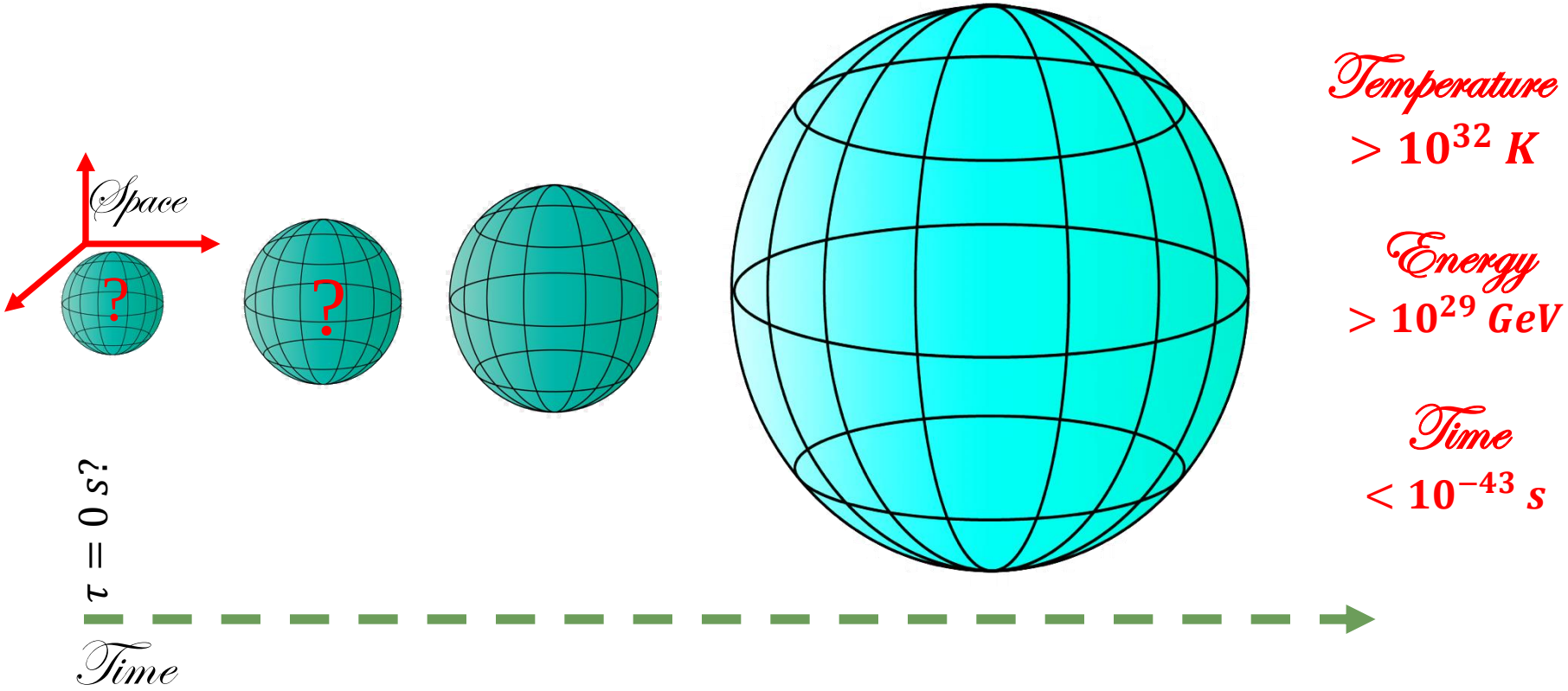
TIGER

TSU Initiative for Gravity and Experimental-nuclear Research

At time zero?

