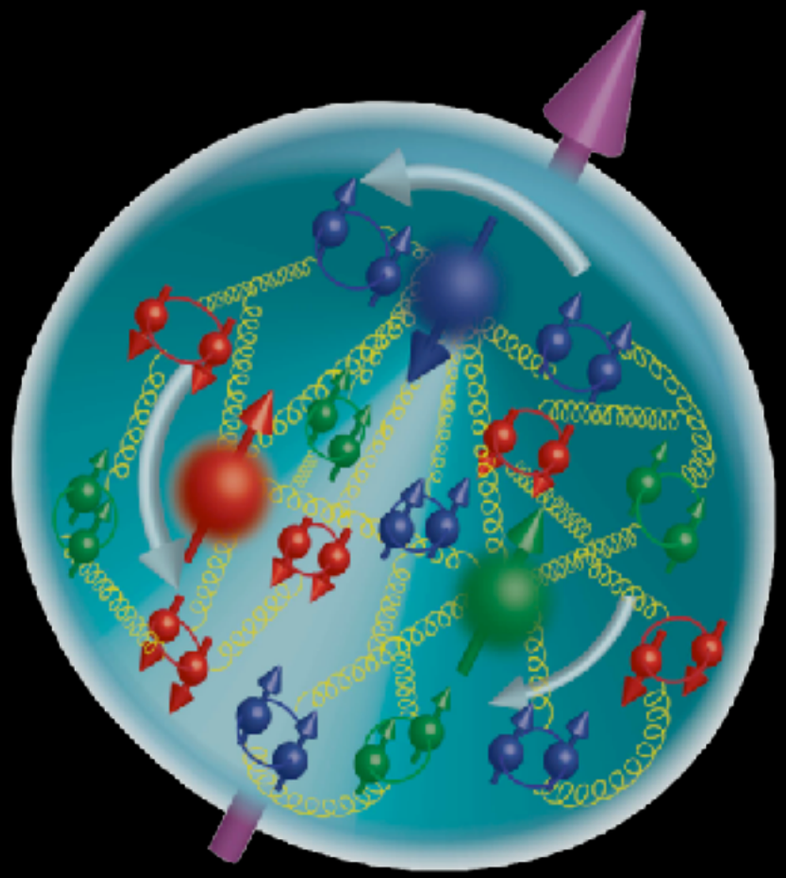
