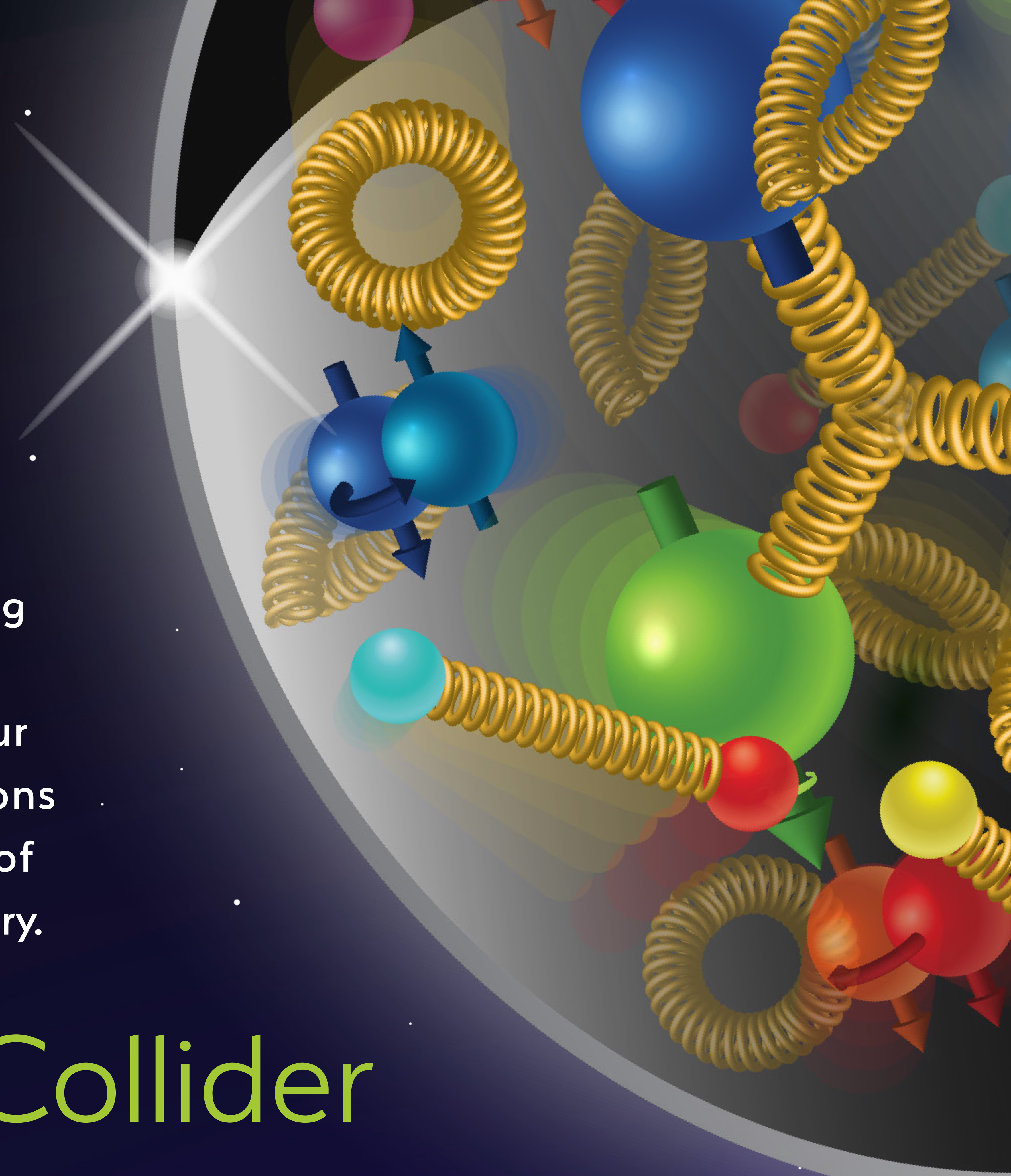


Everything we see in the universe is made up of atoms, with protons and neutrons at their core. To explore *those* particles' complex internal structure, physicists envision building an Electron-Ion Collider (EIC). Like a powerful microscope, this machine will reveal the teeming microcosm of *quarks* bound together by appropriately named *gluons*. Despite all our insight into how individual quarks and gluons interact, how they generate the full range of properties of all visible matter remains a mystery.

The Electron-Ion Collider

The world's most powerful microscope for studying the "glue" that binds the building blocks of all visible matter

3D structure of protons and nuclei

The EIC would consist of two intersecting accelerators that bring high-energy electrons into head-on collisions with protons or atomic nuclei. These collisions will extend our knowledge of the internal structure of protons and complex nuclei, providing the first comprehensive tomographic 3D images of the gluons contained in these building blocks of matter.

