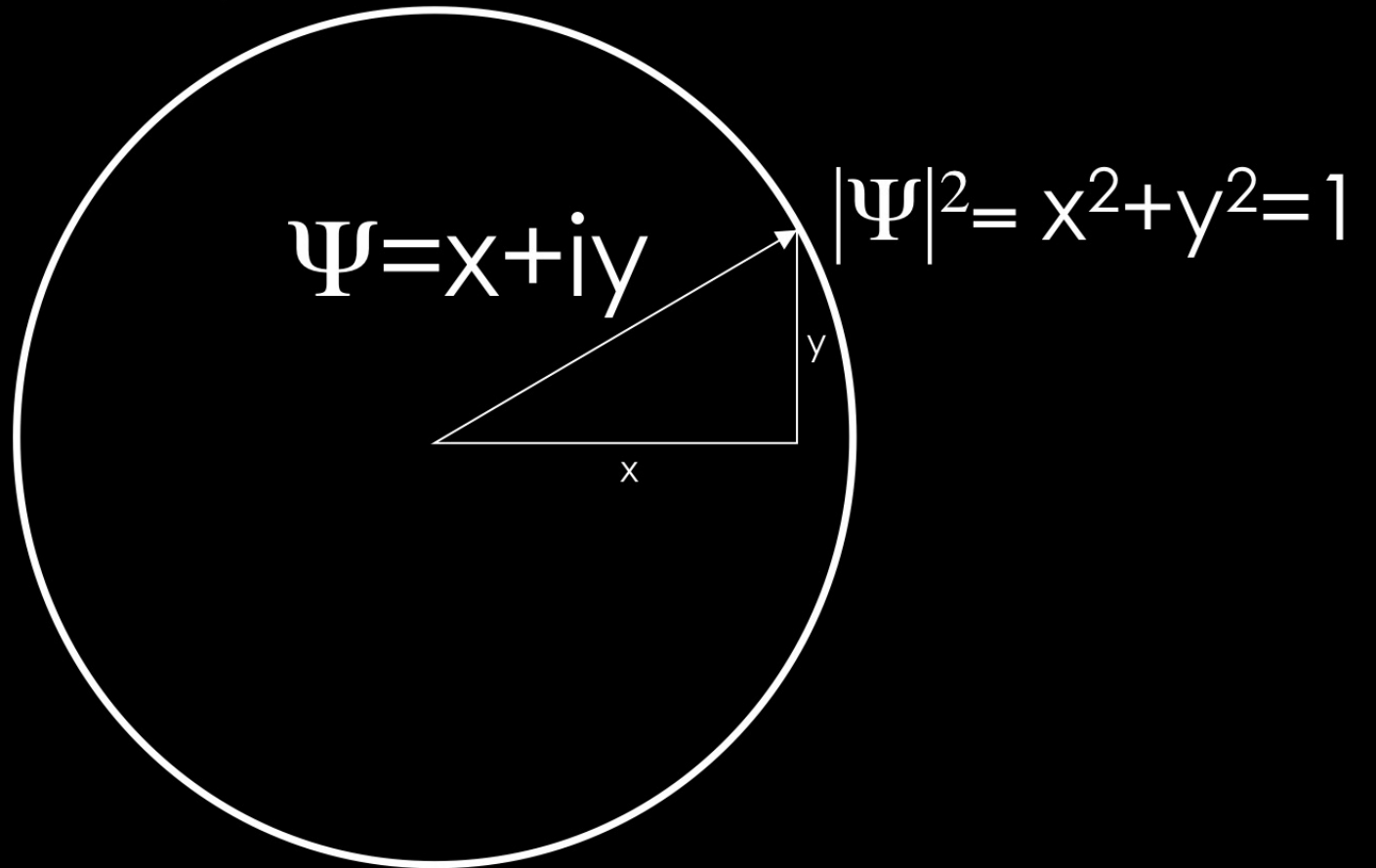


wave particle duality



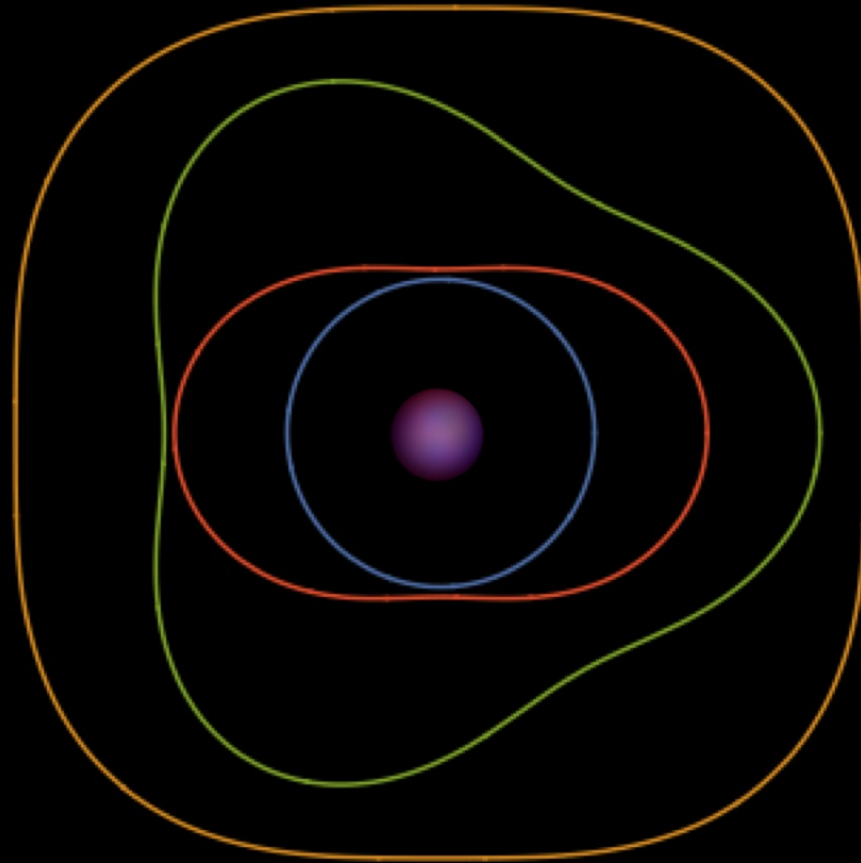
p o s s i b i l i t y w a v e s

p r o b a b i l i t y