Planck Epoch



Temperature

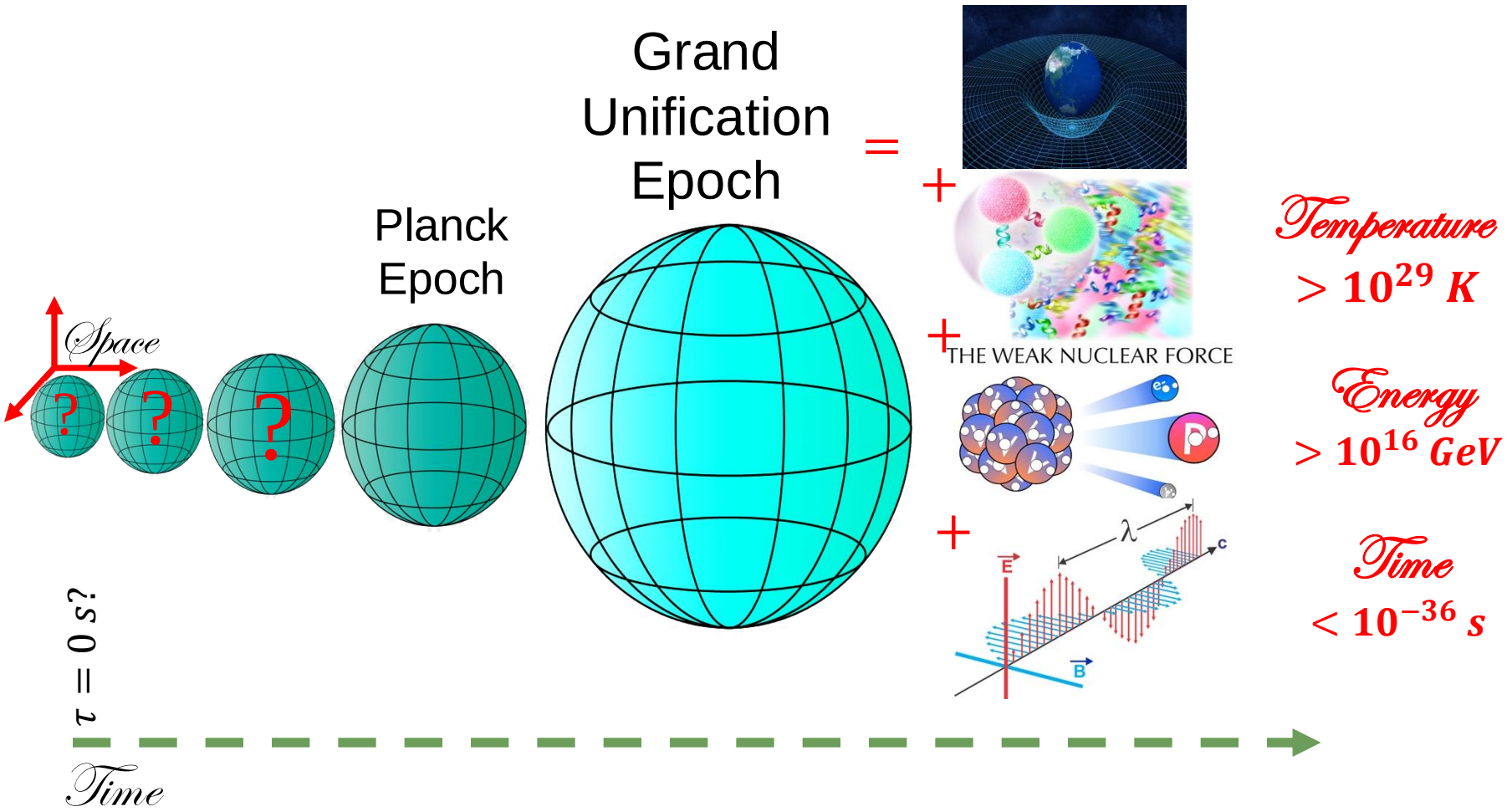
$> 10^{32}\ K$

Energy

$> 10^{29}\ GeV$

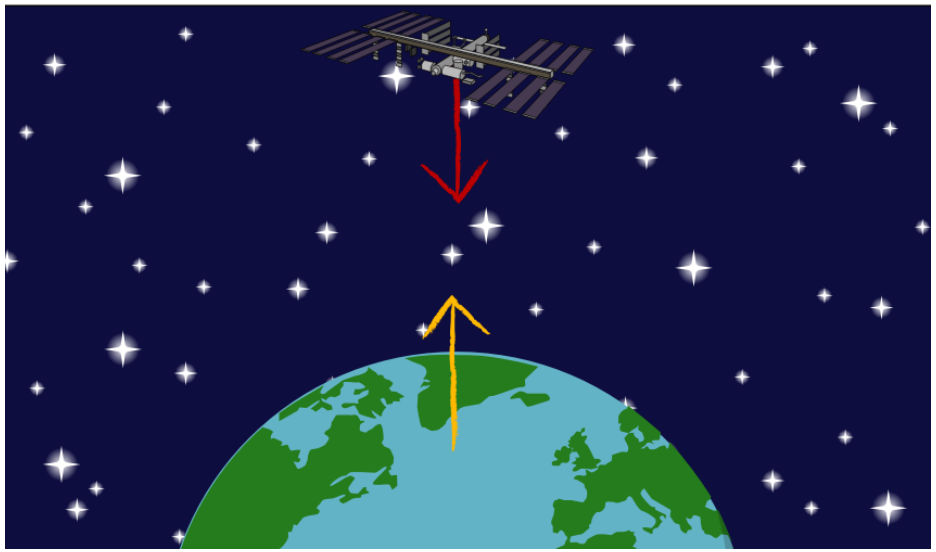
Time

$< 10^{-43}\ s$

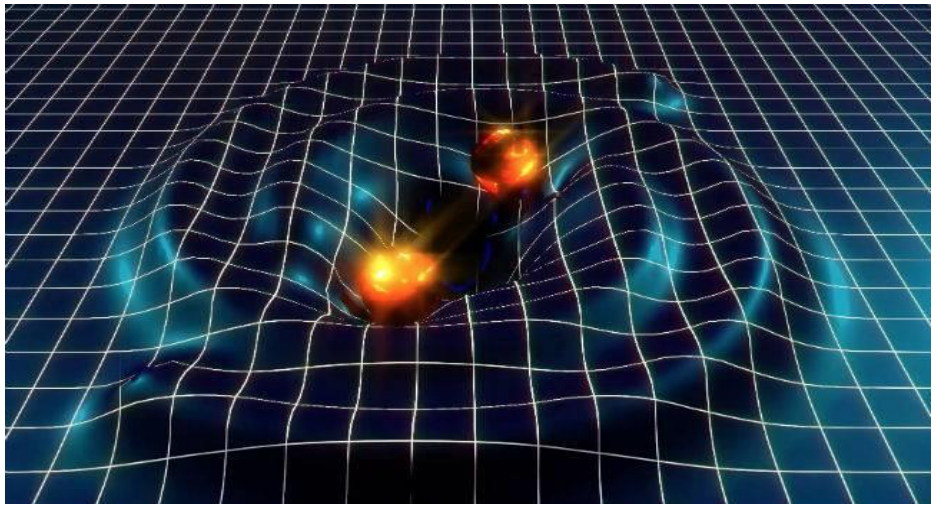

Grand Unification Epoch
Planck Epoch
Space
?
?
?
=
+
+
THE WEAK NUCLEAR FORCE
+
λ
E
B
c
Temperature
$> 10^{29}\ K$
Energy
$> 10^{16}\ GeV$
Time
$< 10^{-36}\ s$
$\tau = 0\ s?$
Time