Solving the mystery of proton spin

The EIC would be the world's first polarized electron-proton collider—meaning the "spins" of both colliding particles can be aligned in a controlled way. This will make it possible to experimentally solve the outstanding mystery of how the teeming quarks and gluons inside the proton combine their spins to generate the overall spin carried by the proton.

Gluon saturation and the color glass condensate

Recent experiments and advances in theory suggest that protons, neutrons, and nuclei at high energies appear as dense "walls" of gluons, creating what may be among the strongest electric and magnetic fields in nature. Discovering and studying this form of matter, the "color glass condensate," will provide deeper insight into why matter in this subatomic realm is stable.

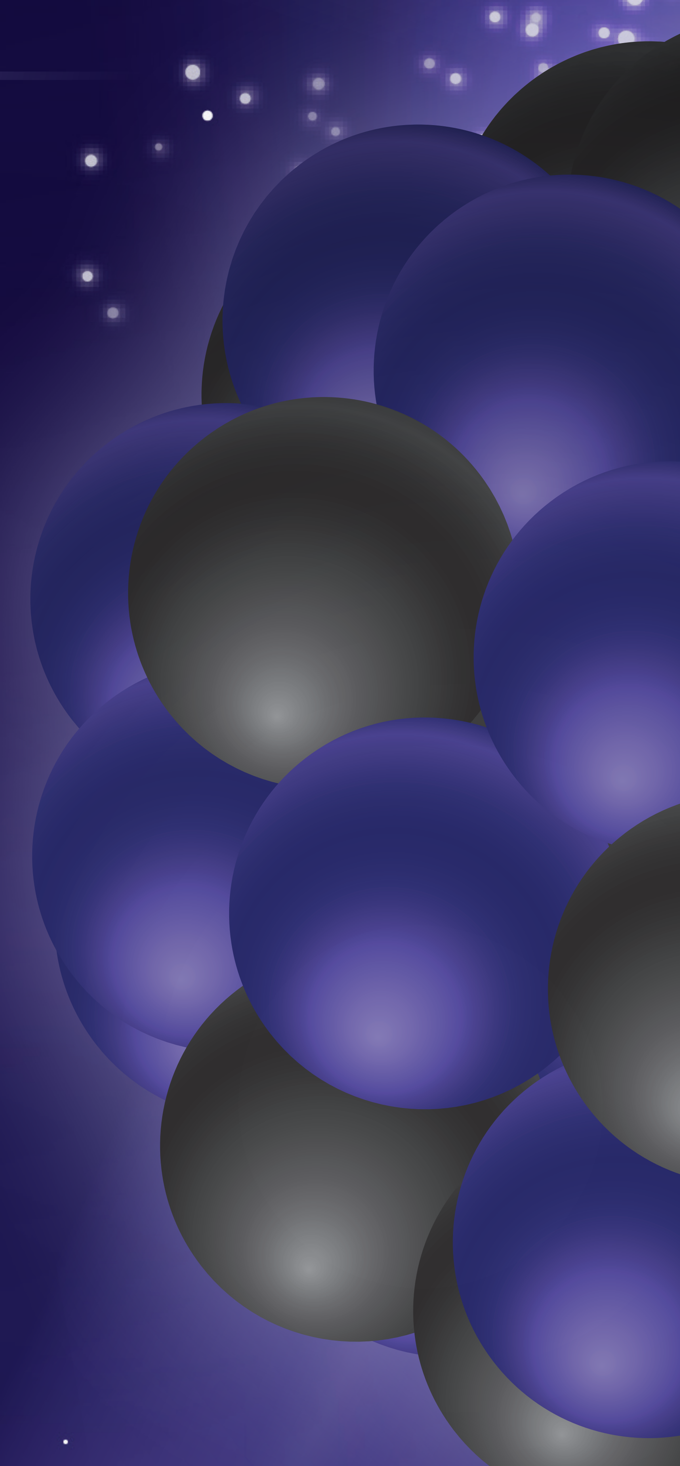
Quark and gluon confinement

Experiments at an EIC would offer novel insight into why quarks or gluons can never be observed in isolation, but must transform into and remain confined within protons and nuclei. The EIC—with its unique combinations of high beam energies and intensities—will cast fresh light into quark and gluon confinement, a key puzzle in the Standard Model of physics.