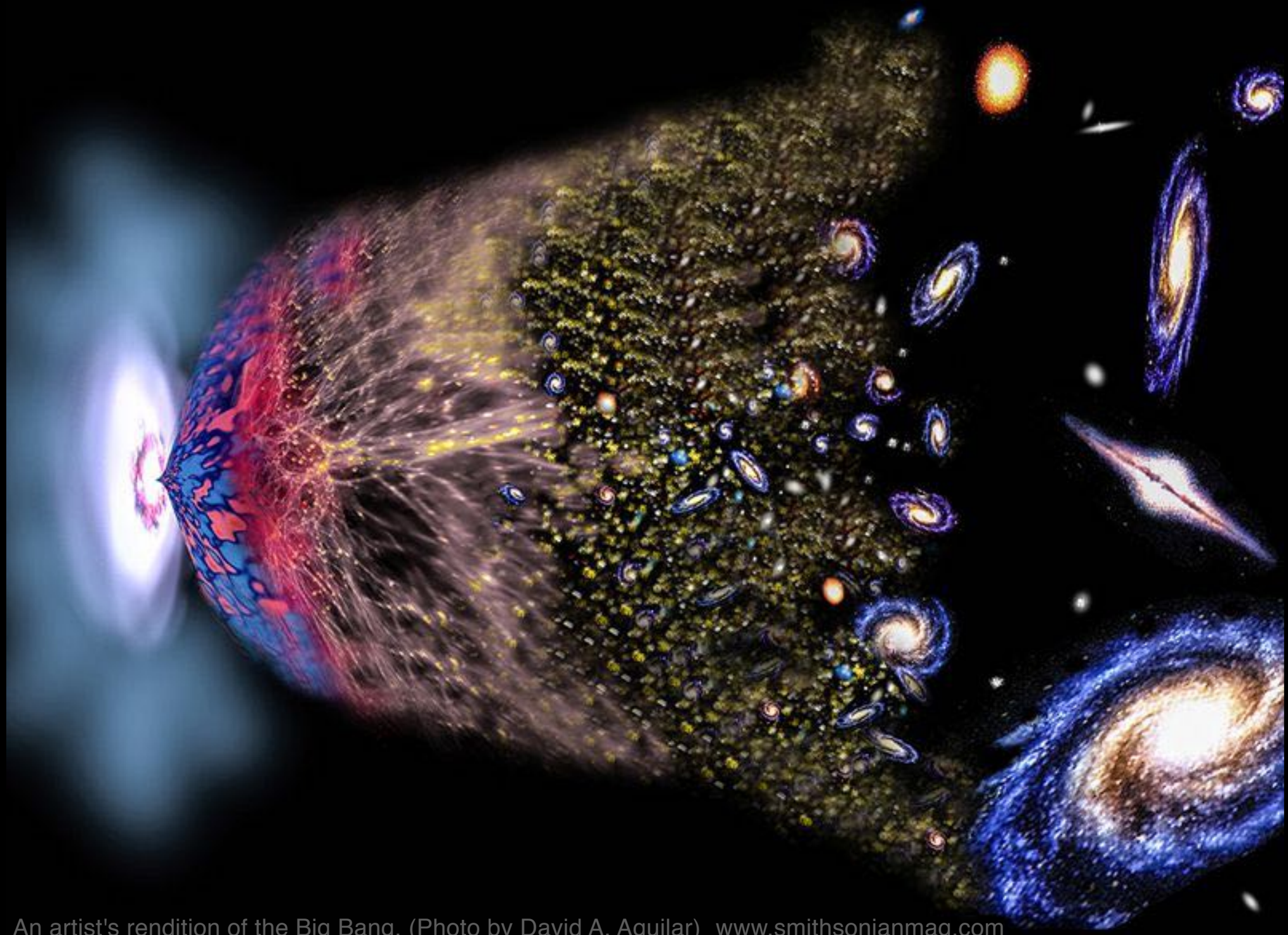