Gravity

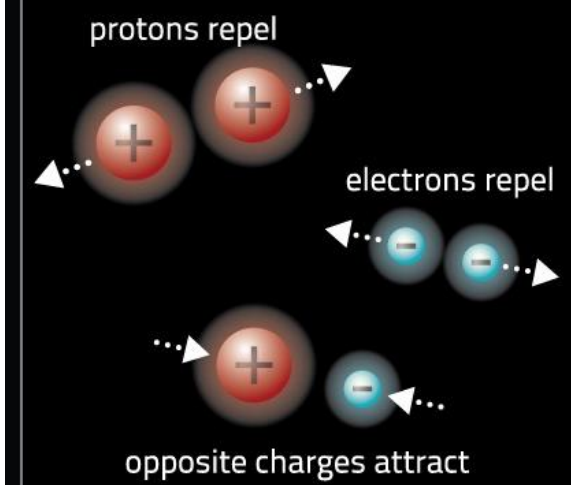
$$F = G\frac{M\ m}{r^2}$$



$$G + \Lambda\, g = 8\,\pi\frac{G}{c^4}\,T$$

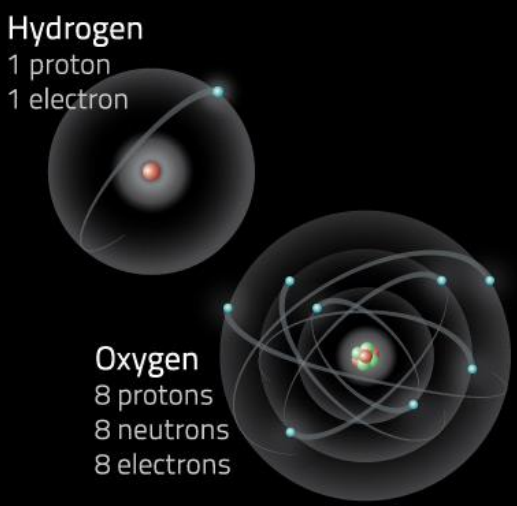


The Electromagnetic Force in Forming Matter



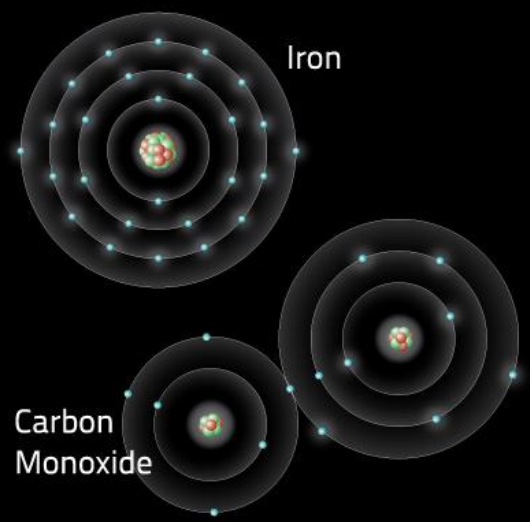
Coulomb's Law

Like charges repel, unlike charges attract. Protons repel each other, and the same is true for electrons, but the electromagnetic force attracts electrons to protons.



Electron Capture

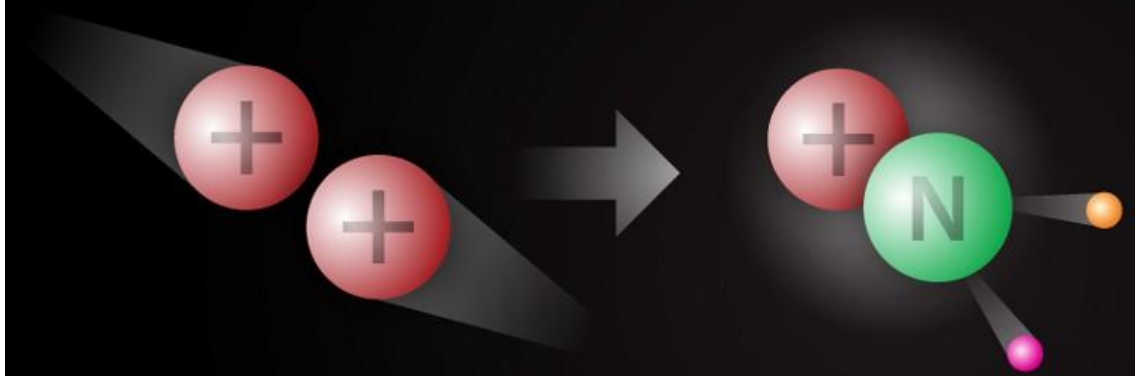
The electromagnetic force pulls electrons into orbit around positively charged atomic nuclei. The larger the nuclei, the more electrons are pulled in.

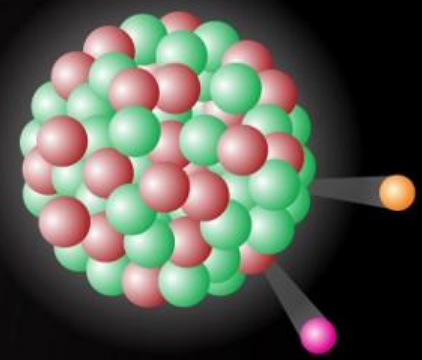


Atoms & Molecules

The electromagnetic force holds atoms and molecules together. Electrons occupy energy levels around atomic nuclei balancing out positive and negative charges.