Benefits beyond physics

Building an EIC would push the field of nuclear physics to the next frontier, expanding opportunities for scientific discovery and technological advances in accelerator and detector technology that could have broader impacts on society. Some examples from past or ongoing nuclear physics endeavors include:

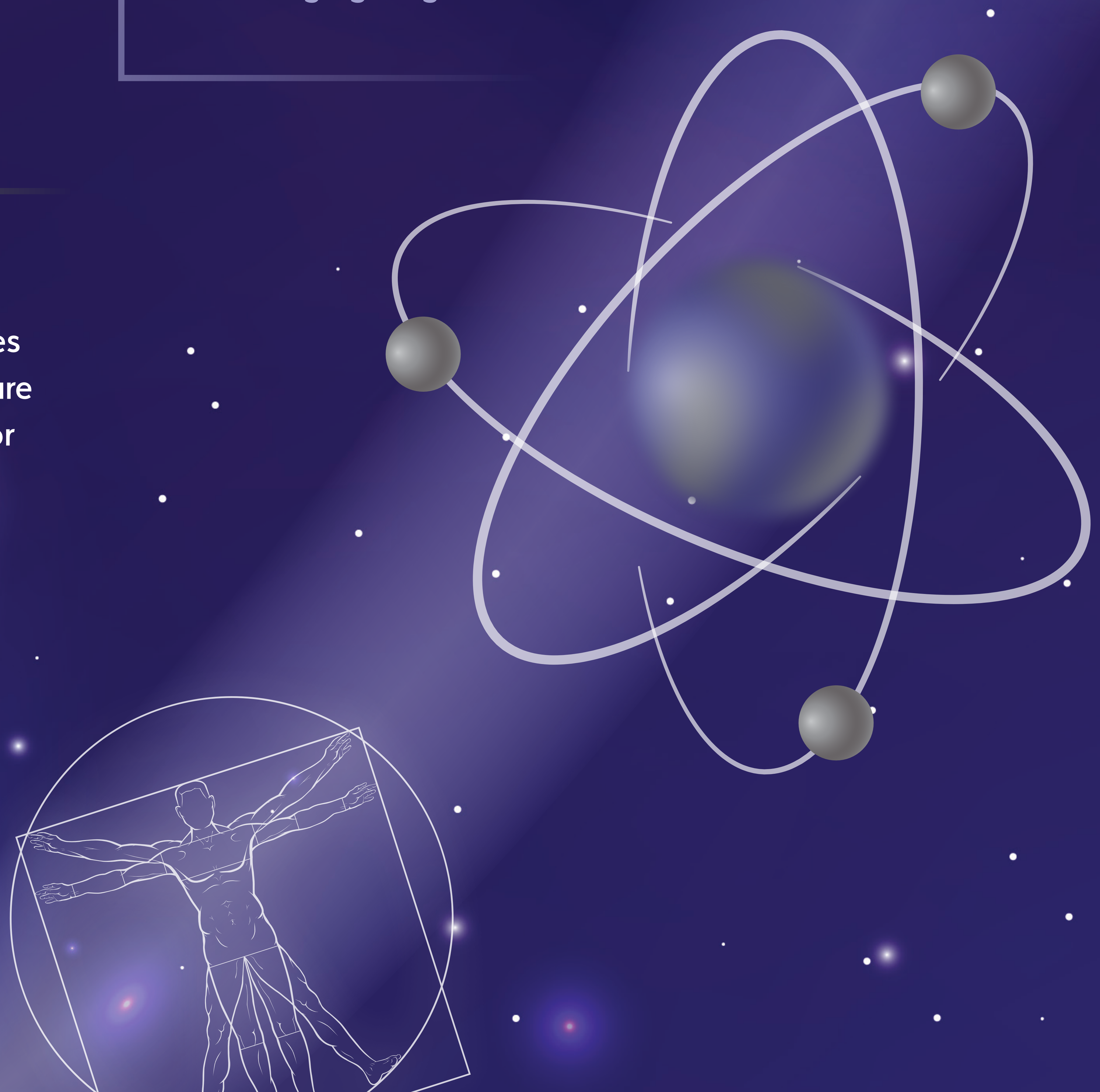
- Advanced accelerators for cancer therapy
- Production of radioisotopes for diagnosing, tracking, and treating disease
- New detector technologies for medicine and national security
- Computational tools for managing "big data"



Community of physicists

A vibrant community of physicists is working to tackle the technological challenges of designing and building a U.S.-based EIC, drawing on the expertise and infrastructure at Brookhaven National Laboratory and the Thomas Jefferson National Accelerator Facility. An EIC User Group of more than 700 physicists from 28 countries around the world is working with these laboratories to realize the EIC.

For more information, see: http://www.eicug.org/web



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