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Topic: **'Many South African scientists are involved in the research being carried out at the Large Hadron Collider at Cern in Europe. Do you think the research findings will benefit humankind?'**

To answer the question directly: yes, the work being done on the Large Hadron Collider ("LHC") at the European Organisation for Nuclear Research ("CERN") benefits humanity on at least three levels. Specifically, the LHC work:
1. Facilitates our efforts to understand the biggest and most important questions about matter, energy, time and the universe;
2. Has stimulated direct and indirect technological innovations;
3. Demonstrates that people of different backgrounds and cultures can work together peacefully.
The purpose of this essay is to describe CERN and the important work that is carried out there, and to describe its benefits to humankind in greater detail.

CERN was established shortly after the end of World War 2, by many of the scientists who had previously helped in developing nuclear weapons. The founders wanted to demonstrate that physics could be put to peaceful use. They also wanted to prove that scientists of different backgrounds and ideologies could work together in the peaceful pursuit of knowledge. This was significant because just a few years before, these scientists' countries were locked in brutal warfare.

On the 9th of December 1949, at the European Cultural Conference, French physicist Louis de Broglie put forward the first official proposal for the creation of this lab. Less than three years later, 12 countries signed an agreement establishing the provisional council- and CERN was born.

In the first 45 years of CERN's existence, the lab developed equipment to run experiments in high-energy physics. The lab specialized in building and running linear accelerators that smashed atoms into each other at very high speeds, and then observed the changes in their physical properties. As technology and computing power improved, the lab ran experiments at higher and higher energy levels, unraveling the mysteries of sub-atomic particles.

In 1998, CERN began constructing the Large Hadron Collider (LHC), which is the largest (and most expensive) machine ever created. 10,000 scientists and engineers, from 100 countries, contributed to the design and construction of the LHC.

The LHC was completed in 2008. It fills a 27-kilometre tunnel with super-conducting magnets, capable of accelerating sub-atomic particles (including hadrons) to nearly the speed of light. When these particles are smashed into each other, their observed behavior explains a lot about the structure of matter, and the interactions and forces governing the building blocks of all things.

These observations, made by sophisticated sensors, after tracking thousands of collisions, have provided evidence in support of the (now) leading theories in physics. The most significant example was the detection of the Higgs Boson, a particle which underlies the "Standard Model" for understanding composition of matter and energy. According to Professor Zeblon Vilakazi of Wits University (and a CERN adjunct professor), evidence of the

existence of the Higgs Boson was a tremendous step forward in our understanding of the basic mysteries of the universe. In Professor Vilakazi's words, "It made it all worthwhile: the thousands of gallons of Red Bull and coffee drunk, the countless hours of calculation and conversation, the expense and the complexity and the frustration. This was a major step forward."

CERN costs about $300 million per year to run, a lot of which is spent on the LHC. Is this money well spent?

At a basic level, if one accepts that it is useful on its own merits to explore and answer the most fundamental questions about space, time, matter, and energy, then CERN is clearly benefiting humanity. The observations in support of the Standard Model, to name but one example, could never have been made without the LHC. This work also inspires young scientists, mathematicians and engineers, who visit CERN or read about its work, and go on to innovate and experiment in all walks of life.

More practically, some technological innovations, particularly in medical diagnostics, have come directly from work done at CERN. Indirectly, technologies such as the World Wide Web and mass distributed computing were developed to support work at CERN, and later adopted for more mainstream uses.

Finally, and maybe most important, CERN demonstrates that people from all cultures, races, religions, and backgrounds can work together in peaceful pursuit of knowledge. CERN has led the way as an example of international co-operation. Some people say that the path to the European Union was paved by the co-operation that created CERN. The 21 member states of CERN have worked together in harmony for more than 60 years, where they used to go to war with regularity.

As Professor Vilakazi says, "At CERN, there are no differences of ideology or creed. There is no time to hate or be intolerant. There is only the pursuit of pure scientific truth, and that is a beautiful thing."

In summary, the work at CERN benefits humanity on multiple levels. Pursuing knowledge for its own sake is useful, particularly knowledge about the fundamental questions that CERN is trying to answer. This also pushes technological innovation in many ways.

Leaving aside the knowledge and the technological innovations, though, the example that CERN sets for us all as a collaborative effort is a great benefit as well.