Weak Nuclear Force





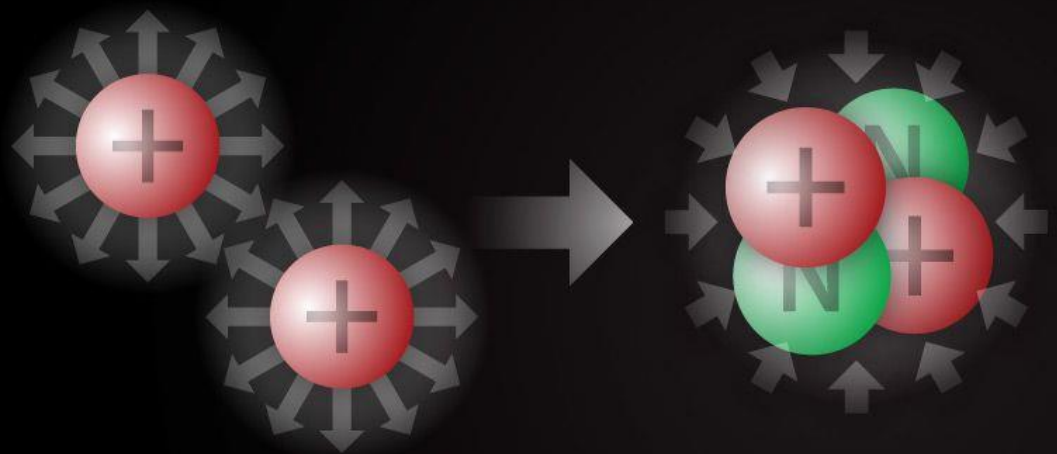
Converting protons into neutrons

When two protons collide and fuse, a disruption in the weak nuclear force emits a positron and neutrino, which converts one of the positively charged proton to a neutrally charged Nuetron. Without the weak nuclear force converting protons into nuetrons, certain complex nuclei cannot form.

Releasing radiation

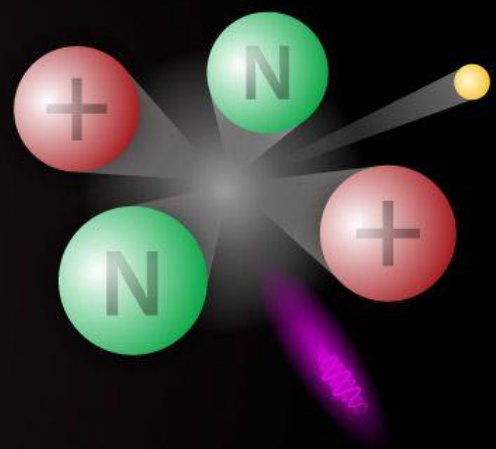
Heavy atoms have an imbalance of protons and nuetrons, so the weak nuclear force converts protons to nuetrons releasing radiation.

Strong Nuclear Force



Binding protons in atomic nuclei

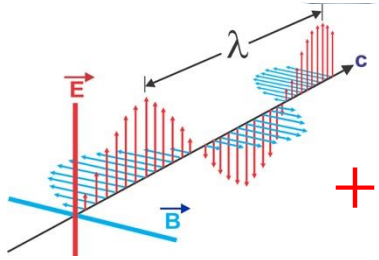
Positively charged particles naturally repel each other, it takes an extreme amount of force to hold protons together. The strong nuclear force overcomes the repulsion between protons to hold together atomic nuclei. Without the strong nuclear force, complex nuclei cannot form.



Breaking the bond

Enormous energy is released as gamma rays and nuetrinos when the strong nuclear force is broken between protons and neutrons.

The Standard Model



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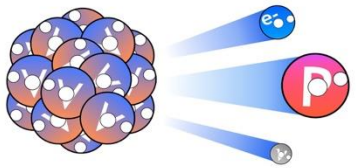