In collaboration with: M. Boglione (U.Turin, Italy), M. Diefenthaler (JLab), W. Melnitchouk (JLab), D. Pitonyak (LVC), T. Rogers (JLab&ODU), N. Sato(JLab)

THE ORIGIN OF PARTICLES PRODUCED IN HIGH-ENERGY COLLISIONS

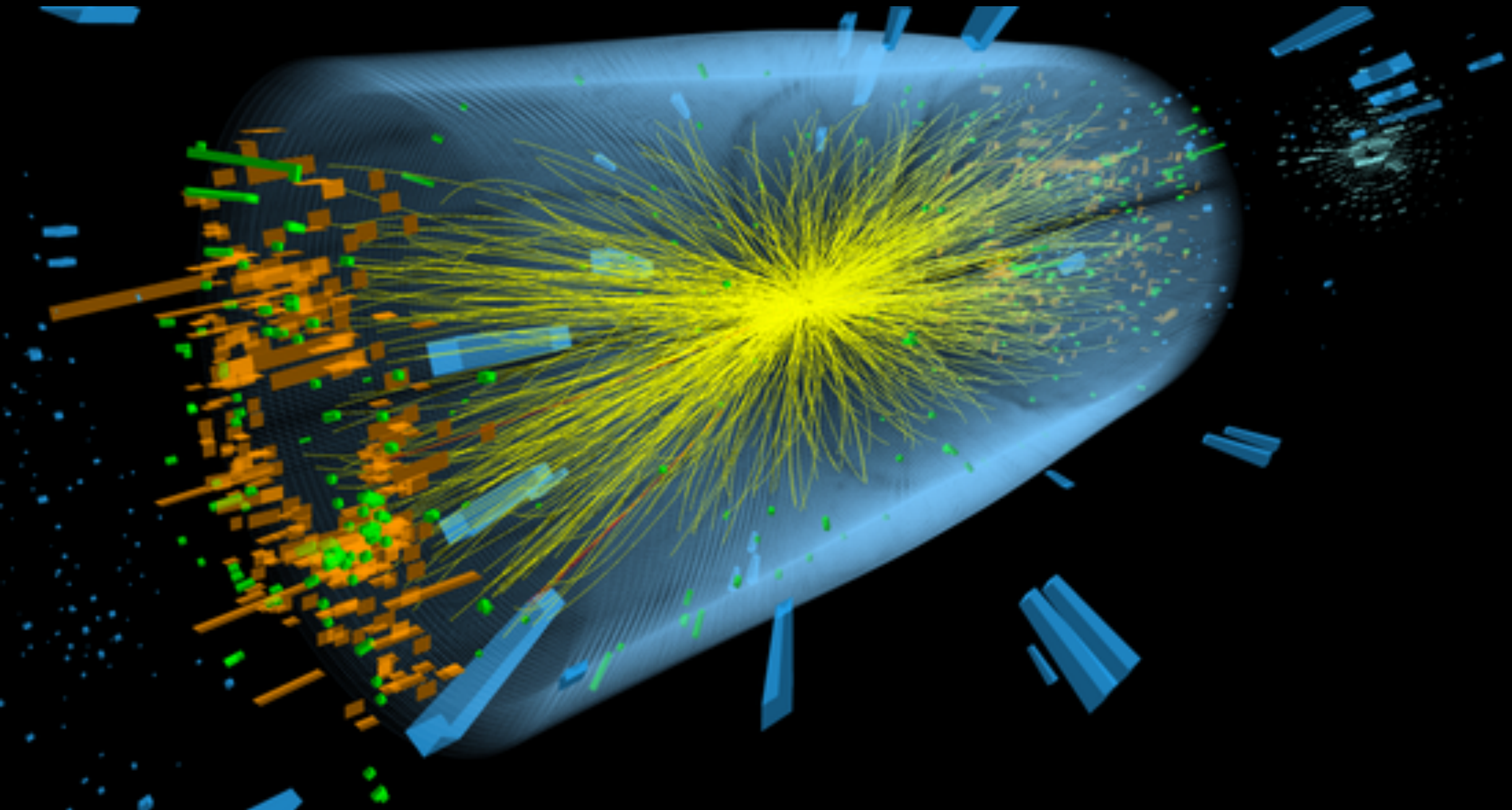
Scott Dolan (PSU Berks)
Alexei Prokudin (PSU Berks)
Leonard Gamberg (PSU Berks)

The Big Bang event that gave rise to the universe some 13.8 billion years ago, created the universe with its own space and time. Big Bang's energy was converted to particles and gave rise to the structure of the universe as we observe it now.