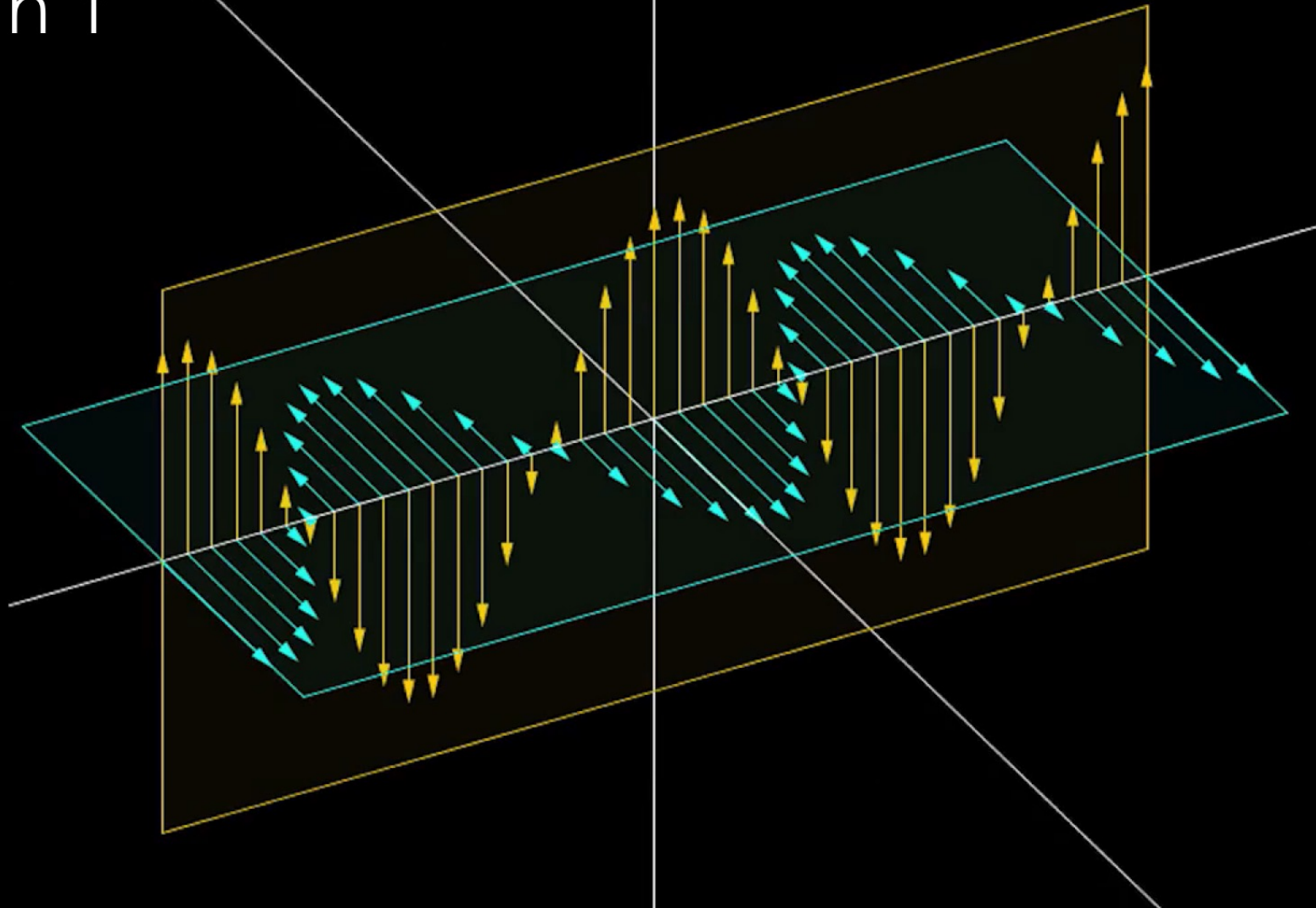




bohr atom

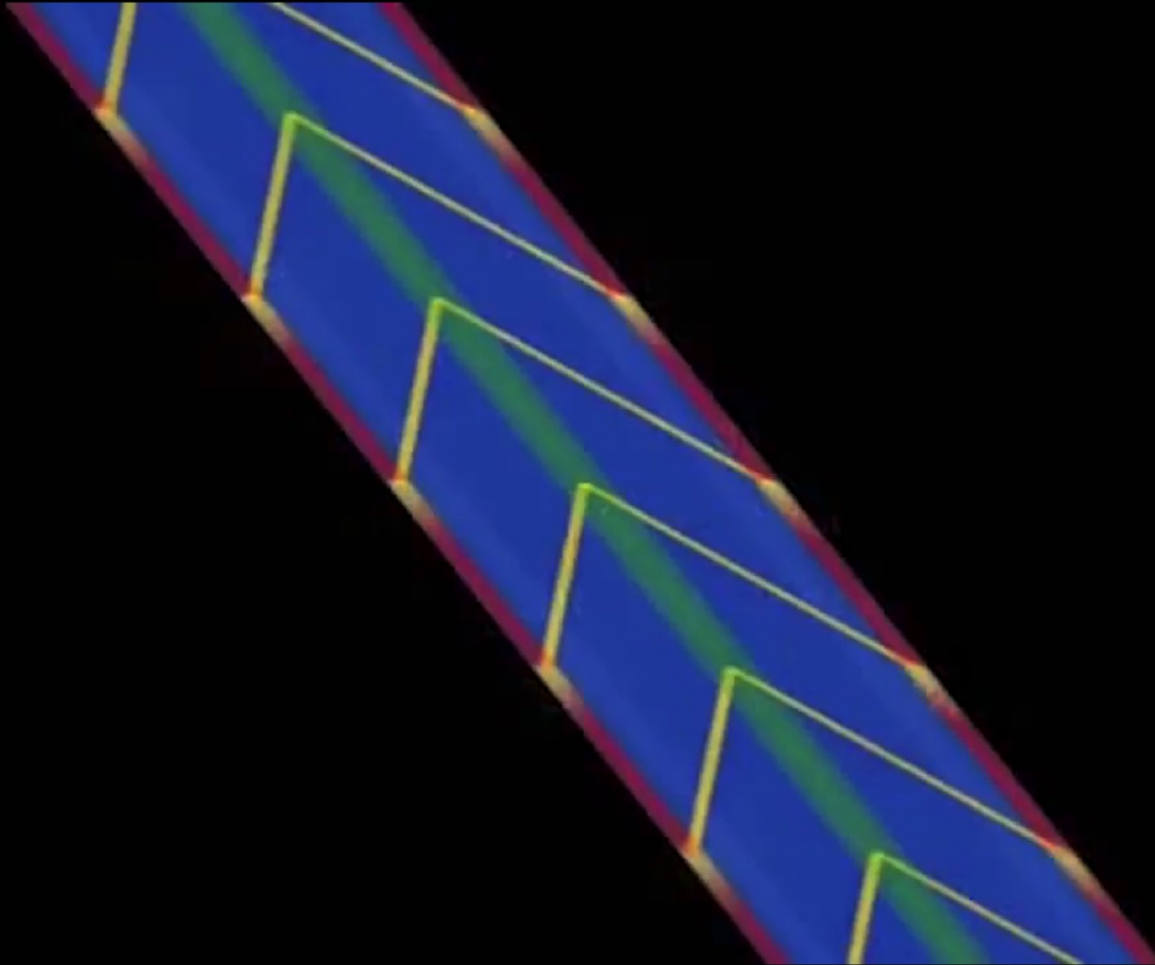


light





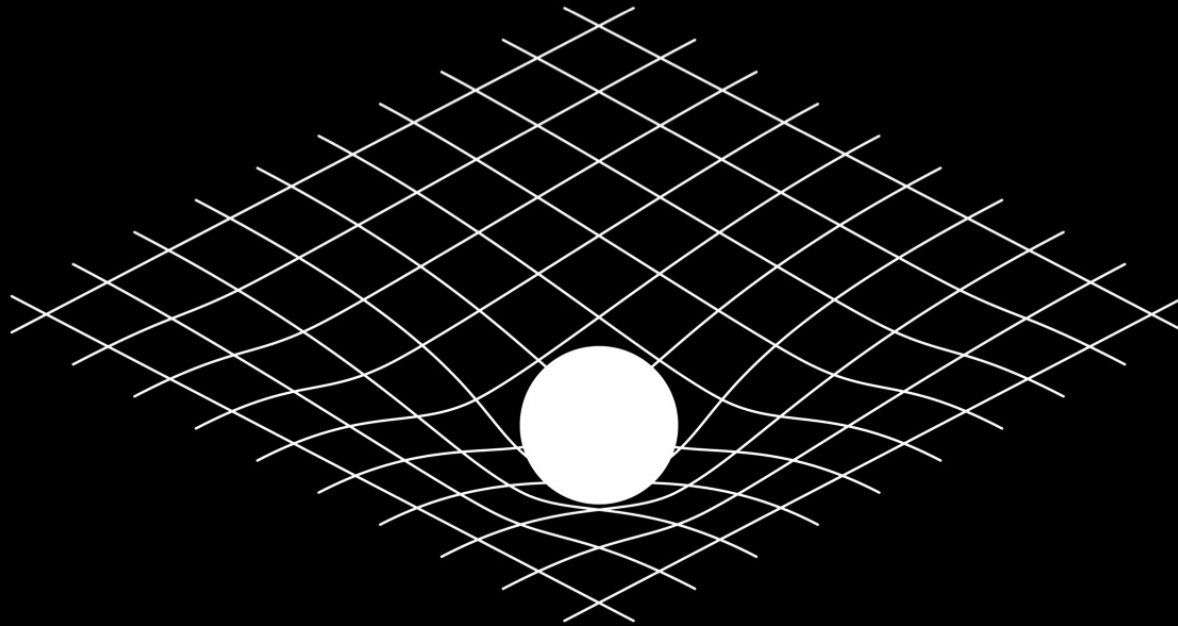
Credit: udiprod