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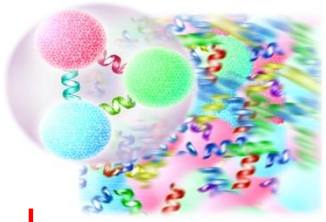
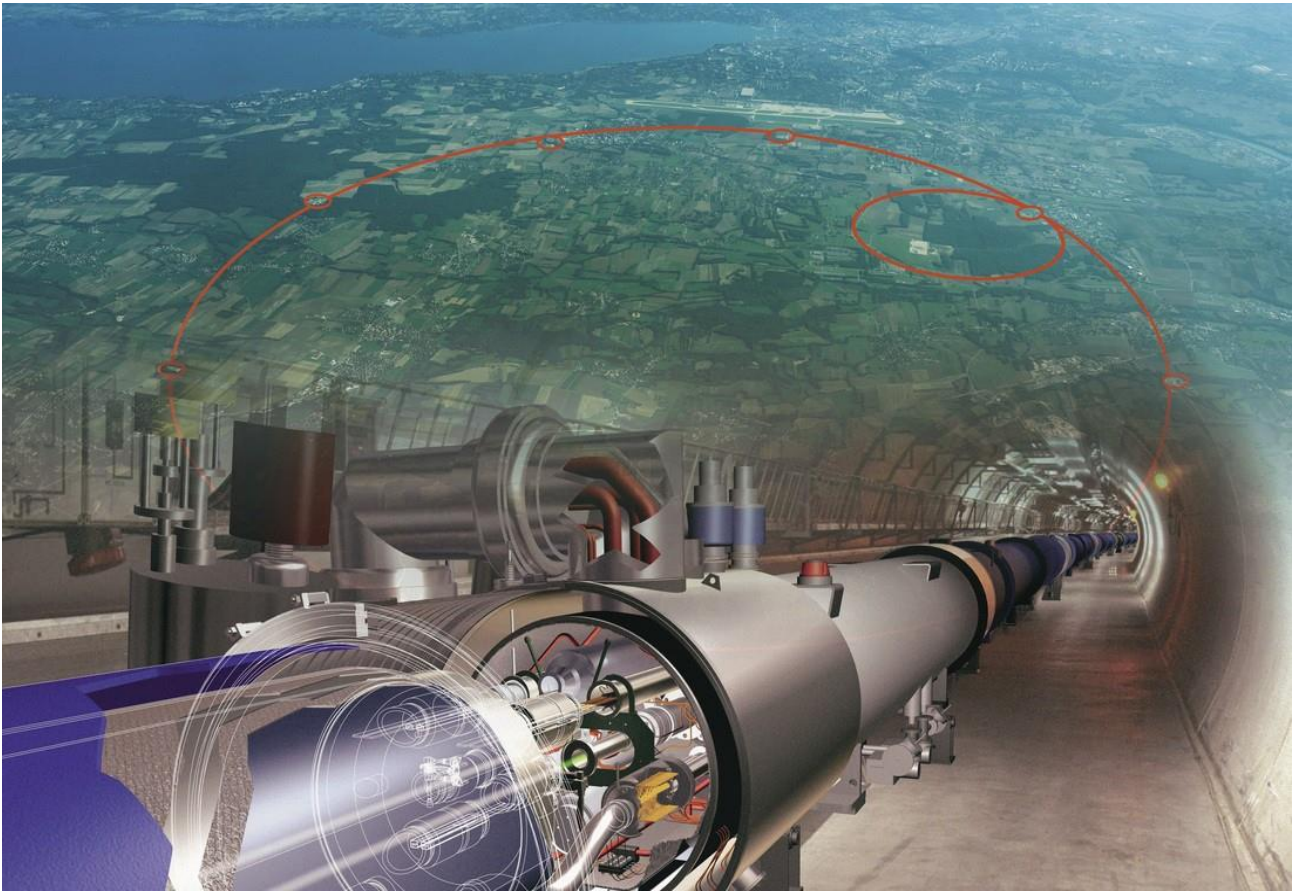
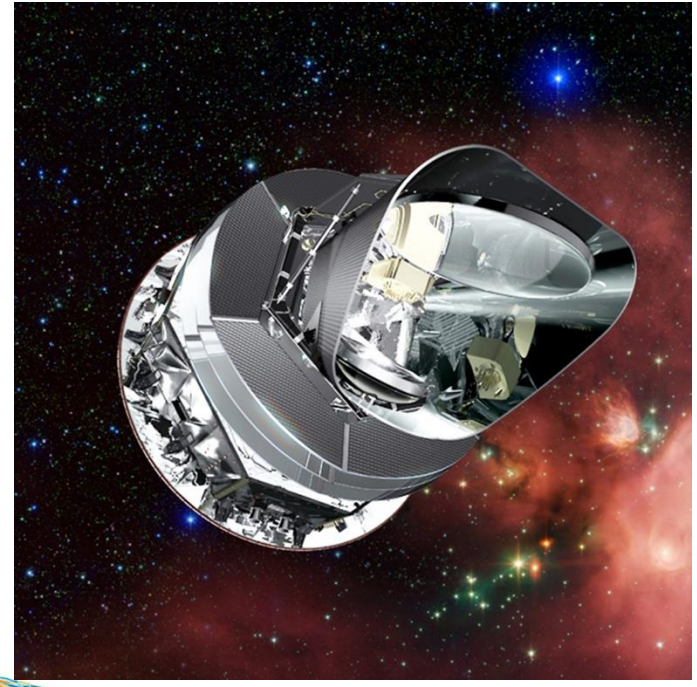
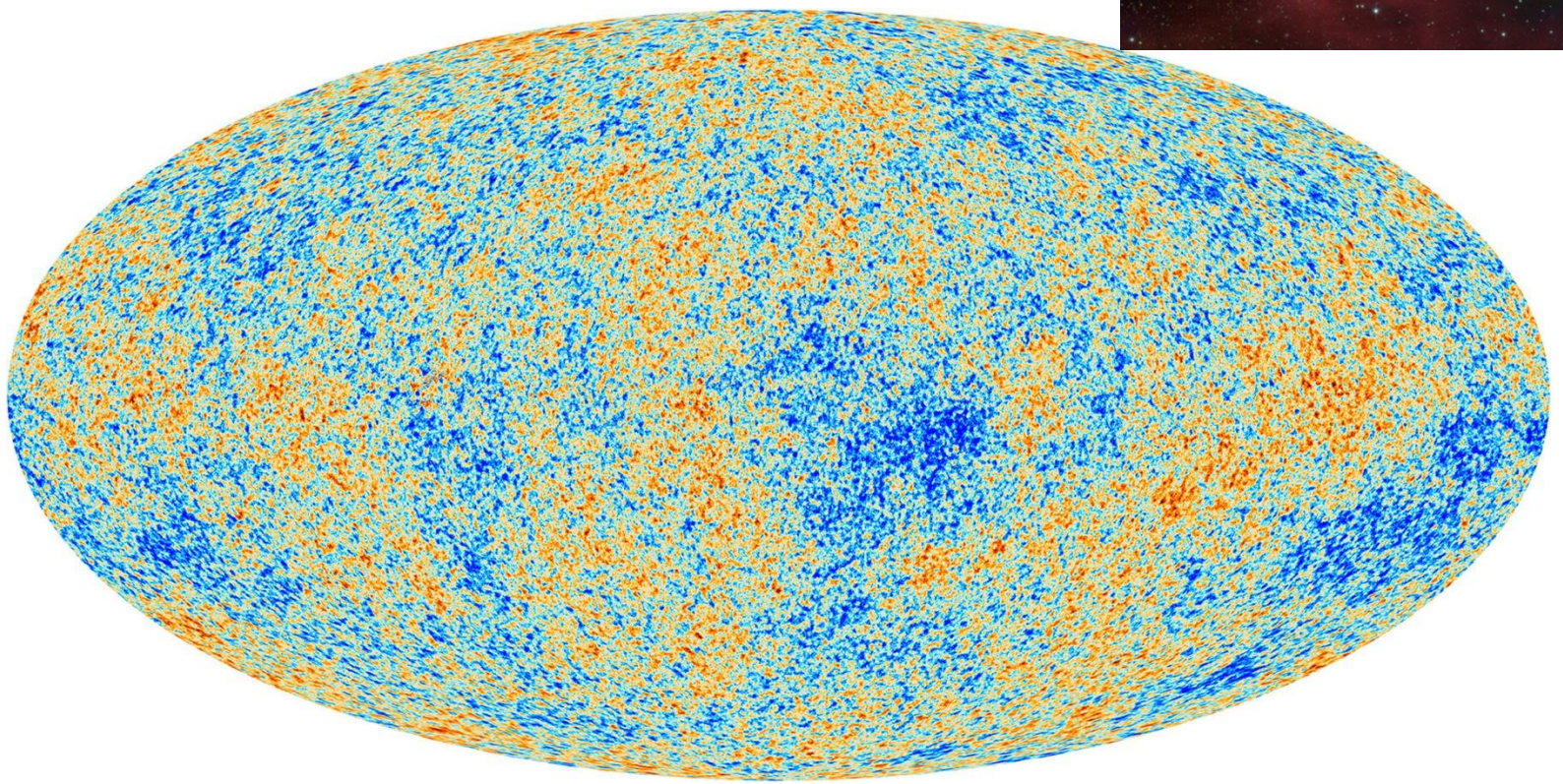