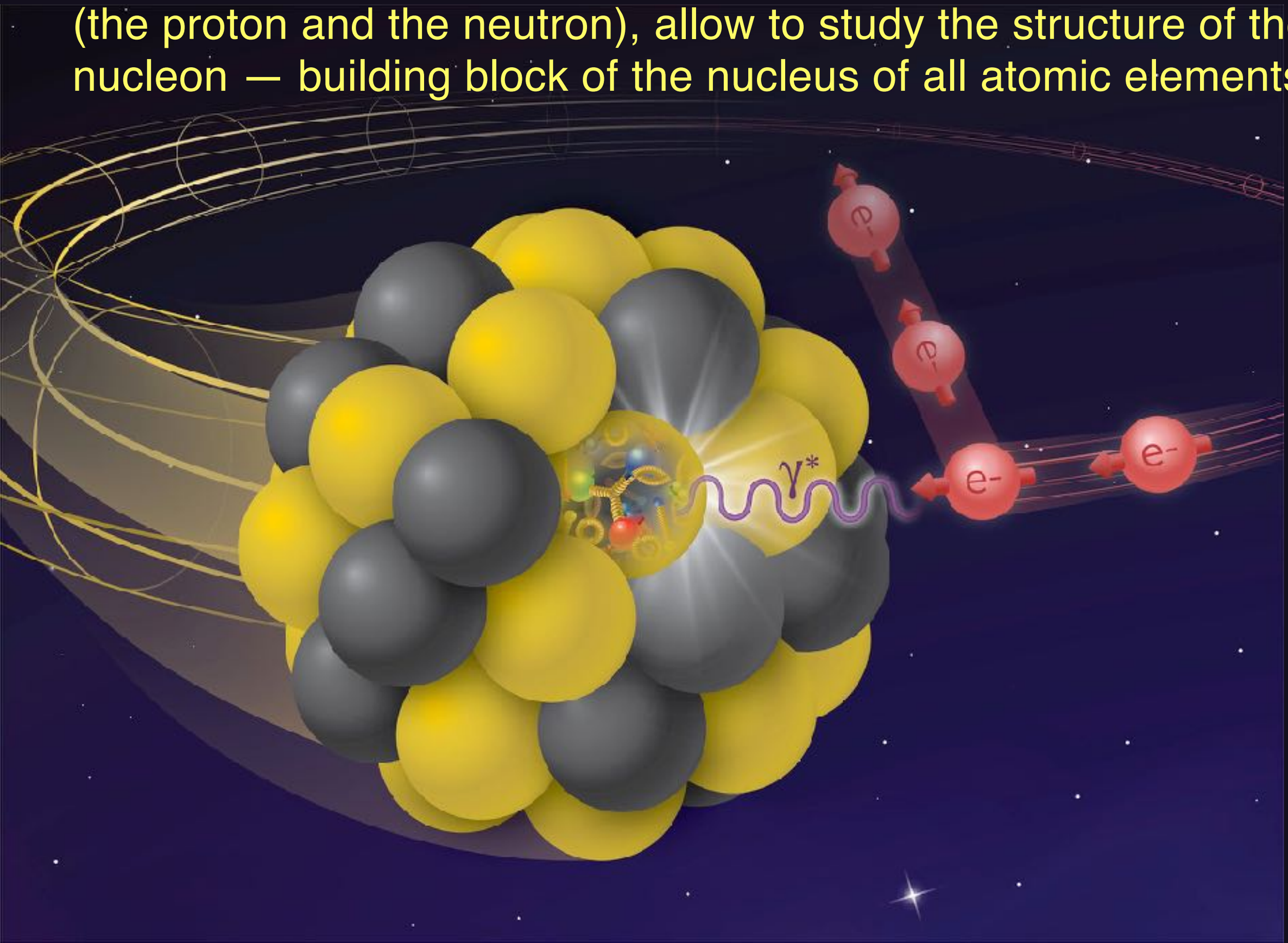
An artist's rendition of the Big Bang. (Photo by David A. Aguilar) www.smithsonianmag.com

Likewise in high energy particle collisions, achieved at modern accelerators, energy is converted into the creation of new particles and the structure of the colliding particles can be studied by observations of the products of the reaction.

