Unleashing the Higgs boson's potential

The Higgs boson is both the simplest and the **most perplexing** particle ever discovered.

It represents a radically **new force** of nature that is responsible for generating the masses of elementary particles.

The Higgs boson uniquely governed the **dynamics of the Universe** a fraction of a second after the Big Bang when the mysterious Higgs field entered into existence.

Yet, like the first images of planets and galaxies, our current picture of this enigmatic particle remains **blurry**.

- → Where does the Higgs boson come from?
- → Is it truly elementary or composite?
- → Is it unique or part of a larger family?
- → Does it interact with as-yet undiscovered particles?

In concert with developments in astronomy and cosmology, precise measurements of the Higgs boson and related particles will probe mysteries that connect the infinitely big with the infinitely small:

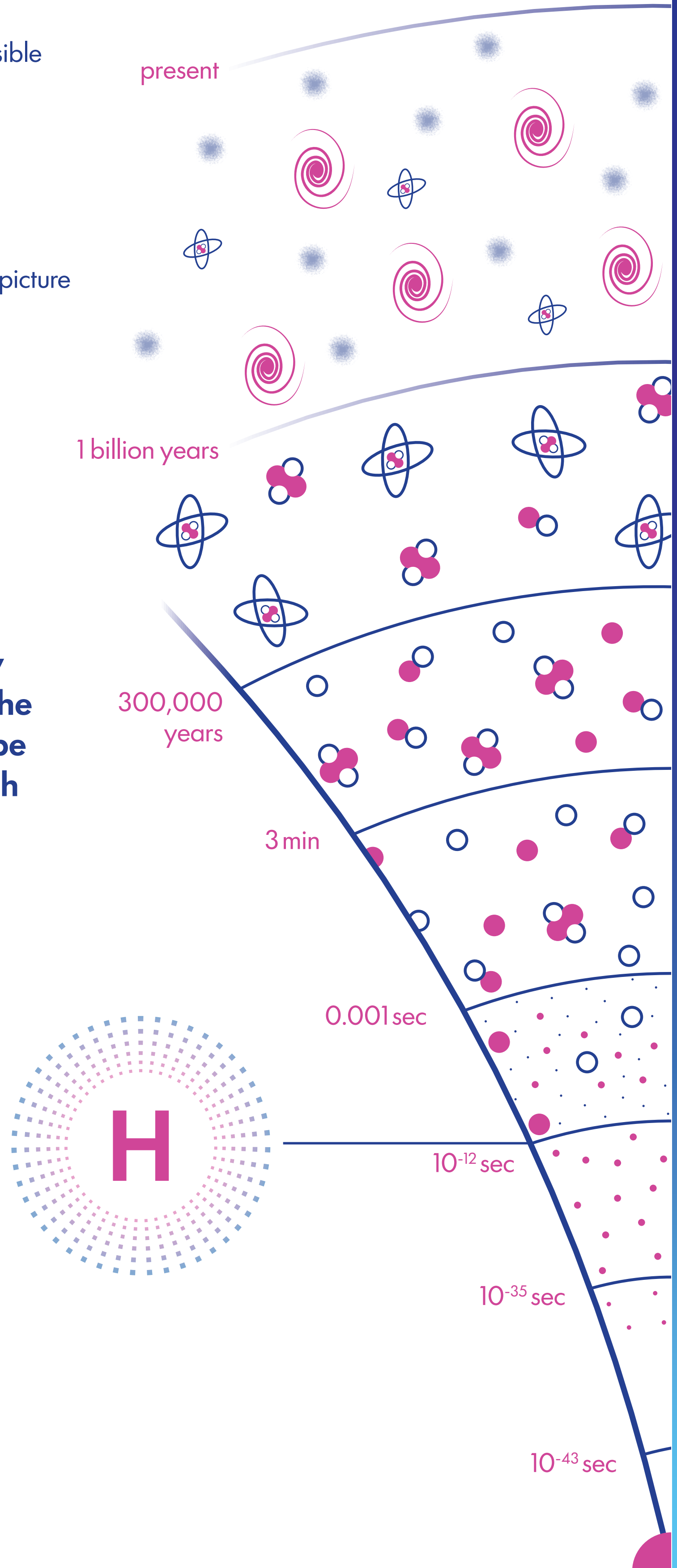
How was matter created from the vacuum?

What is the ultimate fate of the Universe?

What is the nature of dark matter and energy?

How did a tiny amount of matter prevail over antimatter to form galaxies, stars, and life?

Why are the elementary particles arranged in three families with wildly different masses?



CERN

FUTURE CIRCULAR COLLIDER

SCIENCE

The quest to understand the fundamental constituents and laws of the Universe has reached a fascinating turning point.

We are voyaging into uncharted territory, where the Higgs boson can serve as a portal to unknown realms in fundamental physics.

The Future Circular Collider offers the broadest possible exploratory programme with an outstanding discovery potential.

- → **Measure** the properties of the Higgs boson and other key particles with unmatched precision.
- → **Search** for new particles, new forces and potential dark-matter candidates.
- → **Probe** the disappearance of antimatter in the early Universe.
- → **Explore** entirely new phenomena through radical gains in precision and sensitivity.