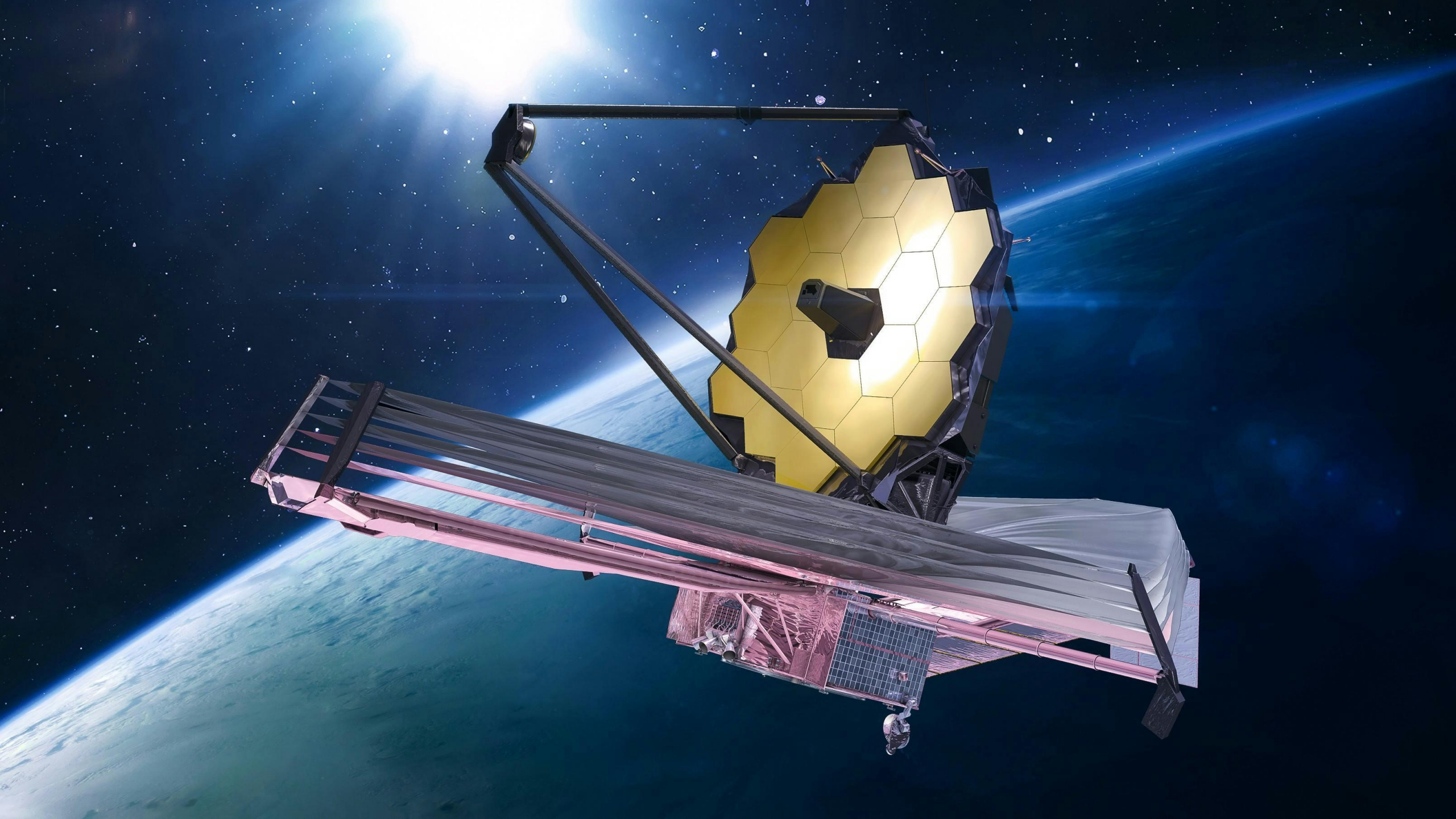
The World Colliders



400,000 years after the Big Bang.







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The Inaugural Workshop of
Exploring the Frontiers of Nuclear, Particle, and Astrophysics

April 9 – 11, 2025