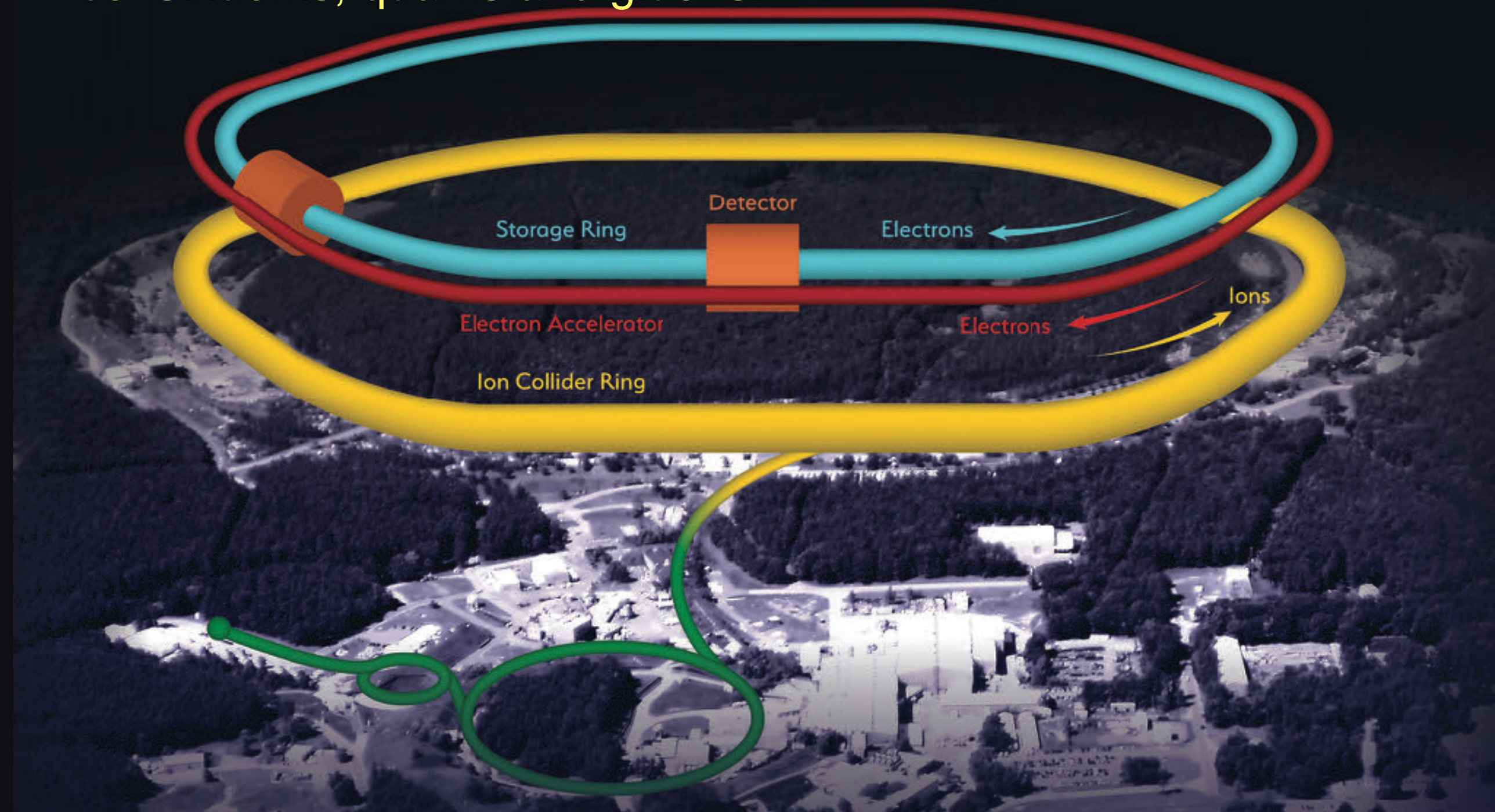


A visualization of complex sprays of subatomic particles, produced from colliding proton beams in CERN's CMS detector at the Large Hadron Collider near Geneva, Switzerland in mid-April of 2018. Credit: CERN