Credit: udiprod

Credit: udiprod

gravity



expanding universe



l o o k i n g b a c k i n t i m e



???

all known physics

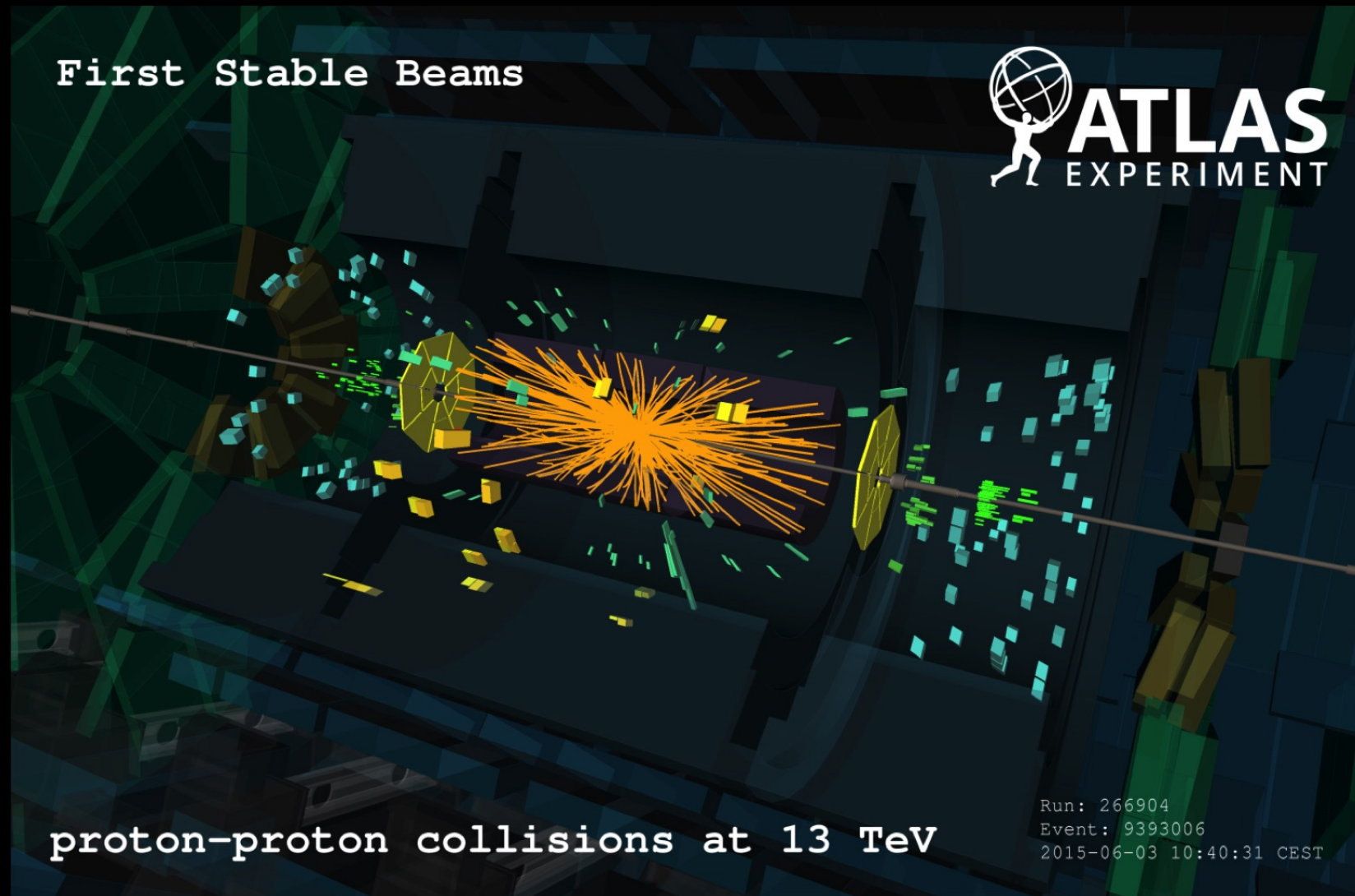
$$\Psi = \int e^{\frac{i}{\hbar} \int \left(\frac{R}{16\pi G} - \frac{1}{4} F^2 + \bar{\psi} i \not{D} \psi - \lambda H \bar{\psi} \psi + |DH|^2 - V(H) \right)}$$