CERN

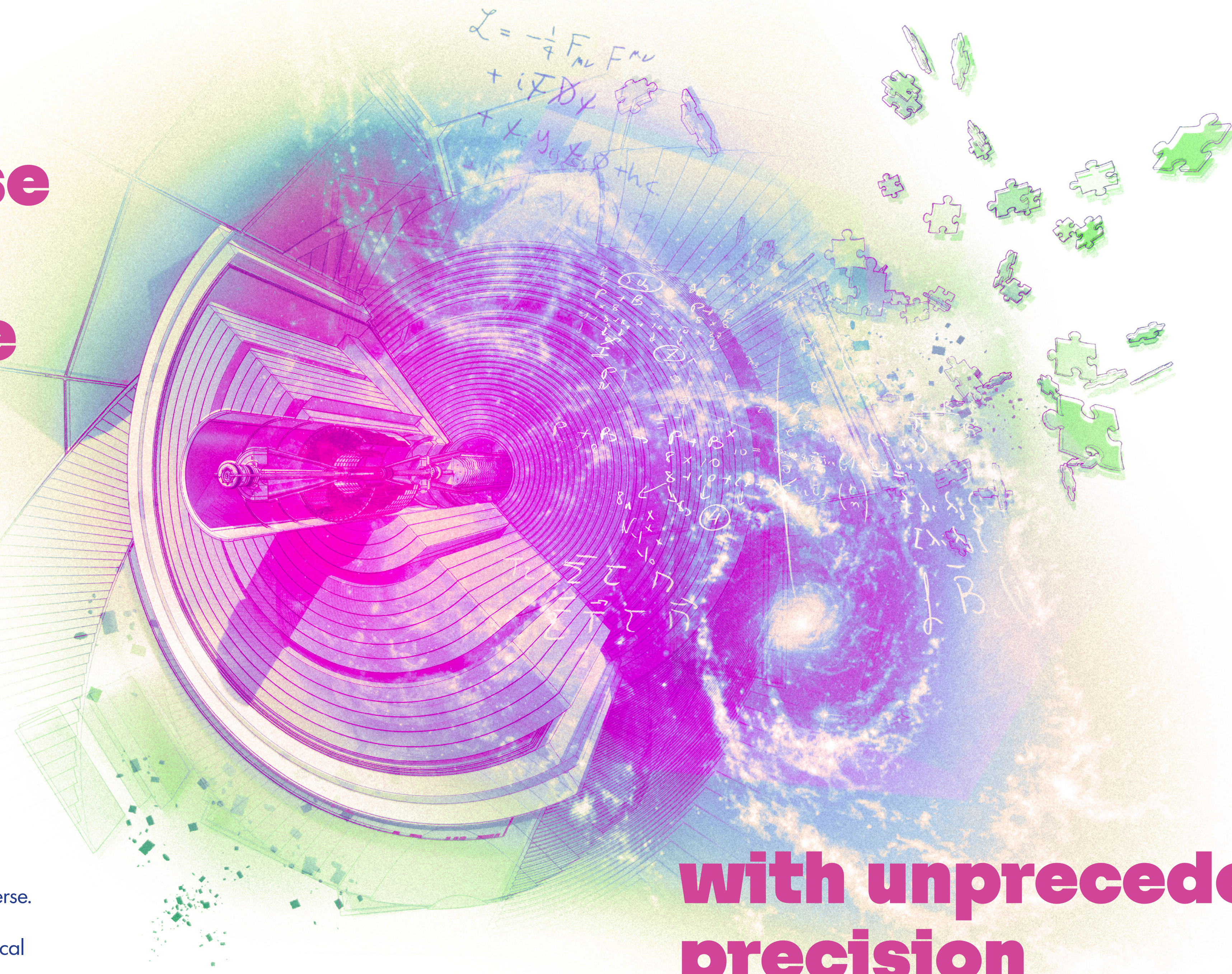
The Universe under a microscope

Since the days of Galileo and Newton we have known that the Universe is governed by **fundamental laws** cast in the language of mathematics.

→ Following this central tenet of science has led us to the **Standard Model** of particle physics – a theory linked to more than **30 Nobel prizes**.

The discovery of the **Higgs boson** at CERN's Large Hadron Collider in 2012 confirmed the Standard Model's final spectacular prediction. But the Standard Model is just a prelude to what remains to be discovered.

→ It does not account for the dark matter and energy that constitute 95% of the Universe.
It says nothing about gravity.
It fails to explain why particles have the critical properties they do.
It breaks down at the smallest distance scales.



> **"The Future Circular Collider will probe the structure of matter and space-time at unexplored distance scales, pushing the limits of the Standard Model in search of a new, revolutionary paradigm in fundamental physics."**

Boson bonanza

Like **tuning a radio** to a particular frequency, the Future Circular Collider will be able to summon into existence copious quantities of **Z** bosons, **W** bosons, **Higgs** bosons and other key fundamental particles in a super-clean collision environment.

→ This will enable new and significantly **more precise** measurements compared to what is possible today at the Large Hadron Collider.

History shows that such leaps in precision lead to **major breakthroughs**.

→ It may **reveal the existence** of new particles that hardly interact at all with those that we know, or hint at the presence of heavy particles which could eventually be found at a future high-energy collider.

Even the tiniest deviation from the Standard Model's predictions would set fundamental physics research on a new path of **discovery**.

with unprecedented precision

Particle colliders allow the fundamental constituents of the Universe to be studied under controlled laboratory conditions.

Whereas the Large Hadron Collider collides protons, which are made up of quarks and gluons, the Future Circular Collider will collide electrons and their antimatter partners, positrons, which are elementary.

Striking at a single point with energies that existed a fraction of a nanosecond after the Big Bang, all their energy will be converted into heavier particles which are recorded by giant detectors.

By studying the outcomes of trillions of collisions, physicists can piece together the underlying events that shape our Universe.