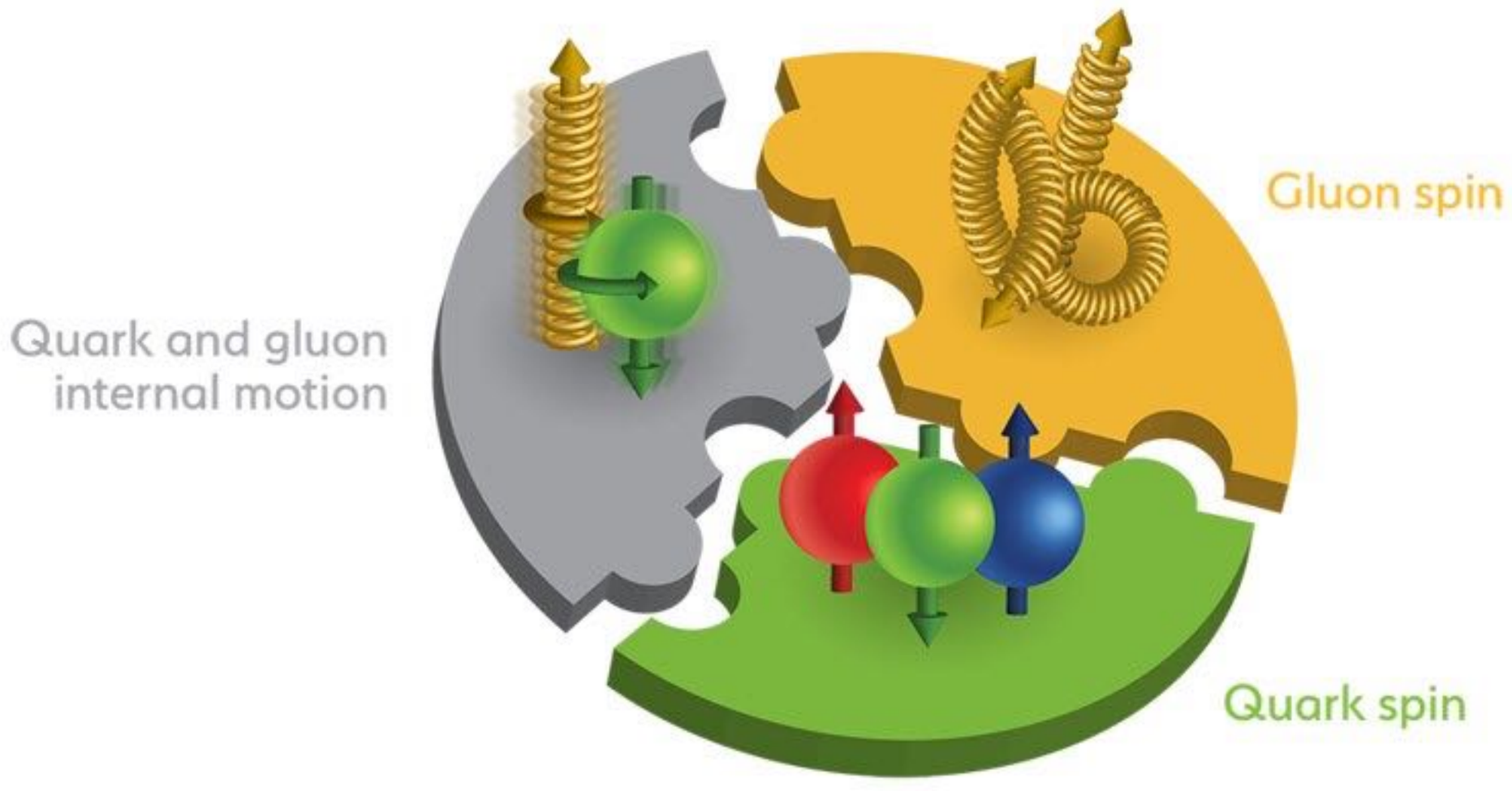
Such collisions, in particular between electrons and the nucleon (the proton and the neutron), allow to study the structure of the nucleon — building block of the nucleus of all atomic elements.