The equation is annotated with names of physicists and concepts in blue text, each with a starburst effect:

- Schrödinger (above the integral symbol)
- Feynman (above the exponential symbol e)
- Planck (below the exponential symbol e)
- Euler (below the exponential symbol e)
- Einstein (above the R term)
- Newton (below the R term)
- Maxwell-Yang-Mills (above the F^2 term)
- Dirac (below the $\not{D}$ term)
- Kobayashi-Maskawa (above the $\lambda H \bar{\psi} \psi$ term)
- Yukawa (below the $\lambda H \bar{\psi} \psi$ term)
- Higgs (below the $V(H)$ term)
- Lagrange (above the $V(H)$ term)

plus neutrino masses and mixing and dark matter

First Stable Beams



proton-proton collisions at 13 TeV

Run: 266904
Event: 9393006
2015-06-03 10:40:31 CEST

dark matter

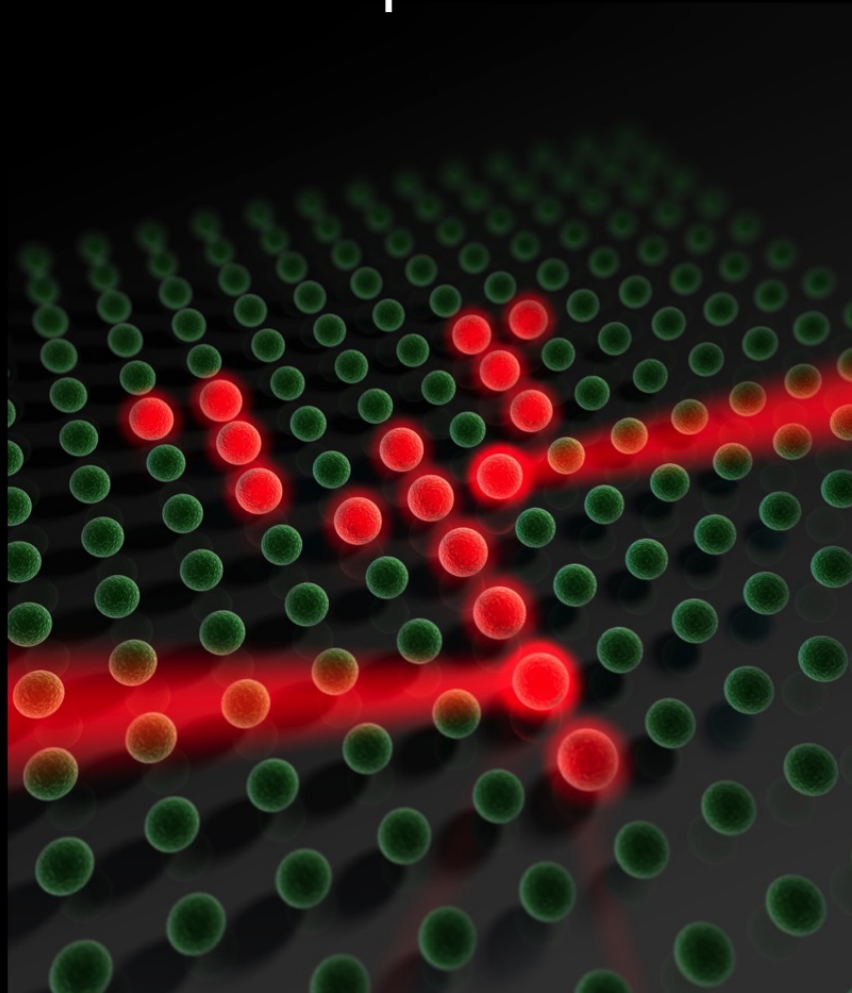
1E 0657-558
“bullet cluster”



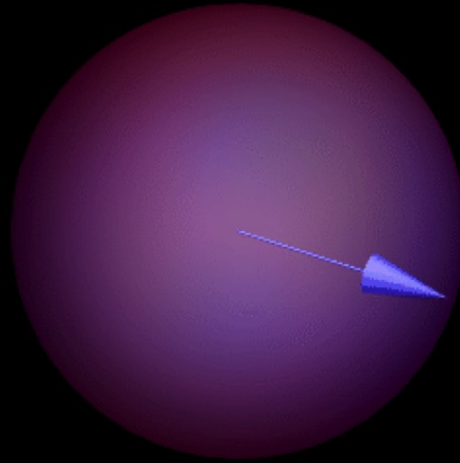
black holes and g-waves



using the quantum



manipulating qubits



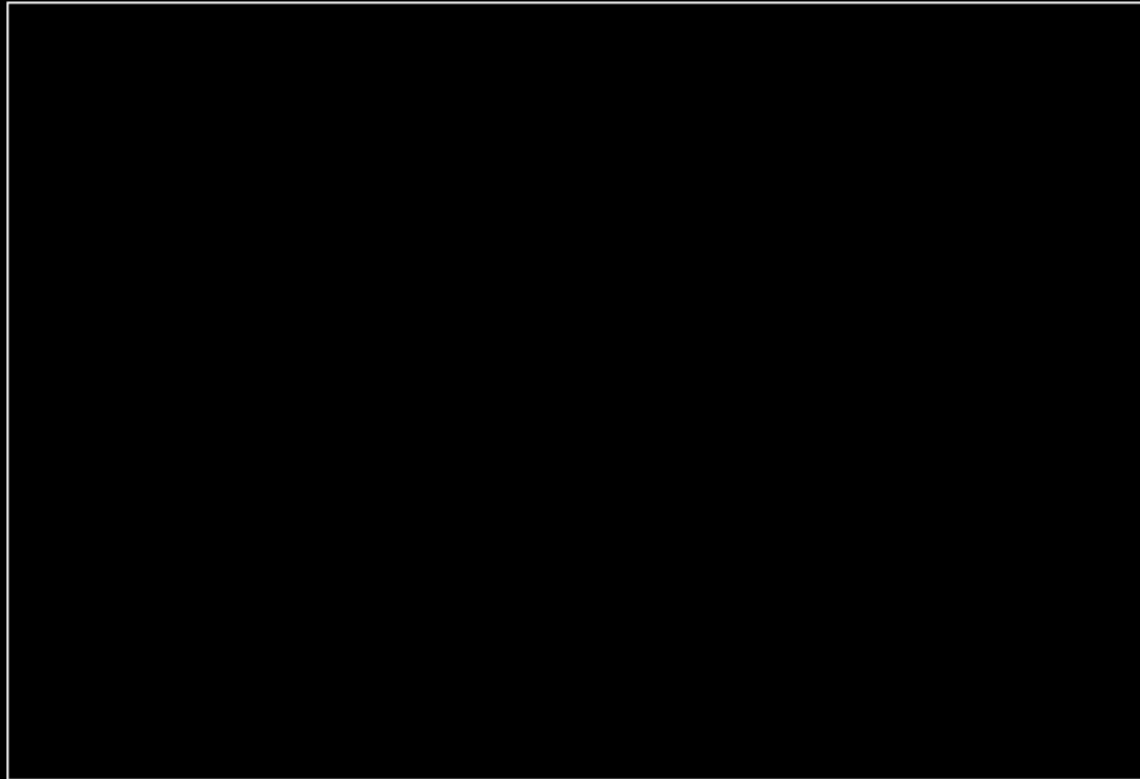
the smallest puzzle



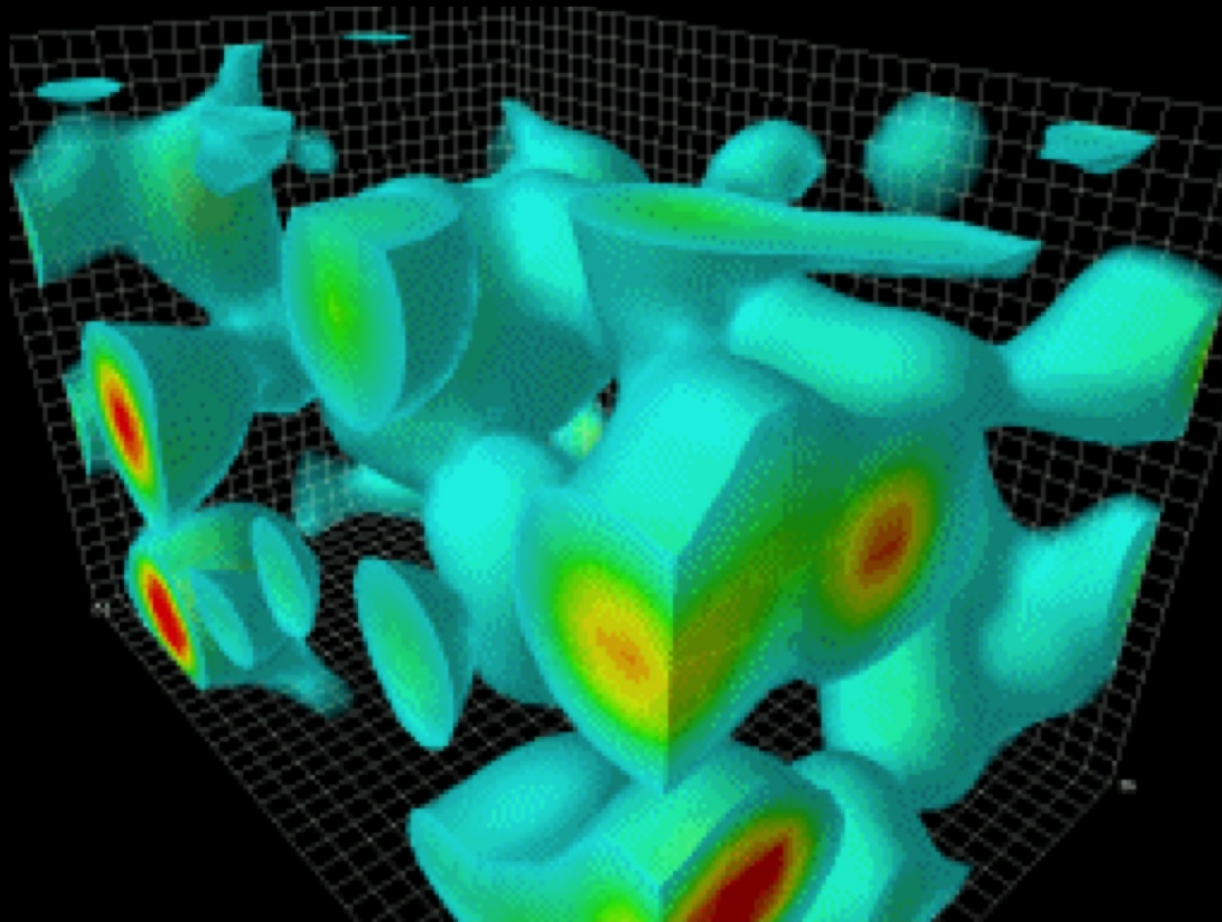
b o u n c i n g u n i v e r s e



the biggest puzzle



QCD vacuum



Credit: D Leinweber

measured vacuum energy

0.000

000

[illegible]