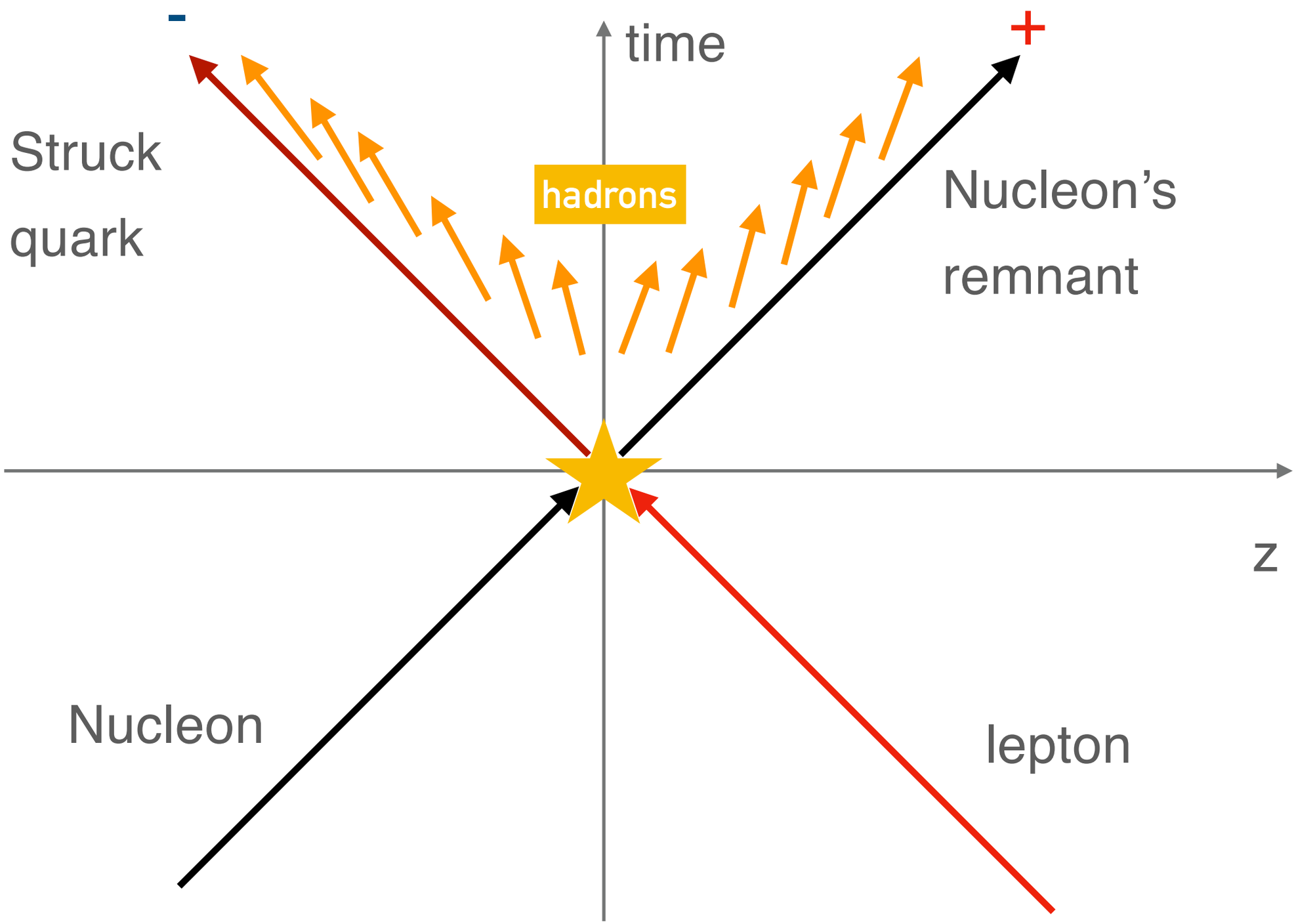
Scientific program of the future Electron-Ion Collider to be built at Brookhaven National Laboratory in 2030's is to unravel the three-dimensional structure of the nucleon and to explain its mass and spin decompositions in terms of its elementary constituents, quarks and gluons.