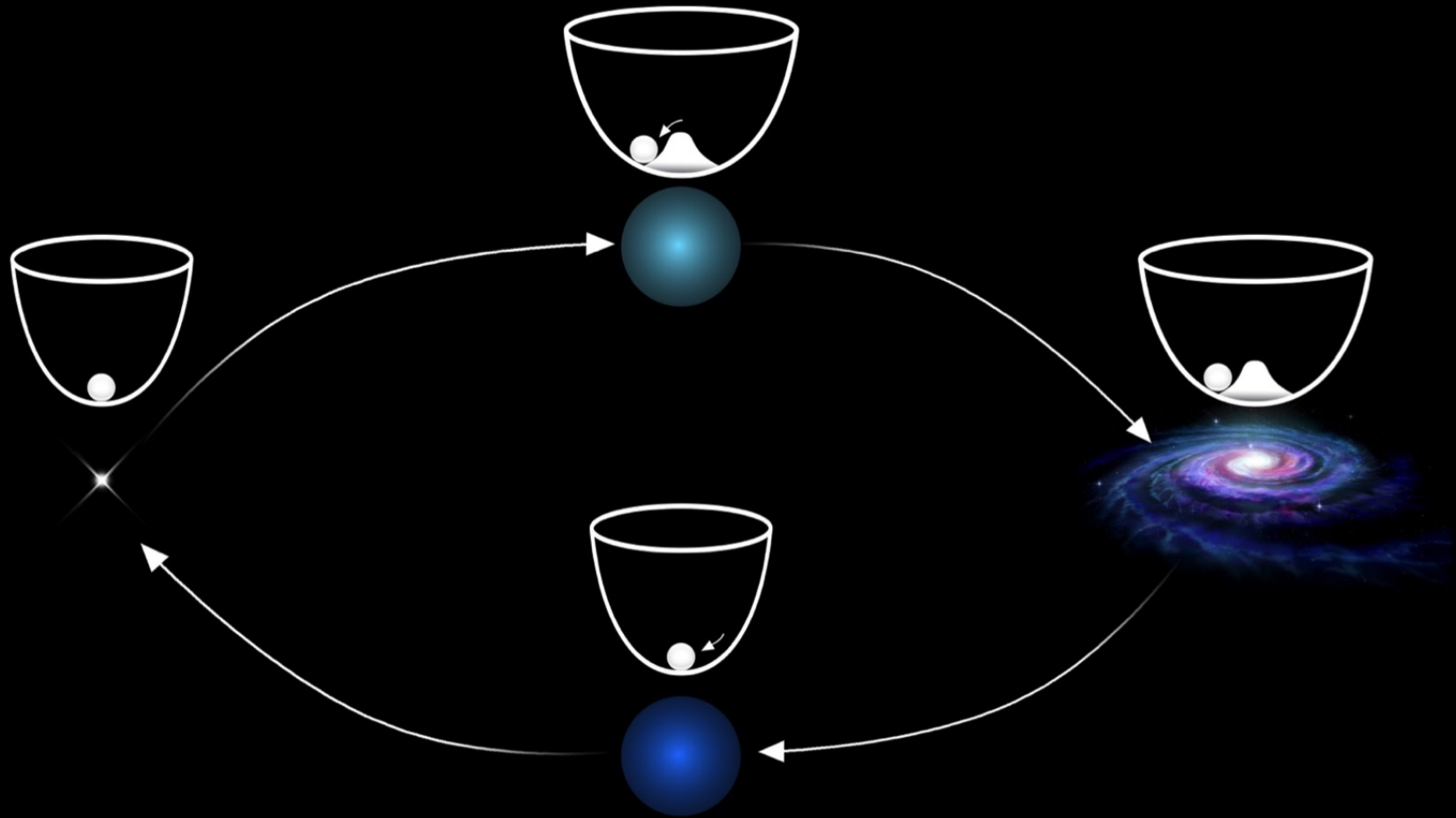
in natural units

how did this fine
adjustment happen?

a multiverse?



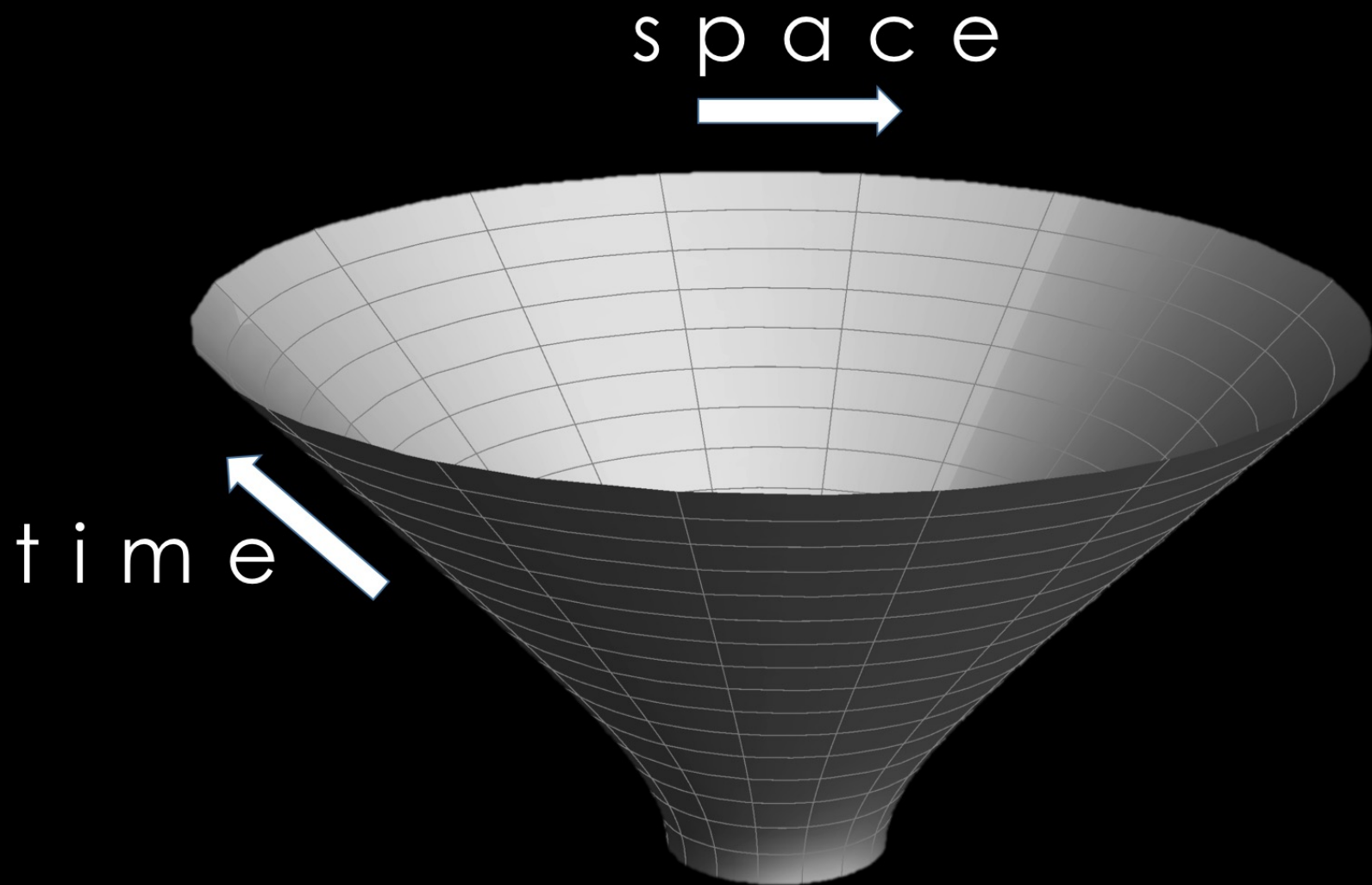
or cyclic universe?



w e s h a l l s e e



thank you



m a g n e t i c f i e l d o f o u r g a l a x y