Quarks and gluons are degrees of freedom of Quantum Chromo-Dynamics (QCD) — the quantum field theory of the strong force that holds together protons and neutrons.



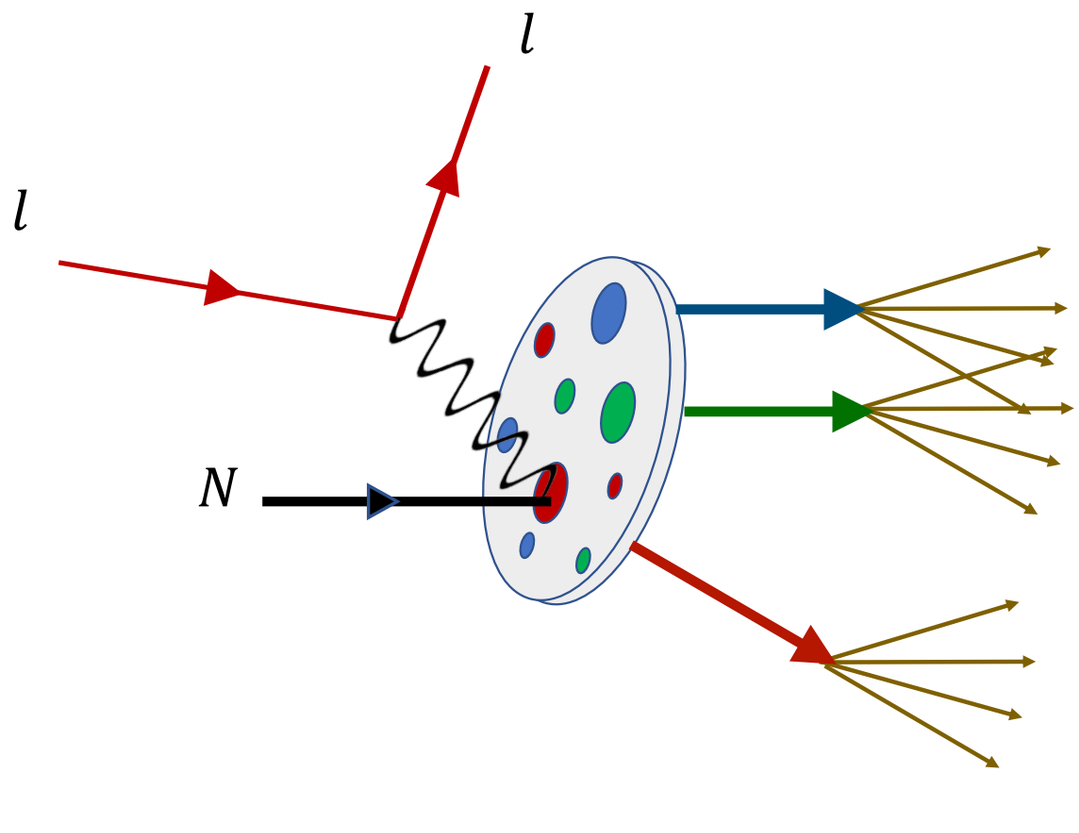
SPACE-TIME PICTURE OF THE COLLISION



SEMI INCLUSIVE DEEP INELASTIC SCATTERING

One particular region, current region, is of outmost importance.

for the 3D structure of the nucleon



Regions:

- Target
- Soft
- Current

Several variables characterize the process

- x_{Bj}, z_h } fractions of momentum
- Q^2 Resolution
- P_T Transverse momentum

AFFINITY

Boglione et al, 1611.10329
Boglione et al, 1904.12882
Current study

- Use a Monte Carlo with parton momenta
- Sample experimental bins for ratios
- Affinity = #times in/(#times in + #times out)

Affinity is from 0% to 100%

indicates a probability of the bin to be in a particular region